U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Impact Statement

Volume 2—Appendixes

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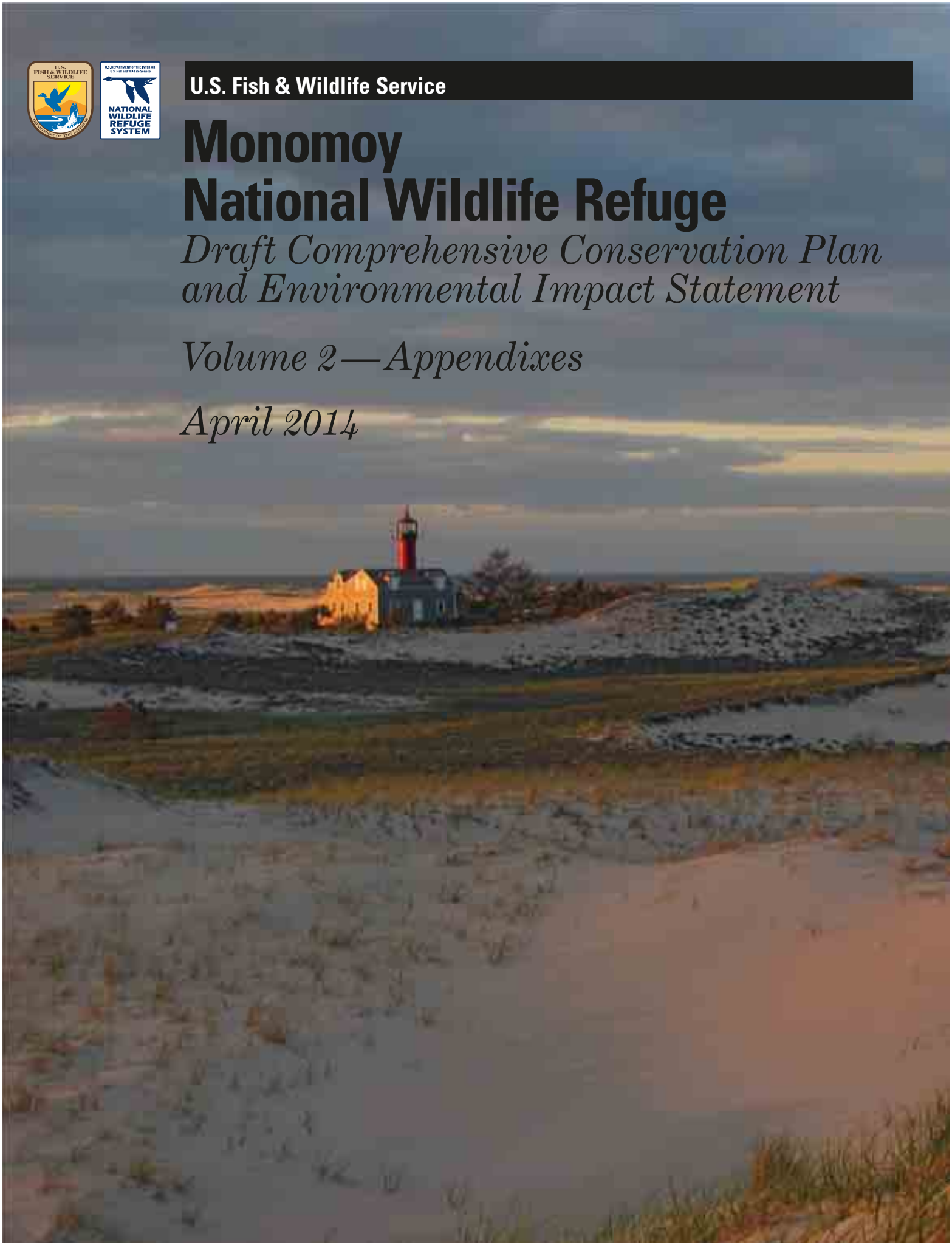

Front cover:

Monomoy Lighthouse at sunset
Ravin Thomasson

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Appendix A

Sarah Tanedo/USFWS

Common tern with chicks

Animal Species Known or Suspected on Monomoy National Wildlife Refuge

Table A.1. Fish Species Known or Suspected at Monomoy National Wildlife Refuge (NWR).

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Lampreys – Petromyzontidae										
Sea Lamprey	*Petromyzon marinus*	-	-	G5	S4	-	-	0.2	0.0	-
Sand Tigers – Odontaspididae										
Sand Tiger Shark	*Carcharias taurus*	-	-	-	-	S	V	0.0	0.5	-
Mackerl Sharks – Lamnidae										
White Shark	*Carcharodon carcharias*		-		-	-	V	-	-	-
Requim Sharks - Charcharhinidae										
Smooth Dogfish	*Mustelus canis*	-	-	-	-	-	-	15.1	71.5	-
Dogfishes – Squalidae										
Spiny Dogfish	*Squalus acanthias*	-	-	-	-	-	-	7.5	3.4	-
Skates – Rajidae										
Thorny Skate	*Amblyraja radiata*	-	-	-	-	S	V	0.3	0.0	-
Little Skate	*Leucoraja erinacea*	-	-	-	-	-	-	78.6	61.5	-
Winter Skate	*Leucoraja ocellata*	-	-	-	-	-	-	60.9	46.5	-
Clearnose Skate	*Raja eglanteria*	-	-	-	-	-	-	0.0	0.2	-
Stingrays – Dasyatidae										
Roughtail Stingray	*Dasyatis centroura*	-	-	-	-	-	-	0.0	1.4	-
Freshwater Eels – Anguillidae										
American Eel	*Anguilla rostrata*	-	-	G5	S5	-	-	0.2	0.2	-
Congers – Congridae										
Conger Eel	*Conger oceanicus*	-	-	-	-	-	-	0.0	0.3	-
Herrings – Clupeidae										
Blueback Herring	*Alosa aestivalis*	-	-	G5	S4	S	-	2.0	0.9	-
Alewife	*Alosa pseudoharengus*	-	-	G5	SNR	S	-	12.3	1.0	-
American Shad	*Alosa sapidissima*	-	-	G5	S3	-	-	4.5	0.0	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Atlantic Menhaden	*Brevoortia tyrannus*	-	-	-	-	-	-	1.0	1.9	-
Atlantic Herring	*Clupea harengus*	-	-	-	-	-	-	9.5	2.4	-
Tunas – Scombridae										
*Atlantic Bluefin Tuna	*Thunnus thynnus*	-	-	-	-	-	-	NA	NA	-
Anchovies – Engraulidae										
Striped Anchovy	*Anchoa hepsetus*	-	-	-	-	-	-	0.0	8.9	-
Bay Anchovy	*Anchoa mitchilli*	-	-	-	-	-	-	0.7	9.4	-
Smelts – Osmeridae										
Rainbow Smelt	*Osmerus mordax*	-	-	-	-	S	-	0.2	0.2	-
Lizardfishes – Synodontidae										
Inshore Lizardfish	*Synodus foetens*	-	-	-	-	-	-	0.0	2.9	-
Lizardfish unclassified	*Synodontidae* spp.	-	-	-	-	-	-	0.0	0.5	-
Snakefish	*Trachinocephalus myops*	-	-	-	-	-	-	0.0	1.0	-
Toadfishes – Batrachoididae										
Oyster Toadfish	*Opsanus tau*	-	-	-	-	-	-	0.2	0.2	-
Goosefishes – Lophiidae										
Goosefish	*Lophius americanus*	-	-	-	-	-	-	0.2	0.0	-
Wolffish –Anarhichadidae										
*Atlantic Wolffish	*Anarhichas lupus*	-	-	-	-	-	-	NA	NA	-
Cods – Gadidae										
Fourbeard Rockling	*Enchelyopus cimbrius*	-	-	-	-	-	-	0.2	0.3	-
Atlantic Cod	*Gadus morhua*	-	-	-	-	-	V	53.4	0.2	-
Haddock	*Melanogrammus aeglefinus*	-	-	-	-	-	-	0.3	0.0	-
Silver Hake	*Merluccius bilinearis*	-	-	-	-	-	-	11.3	4.3	-
Atlantic Tomcod	*Microgadus tomcod*	-	-	-	-	-	-	0.2	0.0	-
Pollock	*Pollachius virens*	-	-	-	-	-	-	13.9	0.0	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Red Hake	*Urophycis chuss*	-	-	-	-	-	-	13.8	2.9	-
Spotted Hake	*Urophycis regia*	-	-	-	-	-	-	5.6	1.2	-
White Hake	*Urophycis tenuis*	-	-	-	-	-	-	9.3	2.2	-
Halfbeaks – Exocoetidae										
Silverstripe Halfbeak	*Hyporhamphus unifasciatus*	-	-	-	-	-	-	NA	NA	-
Needlefishes – Belonidae										
Atlantic Needlefish	*Strongylura marina*	-	-	-	-	-	-	NA	NA	-
Sauries – Scomberesocidae										
Atlantic Saury	*Scomberesox saurus*	-	-	-	-	-	-	NA	NA	-
Killifishes – Cyprinodontidae										
Rainwater Killifish	*Lucania parva*	-	-	-	-	-	-	NA	NA	-
Striped Killifish	*Fundulus majalis*	-	-	-	-	-	-	NA	NA	-
Mummichog	*Fundulus heteroclitus*	-	-	-	-	-	-	NA	NA	-
Livebearers – Poeciliidae										
Mosquitofish	*Gambusia affinis*	-	-	-	-	-	-	NA	NA	-
Silversidees – Atherinidae										
Atlantic Silverside	*Menidia menidia*	-	-	-	-	-	-	0.3	0.0	-
Cornetfishes – Fistulariidae										
Red Cornetfish	*Fistularia petimba*	-	-	-	-	-	-	0.0	0.5	-
Bluespotted Cornetfish	*Fistularia tabacaria*	-	-	-	-	-	-	0.0	4.6	-
Pipefishes – Syngnathidae										
Northern Pipefish	*Syngnathus fuscus*	-	-	-	-	-	-	7.5	17.1	-
Temperate Basses – Percichthyidae										
White Perch	*Morone americana*	-	-	-	-	-	-	NA	NA	-
Striped Bass	*Morone saxatilis*	-	-	-	-	-	-	3.3	0.3	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Sea Basses – Serranidae										
Black Sea Bass	*Centropristis striata*	-	-	-	-	-	-	30.0	81.0	-
Rock Hind	*Epinephelus adscensionis*	-	-	-	-	-	-	0.0	0.2	-
Snowy Grouper	*Epinephelus niveatus*	-	-	-	-	-	V	0.0	0.7	-
Gag	*Mycteroperca microlepis*	-	-	-	-	-	-	0.0	0.2	-
Scamp	*Mycteroperca phenax*	-	-	-	-	-	-	0.0	0.3	-
Bigeyes – Piacanthidae										
Bigeye	*Priacanthus arenatus*	-	-	-	-	-	-	0.0	4.8	-
Glasseye Snapper	*Priacanthus cruentatus*	-	-	-	-	-	-	0.0	1.9	-
Short Bigeye	*Pristigenys alta*	-	-	-	-	-	-	0.0	1.7	-
Bluefishes – Pomatomidae										
Bluefish	*Pomatomus saltatrix*	-	-	-	-	-	-	0.8	22.9	-
Jacks – Carangidae										
African Pompano	*Alectis ciliaris*	-	-	-	-	-	-	0.0	0.3	-
Yellow Jack	*Caranx bartholomaei*	-	-	-	-	-	-	0.0	0.2	-
Blue Runner	*Caranx crysos*	-	-	-	-	-	-	0.0	1.5	-
Crevalle Jack	*Caranx hippos*	-	-	-	-	-	-	NA	NA	-
Mackerel Scad	*Decapterus macarellus*	-	-	-	-	-	-	0.0	14.5	-
Round Scad	*Decapterus punctatus*	-	-	-	-	-	-	0.0	1.2	-
Permit Jack	*Trachinotus falcatus*	-	-	-	-	-	-	NA	NA	-
Rough Scad	*Trachurus lathami*	-	-	-	-	-	-	0.0	2.1	-
Bigeye Scad	*Selar crumenophthalmus*	-	-	-	-	-	-	0.0	0.9	-
Atlantic Moonfish	*Selene setapinnis*	-	-	-	-	-	-	0.0	9.2	-
Lookdown	*Selene vomer*	-	-	-	-	-	-	0.0	0.3	-
Greater Amberjack	*Seriola dumerili*	-	-	-	-	-	-	NA	NA	-
Banded Rudderfish	*Seriola zonata*	-	-	-	-	-	-	0.0	0.3	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Porgies – Sparidae										
Scup	*Stenotomus chrysops*	-	-	-	-	-	-	47.9	99.7	-
Drums – Sciaenidae										
Weakfish	*Cynoscion regalis*	-	-	-	-	-	-	0.0	0.2	-
Spot	*Leiostomus xanthurus*	-	-	-	-	-	-	0.0	0.3	-
Northern Kingfish	*Menticirrhus saxatilis*	-	-	-	-	-	-	0.7	17.1	-
Goatfishes – Mullidae										
Red Goatfish	*Mullus auratus*	-	-	-	-	-	-	0.0	1.2	-
Dwarf Goatfish	*Upeneus parvus*	-	-	-	-	-	-	0.0	0.7	-
Butterflyfishes – Chaetodontidae										
Spotfin Butterflyfish	*Chaetodon ocellatus*	-	-	-	-	-	-	0.0	0.5	-
Wrasses – Labridae										
Tautog	*Tautog onitis*	-	-	-	-	-	-	26.2	15.9	-
Cunner	*Tautogolabrus adspersus*	-	-	-	-	-	-	16.4	10.6	-
Mullets – Mugilidae										
White Mullet	*Mugil curema*	-	-	-	-	-	-	NA	NA	-
Barracudas – Sphyraenidae										
Northern Sennet	*Sphyraena borealis*	-	-	-	-	-	-	0.0	0.9	-
Guaguanche	*Sphyraena guachancho*	-	-	-	-	-	-	0.0	0.9	-
Pricklebacks – Stichaeidae										
Snakeblenny	*Lumpenus lumpretaeformis*	-	-	-	-	-	-	0.2	0.0	-
Radiated Shanny	*Ulvaria subbifurcata*	-	-	-	-	-	-	NA	NA	-
Gunnels – Pholidae										
Rock Gunnel	*Pholis gunnellus*	-	-	-	-	-	-	11.4	2.7	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Eelpouts – Zoarcidae										
Ocean Pout	*Macrozoarces americanus*	-	-	-	-	-	-	0.7	0.0	-
Sand Lances – Ammodytidae										
Northern Sand Lance	*Ammodytes dubius*	-	-	-	-	-	-	13.8	3.4	-
Gobies – Gobiidae										
Naked Goby	*Gobiosoma bosci*	-	-	-	-	-	-	NA	NA	-
Seaboard Goby	*Gobiosoma ginsburgi*	-	-	-	-	-	-	NA	NA	-
Goby unclassified	*Gobiidae* spp.	-	-	-	-	-	-	0.0	0.2	-
Mackerels – Scombridae										
Atlantic Mackerel	*Scomber scombrus*	-	-	-	-	-	-	3.3	0.0	-
Butterfishes – Stromateidae										
Butterfish	*Peprilus triacanthus*	-	-	-	-	-	-	24.7	91.8	-
Searobins – Triglidae										
Northern Searobin	*Prionotus carolinus*	-	-	-	-	-	-	68.8	65.3	-
Striped Searobin	*Prionotus evolans*	-	-	-	-	-	-	7.1	18.8	-
Sculpins – Cottidae										
Sea Raven	*Hemitripterus americanus*	-	-	-	-	-	-	11.6	0.2	-
Grubby	*Myoxocephalus aenaeus*	-	-	-	-	-	-	2.5	0.9	-
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	-	-	-	-	-	-	27.9	0.3	-
Poachers – Agonidae										
Alligatorfish	*Aspidophoroides monopterygius*	-	-	-	-	-	-	0.2	0.0	-
Lumpfishes and Snailfishes – Cyclopteridae										
Lumpfish	*Cyclopterus lumpus*	-	-	-	-	-	-	0.7	0.0	-
Atlantic Seasnail	*Liparis atlanticus*	-	-	-	-	-	-	0.3	0.0	-
Flying Gurnards – Dactylopteridae										
Flying Gurnard	*Dactylopterus volitans*	-	-	-	-	-	-	0.0	0.7	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Lefteye Flounders – Bothidae										
Gulf Stream Flounder	*Citharichthys arctifrons*	-	-	-	-	-	-	2.0	5.8	-
Spotted Whiff	*Citharichthys macrops*	-	-	-	-	-	-	NA	NA	-
Smallmouth Flounder	*Etropus microstomus*	-	-	-	-	-	-	8.3	30.4	-
Summer Flounder	*Paralichthys dentatus*	-	-	-	-	-	-	55.4	64.6	-
Fourspot Flounder	*Paralichthys oblongus*	-	-	-	-	-	-	12.8	8.0	-
Windowpane	*Scophthalmus aquosus*	-	-	-	-	-	-	79.6	32.8	-
Righteye Flounders – Pleuronectidae										
Yellowtail Flounder	*Pleuronectes ferruginea*	-	-	-	-	-	-	2.7	0.0	-
Winter Flounder	*Pseudopleuronectes America*	-	-	-	-	-	-	87.9	23.8	-
Soles – Soleidae										
Hogchoker	*Trinectes maculatus*	-	-	-	-	-	-	0.0	0.2	-
Leatherjackets – Balistidae										
Orange Filefish	*Aluterus schoepfi*	-	-	-	-	-	-	0.0	1.2	-
Scrawled Filefish	*Aluterus scriptus*	-	-	-	-	-	-	0.0	0.3	-
Gray Triggerfish	*Balistes capriscus*	-	-	-	-	-	-	0.0	0.9	-
Planehead Filefish	*Monacanthus hispidus*	-	-	-	-	-	-	0.0	10.3	-
Boxfishes – Ostraciidae										
Trunkfish	*Lactophrys trigonus*	-	-	-	-	-	-	0.0	0.2	-
Puffers – Tetraodontidae										
Northern Puffer	*Sphoeroides maculates*	-	-	-	-	-	-	0.0	11.8	-
Sunfish – Centrarchidae										
Largemouth Bass	*Micropterus salmoides*	-	-	-	-	-	-	NA	NA	-

Source: Data assembled from the Massachusetts Division of Marine Fisheries Nantucket Sound Spring and Fall Trawl Surveys from 1978 to 2010 and the Nantucket Sound Estuarine Winter Flounder Seine Surveys 1976 to 2010.

* Data assembled from the New England Fishery Management Council Essential Fish Habitat and Habitat Area of Particular Concern Designation Alternatives Draft 2012; and NOAA Fisheries Division of Highly Migratory Species Amendment 1 to the consolidated Highly Migratory Species Fishery Management Plan, June 2009.

Table A.2. Reptile Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	NALCC Rep. Species[15]
Water Turtles – Emydidae							
Painted Turtle	*Chrysemys picta*	-	-	-	-	-	M
Sea Turtles – Cheloniidae							
Loggerhead Sea Turtle	*Caretta caretta*	T	T	G3	S1	P/E	M
Green Sea Turtle	*Chelonia mydas*	T	T	G3	S1	T	-
Hawksbill Sea Turtle	*Eretmochelys imbricate*	E	T	G3	S1	E	-
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	E	G1	S1	E	-
Sea Turtles – Dermochelyidae							
Leatherback Sea Turtle	*Dermochelys coriacea*	E	E	G3	S1S2	E	-
Colubrids – Colubridae							
Eastern Hognose Snake	*Heterodon platirhinos*	-	-	G5	S5	-	SM
Eastern Ribbon Snake	*Thamnophis sauritus*	-	-	G5	S5	-	-
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*	-	-	-	-	-	-

Source: Data assembled from the Massachusetts Division of Fisheries and Wildlife, Fauna of Massachusetts Series No. 3, State Reptiles and Amphibians List—Species Distribution, in addition to staff observations of wildlife on the refuge.

Table A.3. Amphibian Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	NALCC Rep. Species[15]
Toads – Bufonidae							
•Fowlers Toad	*Bufo woodhousii fowleri*	-	-	-	-	-	-

Source: Data assembled from the Massachusetts Division of Fisheries and Wildlife, Fauna of Massachusetts Series No. 3, State Reptiles and Amphibians List—Species Distribution, in addition to staff observations of wildlife on the refuge.

•Denotes species suspected to have been breeding on the refuge over the past 20 years.

Table A.4. Bird Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Loons – Gaviidae																	
Red-throated Loon	*Gavia stellata*	-				R5	HH	-	HH	-	-	-	a	r	a	c	-
Common Loon	*Gavia immer*	-	SC	G5	S1	-	-	-	HH	-	-	-	a	u	a	c	
Grebes – Podicipedidae																	
Horned Grebe	*Podiceps auritus*	-				R5	H	-	HH	-	-	-	o		u	o	-
Red-necked Grebe	*Podiceps grisegena*	-	-	-	-	-	-	-	H	-	-	-	r		r	r	-
Eared Grebe	*Podiceps nigricollis*	-	-	-	-	-	-	-	-	-	-	-		x	x		-
•Pied-billed Grebe	*Podilymbus podiceps*	-	E	G5	S1	R5	-	-	HH	-	-	-	u	r	c		-
Fulmars and Shearwaters – Procellariidae																	
Cory's Shearwater	*Calonectris diomedea*	-	-	-	-	-	M	-	H	-	MC	-		o	o		-
Northern Fulmar	*Fulmarus glacialis*	-	-	-	-	-	-	-	L	-	-	-	r		r	r	-
Greater Shearwater	*Puffinus gravis*	-	-	-	-	R5	H	-	HH	-	-	-		o	o		-
Sooty Shearwater	*Puffinus griseus*	-	-	-	-	-	-	-	M	-	MC	-	o	u	r		-
Manx Shearwater	*Puffinus puffinus*	-	-	-	-	-	M	-	M	-	MC	-	r	o	r		-
Storm-petrels – Hydrobatidae																	
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	-	E	G5	S1	-	-	-	M	-	LC	-	r	r	r		-
Wilson's Storm-petrel	*Oceanites oceanicus*	-	-	-	-	-	-	-	L	-	-	-		u			-
Boobies and Gannets – Sulidae																	
Northern Gannet	*Morus bassanus*	-	-	-	-	-	H	-	M	-	-	-	a	u	a	u	-
Brown Booby	*Sula leucogaster*	-	-	-	-	-	-	-	-	-	HC	-			x		-
Cormorants – Phalacrocoracidae																	
Double-crested Cormorant	*Phalacrocorax auritus*	-	-	-	-	-	-	-	L	-	LI	-	a	a	a	r	-
Great Cormorant	*Phalacrocorax carbo*	-	-	-	-	-	-	-	H	-	MC	-	c	r	c	c	-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Frigatebirds – Fregatidae																	
Magnificent Frigatebird	*Fregata magnificens*	-	-	-	-	-	-	-	-	-	HC	-		x			-
Bitterns, Herons, and Egrets – Ardeidae																	
•Great Egret	*Ardea alba egretta*	-	-	-	-	-	-	-	M	-	NR	-	u	u	u		-
Great Blue Heron	*Ardea herodias herodias*	-	-	-	-	-	-	-	H	-	NR	-	c	u	c	u	-
American Bittern	*Botaurus lentiginosus*	-	E	G4	S2	R5	M	-	HH	-	-	-	r		o	r	S
Green Heron	*Butorides striatus*	-	-	G5	S4	-	-	-	M	-	LC	-	u	u	o		-
Cattle Egret	*Bubulcus ibis*	-	-	-	-	-	-	-	M	-	NR	-	r		r		-
Little Blue Heron	*Egretta caerulea*	-	-	-	-	-	M	-	HH	-	HC	-	o	o	o		-
Reddish Egret	*Egretta rufescens*	-	-	-	-	N	-	-	-	-	MC	-		x			-
•Snowy Egret	*Egretta thula*	-	-	G5	S1	R5	M	-	HH	-	HC	-	c	c	c		S
Tricolored Heron	*Egretta tricolor*	-	-	-	-	-	M	-	HH	-	HC	-	r	o	r		-
Least Bittern	*Ixobrychus exilis*	-	E	G5	S1	R5	M	-	HH	-	-	-	r	r			M
Yellow-crowned Night-Heron	*Nyctanassa violacea violacea*	-	-	-	-	-	M	-	H	-	MC	-		r	r		-
•Black-crowned Night-Heron	*Nycticorax nycticorax*	-	-	G5	S2	-	M	-	HH	-	MC	-	c	c	c	r	-
Ibises – Threskiornithidae																	
•Glossy Ibis	*Plegadis falcinellus*	-	-	-	-	-	H	-	HH	-	LC	-	o	u	o		-
New World Vultures – Cathartidae																	
Black Vulture	*Coragyps atratus*	-	-	-	-	-	-	-	-	-	-	-			r		-
Turkey Vulture	*Cathartes aura*	-	-	-	-	-	-		-	-	-	-	o	o	r		-
Swans, Geese, and Ducks – Anatidae																	
Wood Duck	*Aix sponsa*	-	-	-	-	-	M	-	-	H	-	-	r		r		M
•Northern Pintail	*Anas acuta acuta*	-	-	-	-	-	M	-	-	H	-	-	c	u	c	o	M
•American Wigeon	*Anas americana*	-	-	-	-	-	M	-	-	MH	-	-	c	o	c	u	-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
•Northern Shoveler	*Anas clypeata*	-	-	-	-	-	-	-	-	M	-	-	u	u	c		-
•Green-winged Teal	*Anas crecca carolinensis*	-	-	-	-	-	M	-	-	M	-	-	c	c	c	r	-
•Blue-winged Teal	*Anas discors orphan*	-	-	-	-	-	-	-	-	MH	-	-	c	u	c		-
Eurasian Wigeon	*Anas penelope*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	o	-
•Mallard	*Anas platyrhynchos*	-	-	-	-	-	H	-	-	H	-	-	c	c	c	c	-
•American Black Duck	*Anas rubripes*	-	-	G5	S4	-	HH	IIC	-	H	-	-	a	c	a	a	NMS
•Gadwall	*Anas strepera*	-	-	-	-	-	M	-	-	M	-	-	c	c	c	o	-
Greater White-fronted Goose	*Anser albifrons*	-	-	-	-	-	-	-	-	-	-	-				x	-
Redhead	*Aythya american*	-	-	-	-	-	-	-	-	MH	-	-	r		r	r	-
Lesser Scaup	*Aythya affinis*	-	-	-	-	-	H	-	-	H	-	-	u		c	o	-
Ring-necked Duck	*Aythya collaris*	-	-	-	-	-	-	-	-	M	-	-	o		c	o	M
Tufted Duck	*Aythya fuligula*	-	-	-	-	-	-	-	-	-	-	-		x	x		-
Greater Scaup	*Aythya marila*	-	-	-	-	-	H	-	-	M	-	-	u		c	o	-
Canvasback	*Aythya valisineria*	-	-	-	-	-	H	-	-	MH	-	-	o		u	o	M
Canada Goose (resident)	*Branta canadensis*	-	-	-	-	-	-	-	-	AO	-	-					-
Canada Goose (Atlantic)	*Branta canadensis*	-	-	-	-	-	HH	-	-	H	-	-					-
Canada Goose (North Atlantic)	*Branta canadensis canadensis*	-	-	-	-	-	H	-	-	MH	-	-					-
Bufflehead	*Bucephala albeola*	-	-	-	-	-	H	-	-	M	-	-	c		c	c	M
Common Goldeneye	*Bucephala clangula americana*	-	-	-	-	-	M	-	-	MH	-	-	o		c	c	-
Barrow's Goldeneye	*Bucephala islandica*	-	-	-	-	-	-	-	-	M	-	-				r	-
Snow Goose	*Chen caerulescens*	-	-	-	-	-	-	-	-	AO	-	-	r		o		-
Atlantic Brant	*Circus cyaneus*	-	-	-	-	-	HH	-	-	ML	-	-	c	r	c	c	-
Long-tailed Duck	*Clangula hyemalis*	-	-	G5	SNRN	-	H	-	-	MH	-	-	c	r	a	c	N
Tundra Swan	*Cygnus columbianus columbianus*	-	-	-	-	-	H	-	-	ML	-	-			r		-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
•Mute Swan	*Cygnus olor*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Fulvous Whistling Duck	*Dendrocygna bicolor*	-	-	-	-	-	-	-	-	ML	-	-	x		x		-
Harlequin Duck	*Histrionicus histrionicus*	-	-	G4	SNRN	-	M	-	-	M	-	-			r	r	-
Hooded Merganser	*Lophotydes cucullatu*	-	-	-	-	-	M	-	-	H	-	-	o		c	o	-
Black Scoter	*Melanitta americana*	-	-	-	-	-	H	-	-	MH	-	-	c	r	c	c	M
White-winged Scoter	*Melanitta fusca*	-	-	-	-	-	H	-	-	MH	-	-	c	r	a	c	MS
Surf Scoter	*Melanitta perspicillata*	-	-	-	-	-	H	-	-	MH	-	-	c	r	c	c	-
Common Merganser	*Mergus merganser americanus*	-	-	-	-	-	-	-	-	ML	-	-	o		u	o	NS
•Red-breasted Merganser	*Mergus serrator serrator*	-	-	-	-	-	M	-	-	ML	-	-	a	o	a	a	S
•Ruddy Duck	*Oxyura jamaicensis*	-	-	-	-	-	M	-	-	ML	-	-	o	r	c	o	-
Common Eider	*Somateria mollissima*	-	-	G5	S1	-	H	-	-	H	-	-	a	u	a	a	NS
King Eider	*Somateria spectabilis*	-	-	-	-	-	-	-	-	MH	-	-	r		r	r	-
Osprey, Kites, Hawks, and Eagles – Accipitridae																	
Cooper's Hawk	*Accipiter cooperii*	-	-	-	-	-	-	-	-	-	-	-	u		u	o	-
Northern Goshawk	*Accipiter gentilis*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
Sharp-shinned Hawk	*Accipiter striatus velox*	-	SC	G5	S3	-	-	-	-	-	-	-	u		c	o	-
Red-shouldered Hawk	*Buteo lineatus lineatus*	-	-	-	-	-	-	-	-	-	-	-	r		r		M
Red-tailed Hawk	*Buteo jamaicensis*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Rough-legged Hawk	*Buteo lagopus johannis*	-	-	-	-	-	-	-	-	-	-	-			r	r	-
Broad-winged Hawk	*Buteo platypterus*	-	-	G5	S5	-	H	-	-	-	-	-	r	r	r		-
Swainson's Hawk	*Buteo swainsoni*	-	-	-	-	N	-	-	-	-	-	-			x		-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
•Northern Harrier	*Circus cyaneus*	-	T	G5	S1	-	-	-	-	-	-	-	c	u	c	c	-
Bald Eagle	*Haliaeetus leucocephalus*	-	E	G4	S1	R5, N	M	-	-	-	-	-	o	o	o	r	-
Mississippi Kite	*Ictinia mississippiensis*	-	-	-	-	-	-	-	-	-	-	-	x				-
Osprey	*Pandion haliaetus carolinensis*	-	-	-	-	-	-	-	-	-	-	-	c	u	u		-
Falcons – Falconidae																	
Merlin	*Falco columbarius*	-	-	-	-	-	-	-	-	-	-	-	o		u	o	-
Peregrine Falcon	*Falco peregrinus*	-	E	G4	S1	R5, N	-	IIC	-	-	-	-	u		c	o	-
Gyrfalcon	*Falco rusticolus*	-	-	-	-	-	-	-	-	-	-	-			r	r	-
American Kestrel	*Falco sparverius sparverius*	-	-	G5	S4	-	-	-	-	-	-	-	u		u		-
Pheasants – Phasianidae																	
Ring-necked Pheasant	*Phasianus colchicus*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
Quail – Odontophoridae																	
Northern Bobwhite	*Colinus virginianus*	-	-	G5	S5	-	H	-	-	-	-	-	r		r	r	-
Rails – Rallidae																	
American Coot	*Fulica americana*	-	-	-	-	-	-	-	L	-	-	-	o		c	o	-
Common Moorhen	*Gallinula chloropus cachinnans*	-	SC	G5	S1	-	-	-	H	-	-	-	r		r		-
Purple Gallinule	*Porphyrio martinica*	-	-	-	-	-	-	-	M	-	-	-			x		-
•Sora	*Porzana carolina*	-	-	G5	S3	-	M	-	H	-	-	-	o	r	o		-
King Rail	*Rallus elegans*	-	T	G4	S1	-	M	-	HH	-	-	-			r		M
•Virginia Rail	*Rallus limicola*	-	-	-	-	-	-	-	M	-	-	-	r	r	o		N
Clapper Rail	*Rallus longirostris*	-	-	-	-	-	H	-	H	-	-	-			r		M

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Cranes – Gruidae																	
Sandhill Crane	*Grus canadensis*	-	-	-	-	-	-	-	-	-	-	-			x		-
Plovers – Charadriidae																	
•Piping Plover	*Charadrius melodus*	T	T	G3	S2	-	HH	IA	-	-	-	5	u	u	u		NMS
Semipalmated Plover	*Charadrius semipalmatus*	-	-	-	-	-	M	-	-	-	-	2	u	a	c		-
Killdeer	*Charadrius vociferous*	-	-	-	-	-	M	-	-	-	-	3	u		u		-
Wilson's Plover	*Charadrius wilsonia*	-	-	-	-	R5, N	H	-	-	-	-	4	x	x			-
American Golden Plover	*Pluvialis dominica*	-	-	-	-	-	H	-	-	-	-	4	r	r	u		-
Black-bellied Plover	*Pluvialis squatarola*	-	-	-	-	-	H	-	-	-	-	3	a	c	a	o	-
Oystercatchers – Haematopodidae																	
•American Oystercatcher	*Haematopus palliatus*	-	-	G5	S2	R5, N	HH	IA	-	-	-	4	c	c	c		S
Stilts and Avocets – Recurvirostridae																	
Black-necked Stilt	*Himantopus mexicanus*	-	-	-	-	-	-	-	-	-	-	2		x			-
American Avocet	*Recurvirostra americana*	-	-	-	-	-	M	-	-	-	-	3		x	x		-
Sandpipers and Phalaropes – Scolopacidae																	
•Spotted Sandpiper	*Actitis macularia*	-	-	-	-	-	M	-	-	-	-	2	o	o	r		-
Ruddy Turnstone	*Arenaria interpres*	-	-	G5	SNA	-	HH	-	-	-	-	4	c	o	c		-
Upland Sandpiper	*Bartramia longicauda*	-	E	G5	S1	R5, N	M	IB	-	-	-	4	r	o			S
Red Knot	*Calidris canutus rufa*	C	-	G5	S2	R5, N	HH	-	-	-	-	4	c	c	c	r	M
Sanderling	*Calidris alba*	-	-	G5	SNA	-	HH	-	-	-	-	4	a	a	a	u	M
Dunlin	*Calidris alpina*	-	-	-	-	N	H	-	-	-	-	3	a	u	a	u	-
Baird's Sandpiper	*Calidris bairdii*	-	-	-	-	-	-	-	-	-	-	2			r		-
Curlew Sandpiper	*Calidris ferruginea*	-	-	-	-	-	-	-	-	-	-	-	r	r			-

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White-rumped Sandpiper	*Calidris fuscicollis*	-	-	-	-	-	H	-	-	-	-	2	u	u	u		-
Stilt Sandpiper	*Calidris himantipus*	-	-	-	-	-	-	-	-	-	-	3		u	o		-
Purple Sandpiper	*Calidris maritima*	-	-	-	-	R5, N	H	-	-	-	-	2			r		NS
Western Sandpiper	*Calidris mauri*	-	-	-	-	-	M	-	-	-	-	4		o	u		-
Pectoral Sandpiper	*Calidris melanotos*	-	-	-	-	-	-	-	-	-	-	2	r	o	c		-
Little Stint	*Calidris minuta*	-	-	-	-	-	-	-	-	-	-	-		x			-
•Least Sandpiper	*Calidris minutilla*	-	-	-	-	-	M	-	-	-	-	3	c	a	c		-
Semipalmated Sandpiper	*Calidris pusilla*	-	-	-	-	R5, N	H	-	-	-	-	3	a	a	c		NS
Red-necked Stint	*Calidris ruficollis*	-	-	-	-	-	-	-	-	-	-	-	x	x			-
•Willet	*Catoptrophorus semipalmatus*	-	-	-	-	-	H	-	-	-	-	3	c	c	u		M
Common Snipe	*Gallinago gallinago*	-	-	-	-	-	M	-	-	-	-	3	r		o		-
Wandering Tattler	*Heteroscelus incanus*	-	-	-	-	-	-	-	-	-	-	3	x				-
Short-billed Dowitcher	*Limnodromus griseus*	-	-	G5	SNA	R5, N	H	-	-	-	-	4	c	a	c		-
Long-billed Dowitcher	*Limnodromus scolopaceus*	-	-	-	-	-	-	-	-	-	-	2		o	o		-
Black-tailed Godwit	*Limosa limosa*	-	-	-	-	-	-	-	-	-	-	-		x			-
Marbled Godwit	*Limosa fedoa*	-	-	-	-	R5, N	H	-	-	-	-	4		o	u		-
Hudsonian Godwit	*Limosa haemastica*	-	-	-	-	R5, N	H	-	-	-	-	4		c	o		-
Bar-tailed Godwit	*Limosa lapponica*	-	-	-	-	N	-	-	-	-	-	4	x	x			-
Long-billed Curlew	*Numenius americanus*	-	-	-	-	N	-	-	-	-	-	5		x			-
Eurasian Curlew	*Numenius arquata*	-	-	-	-	-	-	-	-	-	-	-			x		-
Whimbrel	*Numenius phaeopus*	-	-	G5	SNA	R5, N	HH	-	-	-	-	4	r	c	c		-
Red Phalarope	*Phalaropus fulicarius*	-	-	-	-	-	M	-	-	-	-	3	r		r		-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Red-necked Phalarope	*Phalaropus lobatus*	-	-	-	-	-	M	-	-	-	-	3	r	r	r		-
•Wilson's Phalarope	*Phalaropus tricolor*	-	-	-	-	-	H	-	-	-	-	4	r	o	r		-
Ruff	*Philomachus pugnax*	-	-	-	-	-	-	-	-	-	-	-	r	r			-
American Woodcock	*Scolopax minor*	-	-	G5	S4	-	HH	IA	-	-	-	4	r		r		N
Lesser Yellowlegs	*Tringa flavipes*	-	-	-	-	R5, N	M	-	-	-	-	3	r	c	c		-
Greater Yellowlegs	*Tringa melanleuca*	-	-	-	-	-	H	-	-	-	-	3	c	a	c		-
Solitary Sandpiper	*Tringa solitaria*	-	-	-	-	R5, N	H	-	-	-	-	4	r	r	r		-
Buff-breasted Sandpiper	*Tryngites subruficollis*	-	-	-	-	R5, N	H	-	-	-	-	4			r		-
Jaegers – Laridae																	
Long-tailed Jaeger	*Stercorarius longicaudus*	-	-	-	-	-	-	-	L	-	LC	-			r		-
Parasitic Jaeger	*Stercorarius parasiticus*	-	-	-	-	-	-	-	L	-	LC	-	o	o	u		-
Pomarine Jaeger	*Stercorarius pomarinus*	-	-	-	-	-	-	-	L	-	LC	-	r	r	o		-
Gulls, Terns, and Skimmers – Laridae																	
Black Tern	*Chlidonias niger*	-	-	-	-	-	-	-	H	-	MC	-	o	u	u		-
Black-headed Gull	*Chroicocephalus ridibundus*	-	-	-	-	-	-	-	L	-	MC	-	r	r	r		-
Gull-billed Tern	*Gelochelidon nilotica*	-	-	-	-	R5, N	HH	-	HH	-	HC	-		r			-
•Herring Gull	*Larus argentatus*	-	-	-	-	-	-	-	H	-	LC	-	a	a	a	a	-
•Laughing Gull	*Larus atricilla*	-	-	G5	S2	-	-	-	H	-	NR	-	c	a	c		-
Mew Gull	*Larus canus*	-	-	-	-	-	-	-	-	-	NR	-			x		-
Ring-billed Gull	*Larus delawarensis*	-	-	-	-	-	-	-	L	-	NR	-	c	c	c	c	-
Lesser Black-backed Gull	*Larus fuscus*	-	-	-	-	-	-	-	L	-	MC	-	r	r	u	o	-
Iceland Gull	*Larus glaucoides*	-	-	-	-	-	-	-	L	-	LC	-	r		r	o	-
Glaucous Gull	*Larus hyperboreus*	-	-	-	-	-	-	-	L	-	NR	-	r		r	r	-

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•Great Black-backed Gull	*Larus marinus*	-	-	-	-	-	-	-	L	-	NR	-	a	a	a	a	-
Little Gull	*Larus minutus*	-	-	-	-	-	-	-	M	-	HC	-	r	r	r		-
Bonaparte's Gull	*Larus philadelphia*	-	-	-	-	-	-	-	M	-	MC	-	u	o	c	o	-
Franklin's Gull	*Leucophaeus pipixcan*	-	-	-	-	-	-	-	-	-	MC	-			r		-
Bridled Tern	*Onychoprion anaethetus*	-	-	-	-	-	H	-	H	-	HC	-			x		-
Sooty Tern	*Onychoprion fuscatus*	-	-	-	-	-	-	-	-	-	MC	-		x	x		-
Ivory Gull	*Pagophila eburnea*	-	-	-	-	-	-	-	-	-	MC	-				x	-
Black-legged Kittiwake	*Rissa tridactyla*	-	-	-	-	-	-	-	L	-	NR	-	u	o	c	c	-
•Black Skimmer	*Rynchops niger*	-	-	-	-	R5, N	M	-	HH	-	HC	-	o	u	o		M
•Least Tern	*Sterna antillarum*	-	SC	G4	S3	R5, N	H	-	HH	-	HC	-	c	c			M
Caspian Tern	*Sterna caspia*	-	-	-	-	-	-	-	L	-	LC	-	r	r	r		-
•Roseate Tern	*Sterna dougallii*	E	E	G4T3	S2	-	HH	-	HH	-	HC	-	u	c	c		-
Forster's Tern	*Sterna forsteri*	-	-	-	-	-	H	-	H	-	MC	-		u	u		-
•Common Tern	*Sterna hirundo*	-	SC	G5	S3	-	M	-	HH	-	LC	-	a	a	c		NMS
Royal Tern	*Sterna maxima*	-	-	-	-	-	M	-	H	-	MC	-		o			-
•Arctic Tern	*Sterna paradisaea*	-	SC	G5	S1	R5	-	-	HH	-	HC	-	o	o			-
Sandwich Tern	*Sterna sandvicensis*	-	-	-	-	-	H	-	L	-	NR	-		r			-
Sabine's Gull	*Xema sabini*	-	-	-	-	-	-	-	L	-	LC	-	r	r	r		-
Alcids – Alcidae																	
Razorbill	*Alca torda*	-	-	-	-	-	M	-	H	-	MC	-	r		o	u	-
Dovekie	*Alle alle*	-	-	-	-	-	-	-	L	-	MC	-			r	o	-
Black Guillemot	*Cepphus grylle*	-	-	-	-	-	-	-	M	-	NR	-				r	-
Atlantic Puffin	*Fratercula arctica*	-	-	-	-	-	-	-	M	-	NR	-			r	r	-
Common Murre	*Uria aalge*	-	-	-	-	-	-	-	M	-	MC	-				r	-
Thick-billed Murre	*Uria lomvia*	-	-	-	-	-	-	-	L	-	MC	-				r	-

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Doves – Columbidae																	
Rock Dove	*Columba livia*	-	-	-	-	-	-	-	-	-	-	-	o	o	o	o	-
•Mourning Dove	*Zenaida macroura carolinensis*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Cuckoos – Cuculidae																	
Black-billed Cuckoo	*Catharus bicknelli*	-	-	-	-	-	-	IA	-	-	-	-	r	r	o		-
Yellow-billed Cuckoo	*Coccyzus americanus*	-	-	-	-	N	-	-	-	-	-	-	r	r	o		-
Owls – Tytonidae																	
Barn Owl	*Tyto alba*	-	SC	G5	S2	-	-	-	-	-	-	-	r		r		-
Owls – Strigidae																	
Northern Saw-whet owl	*Aegolius acadicus*	-	-	-	-	-	-	-	-	-	-	-			r		-
•Short-eared Owl	*Asio flammeus*	-	E	G5	S1	R5, N	-	IIC	-	-	-	-	r	r	o	r	-
Long-eared Owl	*Asio otus*	-	SC	G5	S2	-	-	-	-	-	-	-			r		-
Burrowing Owl	*Athene cunicularia*	-	-	-	-	-	-	-	-	-	-	-		x			-
•Great Horned Owl	*Bubo virginianus*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	u	-
Snowy Owl	*Nyctea scandiaca*	-	-	-	-	-	-	-	-	-	-	-				r	-
Eastern Screech Owl	*Otus asio*	-	-	-	-	-	-	-	-	-	-	-			r	r	-
Goatsuckers – Caprimulgidae																	
Whip-poor-will	*Caprimulgus vociferous*	-	-	G5	S4	R5	H	-	-	-	-	-	r		r		M
Common Nighthawk	*Chordeiles minor*	-	-	-	-	-	-	-	-	-	-	-	r		r		M
Swifts – Apodidae																	
Chimney Swift	*Chaetura pelagica*	-	-	-	-	-	H	IIA	-	-	-	-	o	o	o		-

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Hummingbirds – Trochilidae																	
Ruby-throated Hummingbird	*Archilochus colubris*	-	-	-	-	-	-	-	-	-	-	-	r		u		-
Kingfishers – Alcedinidae																	
•Belted Kingfisher	*Ceryle alcyon*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	r	-
Woodpeckers – Picidae																	
•Northern Flicker	*Colaptes auratus*	-	-	-	-	-	H	-	-	-	-	-	c	u	c	u	-
Red-bellied Woodpecker	*Melanerpes carolinus*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
Red-headed Woodpecker	*Melanerpes eurythrocephalus*	-	-	-	-	R5, N	M	IIC	-	-	-	-			r		-
•Downy Woodpecker	*Picoides pubescensmedianus*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	u	-
Hairy Woodpecker	*Picoides villosus*	-	-	-	-	-	-	IIA	-	-	-	-	o		o	o	-
Yellow-bellied Woodpecker	*Sphyrapicus varius*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Tyrant Flycatchers – Tyrannidae																	
Western Wood-Pewee	*Contopus sordidulus*	-	-	-	-	-	-	-	-	-	-	-			x		-
Eastern Wood-Pewee	*Contopus virens*	-	-	-	-	-	-	IIA	-	-	-	-	o	o	u		M
Alder Flycatcher	*Empidonax alnorum*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Yellow-bellied Flycatcher	*Empidonax flaviventris*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Least Flycatcher	*Empidonax minimus*	-	-	-	-	-	-	-	-	-	-	-	o		o		-
Willow Flycatcher	*Empidonax traillii*	-	-	G5	S4	N	H	-	-	-	-	-	o		o		S
Acadian Flycatcher	*Empidonax virescens*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Olive-sided Flycatcher	*Mionectes olivaceus*	-	-	-	-	R5, N	-	-	-	-	-	-	r		r		-
Ash-throated Flycatcher	*Myiarchus cinerascens*	-	-	-	-	-	-	-	-	-	-	-			x		-
Great Crested Flycatcher	*Myiarchus crinitus*	-	-	-	-	-	H	-	-	-	-	-	o	u	r		-
Eastern Phoebe	*Sayornis phoebe*	-	-	-	-	-	-	-	-	-	-	-	r		o		-

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Say's Phoebe	*Sayornis saya*	-	-	-	-	-	-	-	-	-	-	-			x		-
Scissor-tailed Flycatcher	*Tyrannus forficatus*	-	-	-	-	-	-	-	-	-	-	-			x		-
•Eastern Kingbird	*Tyranus tyranus*	-	-	-	-	-	H	-	-	-	-	-	u	u	u		-
Western Kingbird	*Tyrannus verticalis*	-	-	-	-	-	-	-	-	-	-	-		r	r		-
Cassin's Kingbird	*Tyrannus vociferans*	-	-	-	-	-	-	-	-	-	-	-			x		-
Shrikes – Laniidae																	
Northern Shrike	*Lanius excubitor*	-	-	-	-	-	-	-	-	-	-	-	r		r	R	-
Loggerhead Shrike	*Lanius ludovicianus*	-	-	-	-	R5, N	M	-	-	-	-	-			r		-
Vireos – Vireonidae																	
Yellow-throated Vireo	*Vireo flavifrons*	-	-	-	-	-	H	-	-	-	-	-			r		-
Warbling Vireo	*Vireo gilvus*	-	-	-	-	-	-	-	-	-	-	-	r		r		N
White-eyed Vireo	*Vireo griseus*	-	-	-	-	-	-	-	-	-	-	-			r		-
Red-eyed Vireo	*Vireo olivaceus*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Philadelphia Vireo	*Vireo philadelphicus*	-	-	-	-	-	-	-	-	-	-	-			o		-
Blue-headed Vireo	*Vireo solitarius*	-	-	-	-	-	-	-	-	-	-	-	r		u		-
Crows and Jays – Corvidae																	
•American Crow	*Corvus brachyrhynchos*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Fish Crow	*Corvus ossifragus*	-	-	-	-	-	-	-	-	-	-	-	r	r			-
Blue Jay	*Cyanocitta cristata*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	u	-
Larks – Alaudidae																	
•Horned Lark	*Eremophila alpestris*	-	-	-	-	N	-	-	-	-	-	-	c	c	c	u	-
Swallows – Hirundinidae																	
Barn Swallow	*Hirundo rustica*	-	-	-	-	-	-	-	-	-	-	-	c	u	o		-
Purple Martin	*Progne subis*	-	-	-	-	-	-	-	-	-	-	-	r	r			-
Cave Swallow	*Petrochelidon fulva*	-	-	-	-	-	-	-	-	-	-	-			x		-

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Cliff Swallow	*Petrochelidon pyrrhonota*	-	-	-	-	-	-	-	-	-	-	-	r	r	r	r	-
Brown-chested Martin	*Progne tapera*	-	-	-	-	-	-	-	-	-	-	-		x			-
Bank Swallow	*Riparia riparia*	-	-	-	-	-	-	-	-	-	-	-	o	o			NM
•Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	-	-	-	-	-	-	-	-	-	-	-	u	u			-
•Tree Swallow	*Tachycineta bicolor*	-	-	-	-	-	-	-	-	-	-	-	c	c	a		-
Chickadees and Titmice – Paridae																	
•Tufted Titmouse	*Baeolophus bicolor*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
•Black-capped Chickadee	*Poecile atricapilla*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Nuthatches – Sittidae																	
Red-breasted Nuthatch	*Sitta canadensis*	-	-	-	-	-	-	-	-	-	-	-	u		u	u	-
White-breasted Nuthatch	*Sitta carolinensis*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	u	-
Creepers – Certhiidae																	
Brown Creeper	*Certhia americana*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Wrens – Troglodytidae																	
Marsh Wren	*Cistothorus palustris*	-	-	-	-	-	H	-	-	-	-	-			o		MS
Sedge Wren	*Cistothorus platensis*	-	E	G5	S1	R5	M	IIC	-	-	-	-			r		-
Carolina Wren	*Thryothorus ludovicianus*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	u	-
House Wren	*Troglodytes aedon*	-	-	-	-	-	-	-	-	-	-	-			r		-
Winter Wren	*Troglodytes troglodytes*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Kinglets – Regulidae																	
Ruby-crowned Kinglet	*Regulus calendula*	-	-	-	-	-	-	-	-	-	-	-	o		c		-
Golden-crowned Kinglet	*Regulus satrapa*	-	-	-	-	-	-	-	-	-	-	-	o		c	u	-

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Gnatcatchers – Sylviidae																	
Blue-gray Gnatcatcher	*Polioptila caerulea*	-	-	-	-	-	-	-	-	-	-	-	o		o		-
Thrushes – Turdidae																	
Bicknell's Thrush	*Catharus bicknelli*	-	-	-	-	R5, N	H	-	-	-	-	-	r		r		N
Veery	*Catharus fuscescens*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Hermit Thrush	*Catharus guttatus*	-	-	-	-	-	-	-	-	-	-	-	r		u		-
Gray-cheeked Thrush	*Catharus minimus*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Swainson's Thrush	*Catharus ustulatus*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Wood Thrush	*Hylocichla mustelina*	-	-	G5	S5	R5, N	HH	IA	-	-	-	-	r		r		NMS
Northern Wheatear	*Oenanthe oenanthe*	-	-	-	-	-	-	-	-	-	-	-			x		-
Eastern Bluebird	*Sialia sialis*	-	-	-	-	-	-	-	-	-	-	-	r	r	o	r	-
•American Robin	*Turdus migratorius*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	u	-
Mimids – Mimidae																	
•Gray Catbird	*Dumatella carolinensis*	-	-	-	-	-	M	-	-	-	-	-	c	c	c	r	-
•Northern Mockingbird	*Mimus polyglottos*	-	-	-	-	-	-	-	-	-	-	-	u	u	u	o	-
•Brown Thrasher	*Toxostoma rufum*	-	-	G5	S5	-	H	-	-	-	-	-	r		o		M
Starlings – Sturnidae																	
•European Starling	*Sturnus vulgaris*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Pipits – Motacillidae																	
American Pipit	*Anthus rubescens*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Waxwings – Bombycillidae																	
Cedar Waxwing	*Bombycilla cedrorum*	-	-	-	-	-	-	-	-	-	-	-	u	u	c	o	-
Wood - Warblers – Parulidae																	
Black-throated Blue Warbler	*Dendroica caerulescens*	-	-	-	-	-	-	IB	-	-	-	-	r		o		-
Bay-breasted Warbler	*Dendroica castanea*	-	-	-	-	R5, N	H	-	-	-	-	-	r		o		-
Cerulean Warbler	*Dendroica cerulean*	-	-	-	-	R5, N	M	IB	-	-	-	-			r		-

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Yellow-rumped Warbler	*Dendroica coronata cornata*	-	-	-	-	-	-	-	-	-	-	-	c		a	o	-
Prairie Warbler	*Dendroica discolor*	-	-	G5	S5	R5, N	HH	IA	-	-	-	-	r		o		-
Yellow-throated Warbler	*Dendroica dominica*	-	-	-	-	-	-	-	-	-	-	-			r		-
Blackburnian Warbler	*Dendroica fusca*	-	-	-	-	-	M	IIC	-	-	-	-	r		o		N
Magnolia Warbler	*Dendroica magnolia*	-	-	-	-	-	-	-	-	-	-	-	o		o		-
Palm Warbler	*Dendroica palmarum*	-	-	-	-	-	-	-	-	-	-	-	o		c		N
Chestnut-sided Warbler	*Dendroica pensylvanica*	-	-	-	-	-	-	-	-	-	-	-	r		o		NS
•Yellow Warbler	*Dendroica petechia*	-	-	-	-	-	-	-	-	-	-	-	c	c	o		-
•Pine Warbler	*Dendroica pinus*	-	-	-	-	-	-	-	-	-	-	-	u	o	o		-
Blackpoll Warbler	*Dendroica striata*	-	SC	G5	S1	-	-	-	-	-	-	-	o		u		N
Cape May Warbler	*Dendroica tigrina*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Black-throated Green Warbler	*Dendroica virens*	-	-	-	-	-	-	-	-	-	-	-	o		o		-
•Common Yellowthroat	*Geothlypis trichas*	-	-	-	-	-	-	-	-	-	-	-	c	c	c		-
Worm-eating Warbler	*Helmitheros vermivorus*	-	-	-	-	R5, N	H	IA	-	-	-	-			r		M
Yellow-breasted Chat	*Icteria virens*	-	-	-	-	-	-	-	-	-	-	-			o		-
Black-and-white Warbler	*Mniotilta varia*	-	-	-	-	-	H	IIA	-	-	-	-	u		u		M
Connecticut Warbler	*Oporornis agilis*	-	-	-	-	-	-	-	-	-	-	-			r		-
Kentucky Warbler	*Oporornis formosus*	-	-	-	-	R5, N	H	IB	-	-	-	-			r		M
Mourning Warbler	*Oporornis philadelphia*	-	SC	G5	S1	-	-	-	-	-	-	-	r		r		-
Northern Parula	*Parula americana*	-	T	G5	S2	-	-	-	-	-	-	-	o		o		-
Prothonotary Warbler	*Protonotaria citrea*	-	-	-	-	N	H	-	-	-	-	-	r		r		M
Ovenbird	*Seiurus aurocapillus*	-	-	-	-	-	-	-	-	-	-	-	r		o		NMS

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Northern Waterthrush	*Seiurus noveboracensis*	-	-	-	-	-	-	-	-	-	-	-	o		u		NS
American Redstart	*Setophaga ruticilla*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Orange-crowned Warbler	*Vermivora celata*	-	-	-	-	-	-	-	-	-	-	-			o		-
Golden-winged Warbler	*Vermivora chrysoptera*	-	-	-	-	R5, N	M	IB	-	-	-	-	r		r		-
Tennessee Warbler	*Vermivora peregrina*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Blue-winged Warbler	*Vermivora pinus*	-	-	G5	S3	R5, N	HH	IA	-	-	-	-			o		S
Nashville Warbler	*Vermivora ruficapilla*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Canada Warbler	*Wilsonia canadensis*	-	-	G5	S5	R5, N	M	IIC	-	-	-	-	r		o		-
Hooded Warbler	*Wilsonia citrina*	-	-	-	-	-	-	-	-	-	-	-			r		-
Wilson's Warbler	*Wilsonia pusilla*	-	-	-	-	-	-	-	-	-	-	-	r		o		-
Tanagers – Thraupidae																	
Scarlet Tanager	*Piranga olivacea*	-	-	-	-	-	-	IA	-	-	-	-	r		o		-
Summer Tanager	*Piranga rubra*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Emberizine Sparrows and Their Allies – Emberizidae																	
•Saltmarsh Sparrow	*Ammodramus caudacutus*	-	-	G4	S3	R5, N	HH	IA	-	-	-	-	c	c	o		MS
Henslow's Sparrow	*Ammodramus henslowii*	-	E	G4	S1	R5, N	M	IB	-	-	-	-			r		-
LeConte's Sparrow	*Ammodramus leconteii*	-	-	-	-	-	-	-	-	-	-	-			x		-
•Seaside Sparrow	*Ammodramus maritimus*	-	-	G4	S2	R5, N	HH	IA	-	-	-	-		r	r		-
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	-	-	-	-	R5, N	M	-	-	-	-	-			r		N
Grasshopper Sparrow	*Ammodramus savannarum*	-	T	G5	S2	-	M	-	-	-	-	-			r		M

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Lark Bunting	*Calamospiza melanocorys*	-	-	-	-	-	-	-	-	-	-	-			r		-
Lapland Longspur	*Calcarius lapponicus*	-	-	-	-	-	-	-	-	-	-	-	u		u	o	-
Lark Sparrow	*Chondestes grammacus*	-	-	-	-	-	-	-	-	-	-	-		r	r		-
Dark-eyed Junco	*Junco hyemalis*	-	-	-	-	-	-	-	-	-	-	-	u		c	o	-
Swamp Sparrow	*Melospiza georgiana*	-	-	-	-	-	-	-	-	-	-	-	r		u		-
Lincoln's Sparrow	*Melospiza lincolnii*	-	-	-	-	-	-	-	-	-	-	-			o		-
•Song Sparrow	*Melospiza melodia*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
•Savannah Sparrow	*Passerculus sandwichensis*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Fox Sparrow	*Passerella iliaca*	-	-	-	-	-	-	-	-	-	-	-			o		-
•Eastern Towhee	*Pipilo erythrophthalmus*	-	-	G5	S5	-	H	IIA	-	-	-	-	u	r	u		NM
Snow Bunting	*Plectrophenax nivalis*	-	-	-	-	-	-	-	-	-	-	-	o		c	c	-
Vesper Sparrow	*Pooecetes gramineus*	-	T	G5	S2	-	-	-	-	-	-	-			r		-
American Tree Sparrow	*Spizella arborea*	-	-	-	-	-	-	-	-	-	-	-			o	o	-
Clay-colored Sparrow	*Spizella pallida*	-	-	-	-	-	-	-	-	-	-	-			r		-
•Chipping Sparrow	*Spizella passerina*	-	-	-	-	-	-	-	-	-	-	-	u	u	u		-
Field Sparrow	*Spizella pusilla*	-	-	G5	S5	-	H	-	-	-	-	-	r		o		S
White-throated Sparrow	*Zonotrichia albicollis*	-	-	G5	S5	-	-	-	-	-	-	-	u		c		N
White-crowned Sparrow	*Zonotrichia leucophrys*	-	-	-	-	-	-	-	-	-	-	-	r		u		-
Cardinals and Grosbeaks – Cardinalidae																	
•Northern Cardinal	*Cardinalis cardinalis*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Blue Grosbeak	*Guiraca caerulea caerulea*	-	-	-	-	-	-	-	-	-	-	-	r		r		-
Painted Bunting	*Passerina ciris*	-	-	-	-	-	-	-	-	-	-	-	x		x		-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Indigo Bunting	*Passerina cyanea*	-	-	-	-	-	-	-	-	-	-	-	o		u		-
Rose-breasted Grosbeak	*Pheuctitus ludovicianus*	-	-	-	-	-	-	IIA	-	-	-	-	o		u		-
Dickcissel	*Spiza americana*	-	-	-	-	-	-	-	-	-	-	-			r		-
Blackbirds and Orioles – Icterids																	
•Red-winged Blackbird	*Agelaius phoeniceus*	-	-	-	-	-	-	-	-	-	-	-	c	c	c		-
Bobolink	*Dolichonyx oryzivorus*	-	-	-	-	-	-	III	-	-	-	-	o		c		NS
Rusty Blackbird	*Euphagus carolinus*	-	-	-	-	R5, N	H	-	-	-	-	-			u		-
Baltimore Oriole	*Icterus galbula*	-	-	-	-	-	H	1A	-	-	-		u	u	c		-
Orchard Oriole	*Icterus spurius*	-	-	-	-	-	-	-	-	-	-	-	r	r			-
Brown-headed Cowbird	*Molothrus ater*	-	-	-	-	-	-	-	-	-	-	-	u	u	u		-
Eastern Meadowlark	*Sternella magna*	-	-	G5	S4	-	-	-	-	-	-	-	r		o		MS
•Common Grackle	*Quiscalus quiscula*	-	-	-	-	-	-	-	-	-	-	-	c	c	c		-
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	-	-	-	-	-	-	-	-	-	-	-		r	r		-
Finches – Fringillidae																	
Common Redpoll	*Carduelis flammea*	-	-	-	-	-	-	-	-	-	-	-				r	-
•American Goldfinch	*Carduelis tristis*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Purple Finch	*Carpodacus purpureus*	-	-	-	-	-	-	2A	-	-	-	-	o		o	r	-
•House Finch	*Carpodacus mexicanus*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-
Evening Grosbeak	*Coccothraustes vespertinus*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
Red Crossbill	*Loxia curvirostra*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
White-winged Crossbill	*Loxia leucoptera*	-	-	-	-	-	-	-	-	-	-	-	r		r	r	-
Pine Grosbeak	*Pinicola enucleator*	-	-	-	-	-	-	-	-	-	-	-				r	-
Pine Siskin	*Spinus pinus*	-	-	-	-	-	-	-	-	-	-	-	r		o	r	-

Common Name	Scientific Name	Federal Legal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	BCC[7]	BCR 30[8]	PIF 09[9]	MANEM[10]	NAWMP[11]	NAWCP[12]	U.S. SCP[13]	Spring[14]	Summer[14]	Fall[14]	Winter[14]	NALCC Rep. Species[15]
Old World Sparrows – Passeridae																	
•House Sparrow	*Passer domesticus*	-	-	-	-	-	-	-	-	-	-	-	c	c	c	c	-

Source: Data adapted from the Monomoy National Wildlife Refuge Bird List prepared with the assistance of Blair Nikula.
•Denotes species suspected to have been breeding on the refuge over the past 20 years.

Table A.5. Mammal Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	NALCC Rep. Species[15]
Opossums –Didelphidae							
Virginia Opossum	*Didelphis virginiana*	-	-	-	-	-	-
Tree Squirrels and Marmots – Sciuridae							
Eastern Gray Squirrel	*Sciurus carolinensis*	-	-	-	-	-	-
Red Squirrel	*Tamiasciurus hudsonicus*	-	-	-	-	-	-
Eastern Chipmunk	*Tamias striatus*	-	-	-	-	-	-
Shrews – Soricidae							
Northern Short-tailed Shrew	*Blarina brevicauda*	-	-	-	-	-	-
Masked Shrew (Cinereus)	*Sorex cinereus*	-	-	-	-	-	-
Plainnose Bats – Vespertilionidae							
Big Brown Bat	*Eptesicus fuscus*	-	-	-	-	-	-
Eastern Red Bat	*Lasiurus borealis*	-	-	G5	S4	-	NMS
Hoary Bat	*Lasiurus cinereus*	-	-	G5	SU	-	-
Raccoons, Coatis, and Ringtails – Procyonidae							
Raccoon	*Procyon lotor*	-	-	-	-	-	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	NALCC Rep. Species[15]
Weasels, Mink, Martens, and Otters – Mustelidae							
North American River Otter	*Lutra canadensis*	-	-	-	-	-	-
Skunks – Mephitidae							
Striped Skunk	*Mephitis mephitis*	-	-	-	-	-	-
Dogs, Foxes, and Wolves – Canidae							
Eastern Coyote	*Canis latrans*	-	-	-	-	-	-
Red Fox	*Vulpes vulpes*	-	-	-	-	-	-
Cats – Felidae							
Domestic Cat	*Felis catus*	-	-	-	-	-	-
Hair Seals – Phocidae							
Hooded Seal	*Cystophora cristata*	-	-	-	-	-	-
Gray Seal	*Halichoerus grypus*	-	-	-	-	-	-
Harp Seal	*Pagophilus groenlandicus*	-	-	-	-	-	-
Harbor Seal	*Phoca vitulina*	-	-	-	-	-	-
Mice, Rats, Voles, and Lemmings – Cricetidae							
Meadow Vole	*Microtus pennsylvanicus*	-	-	-	-	-	-
Common Muskrat	*Ondatra zibethicus*	-	-	-	-	-	-
White-footed Mouse	*Peromyscus leucopus*	-	-	-	-	-	-
Old World Rats and Mice – Muridae							
House Mouse	*Mus musculus*	-	-	-	-	-	-
Jumping Mice – Dipodidae							
Meadow Jumping Mouse	*Zapus hudsonius*	-	-	-	-	-	-
Hares and Rabbits – Leporidae							
Eastern Cottontail	*Sylvilagus floridanus*	-	-	-	-	-	-
Deer, Elk, and Moose – Cervidae							
White-tailed Deer	*Odocoileus virginianus*	-	-	-	-	-	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	NALCC Rep. Species[15]
Sperm Whale – Physeteridae							
Sperm Whale	*Physeter macrocephalus*	E	E	G3G4	S1	E/D	-
Dolphins and Porpoises – Delphinidae							
Short-Beaked Common Dolphin	*Delphinus delphis*	-	-	-	-	-	-
Short-finned Pilot Whale	*Globicephala macrorhynchus*	-	-	-	-	-	-
Long-finned Dolphin	*Globicephala melas*	-	-	-	-	-	-
Risso's Dolphin	*Grampus griseus*	-	-	-	-	-	-
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	-	-	-	-	-	-
White-beaked Dolphin	*Lagenorhynchus albirostris*	-	-	-	-	-	-
Harbor Porpoise	*Phocoena phocoena*	-	-	G4G5	S4	-	-
Northern Bottlenose Dolphin	*Tursiops truncatus*	-	-	-	-	D	-
Finback Whales - Balaenopteridae							
Minke Whale	*Balaenoptera acutorostrata*	-	-	-	-	-	-
Sei Whale	*Balaenoptera borealis*	E	E	G3	S1S2	E/D	-
Blue Whale	*Balaenoptera musculus*	E	E	G3G4	S1	E/D	-
Fin Whale	*Balaenoptera physalus*	E	E	G3G4	S1S2	E/D	-
Humpback Whale	*Megaptera novaeangliae*	E	E	G3	S1S2	E/D	-
Right and Bowhead Whales - Balaenidae							
North Atlantic Right Whale	*Eubalaena glacialis*	E	E	G1	S1S2	E/D	-

Source: Data assembled from the Massachusetts Division of Fisheries and Wildlife, State Mammal List—Species Distribution, in addition to staff observations of wildlife on the refuge.

Table A.6. Butterfly and Moth Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NALCC Rep. Species[15]
Swallowtails – Papilionidae						
Eastern Tiger Swallowtail	*Papilio glaucus*	-	-	-	-	-
Black Swallowtail	*Papilio polyxenes*	-	-	-	-	-
Whites, Sulphurs, and Orange Tips – Pieridae						
Orange Sulphur	*Colias eurytheme*	-	-	-	-	-
Clouded Sulphur	*Colias philodice*	-	-	-	-	-
Cloudless Sulphur	*Phoebis sennae*	-	-	-	-	-
Cabbage White	*Pieris rapae*	-	-	-	-	-
Gossamer-winged Butterflies - Lycaenidae						
Brown Elfin	*Callophrys augustinus*	-	-	-	-	-
Spring Azure	*Celastrina ladon*	-	-	-	-	-
'Summer' Spring Azure	*Celastrina neglecta*	-	-	-	-	-
American Copper	*Lycaena phlaeas*	-	-	-	-	-
Brush-footed Butterflies – Nymphalidae						
Common Wood Nymph	*Cercyonis pegala*	-	-	-	-	-
Variegated Fritillary	*Euptoieta claudia*	-	-	-	-	-
Common Buckeye	*Junonia coenia*	-	-	-	-	-
Viceroy	*Limenitis archippus*	-	-	-	-	-
Mourning Cloak	*Nymphalis antiopa*	-	-	-	-	-
Pearl Crescent	*Phyciodes tharos*	-	-	-	-	-
Question Mark	*Polygonia interrogationis*	-	-	-	-	-
Red Admiral	*Vanessa atalanta*	-	-	-	-	-
Painted Lady	*Vanessa cardui*	-	-	-	-	-
American Lady	*Vanessa virginiensis*	-	-	-	-	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NALCC Rep. Species[15]
Milkweed Butterflies - Danaidae						
Monarch	*Danaus plexippus*	-	-	-	-	-
Skippers – Hesperiidae						
Dun Skipper	*Euphyes vestris*	-	-	-	-	-
Long-tailed Skipper	*Urbanus proteus*	-	-	-	-	-

Source: Data assembled from observations of Massachusetts Butterfly Club members at Monomoy NWR from 1991 to 2010.

Table A.7. Dragonfly and Damselfly Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NALCC Rep. Species[15]
Pond Damsel – Coenagrionidae						
•Familiar Bluet	*Enallagma civile*	-	-	-	-	-
Citrine Forktail	*Ischnura hastata*	-	-	-	-	-
Fragile Forktail	*Ischnura posita*	-	-	-	-	-
Rambur's Forktail	*Ischnura ramburii*	-	-	-	-	-
•Eastern Forktail	*Ischnura verticalis*	-	-	-	-	-
Damer – Aeshnidae						
Common Green Darner	*Anax junius*	-	-	-	-	-
Swamp Darner	*Epiaeschna heros*	-	-	-	-	-
Skimmer – Libellulidae						
Calico Pennant	*Celithemis elisa*	-	-	-	-	-
Eastern Pondhawk	*Erythemis simplicicollis*	-	-	-	-	-
•Seaside Dragonlet	*Erythrodiplax berenice*	-	-	-	-	-
•Needham's Skimmer	*Libellula needhami*	-	-	-	-	-
Twelve-spotted Skimmer	*Libellula pulchella*	-	-	-	-	-
Painted Skimmer	*Libellula semifasciata*	-	-	-	-	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NALCC Rep. Species[15]
Great Blue Skimmer	*Libellula vibrans*	-	-	-	-	-
Blue Dasher	*Pachydiplax longipennis*	-	-	-	-	-
Wandering Glider	*Pantala flavescens*	-	-	-	-	-
Spot-winged Glider	*Pantala hymenaea*	-	-	-	-	-
Eastern Amberwing	*Perithemis tenera*	-	-	-	-	-
Common Whitetail	*Plathemis lydia*	-	-	-	-	-
Variegated Meadowhawk	*Sympetrum corruptum*	-	-	-	-	-
•Saffron-bordered Meadowhawk	*Sympetrum costiferum*	-	-	-	-	-
Cherry-faced (Ruby) Meadowhawk	*Sympetrum internum/rubicundulum*	-	-	-	-	-
Striped Saddlebags	*Tramea calverti*	-	-	-	-	-
Carolina Saddlebags	*Tramea carolina*	-	-	-	-	-
Black Saddlebags	*Tramea lacerata*	-	-	-	-	-

Source: Data collected from observations by Blair Nikula of Odonata on the refuge.
•Denotes species suspected to have been breeding on the refuge over the past 20 years.

Table A.8. Tiger Beetle Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NALCC Rep. Species[15]
Ground Beetles, Scarab Beetles, and Tiger Beetles - Carabidae						
•Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	T	E	G4T2	S1	-
•Hairy-necked Tiger Beetle	*Cicindela hirticollis hirticollis*	-	-	-	-	-
•Hairy-necked Tiger Beetle (subspecies)	*Cicindela hirticollis rhodensis*	-	-	-	-	-
•Saltmarsh Tiger Beetle	*Cicindela marginata*	-	-	-	-	-
Bronzed Tiger Beetle	*Cicindela repanda*					

Source: Data collected from Northeastern Beach Tiger Beetle Surveys completed by Neil Kapitulik.
•Denotes species suspected to have been breeding on the refuge over the past 20 years.

Table A.9. Crustacean Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Mantis Shrimp										
Mantis Shrimp unclassified	Order Stomatopoda	-	-	-	-	-	-	1.5	0.7	-
Shrimp – Crangonidae										
Sand Shrimp	*Crangon septemspinosa*	-	-	-	-	-	-	NA	NA	-
Lobster – Nephropsidae										
American Lobster	*Homarus americanus*	-	-	-	-	-	-	27.7	9.7	-
Hermit Crabs – Paguridae										
Hermit Crab unclassified	*Paguroidea* spp.	-	-	-	-	-	-	NA	NA	-
Long-clawed Hermit Crab	*Pagurus longicarpus*	-	-	-	-	-	-	NA	NA	-
True Crabs – Calappidae										
Flame Box Crab	*Calappa flammea*	-	-	-	-	-	-	0	0.2	-
True Crabs – Majidae										
Spider Crab unclassified	Family Majidae	-	-	-	-	-	-	88.2	77.9	-
True Crabs – Cancridae										
Jonah Crab	*Cancer borealis*	-	-	-	-	-	-	0.5	0.5	-
Atlantic Rock Crab	*Cancer irroratus*	-	-	-	-	-	-	69	35.9	-
True Crabs – Portunidae										
Blue Crab	*Callinectes sapidus*	-	-	-	-	-	-	1.2	1	-
Green Crab	*Carcinus maenas*	-	-	-	-	-	-	NA	NA	-
Lady (Calico) Crab	*Ovalipes ocellatus*	-	-	-	-	-	-	44.3	67.5	-
Amphipods – Ampeliscidae										
-	*Ampelisca abdita*	-	-	-	-	-	-	NA	NA	-
Amphipods – Gammaridae										
Scuds	*Gammarus* spp.	-	-	-	-	-	-	NA	NA	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Amphipods – Haustoriidae										
-	*Haustorius canadensis*	-	-	-	-	-	-	NA	NA	-
-	*Acanthohaustorius millsi*	-	-	-	-	-	-	NA	NA	-
Arthropods – Diastylidae										
-	*Dastylis polita*	-	-	-	-	-	-	NA	NA	-
-	*Oxyurostylis smithi*	-	-	-	-	-	-	NA	NA	-
Arthropods – Idoteidae										
-	*Edotea triloba*	-	-	-	-	-	-	NA	NA	-
-	*Chirodotea coeca*	-	-	-	-	-	-	NA	NA	-

Source: Data assembled from the Massachusetts Division of Marine Fisheries Nantucket Sound Spring and Fall Trawl Surveys from 1978 to 2010; the Nantucket Sound Estuarine Winter Flounder Seine Surveys 1976 to 2010; Weiss 1995; and Leavitt and Peters 2005.

Table A.10. Bivalve Species Known or Suspected on Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Bivalves – Mytilidae										
Northern Horse Mussel*	Modiolus modiolus	-	-	-	-	-	-	0	0.7	-
Blue Mussel*	Mytilus edulis	-	-	-	-	-	-	2.3	1.7	-
Bivalves – Pectinidae										
Bay Scallop	*Argopecten irradians*	-	-	-	-	-	-	5.1	4.8	-
Sea Scallop	*Placopecten magellanicus*	-	-	-	-	-	-	1.7	0	-
Bivalves – Articidae										
Ocean Quahog	*Artica islandica*	-	-	-	-	-	-	0.3	0.2	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Bivavles – Verneridae										
Northern Quahog	*Mercenaria mercenaria*	-	-	-	-	-	-	0.2	0.5	-
Amethyst Gem Clam	*Gemma gemma*									
Bivalves – Mactridae										
Atlantic Surf Clam	*Spisula solidissima*	-	-	-	-	-	-	3.6	3.1	-
Bivalves – Solenidae										
Razor Clam	*Ensis directus*	-	-	-	-	-	-	NA	NA	-
Bivalves – Myidae										
Softshell Clam	*Mya arenaria*	-	-	-	-	-	-	NA	NA	-
Bivalves – Tellinidae										
Baltic Clam	*Macoma balthica*	-	-	-	-	-	-	NA	NA	-
Northern Dwarf Tellin	*Tellina agilis*	-	-	-	-	-	-	NA	NA	-
Bivalves – Solemyidae										
Atlantic Awning Clam	*Solemya velum*	-	-	-	-	-	-	NA	NA	-
Bivalves – Periplomatidae										
-	*Periploma papyratium*	-	-	-	-	-	-	NA	NA	-

Source: Data assembled from the Massachusetts Division of Marine Fisheries Nantucket Sound Spring and Fall Trawl Surveys from 1978 to 2010; the Nantucket Sound Estuarine Winter Flounder Seine Surveys 1976 to 2010; Weiss 1995; and Leavitt and Peters 2005.

Table A.11. Miscellaneous Marine Invertebrate Species at Monomoy NWR.

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Shelled Gastropods - Melongenidae										
Channeled Whelk	*Busycotypus canaliculatus*	-	-	-	-	-	-	54.7	48.7	-
Knobbed Whelk	*Busycon carica*	-	-	-	-	-	-	26.4	53.8	-

Common Name	Scientific Name	Federal Status[1]	MA Legal Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	NOAA Fisheries Listing[4]	AFS Status[5]	Spring Occurrence (%)[6]	Fall Occurrence (%)[6]	NALCC Rep. Species[15]
Moon Snails – Naticidae										
Northern Moonsnail	*Euspira heros*	-	-	-	-	-	-	3.2	0.5	-
Moon Snail/Shark Eye*	Family Naticidae	-	-	-	-	-	-	24.4	8.2	-
-	*Neverita (Polynices) duplicata*	-	-	-	-	-	-	NA	NA	-
Mud Snails – Nassariidae										
Eastern Mudsnail	*Illyanassa obsoletus*	-	-	-	-	-	-	NA	NA	-
Dove Snails – Columbellidae										
Dove Snails	*Anachis avara*	-	-	-	-	-	-	NA	NA	-
Mud Snails – Hydrobiidae										
-	*Hydrobia* spp.	-	-	-	-	-	-	NA	NA	-
Chalice Bubble Snails – Cylichnidae										
Channeled Barrel-bubble	*Acteocina canaliculata*	-	-	-	-	-	-	NA	NA	-
Squids and Octopuses - Loliginidae										
Longfin Squid	*Loligo pealaii*	-	-	-	-	-	-	90.5	99.8	-
Squids and Octopuses – Ommastrephidae										
Northern Shortfin Squid	*Illex illecebrosus*	-	-	-	-	-	-	0.8	0	-
Horseshoe Crabs – Limulidae										
Horseshoe Crab	*Limulus polyphemus*	-	-	-	-	-	-	20.7	23.1	MS
Sea Urchins – Strongylocentrotidae										
Sea urchin unclassified (Green Urchin)	*Strongylocentrotus drobachiensis*	-	-	-	-	-	-	0.3	0	-

Source: Data assembled from the Massachusetts Division of Marine Fisheries Nantucket Sound Spring and Fall Trawl Surveys from 1978 to 2010 and the Nantucket Sound Estuarine Winter Flounder Seine Surveys 1976 to 2010; Weiss 1995; Leavitt and Peters 2005.

Table A.12. Miscellaneous Terrestrial Invertebrates Known to be Present on Monomoy NWR.

Order/Class	Examples of species within the order that may occur on the refuge
Amphipoda	Amphipods
Arachnida	Harvestmen, mites, ticks, spiders
Diptera	Flies
Hymenoptera	Sawflies, ichneumons, chalcids, ants, wasps, bees
Neuroptera	Dobsonflies, fishflies, alderflies, lacewings, antlions
Orthoptera	Grasshoppers, crickets, cockroaches, mantids, walkingsticks
Siphonoptera	Fleas
Zoraoptera	Zorapterans

Source: Data assembled from the Effects of Herring Gulls and Great Black-backed Gulls on Breeding Piping Plovers, South Monomoy Island, Massachusetts, Keane 2002.

Table A.13. Marine Worms Known or Suspected at Monomoy NWR.

Common Name	Scientific Name
Phylum Nemertea	
Milky Ribbon Worm	*Cerebratulus lacteus*
Micruran Nemerteans	*Micrura* spp.
Phylum Annelida – Class Polychaeta – Family Capitellidae	
-	*Capitella capitata*
-	*Heteromastus filifomis*
Phylum Annelida – Class Polychaeta – Family Orbiniidae	
-	*Scoloplos fragilis*
-	*Scoloplos acutus*
-	*Scoloplos robustus*
Phylum Annelida – Class Polychaeta – Family Nereidae	
Common Clam Worm	*Nereis succinea*
-	*Nereis arenaceodonta*
Sandworm	*Nereis virens*
Phylum Annelida – Class Polychaeta – Family Chaetopteridae	
-	*Spiochaetopterus oculatus*
Phylum Annelida – Class Polychaeta – Family Maldanidae	
Bamboo Worm	*Clymenella torquata*
Phylum Annelida – Class Polychaeta – Family Glyceridae	
Common Blood Worm	*Glycera dibranchiata*
Phylum Annelida – Class Polychaeta – Family Pectinaridae	
Trumpet Worm	*Pectinaria gouldii*
Phylum Annelida – Class Polychaeta – Family Arenicolidae	
Lugworm	*Arenicola marina*

Common Name	Scientific Name
Phylum Annelida – Class Polychaeta – Family Lumbrineridae	
Thread Worms	*Lumbrineris tenuis*
Phylum Annelida – Class Polychaeta – Family Nephtyidae	
Red-Lined Worms	*Nephtys picta*
Red-Lined Worms	*Nephtys caeca*
Red-Lined Worms	*Nephtys bucera*
Phylum Annelida – Class Polychaeta – Family Phyllodocidae	
Paddle Worms	*Eteone heteropoda*
Paddle Worms	*Phyllodoce mucosa*
Phylum Annelida – Class Polychaeta – Family Spionidae	
-	*Spio setosa*
Bee Spionid	*Spiophanes bombyx*
	Strebelospio benedictii
Mud Worm	*Polydora cornuta*
-	*Scolepsis squamata*
-	*Pygospio elegans*
-	*Prionospio heterobranchia*
Phylum Annelida – Class Polychaeta – Family Oligochaeta	
-	*Phyllodrilus monospermathecus*
-	*Monophylephorus irroratus*
Phylum Annelida – Class Polychaeta – Family Echinodermata	
-	*Leptosynapta inhaerens*
Phylum Annelida – Class Polychaeta – Family Hemichordata	
Acorn Worm	*Saccoglosus kowaleskii*
Phylum Annelida – Class Polychaeta – Family Syllidae	
-	*Syllides verrilli*
-	*Brania wellfleetensis*
Phylum Annelida – Class Polychaeta – Family Cirratulidae	
Fringed Worms	*Tharyx* spp.
Phylum Annelida – Class Polychaeta – Family Paraonidae	
Paraonid Worms	*Paranois fulgens*
*Source: Weiss 1*995; and Leavitt and Peters 2005	

[1] Federal and State Legal Status Codes (under Federal and Massachusetts Endangered Species Lists): E=Endangered; T=Threatened; SC=State Species of Special Concern; C=Candidate Species.

[2] Natureserve Global Conservation Status Ranks: G1=Critically Imperiled; G2=Imperiled; G3=Vulnerable; G4=Apparently Secure; G5=Secure; T#=Infraspecific Taxon (MA DFG 2006).

[3] Massachusetts Rarity Rank: S =Critically Imperiled; S2=Imperiled; S3=Either very rare or uncommon, vulnerable; S4=Widespread, abundant, apparently secure; S5=Secure; SNR=Unranked; N=Non-Breeding; SNA=Not Applicable; SU=Unrankable (MA DFG 2006).

[4] NOAA Fisheries Office of Protected Resources: E=Endangered; T=Threatened; P=Proposed; C=Candidate; S=Species of Concern; F=Foreign; D=Depleted; DL=Delisted.

[5] American Fisheries Society's Marine, Estuarine, and Diadromous Fish stocks at Risk of Extinction: E=Endangered; T=Threatened; V=Vulnerable; CD=Conservation Dependent (Musick et al. 2000).

[6] NA: indicates that there is no available data on this species included in trawl report and species was identified as one that should be included anyway.

***:** indicates that summary data may be incomplete (per this DMF and observations for all years and/or recorded under additional species codes in 1 or more years).

[7] U.S. Fish and Wildlife Service Division of Migratory Birds, Birds of Conservation Concern for Region 5 (Northeast) (USFWS 2008). R5=Species identified as a species of conservation concern in Region 5; N=Species identified as a species of conservation concern nationally.

[8] Bird Conservation Region 30: New England/Mid-Atlantic Coast Conservation Priority Category (ACJV 2007). HH=Highest Priority; H=High Priority; M=Moderate Priority.

[9] Partners in Flight (PIF) Bird Conservation Plan for Southern New England: Physiographic Area 09 (Dettmers and Rosenberg 2000). IA=High continental priority and high regional responsibility; IB=High continental priority and low regional responsibility; IIA=High regional concern; IIC=High regional threats; III=Additional Watch List

[10] Waterbird Conservation Plan for the Mid-Atlantic/New England/Maritimes Region: 2006-2010, MANEM Waterbird Working Group. HH=Highest conservation concern; H=High conservation concern; M=Moderate conservation concern; L=Low conservation concern.

[11] North American Waterfowl Management Plan (NAWMP), Atlantic Coast Joint Venture, Waterfowl Implementation Plan, Revision June 2005 (Draft). H=High; MH=Moderate High; M=Moderate; ML=Moderate Low; AO=Above Objective.

[12] North American Waterbird Conservation Plan (NAWCP), Categories of Conservation Concern (Kushlan et al. 2002). HI=Highly Imperiled; HC=High Concern; MC=Moderate Concern; LC=Low Concern; NR=Not Currently At Risk; IL=Information Lacking.

[13] U.S. Shorebird Conservation Plan, Conservation Category Codes (Brown et al. 2001, Clark and Niles 2000). 5=Highly imperiled; 4=Species of high concern; 3=Species of moderate concern; 2=Species of low concern; 1=Species not at risk.

[14] Spring, Summer, Fall, Winter Relative Abundance: a=abundant; c=common; u=uncommon; o=occasional; r=rare; and x=accidental.

[15] North Atlantic Landscape Conservation Cooperative Representative Species (NALCC): N=Northern; NALCC Representative; M=Mid NALCC Representative; S=Southern NALCC Representative.

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Appendix B

USFWS

Seabeach sandwort (Arenaria peploides)

Plant Species Known or Suspected on Monomoy National Wildlife Refuge

Table B.1. Plant Species Known or Suspected on Monomoy National Wildlife Refuge (NWR).

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Horsetail – Equisetaceae					
Equisetum arvense L.	-	G5	S5	Rare	
Club-moss – Lycopodiaceae					
Lycopodium inundatum L.	-	G5	S5	Occasional	
Lycopodium inundatum L. var. *bigelovii* Tuckerm	-	-	S4	Occasional	
Adder's tongue – Ophioglossaceae					
Ophioglossum vulgatum L.	T	G5	S2	Rare	
Royal fern – Osmundaceae					
Osmunda regalis L.	-	G5	S5	Common	
Osmunda cinnamomea L.	-	G5	S5	Common	
Wood fern – Dryopteridaceae					
Onoclea sensibilis L.	-	G5	SNA	Common	
Dryopteris carthusiana (Vill.) H.P.Fuchs	-	G5	S4	Rare	*Dryopteris spinulosa* var. *intermedia*
Thelypterioid fern – Thelypteridaceae					
Thelypteris palustris Schott var. *pubescens* (Lawson) Fernald	-	G5T5	S5	Abundant	*Dryopteris thelypteris* (L.) Gray var. *pubescens*
Pine – Pinaceae					
*Pinus resinosa**	WL	G5	S2S3	Cultivated	
Pinus sylvestris L.*	-	GNR	SNR	Cultivated	
Pinus rigida Mill.	-	G5	S5	Occasional	
Pinus thunbergii Parl.*	-	GNR	SNR	Cultivated	
Juniperus virginiana L.	-	G5	S5	Occasional	
Arrow-grass – Juncaginaceae					
Triglochin maritima L.	-	G5	S4	Abundant	
Eel-grass – Zosteraceae					
Zostera marina L. var. *stenophylla* Aschers. & Graebn.	-	G5	S5	Abundant	
Potamogeton pectinatus L.	-	G5	S4	Abundant	*Stuckenia pectinata* (L.) Boerner
Potamogeton perfoliatus L. var. *bupleuroides*	-	G5	S5	-	
Ruppia maritima L.	-	G5	S4S5	Occasional	
Duckweed – Lemnaceae					
Spirodela polyrrhiza (L.) Schleid.	-	G5	S5	Common	
Sedge – Cyperacaea					
Cyperus diandrus Torr.	-	G5	S5	-	
Cyperus filicinus Vahl	-	G5	S4	Occasional	
Cyperus strigosus L.	-	G5	S5	Occasional	
Cyperus grayi Torr.	-	G5	S4	Occasional	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Cyperus lupulinus (Spreng.) Marcks	-	G5T5	S5	Occasional	*Cyperus filiculmis* Vahl
Eleocharis parvula (R. & S.) Link	-	G5	S4	Common	
Eleocharis halophia Fern & Brack.	-	G4	S4	Common	
Eleocharis tenuis (Willd.) Schultes	-	G5	S5	Rare	
Scirpus americanus Pers.	-	G5	S4	Common	
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	-	G5	S5	Occasional	*Scirpus validus* Vahl
Schoenoplectus robustus (Pursh) M.T. Strong	-	G5	S5	Rare	*Scripus robustus* (Pursh); *Bolboschoenus robustus* (Pursh)
Schoenoplectus maritimus (L.) Lye	-	G5	S5	-	*Scirpus paludosus* Nelson
Scirpus cyperinus (L.) Kunth	-	G5	S5	Common	
Eriophorum virginicum L.	-	G5	S5	Occasional	
Rhynchospora capitellata (Michx.) Vahl	-	G5	S5	Occasional	
Carex canescens L.	-	G5	S4	Occasional	
Carex atlantica Bailey	-	G5	S5	Occasional	
Carex seorsa Howe	-	G4	S4	Unk. Loc.	
Carex scoparia Schkuhr	-	G5	S5	Unk. Loc.	
Carex albolutescens Schwein.	-	G5	S3?	Occasional	
Carex longii Mackenz.	-	G5	S4	Occasional	
Carex silicea Olney	-	G5	S4	Common	
Carex hormathodes Fern.	-	G4G5	S5	Occasional	
Carex debilis Michx. var. *rudgei* Bailey	-	G5T5	S5	Rare	
Carex comosa Boott	-	G5	S5	Rare	
Carex lurida Wahlenb.	-	G5	S5	Occasional	
Grass – Poacea (Gramineae)					
Bromus tectorum L.	-	GNR	SNA	Occasional	
Festuca rubra L.*	-	G5	SNA	Common	
Puccinellia maritima (Hudson) Parl.	-	GNR	S4	Rare	
Eragrostis pilosa L. Beauv.*	-	G4	SNA	-	
Distichlis spicata L. Greene	-	G5	S5	Common	
*Phragmites australis**	I	G5	SNA	Common	
*Thinopyrum pycnanthum**	-	GNR	SNA	Common	*Agropyron pungens* (Pers.) R. & S.
Elymus repens (L.) Gould*	-	GNR	SNA	Occasional	*Agropyron repens* (L.) Beauv.
Elymus virginicus L. var. *halophilus* (Bickn.) Wieg.	-	G5T5	S4	Rare	
Aira caryophyllea L.*	-	GNR	SNA	Rare	
Danthonia spicata (L.) Beauv.	-	G5	S5	Rare	
Ammophila breviligulata Fern.	-	G5	S4	Abundant	
Agrostis stolonifera L.	-	G5	S5	-	
Agrostis capillaris L.*	-	GNR	SNA	-	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Agrostis hyemalis (Walt.) BSP.	-	G5	S4	Occasional	
Agrostis scabra Willd.	-	G5	S5	Occasional	
Spartina alterniflora Loisel.	-	G5	S5	Abundant	
Spartina patens (Ait.) Muhl.	-	G5	S5	Abundant	
Leersia oryzoides (L.) Sw.	-	G5	S5	Rare	
Digitaria sanguinalis (L.) Scop.*	-	G5	SNA	Rare	
Panicum dichotomiflorum Michx.	-	G5	S5	Occasional	
Panicum virgatum L.	-	G5	S5	Abundant	
Dichanthelium meridionale (Ashe) Freckmann	-	G5	S4	Common	*Panicum meridionale* Ashe
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann	-	G5T5	S5	-	*Panicum lanuginosum* Ell. var. *implicatum* (Scribn.) Fern
Dichanthelium clandestinum (L.) Gould	-	G5?	S5	Rare	*Panicum clandestinum* L.
Schizachyrium scoparium (Michx.) Nash	-	G5	S5	Common	*Andropogon scoparius* Michx.
Andropogon virginicus L. var. *virginicus*	-	G5T5	S4	Occasional	
Andropogon virginicus L. var. *abbreviatus* (Hack.) Fern. & Griscom	-	G5	S4	Occasional	
Rush – Juncaceae					
Juncus ambiguus Guss.	WL	G5	S1?	Occasional	*Juncus bufonius* L. var. *halophilus* Buchenau and Fern.
Juncus gerardii Loisel.	-	G5	S5	Abundant	
Juncus tenuis Willd.	-	G5	S5	Rare	
Juncus dichotomus Ell.	-	G5	S4	Common	
Juncus greenei Oakes and Tuckerm.	-	G5	S5	Common	
Juncus effusus L.*	-	G5	SNA	Abundant	
Juncus arcticus Willd. ssp. *littoralis* (Engelm.) Hultén	-	G5	S4	Occasional	*Juncus balticus* Willd.
Juncus canadensis J. Gay	-	G5	S5	Occasional	
Juncus subcaudatus (Engelm.) Coville and Blake	-	G5	-	Occasional	
Juncus acuminatus Michx.	-	G5	S5	Common	
Juncus articulatus L.	-	G5	S5	Rare	
Luzula multiflora (Retz.) LeJeune	-	G5	S5	Rare	
Cat-tail – Typhaceae					
Typha angustifolia L.	-	G5	S5	Abundant	
Iris – Iridaceae					
Sisyrinchium angustifolium Mill.	-	G5	S4	Occasional	
Iris prismatica Pursh	-	G4G5	S4	Rare	
Iris versicolor L.	-	G5	S5	Abundant	
Lily – Liliaceae					
Smilacina stellata (L.) Desf.	-	G5	S4	Rare	*Maianthemum stellatum* (L.) Link
Smilax rotundifolia L.	-	G5	S5	Rare	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Orchid – Orchidaceae					
Habenaria lacera (Michx.) Lodd.	-	G5	S4	Rare	*Platanthera lacera* (Michaux) G. Don
Pogonia ophioglossoides (L.) Ker	-	G5	S5	Occasional	
Spiranthes cernua (L.) Richard	-	G5	S5	Occasional	
Aster – Asteraceae (Compositae)					
Eupatorium dubium Willd.	-	G5	S5	Occasional	*Eutrochium dubium* (Willd. ex Poir.) E.E. Lamont
Eupatorium perfoliatum L.	-	G5	S5	Rare	
Pityopsis falcata (Pursh) Nutt.	-	G3G4	S4	Abundant	*Chrysopsis falcata* (Pursh) Ell.
Solidago sempervirens L.	-	G5	S5	Abundant	
Solidago rugosa Ait.	-	G5	S4	Rare	
Euthamia galetorum Greene	-	G5	S5	Common	*Solidago graminifolia* (L.) Salisb.; *Euthamia graminifolia* (L.) Nutt.
Euthamia caroliniana (L.) Greene ex Porter & Britton	-	G5	S5	Common	*Solidago tenuifolia* Pursh
Symphyotrichum pilosum (Willd.) G.L. Nesom var. *pringlei* (A. Gray) G.L. Nesom	-	G5T5	S5	Rare	*Aster pilosus* Willd. var. *demotus* Blake
Symphyotrichum ericoides (L.) G.L. Nesom var. *ericoides*	-	G5	S5	Rare	*Aster ericoides* L.
Symphyotrichum dumosum (L.) G.L. Nesom var. *dumosum*	-	G5T3T5	S5	Rare	*Aster dumosus* L.
Symphyotrichum novi-belgii (L.) G.L. Nesom var. *novi-belgii*	-	G5	S5	Occasional	*Aster novi-belgii* L.
Ionactis linariifolius (L.) Greene	-	G5	S5	Occasional	*Aster linariifolius* L.
Symphyotrichum subulatum (Michx.) G.L. Nesom	-	G5	S4	Occasional	*Aster subulatus* Michx.
Conyza canadensis (L.) Cronquist var. *canadensis*	-	G5	S5	Rare	*Erigeron canadensis* L.
Conyza canadensis (L.) Cronquist var. *pusilla* (Nutt.) Cronquist	-	G5T5	S5	Common	*Erigeron pusillus* Nutt.
Baccharis halimifolia L.	-	G5	S4	Common	
Pluchea odorata (L.) Cass. var. *odorata*	-	G5T5	S4	Common	*Pluchea purpurascens* (Sw.) DC.
Anaphalis margaritacea (L.) C. B. Clarke	-	G5	S5	Unk. Loc.	
Pseudognaphalium obtusifolium (L.)	-	G5	S5	Common	*Gnaphalium obtusifolium* L.
Iva frutescens L.	-	G5	S4	Occasional	
Ambrosia artemisiifolia L.	-	G5	S5	Occasional	
Xanthium strumarium L. var. *glabratum* (DC.) Cronquist	-	G5T5?	S4	Unk. Loc.	*Xanthium chinense* Mills.
Xanthium strumarium L.	-	G5	-	Common	
Xanthium strumarium L. var. *canadense* (Mill.) Torr. & A. Gray	-	G5T5	S5	-	*Xanthium echinatum* Murr.
Bidens cernua L.	-	G5	S5	Common	
Bidens frondosa L.	-	G5	S5	Occasional	
Achillea millefolium L.*	-	G5	SNA	Occasional	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Leucanthemum vulgare Lam.*	-	GNR	SNA	Rare	*Chrysanthemum leucanthemum* L.
Artemisia campestris L. ssp. *caudata* (Michx.) H.M. Hall & Clem.	-	G5T5	S4	Occasional	*Artemisia caudata* Michx.
Artemisia stelleriana Bess.*	-	G4?	SNA	Common	
Erechtites hieracifolia (L.) Raf.	-	G5	S5	Rare	
Senecio vulgaris L.*	-	GNR	SNA	Rare	
Cirsium vulgare (Savi) Tenore*	-	GNR	SNA	Common	
Cirsium arvense (L.) Scop.*	-	GNR	SNA	Rare	
Cichorium intybus L.*	-	GNR	SNA	Rare	
Hypochaeris radicata L.*	-	GNR	SNA	Occasional	
Taraxacum officinale Weber*	-	G5	SNA	Occasional	
Sonchus arvensis L.*	-	GNR	SNA	Rare	
Sonchus asper (L.) Hill*	-	GNR	SNA	Occasional	
Lactuca canadensis L. var. *latifolia* Ktze.	-	G5	S5	Occasional	
Lactuca biennis (Moench) Fern.	-	G5	S5	Rare	
Hieracium florentinum All.*	-	GNR	SNA	Common	*Hieracium piloselloides* Vill.
Honeysuckle – Caprifoliaceae					
Lonicera morrowii A. Gray*	I	GNR	SNA	Rare	
Viburnum dentatum L.	-	G5	S5	Occasional	
Viburnum recognitum Fern.	-	G4G5	S5	Occasional	
Gentian – Gentianaceae					
Bartonia virginica (L.) BSP.	-	G5	S4	Rare	
Mint – Lamiaceae (Labiatae)					
Teucrium canadense L.	-	G5	S4	Abundant	
Scutellaria galericulata L.	-	G5	S5	Common	*Scutellaria epilobiifolia* A. Hamilton
Scutellaria x *churchilliana* Fern.	-	GNA	-	Common	
Lycopus virginicus L.	-	G5	S5	Rare	
Lycopus uniflorus Michx.	-	G5	S5	Common	
Lycopus americanus Muhl.	-	G5	S5	Common	
Plantain – Plantaginaceae					
Plantago major L.*	-	G5	SNA	Rare	
Plantago maritima L. var. *juncoides* (Lam.) A. Gray	-	G5T5	S4S5	Occasional	*Plantago oliganthos* E. & S.
Plantago lanceolata L.*	-	G5	SNA	Occasional	
Madder – Rubiaceae					
Galium trifidum L.	-	G5	-	Abundant	
Figwort – Scrophulariaceae					
Verbascum thapsus L.*	-	GNR	SNA	Occasional	
Linaria vulgaris Hill*	-	GNR	SNA	Occasional	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Nuttallanthus canadensis (L.) D.A. Sutton	-	G5	S5	Common	*Linaria canadensis* (L.) Dumont
Limosella australis R. Br.	-	G4G5	S4	Common	*Limosella subulata* Ives
Lindernia dubia (L.) Pennell var. *anagallidea* (Michx.) Cooperr.	-	G5T4	S5	Occasional	*Lindernia anagallidea* (Michx.) Pennell
Veronica arvensis L.*	-	GNR	SNA	Rare	
Gerardia purpurea L.	-	G5	S4	Common	
Agalinis tenuifolia (Vahl) Raf.	-	G5	S4	Common	
Morning Glory – Convolvulaceae					
Calystegia sepium (L.) R. Br. ssp. *sepium**	-	G5TU	SNA	Common	*Convolvulus sepium* L.
Cuscuta compacta Juss.	-	G5	S4	Occasional	
Potato – Solanaceae					
Solanum dulcamara L.*	-	GNR	SNA	Occasional	
Solanum americanum Mill.	-	G5	S4S5	Occasional	
Solanum lycopersicum L.*	-	GNR	SNA	Rare	*Lycopersicum esculentum* Mill.
Fig-marigold – Aizoaceae					
Mollugo verticillata L.*	-	GNR	SNA	Occasional	
Pink – Caryophyllaceae					
Spergularia salina J. Presl & C. Presl	-	G5	S4	Occasional	*Spergularia marina* (L.) Griseb.
Honckenya peploides (L.) Ehrh. ssp. *diffusa* (Hornem.) Hultén	-	G5T5	S4	Common	*Arenaria peploides* L.
Stellaria media (L.) Cyrillo*	-	GNR	SNA	Occasional	
Cerastium fontanum Baumg. ssp. *vulgare* (Hartm.) Greuter & Burdet*	-	GNRTNR	SNA	Occasional	*Cerastium vulgatum* L. 1762, non 1755
Dianthus armeria L.*	-	GNR	SNA	Rare	
Goosefoot – Chenopodiaceae					
Atriplex patula L. var. hastata (L.) Gray*	-	G5	SNA	Common	
Atriplex cristata Humb. & Bonpl. ex Willd.	-	G5	S4	Common	*Atriplex arenaria* Nutt.
Salicornia bigelovii Torr.	-	G5	S4	Occasional	
Salicornia maritima Wolff & Jefferies	-	G5	S5	Common	*Salicornia europaea L.*
Salicornia virginica L.	-	G5	S5	Occasional	
Suaeda maritima (L.) Dumort.	-	G5	S4	Common	
Suaeda maritima (L.) Dumort. ssp. *richii* (Fernald) Bassett & C.W. Crompton	WL	G5T3	S2S3	Occasional	*Suaeda richii Fern.*
Suaeda calceoliformis (Hook.) Moq.	SC	G5	S2S3	Rare	*Suaeda americana* (Pers.) Fern.
Suaeda linearis (Ell.) Moq.	-	G5	S4	Rare	
Salsola kali L.	-	GNR	S4	Common	
Pokeweed – Phytolacceae					
Phytolacca americana L.	-	G5	S5	Occasional	
Leadwort – Plumbaginaceae					
Limonium carolinianum (Walt.) Britt.	-	G5	S4	Abundant	*Limonium nashii* Small

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Buckwheat – Polygonaceae					
Rumex crispus L.*	-	GNR	SNA	Common	
Rumex acetosella L.*	-	GNR	SNA	Abundant	
Polygonum glaucum Nutt.	SC	G3	S3	Rare	
Polygonum pensylvanicum L. var. *nesophilum* Fern.	-	G5	S5	Occasional	
Polygonum persicaria L.*	-	G3G5	SNA	-	
Polygonum punctatum Ell. var. *leptostachyum* (Meisn.) Small	-	G5	S5	Common	
Polygonum hydropiperoides Michx.	-	G5	S5	Abundant	
Polygonum scandens. L.	-	G5	S5	Occasional	*Fallopia scandens* (L.) Holub
Polygonella articulata (L.) Meisn.	-	G5	S4	Occasional	
Mustard – Brassicaceae (Cruciferae)					
Draba verna L.*	-	GNR	SNA	Occasional	
Lepidium campestre (L.) R. Br.*	-	GNR	SNA	Occasional	
Lepidium virginicum L.	-	G5	S5	Common	
Cakile edentula (Bigel.) Hook.	-	G5	S4S5	Common	
Raphanus raphanistrum L.*	-	GNR	SNA	Occasional	
Barbarea vulgaris R. Br.*	-	GNR	SNA	Occasional	
Clethra – Clethraceae					
Clethra alnifolia L.	-	G5	S5	Occasional	
Heath – Ericaceae					
Kalmia angustifolia L.	-	G5	S5	Occasional	
Lyonia ligustrina (L.) DC.	-	G5	S5	Occasional	
Arctostaphylos uva-ursi (L.) Spreng.	-	G5	S5	Unk. Loc.	
Gaylussacia baccata (Wang.) K. Koch	-	G5	S5	Rare	
Vaccinium corymbosum L.	-	G5	S5	Occasional	
Vaccinium angustifolium Ait.	-	G5	S5	Occasional	
Vaccinium macrocarpon Ait.	-	G4	S5	Occasional	
Mallow – Malvaceae					
Hibiscus moscheutos L.	-	G5	S4	Common	*Hibiscus palustris* L.
Sundew – Droseraceae					
Drosera rotundifolia L.	-	G5	S4S5	Occasional	
Primrose – Primulaceae					
Lysimachia terrestris (L.) BSP.	-	G5	S5	Occasional	
Trientalis borealis Raf.	-	G5	S5	Rare	
Willow – Salicaceae					
Salix nigra Marsh.	-	G5	S5	Rare	
Salix bebbiana Sarg.	-	G5	S5	Occasional	
Salix discolor Muhl.	-	G5	S5	Occasional	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Mangosteen – Clusiaceae (Guttiferae)					
Hypericum boreale (Britt.) Bickn.	-	G5	S5	Common	
Hypericum canadense L.	-	G5	S5	Rare	
Triadenum virginicum (L.) Raf.	-	G5	S5	Abundant	*Hypericum virginicum* L.
Rock-rose – Cistaceae					
Hudsonia tomentosa Nutt.	-	G5	S4	Abundant	
Lechea villosa Ell.	-	G5	S5	Occasional	
Lechea maritima Leggett	-	G5	S5	Common	
Cucumber – Cucurbitaceae					
Cucurbita pepo L.*	-	G4G5	SNA	Rare	
Violet – Violaceae					
Viola macloskeyi Lloyd ssp. *pallens* (Banks ex Ging) M.S. Baker	-	G5T5	S5	Unk. Loc.	*Viola pallens* (Banks) Brainerd
Viola lanceolata L.	-	G5	S5	Occasional	
Birch – Betulaceae					
Betula populifolia Marsh.	-	G5	S5	Rare	
Beech – Fagaceae					
Quercus ilicifolia Wang.	-	G5	S5	Rare	
Bayberry – Myricaceae					
Morella pensylvanica (Mirb.) Kartesz	-	G5	S5	Abundant	*Myrica pensylvanica* Loisel.
Myrica gale L.	-	G5	S5	Rare	
Hornwort – Ceratophyllaceae					
Ceratophyllum demersum L.	-	G5	S5	Common	
Water-lily – Nymphaeaceae					
Nymphaea odorata Ait.	-	G5	S5	Common	
Poppy – Papaveraceae					
Glaucium flavum Crantz*	I	GNR	SNA	Rare	
Carrot – Apaceae (Umbelliferae)					
Ptilimnium capillaceum (Michx.) Raf.	-	G5	S4	Abundant	
Ligusticum scothicum L.	-	G5	S4	Occasional	
Daucus carota L.*	-	GNR	SNA	Rare	
Holly – Aquifoliaceae					
Ilex opaca Ait.	-	G5	S4	Cultivated	
Ilex verticillata (L.) Gray	-	G5	S5	Occasional	
Spurge – Euphorbiaceae					
Euphorbia cyparissias L.*	L	G5	SNA	Rare	
Chamaesyce polygonifolia (L.) Small	-	G5?	S4	Common	*Euphorbia polygonifolia* L.

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Pea – Fabaceae (Leguminosa)					
Trifolium arvense L.*	-	GNR	SNA	Unk. Loc	
Trifolium repens L.*	-	GNR	SNA	Unk. Loc	
Trifolium aureum Pollich*	-	GNR	SNA	Unk. Loc	*Trifolium agrarium* L.
Lathyrus japonicus Willd.	-	G5	S4S5	Abundant	
Wood-sorrel – Oxalidaceae					
Oxalis stricta L.	-	G5	S5	Rare	
Flax – Linaceae					
Linum striatum Walt. var. *multijugum* Fern.	WL	G5	S2S3	Occasional	
Loosestrife – Lythraceae					
Decodon verticillatus (L.) Ell.	-	G5	S5	Common	
Decodon salicaria L.*	I	G5	SNA	Rare	*Lythrum salicaria* L.
Evening primrose – Onagraceae					
Ludwigia palustris (L.) Ell. var. *americana* (DC) Fern. & Griscom	-	G5	S5	Common	
Epilobium leptophyllum Raf.	-	G5	S4S5	Occasional	
Epilobium ciliatum Raf. ssp. *ciliatum*	-	G5T5	S5	Occasional	*Epilobium glandulosum* Lehm. var. *adenocaulon* (Haussk.) Fern.
Oenothera biennis L.	-	G5	S5	Occasional	
Oenothera parviflora L.	-	G4?	S4	Common	
Oenothera perennis L.	-	G5	S5	Occasional	
Oleaster – Elaeagnaceae					
*Elaeagnus umbellata Thunb.**	I	GNR	SNA	Cultivated	
Rose – Rosaceae					
Spiraea tomentosa L.	-	G5	S4	Common	
Pyrus communis L.*	-	G5	SNA	Cultivated	
Photinia pyrifolia (Lam.) K.R. Robertson & Phipps	-	G4G5Q	S4S5	Rare	*Pyrus arbutifolia* (L.) L. f.
Amelanchier canadensis (L.) Medic.	-	G5	S5	Occasional	
Potentilla norvegica L.	-	G5	S5	Occasional	
Potentilla simplex Michx.	-	G5	S5	Occasional	
Argentina egedii (Wormsk.) Rydb. ssp. *groenlandica* (Tratt.) A. Löve	-	G5T4T5	S4	Rare	*Potentilla egedii* Wormsk. var. *groenlandica* (Tratt.) Polunin
Rubus idaeus L. var. *strigosus* (Michx.) Maxim	-	G5T5	S5	Occasional	
Rubus hispidus L.	-	G5	S5	Common	
Rubus pensilvanicus Poir.	-	G5	S5	Occasional	
Rosa virginiana Mill.	-	G5	S5	Occasional	
Rosa carolina L.	-	G5	S5	Rare	
Rosa rugosa Thumb.*	-	GNR	SNA	Common	

Family – Genus Species	MA Status[1]	Global Rarity Rank[2]	MA Rarity Rank[3]	Refuge Status	Synonyms
Prunus maritima Marsh.	-	G4	S4	Common	
Prunus persica (L.) Batsch*	-	G5	SNA	Cultivated	
Prunus serotina Ehrh.	-	G5	S5	Occasional	
Sumac – Anacardiaceae					
Toxicodendron radicans (L.) Kuntze	-	G5	S5	Abundant	*Rhus radicans* L.

Source: Data compiled from the 1965 Plant List of Monomoy National Wildlife Refuge, the Flora of Monomoy Island, Massachusetts from 1969, and Additions to the Flora of Monomoy Island from 1985.

***** = Introduced to Barnstable County. (Introduced species identified in "The Vascular Plants of Massachusetts: A County Checklist." Each introduced species has an * at the end of the plant name. The introduced species are defined by county on the right side of the county checklist.)

1 Federal and State Legal Status Codes (under Federal and Massachusetts Endangered Species Lists): E=Endangered; T=Threatened; SC=State species of Special Concern; WL=Watch List; H=Historic; I=Invasive; L=Likely Invasive; P=Potentially Invasive.

2 NatureServe Global Conservation Status Ranks: G1=Critically Imperiled; G2=Imperiled; G3=Vulnerable; G4=Apparently Secure; G5=Secure; GNR=Unranked; G#G# =Range Rank (range of uncertainty about exact status); T# =Infraspecific Taxon; ? =Inexact Numeric Rank; Q=Questionable Taxonomy.

3 Massachusetts State Rarity Ranks: S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable; S4=Apparently Secure; S5=Secure; SNR=Unranked; SX=Presumed Extirpated; SH=Historical; SNA=Not Applicable.

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Appendix C

USFWS

Wetland vegetation

Vegetation Alliances and Associations of Monomoy National Wildlife Refuge

- I. Forest
- II. Woodland
- III. Shrubland
- IV. Dwarf-shrubland
- V. Herbaceous Vegetation
- VII. Sparse Vegetation

INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD: TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

Alliances and Associations of Monomoy National Wildlife Refuge

19 November 2010

by

NatureServe

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This subset of the International Ecological Classification Standard covers vegetation alliances and associations of Monomoy National Wildlife Refuge. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Lesley A. Sneddon, Senior Regional Ecologist, Boston, MA <lesley_sneddon@natureserve.org>.

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I. Forest

I.B.2.N.a. Lowland or submontane cold-deciduous forest

Amelanchier canadensis - *Viburnum* spp. - *Morella pensylvanica* Scrub Forest (CEGL006379)
Canadian Serviceberry - Viburnum species - Northern Bayberry Scrub Forest
Northern Tall Maritime Shrubland **Classif. Resp.: East**

ELEMENT CONCEPT

Summary: This tall maritime shrubland or scrub forest community characteristically replaces maritime forests that have been cleared. The community is variable in composition and generally includes *Amelanchier canadensis, Prunus serotina, Sassafras albidum, Nyssa sylvatica, Acer rubrum, Juniperus virginiana* in the canopy. The oaks *Quercus velutina, Quercus stellata, Quercus alba* may or may not be present. The shrubs *Morella pensylvanica (= Myrica pensylvanica), Photinia* spp. (= *Aronia* spp.), *Viburnum* spp. may form an understory or contribute substantial cover to the canopy. Vines are often prevalent, including *Smilax* spp., *Vitis* spp., *Toxicodendron radicans, Parthenocissus quinquefolia*. The herbaceous layer is generally sparse. These shrublands are usually very dense, and often maintained in their current state by constant winds and salt spray.

ELEMENT DESCRIPTION

Environment: This tall maritime shrubland or scrub forest community characteristically replaces maritime forests that have been cleared. It occurs at former agricultural sites on sandy loam soils. These shrublands are usually very dense and often maintained in their current state by constant winds and salt spray.
Vegetation: This tall shrubland community is variable in composition and generally includes *Amelanchier canadensis, Prunus serotina, Sassafras albidum, Nyssa sylvatica, Acer rubrum*, and *Juniperus virginiana* in the canopy. The oaks *Quercus velutina, Quercus stellata*, and *Quercus alba* may or may not be present. The shrubs *Morella pensylvanica, Photinia* spp., *Viburnum* spp., and *Gaylussacia baccata* may form an understory or contribute substantial cover to the canopy. Vines are often prevalent, including *Smilax* spp., *Vitis* spp., *Toxicodendron radicans*, and *Parthenocissus quinquefolia*. The herbaceous layer is generally sparse.
Dynamics: This tall maritime shrubland community characteristically replaces maritime forests that have been cleared. Successional relationships with maritime forest associations need to be determined.
Related Concepts:

- Coastal dune shrubland (Breden 1989) **?**
- Coastal dune woodland (Breden 1989) **?**
- SNE coastal rocky headland community (Rawinski 1984) ?

Conservation Ranking
GRank: GNR (1-Dec-1997) **Reasons**:

ELEMENT DISTRIBUTION

Range:
Nations: CA, US
Subnations: CT, MA, ME?, NH, NJ, NY, RI, QC
Distribution with Crosswalk data:

ELEMENT SOURCES

References: Breden 1989**,** Breden et al. 2001, Eastern Ecology Working Group n.d.*, Edinger et al. 2002, Metzler and Barrett 2001, NRCS 2001b, Rawinski 1984, Reschke 1990, Swain and Kearsley 2001

II. Woodland

II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen woodland

Pinus rigida Woodland Alliance (A.524)

Pitch Pine Woodland Alliance

Alliance Summary: This alliance includes evergreen woodlands of rock outcrops, summits, exposed slopes or, less frequently, sandy soils. In the southeastern United States, associations are dominated by *Pinus rigida* with or without an admixture of *Pinus virginiana*. In the northeastern United States, associated canopy species include *Pinus resinosa,*

Pinus strobus, and *Pinus banksiana*, sometimes with an understory of *Quercus ilicifolia*. In the northeastern United States, associations in this alliance occur on xeric, sandy terraces within the Coastal Plain from southern Maine to Cape Henlopen, Delaware, including paleodunes and other habitats of the New Jersey pine barrens. Examples also occur on coastal acidic rock outcrops and rocky summits of southern Maine, eastern New York, and Cape Cod, Massachusetts. Other possible habitats include sand plains, flat glacial outwash plains, sand dunes and glacial till. In the North Atlantic Coast ecoregion, stands are on sandy soils, which are typically well-drained and nutrient-poor. The habitats are fire-maintained or with a maritime influence. In the southeastern United States, associations in this alliance occur at low elevations in the Ridge and Valley, and Cumberland Mountains, on sites outside the geographic range of *Pinus pungens*. Fire plays an important role in maintaining these communities, but on the most extreme sites, these communities are maintained by topo-edaphic conditions.

Pinus rigida / Quercus ilicifolia / Morella pensylvanica Woodland (CEGL006315)

Pitch Pine / Bear Oak / Northern Bayberry Woodland
Coastal Pitch Pine / Scrub Oak Barrens

ELEMENT CONCEPT

Summary: These woodlands of pine barrens in the North Atlantic Coast ecoregion are characterized by droughty, fire-prone vegetation, sandy soils and maritime influence. *Pinus rigida* is strongly dominant in the canopy. *Quercus ilicifolia* forms a dense, 1- to 2-m tall shrub layer with occasional *Quercus prinoides*. Dwarf-shrubs such as *Gaylussacia baccata, Morella pensylvanica (= Myrica pensylvanica), Vaccinium pallidum*, and *Vaccinium angustifolium* intermingle with the tall shrubs. Herbs tend to be sparse, although more open areas may support patches of *Schizachyrium scoparium* and *Deschampsia flexuosa*, or *Carex pensylvanica* and *Carex swanii*. Additional scattered herbs include *Comptonia peregrina, Pteridium aquilinum, Gaultheria procumbens*, and *Arctostaphylos uva-ursi*. Diagnostic characteristics include the presence of *Morella pensylvanica* to indicate coastal setting.

Environment: These woodlands of pine barrens in the North Atlantic Coast ecoregion are characterized by droughty, fire-prone vegetation, sandy soils and maritime influence. Soils are acidic and well-drained.

Vegetation: *Pinus rigida* is strongly dominant in the canopy. *Quercus ilicifolia* forms a dense, 1- to 2-m tall shrub layer with occasional *Quercus prinoides*. Dwarf-shrubs such as *Gaylussacia baccata, Morella pensylvanica, Vaccinium pallidum*, and *Vaccinium angustifolium* intermingle with the tall shrubs. Herbs tend to be sparse, although more open areas may support patches of *Schizachyrium scoparium* and *Deschampsia flexuosa*, or *Carex pensylvanica* and *Carex swanii*. Additional scattered herbs include *Comptonia peregrina, Pteridium aquilinum, Gaultheria procumbens*, and *Arctostaphylos uva-ursi*. Diagnostic characteristics include the presence of *Morella pensylvanica* to indicate coastal setting.

Dynamics: These are fire-maintained systems.

Related Concepts:

- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) B
- Maritime forest (Rawinski 1984) B
- Maritime forest, dune subtype (Rawinski 1984) ?
- New England pitch pine/scrub oak barrens (Rawinski 1984) ?
- SNE dry oak/pine forest on sandy/gravelly soils (Rawinski 1984) B
- SNE dry oak/pine forests on acidic bedrock or till (Rawinski 1984) B
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) B

CONSERVATION RANKING

GRank: G3 (1997-12-1) **Reasons**:

ELEMENT DISTRIBUTION

Range: Occurs in coastal areas of Massachusetts, Rhode Island, New York, and New Jersey.
Subnations: CT, MA, NJ, NY, RI
TNC Ecoregions: 61:C, 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCP, 221B:CC, 232Aa:CCC, 232Ab:CCC
Federal Lands: NPS (Cape Cod); USFWS (Massasoit?, Monomoy, Parker River)

ELEMENT SOURCES

References: Breden et al. 2001, Eastern Ecology Working Group n.d., Lundgren et al. 2000, Motzkin and Foster 2002, Rawinski 1984, Swain and Kearsley 2001

III. Shrubland

III.B.2.N.a. Temperate cold-deciduous shrubland

Morella pensylvanica - (Prunus maritima) Shrubland Alliance (A.902)

Northern Bayberry - (Beach Plum) Shrubland Alliance

Alliance Summary: This alliance includes maritime shrublands and dune thickets of the Mid-Atlantic Coast dominated by *Morella pensylvanica (= Myrica pensylvanica)*, with *Baccharis halimifolia, Rhus copallinum*, and stunted individuals of *Pinus taeda*. *Prunus maritima* is characteristic of this community from Maryland to the north. The constant movement of sand in this community limits the herbaceous cover. Typical herbaceous species include *Ammophila breviligulata, Cenchrus tribuloides, Chamaesyce polygonifolia, Cyperus grayi, Dichanthelium acuminatum, Diodia teres, Hudsonia tomentosa, Lechea maritima, Oenothera humifusa, Panicum amarum var. amarulum, Parthenocissus quinquefolia, Rumex acetosella, Solidago sempervirens, Spartina patens, Toxicodendron radicans*, and *Triplasis purpurea*. This maritime shrubland usually occupies the intermediate areas between the very unstable oceanward portions of the dunes and the more protected backdunes, where it forms partially open to dense shrub thickets. The substrate is sand with no soil profile development, and with variable amounts of accumulated leaf litter. Where this community occupies the lee side of foredunes, greater exposure to winds and storms contributes to a shorter stature and more open aspect of the vegetation. Here there are large patches of open unvegetated or sparsely vegetated sand.

Morella pensylvanica - Prunus maritima Shrubland (CEGL006295)

Northern Bayberry - Beach Plum Shrubland
Northern Bayberry Dune Shrubland

ELEMENT CONCEPT

Summary: This association comprises maritime dune shrublands of protected slopes and hollows of dry, stabilized maritime backdunes along the northern Atlantic Coast. It is dominated by *Morella pensylvanica (= Myrica pensylvanica)* and *Prunus maritima*. Additional shrubs that are commonly present but with low cover can include *Rosa carolina, Rosa rugosa, Baccharis halimifolia, Rhus typhina*, or *Juniperus virginiana*. Although *Rosa rugosa* is not a native species, it is naturalized and is nearly restricted to this vegetation, where it grows in similar habit and physiognomy as the other two shrubs characteristic of this vegetation. The herbaceous layer tends to be sparse and low, particularly where shrub growth is dense, and can include dune grassland or adjacent upland species such as *Ammophila breviligulata, Solidago sempervirens, Hudsonia tomentosa, Lechea maritima, Juncus greenei, Carex silicea, Polygonella articulata, Symphyotrichum subulatum (= Aster subulatus), Solidago rugosa, Achillea millefolium, Oenothera parviflora, Euthamia* spp., *Cyperus grayi, Cyperus polystachyos, Schizachyrium scoparium*, and others. Typical vine associates are *Toxicodendron radicans, Parthenocissus quinquefolia*, and *Smilax* spp. Large patches of open unvegetated or sparsely vegetated sand are present in some examples. Depending on exposure, these shrublands range from over 2 m tall in sheltered areas to less than 1 m tall in areas with greater exposure to winds and storms.

Environment: This association occurs on protected slopes and hollows of dry, stabilized maritime backdunes where the water table is greater than 1 m from the surface.

Vegetation: This shrubland vegetation is dominated by *Morella pensylvanica (= Myrica pensylvanica)* and *Prunus maritima*. Additional shrubs that are commonly present but with low cover can include *Rosa carolina, Rosa rugosa, Baccharis halimifolia, Rhus copallinum, Rhus typhina*, or *Juniperus virginiana*. The herbaceous layer tends to be sparse and can include dune grassland or adjacent upland species such as *Ammophila breviligulata, Solidago sempervirens, Hudsonia tomentosa, Lechea maritima, Juncus greenei, Carex silicea, Polygonella articulata, Symphyotrichum subulatum (= Aster subulatus), Solidago rugosa, Achillea millefolium, Oenothera parviflora, Euthamia* spp., *Cyperus grayi, Cyperus polystachyos, Schizachyrium scoparium*, and others. Typical vine associates are *Toxicodendron radicans, Parthenocissus quinquefolia*, and *Smilax* spp. Large patches of open unvegetated or sparsely vegetated sand are present in some examples. Depending on exposure, these shrublands range from over 2 m tall in sheltered areas to less than 1 m tall in areas with greater exposure to winds and storms.

Dynamics: This vegetation can be a probable intermediate in succession between beach dune and sunken forest; further dune development and protection from salt spray allows development of sunken forest vegetation (Art 1976).

Similar Associations:

- *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881)
- *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399)

Related Concepts:
- *Myrica* thicket (Chrysler 1930) ?
- Coastal dune community (Rawinski 1984) ?
- Dune shrubland (Breden 1989) ?
- Low dune thicket (Martin 1959b) ?
- Maritime Shrubland on Dunes (Lundgren 2000) ?
- Rose - Bayberry Maritime Shrubland (Gawler 2002) B
- SNE coastal rocky headland community (Rawinski 1984) ?
- Short shrub thicket (Dunlop and Crow 1985) ?

Classification Comments: This vegetation is compositionally similar to maritime rocky headland, *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399). *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881) is the southern analog of this association.

CONSERVATION RANKING
GRank: G4 (1997-12-1) **Reasons**:

ELEMENT DISTRIBUTION
Range: This association occurs from Maine to New Jersey.
Subnations: CT, DE?, MA, ME, NH, NJ, NY, RI
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC
Federal Lands: NPS (Cape Cod, Fire Island, Gateway); USFWS (E.B. Forsythe, Monomoy, Muskeget Island, Nomans Land Island, Parker River)

ELEMENT SOURCES
References: Art 1976, Breden 1989, Breden et al. 2001, Chrysler 1930, Conard 1935, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Lundgren 2000, Martin 1959b, McDonnell 1979, Metzler and Barrett 2001, Metzler and Barrett 2004, Moul 1969, NRCS 2001b, Nelson and Fink 1980, Nichols 1920, Rawinski 1984, Reschke 1990, Sneddon and Lundgren 2001, Sperduto 1997b, Sperduto 2000a, Swain and Kearsley 2001

III.B.2.N.e. Seasonally flooded cold-deciduous shrubland

Morella (cerifera, pensylvanica) - Vaccinium formosum Seasonally Flooded Shrubland Alliance (A.1010)

(Wax-myrtle, Northern Bayberry) - Southern Blueberry Seasonally Flooded Shrubland Alliance

Alliance Summary: This alliance includes shrub wetlands of mid-Atlantic barrier islands. The two most characteristic shrubs are *Morella cerifera (= Myrica cerifera)* and *Vaccinium corymbosum*. *Rosa palustris* and *Morella pensylvanica (= Myrica pensylvanica)* are two other common shrub associates. Unlike the *Morella cerifera* wetland alliance, this alliance is of generally shorter stature and total shrub cover; and, although quite variable, is usually considerably more open. Herbaceous composition is variable, but *Panicum virgatum, Andropogon virginicus, Schizachyrium scoparium*, and other grasses are common. Other herbs include *Juncus* spp., *Pluchea foetida, Triadenum virginicum, Drosera intermedia*, and *Osmunda regalis*. Standing water is commonly found in the spring, but water levels may drop substantially toward the end of the summer. The southern range limit of this alliance is not well known, but it is confined to barrier islands from Delaware south.

Morella pensylvanica – Toxicodendron / Typha latifolia Shrubland (CEGL006444)

Northern Bayberry – Poison Ivy / Cattail Shrubland
Bayberry Shrub Wetland

ELEMENT CONCEPT
Summary: This shrub wetland of shallow basins occurs in coastal southern New England. It occurs in interdunal swales of barrier beaches, or in wetlands of regions underlain by morainal deposits. The dominant shrub is *Morella pensylvanica*, which can achieve heights of 2.5m on the periphery of the wetland. Associated shrubs may include *Vaccinium corymbosum, Clethra alnifolia, Decodon verticillatus,* and *Toxicodendron radicans.* The herbaceous layer is variable, but generally includes *Typha latifolia* or *Typha angustifolia, Thelypteris palustris, Osmunda cinnamomea,*

Euthamia tenuifolia, and *Triadenum virginicum.* Other associated herbs may include *Vaccinium macrocarpon, Lysimachia terrestris, Scirpus cyperinus,* and species of *Polygonum.* The substrate is usually peat of variable depth overlying sand. This association is known from Cape Cod, Massachusetts, and Block Island, Rhode Island and may occur elsewhere.
Environment: This community occurs in interdunal depressions of barrier island dunes or in areas underlain by morainal deposits. The substrate is peat of variable depth.
Vegetation: The dominant shrub is *Morella pensylvanica*, which can achieve heights of 2.5m on the periphery of the wetland. Associated shrubs may include *Vaccinium corymbosum, Clethra alnifolia, Decodon verticillatus,* and *Toxicodendron radicans.* The herbaceous layer is variable, but generally includes *Typha latifolia* or *Typha angustifolia, Thelypteris palustris, Osmunda cinnamomea, Euthamia tenuifolia,* and *Triadenum virginicum.* Other associated herbs may include *Vaccinium macrocarpon, Lysimachia terrestris, Scirpus cyperinus,* and species of *Polygonum.*
Dynamics:
Similar Associations:
(Morella cerifera) - Panicum virgatum - Spartina patens Herbaceous Vegetation (CEGL004129)
Related Concepts:
- Mesic shrub thicket (Martin 1959b) ?

Classification Comments:

CONSERVATION RANKING
GRank: GNR **Reasons**: this association has not yet been ranked.

ELEMENT DISTRIBUTION
Range: This association is known from Massachusetts and Rhode Island, and may occur elsewhere.
Subnations: MA, RI
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC, 232Aa:CCC
Federal Lands: USFWS (Monomoy, Nomans Land Island)

ELEMENT SOURCES
References: Hadjian 1995; Sneddon 2010

IV. Dwarf-shrubland

IV.A.1.N.a. Cespitose needle-leaved or microphyllous evergreen dwarf-shrubland

Hudsonia tomentosa Dwarf-shrubland Alliance (A.1062)

Woolly Beach-heather Dwarf-shrubland Alliance

Alliance Summary: This alliance consists of sandy or rocky areas dominated by *Hudsonia tomentosa*. This alliance is largely confined to maritime interdunes. This alliance occurs on well-drained sands of back dunes and interdunes, and is documented from Assateague Island; it is a maritime dwarf-shrubland characterized by *Hudsonia tomentosa*, a species adapted to sand burial. *Hudsonia tomentosa* is dominant, occurring as discrete patches that may coalesce into a dense mat on older, more stabilized dunes. A number of other shrubs, such as *Morella pensylvanica (= Myrica pensylvanica), Morella cerifera (= Myrica cerifera), Pinus taeda* saplings, and *Prunus maritima*, may occur but are low in abundance and cover. *Morella pensylvanica* shrubs and *Pinus taeda* saplings are almost non-existent but can occur as scattered individuals. Herbaceous vegetation is also quite sparse (less than 5% cover) but may include scattered individuals of *Panicum amarum var. amarulum, Panicum amarum var. amarum, Solidago sempervirens, Nuttallanthus canadensis, Lechea maritima, Ammophila breviligulata, Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium), Schizachyrium littorale (= Schizachyrium scoparium ssp. littorale), Dichanthelium acuminatum, Oenothera humifusa, Cyperus grayi, Artemisia stelleriana, Chamaesyce polygonifolia*, and *Diodia teres*. *Toxicodendron radicans* is a common vine. Scattered vines of *Smilax rotundifolia* and canes of *Rubus argutus* are occasional. The unstable substrate is influenced by wind-deposited sand and supports no soil development; large patches of sparsely vegetated or unvegetated sand are common.

Hudsonia tomentosa - *Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143)

Woolly Beach-heather - Kinnikinnick or Bearberry Dwarf-shrubland
Northern Beach-heather Dune Shrubland

ELEMENT CONCEPT

Summary: This association comprises dune heathlands of the north Atlantic coast from southern Maine to Long Island, New York, dominated by *Hudsonia tomentosa*. It occurs in well-developed dune systems in the lee side of primary dunes or on secondary dunes with active sand deposition and movement. *Hudsonia tomentosa* is a dominant as well as keystone species of this community, binding sand in place and forming more suitable habitat for other plants to become established. Associated herbs generally occur in low abundance and include *Polygonella articulata, Lechea maritima, Deschampsia flexuosa, Minuartia caroliniana, Ionactis linariifolius, Solidago sempervirens, Lathyrus japonicus, Artemisia stelleriana, Carex silicea, Chamaesyce polygonifolia, Cyperus polystachyos*, and scattered *Ammophila breviligulata*. Older, more stabilized dunes tend to have greater species diversity and less sand deposition. In these areas *Arctostaphylos uva-ursi* can displace *Hudsonia tomentosa* or codominate, and Asteraceae species and *Cladina* spp. are common. Scattered individuals of *Morella pensylvanica (= Myrica pensylvanica), Rosa rugosa, Prunus maritima*, or *Gaylussacia baccata* may occur within this community.

Environment: This association occurs in well-developed sand dune systems in the lee side of primary dunes or on secondary dunes with active sand deposition and movement. Conditions are xeric; plants must be adapted to low moisture, high surface temperature, and high light intensity.

Vegetation: This dwarf-shrubland is dominated by *Hudsonia tomentosa*. Associated species generally occur in low abundance and include *Polygonella articulata, Lechea maritima, Minuartia caroliniana, Ionactis linariifolius, Solidago sempervirens, Lathyrus japonicus, Artemisia stelleriana, Carex silicea, Chamaesyce polygonifolia, Cyperus polystachyos*, and scattered *Ammophila breviligulata*. Older, more stabilized dunes tend to have greater species diversity and less sand deposition. In these areas *Arctostaphylos uva-ursi* can displace *Hudsonia tomentosa* or codominate, and Asteraceae species and *Cladina* spp. are common. Scattered individuals of *Morella pensylvanica (= Myrica pensylvanica), Rosa rugosa, Prunus maritima*, or *Gaylussacia baccata* may occur within this community.

Dynamics: This association occurs in large dune systems with active sand deposition and movement. This association grades into dune grasslands dominated by *Ammophila breviligulata* or into maritime shrub thickets.

Similar Associations:

- *Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation (CEGL006274)
- *Hudsonia tomentosa / Panicum amarum var. amarulum* Dwarf-shrubland (CEGL003950)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024)

Related Concepts:

- Coastal dune community (Rawinski 1984) ?
- Dune heath (Johnson 1985b) ?
- Interdune (McDonnell 1979) ?
- New England heath sand barrens / coastal heathland (Rawinski 1984) ?
- Pitch Pine Dune Woodland (Gawler 2002) B

Classification Comments: *Hudsonia tomentosa / Panicum amarum var. amarulum* Dwarf-shrubland (CEGL003950) is a southern analog of this association.

CONSERVATION RANKING

GRank: G2G3 (2007-1-30) **Reasons:** This small-patch community is restricted to coastal sand dunes from southern Maine to Long Island, New York, and is faced with threats to most coastal areas of the Northeast in general: commercial and residential development, trampling by beach users, and beach stabilization in particular. An estimated 70 occurrences covering 1000-1300 acres in total exist rangewide.

ELEMENT DISTRIBUTION

Range: This association is restricted to coastal sand dunes from southern Maine to Long Island, New York.
Subnations: CT, MA, ME, NJ, NY, QC, RI
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC
Federal Lands: NPS (Cape Cod, Fire Island, Gateway); USFWS (Monomoy, Parker River)

ELEMENT SOURCES

References: Conard 1935, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2002, Godfrey et al. 1978, Gwilliam unpubl. data 1998, Johnson 1985b, Lundgren 1998, Lundgren et al. 2000, McDonnell 1979, Metzler and Barrett 2001, NRCS 2001b, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Robichaud and Buell 1973, Swain and Kearsley 2001, Van Luven 1990, Zaremba 1989

IV.A.1.N.g. Saturated needle-leaved or microphyllous evergreen dwarf-shrubland

Vaccinium macrocarpon Saturated Dwarf-shrubland Alliance (A.1094)

Large Cranberry Saturated Dwarf-shrubland Alliance

Alliance Summary: This alliance, found in parts of the northeastern United States, contains vegetation found in maritime dune-swale communities and mountain bogs of Central Appalachians (beyond the range of *Chamaedaphne calyculata*), as well as cranberry bogs in Ohio. Further information is needed to characterize this alliance.

Cladium mariscoides / Vaccinium macrocarpon - Morella pensylvanica Dwarf-shrubland (CEGL006141)

Smooth Sawgrass / Large Cranberry - Northern Bayberry Dwarf-shrubland
Northern Interdunal Cranberry Swale

ELEMENT CONCEPT

Summary: This association is a small-patch seasonally flooded wetland within low swales behind backdunes of major dune systems of the northeastern coast. Vegetation is characterized by *Vaccinium macrocarpon, Sphagnum* spp., and scattered *Morella pensylvanica (= Myrica pensylvanica), Myrica gale*, and/or *Vaccinium corymbosum*. *Vaccinium macrocarpon* is generally dominant, but a number of rushes, sedges, grasses, and forbs co-occur and often obscure the low-growing *Vaccinium macrocarpon*. *Morella pensylvanica*, although a minor component of the vegetation and generally restricted to the wetland edge, characterizes this community as coastal. The wetland is seasonally flooded and is often dry on the surface late in the growing season. A shallow layer of peat overtops deep sand deposits. Associated species commonly include *Juncus* spp. (*Juncus canadensis, Juncus greenei, Juncus balticus, Juncus biflorus, Juncus scirpoides, Juncus pelocarpus* and/or others), *Cladium mariscoides, Xyris torta, Xyris difformis, Rhynchospora capitellata, Rhynchospora alba, Cyperus* spp., *Drosera rotundifolia, Drosera intermedia, Drosera filiformis, Pogonia ophioglossoides*, and scattered clumps of *Schoenoplectus pungens* or *Scirpus cyperinus* in small wet pockets. *Sphagnum* spp. (*Sphagnum rubellum, Sphagnum compactum*, and possibly others) cover the surface. Species occurring less frequently can include *Linum striatum, Lycopodiella inundata (= Lycopodium inundatum), Polygala cruciata, Calopogon* spp., *Platanthera* spp., *Utricularia subulata, Triadenum* sp., and others. Floristics can vary among swales due to hydrology, soils, or disturbance regime.

Environment: This association occurs in small, low, wet swales between coastal backdunes. These wet swales occur where the dune surface intersects fresh groundwater lens. These swales are seasonally flooded and often surficially dry by late summer. The duration of flooding is long enough to prevent extensive shrub establishment and to allow carpets of *Sphagnum* to develop. Substrate is shallow peat over sand.

Vegetation: Species composition can vary considerably between swales. This association comprises a later successional phase of freshwater coastal swale development. Vegetation is characterized by *Vaccinium macrocarpon, Sphagnum* spp., and scattered *Morella pensylvanica, Myrica gale*, and/or *Vaccinium corymbosum*. *Vaccinium macrocarpon* can have up to 90% cover, but can be obscured by taller herbs. Associated species commonly include *Juncus* spp. (*Juncus canadensis, Juncus greenei, Juncus balticus, Juncus biflorus, Juncus pelocarpus*, and/or others), *Cladium mariscoides, Xyris torta, Xyris difformis, Rhynchospora capitellata, Rhynchospora scirpoides, Rhynchospora alba, Cyperus* spp., *Drosera rotundifolia, Drosera intermedia, Drosera filiformis, Pogonia ophioglossoides*, and scattered clumps of *Schoenoplectus pungens* or *Scirpus cyperinus* in small wet pockets. *Sphagnum* spp. (*Sphagnum rubellum, Sphagnum compactum*, and possibly others) cover the surface. Species occurring less frequently can include *Linum striatum, Lycopodiella inundata (= Lycopodium inundatum), Polygala cruciata, Calopogon* spp., *Platanthera* spp., *Utricularia subulata, Triadenum* sp., and others. Floristics can vary between swales due to hydrology, soils, or disturbance regime.

Dynamics: This association occurs in wet swales where the dune surface intersects fresh groundwater lens. Water table fluctuations depend on precipitation, which is the primary water input, and the rate of subsurface drainage. Short-term dynamics in vegetation composition are driven by water level fluctuations; drought conditions allow tree and shrub

colonization, which can shade out herbs, while increased flooding favors herbaceous species and eliminates shrubs. This vegetation can grade into mesic shrubland or dune grassland vegetation.

Similar Associations:

- *Myrica gale - Morella pensylvanica* Saturated Shrubland (CEGL006339)
- *Pinus rigida / Vaccinium macrocarpon* Woodland (CEGL006127)
- *Vaccinium oxycoccos - (Vaccinium macrocarpon) / Rhynchospora alba - Drosera rotundifolia / Sphagnum* spp. Dwarf-shrubland (CEGL007856)

Related Concepts:

- *Cladium mariscoides* Herbaceous Vegetation (Clancy 1996) F
- *Vaccinium macrocarpon* - Mixed orchid / *Sphagnum* (McAvoy and Clancy 1994) ?
- *Vaccinium macrocarpon* Dwarf-shrubland (Clancy 1996) F
- Coastal interdunal marsh/swale (Rawinski 1984) ?
- Cranberry bog (Martin 1959b) ?
- Cranberry marsh (Johnson 1985b) ?
- Cranberry swale (Lundgren 2000) ?
- Cranberry swale (McDonnell 1979) ?
- Interdunal swales (Breden 1989) ?
- Wet poor fen (Dowhan and Rozsa 1989) ?
- Wet swale (Dunlop and Crow 1985) ?

CONSERVATION RANKING

GRank: G2G3 (2007-1-31) **Reasons:** This association is a small-patch community with occurrences confined to low areas that are influenced by the water table between sand dunes. This vegetation is naturally limited by the intersection of two features: (1) swales dominated by large cranberry, which as a vegetation type occurs from Cape Henlopen, Delaware, north to Massachusetts; and (2) major dune systems of relatively broad extent that are characterized by dune and swale microtopography, a landform within that limited range that is restricted to Cape Cod, Long Island, and the barrier islands of New Jersey. The vegetation is restricted to large dune systems because it requires habitat to allow for the extirpation and re-creation of individual occurrences that may be naturally extirpated by coastal storms and overwash. Average size of this community is usually less than one acre, ranging to no more than a few acres at maximum. Fewer than 100 occurrences are estimated in five states, totaling no more than 125 acres. Coastal systems in general are severely threatened due to habitat loss imposed by housing expansion, and by foot traffic created by recreation seekers on beaches.

ELEMENT DISTRIBUTION

Range: This community is confined to major dune systems of the northeastern coast (over an estimated 350 square km). Most occurrences are found in Massachusetts, New York, New Jersey, with occasional occurrences in Rhode Island and Delaware. There is one degraded occurrence in New Hampshire. There are no known occurrences in Connecticut.
Subnations: DE, MA, NH, NJ, NY, QC, RI
TNC Ecoregions: 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ak:CCC, 232Aa:CCC, 232Bz:CCC
Federal Lands: NPS (Cape Cod, Fire Island); USFWS (Monomoy?, Nomans Land Island?, Parker River)

ELEMENT SOURCES

References: Benedict 1977a, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1996, Conard 1935, Dowhan and Rozsa 1989, Dunlop and Crow 1985, Eastern Ecology Working Group n.d., Edinger et al. 2002, Johnson 1981b, Johnson 1985b, Lundgren 1998, Lundgren 2000, Martin 1959b, McAvoy and Clancy 1994, McDonnell 1979, Moul 1969, Rawinski 1984, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001

V. Herbaceous Vegetation

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland

Ammophila breviligulata Herbaceous Alliance (A.1207)

American Beachgrass Herbaceous Alliance

Alliance Summary: This dune grassland alliance occurs almost exclusively on sandy, unstable, droughty substrates with no soil profile development. Eolian processes cause active sand deposition and erosion. The sand substrate is usually

visible, and litter accumulation from plant debris is nearly absent. This alliance generally occurs on foredunes that receive the force of wind and salt spray but is beyond the influence of most storm tides. It includes maritime dune grasslands dominated by *Ammophila breviligulata, Panicum amarum var. amarum*, and *Panicum amarum var. amarulum*. Plant cover is variable, ranging from 10-75%, but is usually low. Other associated species include *Solidago sempervirens, Strophostyles helvula, Triplasis purpurea, Cenchrus tribuloides, Chamaesyce polygonifolia, Oenothera humifusa, Schoenoplectus pungens (= Scirpus pungens)* (where overwashed by sand), *Diodia teres, Cakile edentula ssp. edentula, Nuttallanthus canadensis, Salsola kali ssp. kali (= Salsola caroliniana), Lechea maritima*, and *Spartina patens*. Sparse individuals of stunted *Morella pensylvanica (= Myrica pensylvanica)* shrubs and seedlings may occur, but make up less than 2% of the total vegetation cover. Diagnostic species are *Ammophila breviligulata, Solidago sempervirens, Panicum amarum var. amarulum*, and *Oenothera humifusa*.

Ammophila breviligulata - *Lathyrus japonicus* Herbaceous Vegetation (CEGL006274)

American Beachgrass - Beach Pea Herbaceous Vegetation
Northern Beachgrass Dune

ELEMENT CONCEPT

Summary: This dune grassland of maritime beaches occurs along the North Atlantic coast from New Jersey north to central Maine. This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. The substrate is wind-deposited sand with no soil development. *Ammophila breviligulata* is the dominant species, often occurring monotypically. *Lathyrus japonicus* is a common associate and can be codominant. Other associated species include *Solidago sempervirens, Lechea maritima, Aristida tuberculosa, Schizachyrium scoparium, Carex silicea, Polygonella articulata*, and *Artemisia stelleriana*. Dwarf-shrubs, such as *Hudsonia tomentosa*, can occur sporadically and form locally dominant patches. Vegetation cover is often sparse, and bare sand is usually evident.

Environment: This association primarily occurs on active maritime dunes, on both foredunes that are exposed to onshore winds and salt spray as well as more protected interdunes. This grassland generally occurs beyond the influence of storm tides. Substrate is sand with no soil profile development.

Vegetation: This association is characterized and dominated by *Ammophila breviligulata*, which can occur monotypically, especially on foredunes or other areas of active and rapid sand deposition. *Lathyrus japonicus* is the most common associate and can be codominant. Other associated species include *Solidago sempervirens, Lechea maritima, Aristida tuberculosa, Schizachyrium scoparium, Carex silicea, Polygonella articulata*, and *Artemisia stelleriana*. Dwarf-shrubs, such as *Hudsonia tomentosa, Rosa rugosa, Morella pensylvanica (= Myrica pensylvanica)*, or stunted *Prunus maritima*, can occur sporadically and form locally dominant patches within the grassland.

Dynamics: This association occurs on the shifting sands of active dune systems. Sand is wind-deposited and tends to accumulate where vegetation slows the surface wind velocity (Martin 1959b). Rhizomes of *Ammophila breviligulata* stabilize the dunes, growing upward through layers of sand deposition. *Ammophila breviligulata* tends to grow best where there is relatively rapid sand deposition; it can grow through one meter of sand accumulation (Zaremba and Leatherman 1984). Species diversity of this association tends to increase landward in more protected areas where the substrate is more stable. This dune grassland can merge into beach strand vegetation seaward and maritime heath communities landward.

Similar Associations:

- *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043)
- *Hudsonia tomentosa* - Arctostaphylos uva-ursi Dwarf-shrubland (CEGL006143)

Related Concepts:

- Coastal dune community (Rawinski 1984) ?
- Coastal dune grass community (Breden 1989) B
- Dune Grassland (Gawler 2002) =
- Dune grass community (Nelson and Fink 1980) =
- Dunegrass (Martin 1959b) ?

Classification Comments: The southern analog of this dune grassland association is *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043), which is differentiated by having *Panicum amarum* as a codominant species in addition to the presence of more southern species such as *Cenchrus tribuloides* and *Oenothera humifusa*, plus the absence of *Lathyrus japonicus*. These two *Ammophila breviligulata*-dominated associations overlap geographically in New Jersey. This association is often adjacent to *Hudsonia tomentosa* dwarf-shrublands and they have much species overlap; when dwarf-shrub cover exceeds 25%, the community is considered *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143).

CONSERVATION RANKING
GRank: G4? (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION
Range: This association occurs along the northern Atlantic Coast from Maine to New Jersey.
Subnations: CT, DE?, MA, ME, NH, NJ, NY, QC, RI
TNC Ecoregions: 62:C, 63:C
USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Sagamore Hill); USFWS (E.B. Forsythe, Monomoy, Muskeget Island, Nomans Land Island, Parker River)

ELEMENT SOURCES
References: Breden 1989, Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Gawler 2001, Gawler 2002, Johnson 1981b, Johnson 1985b, Martin 1959b, Metzler and Barrett 2001, Moul 1969, NRCS 2001b, Nelson and Fink 1980, Rawinski 1984, Reschke 1990, Sperduto 1997a, Swain and Kearsley 2001, Zaremba and Leatherman 1984

V.A.5.N.e. Short sod temperate or subpolar grassland

Spartina patens - (Schoenoplectus pungens) Herbaceous Alliance (A.1274)

Saltmeadow Cordgrass - (Common Threesquare) Herbaceous Alliance

Alliance Summary: This alliance includes upland dune grassland of barrier islands of the Mid-Atlantic and Gulf coasts. *Spartina patens* and *Schoenoplectus pungens (= Scirpus pungens)* are characteristically dominant, though other graminoids such as *Schoenoplectus pungens, Sporobolus virginicus, Cenchrus spinifex (= Cenchrus incertus), Cenchrus tribuloides*, and *Paspalum distichum* may be codominant or prominent within their respective ranges. In parts of the range of this alliance, *Spartina patens* is dominant and *Schoenoplectus pungens* may be absent. This community characteristically occupies overwash terraces or low dunes, less well-developed than those dominated by *Uniola paniculata* (from North Carolina south and west to Texas and Tamaulipas, Mexico) or by *Ammophila breviligulata* (from North Carolina northwards). Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominal species in the northern part of the range, it may be of greater diversity. Other components of this vegetation include *Strophostyles helvula, Solidago sempervirens, Cenchrus tribuloides, Setaria parviflora, Distichlis spicata, Sabatia stellaris, Ammophila breviligulata, Suaeda linearis, Bassia hirsuta* (an exotic), *Atriplex patula, Polygonum glaucum, Spergularia salina (= Spergularia marina), Salicornia bigelovii, Salicornia virginica, Fimbristylis castanea*, and *Cakile edentula ssp. edentula*. Woody species may include scattered individuals of *Toxicodendron radicans, Solidago sempervirens, Lythrum lineare, Kosteletzkya virginica*, and seedlings of *Baccharis halimifolia*. The plants of this community are influenced by sand deposited by storm surges. Storm overwash is a prevalent natural disturbance to this community. This community appears to be successional between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Spartina patens - Schoenoplectus pungens - Solidago sempervirens Herbaceous Vegetation (CEGL004097)

Saltmeadow Cordgrass - Common Threesquare - Seaside Goldenrod Herbaceous Vegetation
Overwash Dune Grassland

ELEMENT CONCEPT
Summary: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces ranging from Massachusetts to North Carolina. It forms a drier, later successional phase beginning from water-deposited sand of storm overwash. Sand movement, plant burial, and dune formation rates are not so high as to form *Ammophila breviligulata*-dominated primary dunes, but can be found as a fringe around the outer edge of those dunes. *Spartina patens* is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens (= Scirpus pungens)* or *Solidago sempervirens*. Less common associates can include *Cyperus grayi, Cenchrus tribuloides, Setaria parviflora, Festuca rubra, Schizachyrium littorale, Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium)*, and occasional scattered individuals of *Toxicodendron radicans* and seedlings of *Baccharis*

halimifolia. Bare sand is often visible through the vegetation, and there is no soil profile development. *Ammophila breviligulata* or *Uniola paniculata* may invade from the surrounding dunes. This community appears to be a successional step between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands.

Environment: This community is an upland dune grassland or overwash area of Atlantic barrier islands on embryo dunes or back sides of beaches forming from overwash terraces. The plants of this community are influenced by water-deposited sand caused by storm surges. They differ ecologically from dune grasslands dominated by *Ammophila breviligulata* or *Uniola paniculata*, which are primarily impacted by wind-deposited sand. Storm overwash is a prevalent natural disturbance to this community.

Vegetation: *Spartina patens* is dominant, ranging from quite sparse (25% cover) to dense, and can be monotypic in early-successional expressions. As the vegetation develops, common associated species can include *Schoenoplectus pungens (= Scirpus pungens)* or *Solidago sempervirens*. Less common associates can include *Cyperus grayi, Cenchrus tribuloides, Setaria parviflora, Festuca rubra, Schizachyrium littorale, Pseudognaphalium obtusifolium (= Gnaphalium obtusifolium)*, and occasional scattered individuals of *Toxicodendron radicans* and seedlings of *Baccharis halimifolia*. *Ammophila breviligulata* or *Uniola paniculata* may invade from the surrounding dunes. This community is characterized by upland maritime dune grassland vegetation. *Spartina patens*, and sometimes *Schoenoplectus pungens (= Scirpus pungens)*, or both are dominant on dunes or overwash terraces. Total vegetation cover is variable, ranging from quite sparse (25% cover) to dense. Bare sand is often visible through the vegetation, and there is no soil profile development. Species diversity is variable; although it may be quite low and confined to the nominate species in the northern part of the range, it may be of greater diversity, including *Strophostyles helvula, Solidago sempervirens, Cenchrus tribuloides, Setaria parviflora, Distichlis spicata, Sabatia stellaris, Ammophila breviligulata, Suaeda linearis, Bassia hirsuta, Atriplex patula, Fimbristylis castanea*, and *Cakile edentula ssp. edentula*.

Dynamics: This association forms a drier, later successional phase of an overwash community begun from water-deposited sand of storm overwash; it appears to be a successional step between interdunal herbaceous wetlands and interdunal herbaceous/shrub uplands. Undisturbed water-deposited sand is colonized by *Spartina patens* and/or *Schoenoplectus pungens* plus additional associates like *Suaeda linearis, Bassia hirsuta, Atriplex patula*, and *Fimbristylis castanea* that have low percent cover. This wetter, early-successional phase is currently covered by *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342). With time since overwash, sand movement, plant burial, and dune formation rates increase, but are not so high as to form *Ammophila breviligulata*-dominated primary dunes. However, this association can be found as a fringe around the lower, outer edge of those dunes.

Similar Associations:

- *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342)
- *Spartina patens - Schizachyrium maritimum* - Solidago sempervirens Herbaceous Vegetation (CEGL008445)

Related Concepts:

- *Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation (Bowman 2000) =
- Dry community of barrier flats (Travis and Godfrey 1976) B
- Dry maritime grassland (Lea 2002b) ?
- Dunegrass community (Higgins et al. 1971) B
- Grassland community (Baumann 1978b) =
- Low dune community (Boule 1979) =
- Maritime Dry Grassland (Schafale and Weakley 1990) ?
- Maritime Dry Grassland (Typic Subtype) (Schafale 2000) ?
- Maritime Dune Grassland (Harrison 2004) B
- Maritime Dune Grassland (Fleming and Coulling 2001) B
- Secondary dunes (Klotz 1986) B
- Wash (Hill 1986) =
- Wash (Higgins et al. 1971) =

Classification Comments: This community differs ecologically from dune grasslands dominated by *Ammophila breviligulata* or *Uniola paniculata*, which are primarily impacted by wind-deposited sand. This community is impacted by wave-deposited sand. It is drier than brackish swales and vegetation that immediately colonizes water-borne sand from storm overwash, such as *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342). *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445) is a southern analog of this association that occurs along the Gulf Coast.

CONSERVATION RANKING
GRank: G2G3 (1998-11-4) **Reasons:** This dune grassland community is restricted to overwash areas of major maritime dune systems. It is typically small in extent, not usually more than a few acres in size. It is best developed on barrier islands of Delaware, Maryland, Virginia, and North Carolina; it extends sporadically farther north to Massachusetts. As part of a dynamic system, the community is in a sense ephemeral, being buried over time by sand deposition, and being formed anew in other areas subjected to overwash. Because of the dynamic forces structuring the community, it requires sufficient area in large dune systems to accommodate this shifting mosaic. Although not extremely rare (an estimated 100-200 occurrence exist rangewide), the community is restricted to a specialized habitat and is threatened by a number of activities, including dune stabilization, and outright destruction of habitat through human activities.

ELEMENT DISTRIBUTION
Range: This community is an upland dune grassland or overwash area of Atlantic barrier islands from Massachusetts to North Carolina.
Subnations: DE, MA, MD, NC, NJ, NY, QC, VA
TNC Ecoregions: 57:C, 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ci:CCC
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Hatteras, Cape Lookout, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay?, E.B. Forsythe, Monomoy, Prime Hook)

ELEMENT SOURCES
References: Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming and Coulling 2001, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Higgins et al. 1971, Hill 1986, Klotz 1986, Lea 2002b, NRCS 2001b, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, TNC 1995c, Travis and Godfrey 1976, Zaremba and Leatherman 1984

Spartina patens - *Thinopyrum pycnanthum* Herbaceous Vegetation (CEGL006149)
Saltmeadow Cordgrass - Tick Quackgrass Herbaceous Vegetation
Salt Hay Dune

ELEMENT CONCEPT
Summary: This dune grassland of central New England occurs on the interface between upper salt marshes and sand dunes. These low dunes may be periodically flooded by storm tides, most frequently during the winter when plants are dormant. The association is characterized by a dominance of *Spartina patens (= var. monogyna), Elymus repens (= Agropyron repens)*, or *Thinopyrum pycnanthum (= Agropyron pungens)*. All three species may be present or one may occur alone. Other associates are rare, but when present may include *Ammophila breviligulata, Oenothera biennis, Artemisia campestris ssp. caudata (= Artemisia caudata), Solidago sempervirens*, and *Rosa rugosa*.
Environment: This dune grassland of central New England occurs on the interface between upper salt marshes and sand dunes. These low dunes may be periodically flooded by storm tides, most frequently during the winter when plants are dormant.
Vegetation: The association is characterized by a dominance of *Spartina patens, Elymus repens*, or *Thinopyrum pycnanthum*. All three species may be present or one may occur alone. Other associates are rare but, when present, may include *Ammophila breviligulata, Oenothera biennis, Artemisia campestris ssp. caudata, Solidago sempervirens*, and *Rosa rugosa*.
Dynamics:
Similar Associations:
Related Concepts:
Classification Comments:

CONSERVATION RANKING
GRank: GNR **Reasons:** this association has not yet been ranked.

ELEMENT DISTRIBUTION
Range: This association is documented from coastal Massachusetts.
Subnations:
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC
Federal Lands: NPS (Cape Cod); USFWS (Monomoy)
Element Sources
References: McDonnell 1979.

V.A.5.N.k. Seasonally flooded temperate or subpolar grassland *Spartina patens* Seasonally Flooded Herbaceous Alliance (A.1390)

Saltmeadow Cordgrass Seasonally Flooded Herbaceous Alliance

Alliance Summary: This alliance consists of seasonally flooded (non-tidal) wetlands dominated by *Spartina patens*, occurring from northeastern United States south and west to Tamaulipas, Mexico.

Spartina patens - *Eleocharis parvula* Herbaceous Vegetation (CEGL006342)

Saltmeadow Cordgrass - Dwarf Spikerush Herbaceous Vegetation
Northeastern Atlantic Brackish Interdunal Swale

ELEMENT CONCEPT

Summary: This brackish, interdunal swale and overwash community of the northeastern Atlantic coast occurs in low areas behind primary or secondary sand dunes. The substrate is sand with little or no organic accumulation. The water source for this wetland community is variable, including seasonally high groundwater table, salt spray, and sporadic tidal overwash, resulting in widely variable salinity levels. The dominant species is generally *Spartina patens*, but it can be *Eleocharis parvula, Schoenoplectus pungens (= Scirpus pungens), Cyperus polystachyos*, and/or *Juncus articulatus*. Associated species depend on salinity and hydrology of a site and can include *Leptochloa fusca ssp. fascicularis (= Diplachne maritima), Schoenoplectus maritimus (= Scirpus maritimus), Juncus ambiguus (= Juncus bufonius var. halophila), Juncus scirpoides, Ptilimnium capillaceum, Rumex maritimus, Symphyotrichum subulatum (= Aster subulatus), Chenopodium rubrum, Pluchea odorata, Hibiscus moscheutos ssp. moscheutos (= Hibiscus palustris), Polygonum ramosissimum, Triglochin maritima, Panicum virgatum, Schoenoplectus robustus*, and *Argentina anserina (= Potentilla anserina)*. *Iva frutescens* and *Baccharis halimifolia* may occur on hummocks within the swale. Mats of blue-green and/or brown algae can proliferate across the soil surface.

Environment: This community occupies brackish interdunal swales and overwash flats between coastal sand dunes. Surface water is oligo- to mesohaline; the dune surface intersects the freshwater lens with salinity input from salt spray and/or storm tide overwash. Substrate is deep sand with or without a layer of surficial peat.

Vegetation: This association is dominated by graminoids, especially *Spartina patens, Eleocharis parvula, Schoenoplectus pungens (= Scirpus pungens), Cyperus polystachyos*, and *Juncus articulatus*, although local dominance can change from year to year. Associated species depend on salinity and hydrology of a site and can include *Leptochloa fusca ssp. fascicularis (= Diplachne maritima), Schoenoplectus maritimus (= Scirpus maritimus), Juncus ambiguus (= Juncus bufonius var. halophila), Juncus scirpoides, Ptilimnium capillaceum, Rumex maritimus, Symphyotrichum subulatum (= Aster subulatus), Chenopodium rubrum, Pluchea odorata, Hibiscus moscheutos ssp. moscheutos (= Hibiscus palustris), Polygonum ramosissimum, Triglochin maritima, Panicum virgatum, Schoenoplectus robustus*, and *Argentina anserina (= Potentilla anserina)*. *Iva frutescens* and *Baccharis halimifolia* may occur on hummocks within the swale. Mats of blue-green and/or brown algae can proliferate across the soil surface. *Phragmites australis* can readily invade in this environmental setting.

Dynamics: Brackish swale vegetation can be ephemeral or can represent early stages of salt marsh or coastal salt pond development (Reschke 1990). Overwash flats can succeed into dune grasslands with sand accumulation and plant burial.

Similar Associations:

- *Schoenoplectus pungens - Eleocharis parvula Herbaceous Vegetation (CEGL006398)*
- *Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation (CEGL004097)

Related Concepts:

- Coastal interdunal marsh/swale (Rawinski 1984) ?
- Maritime Wet Grassland (Fleming and Coulling 2001) B
- Overwash Community (Lea 2002b) ?

Classification Comments: This association is similar to coastal salt pond vegetation, *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398).

CONSERVATION RANKING

GRank: GNR (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This association is currently described from Maryland, New Jersey, New York, Massachusetts, and New Hampshire. It likely occurs in other states.

Subnations: DE, MA, MD, NH, NJ, NY, QC, VA

TNC Ecoregions: 57:?, 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ak:CCC, 232Aa:CCC, 232Ac:CCC, 232Bz:CCC
Federal Lands: NPS (Fire Island, Gateway); USFWS (Monomoy?)

ELEMENT SOURCES
References: Breden et al. 2001, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming and Coulling 2001, Harrison 2004, Hunt 1997b, Lea 2002b, Lundgren 1998, NRCS 2001b, Rawinski 1984, Reschke 1990, Sneddon and Lundgren 2001, Sperduto 2000b, Swain and Kearsley 2001

V.A.5.N.L. Semipermanently flooded temperate or subpolar grassland

Typha (angustifolia, latifolia) - (*Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance (A.1436)

(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance

Alliance Summary: This alliance, found in virtually every state in the United States and probably most Canadian provinces, contains stands dominated by *Typha angustifolia* and/or *Typha latifolia*, either alone or in combination with other tall emergent marsh species. This alliance is found most commonly along lake margins and in shallow basins, and occasionally in river backwaters. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm. *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes. *Lythrum salicaria*, an exotic species from Europe, has become a common associate of many eastern *Typha* marshes. In the Southeast, this alliance is widespread and currently representative of a wide variety of mixed marshes with no clear dominants. Vegetation in this alliance may be natural or semi-natural and includes mixed stands of the nominal species, as well as essentially monospecific stands of *Typha latifolia*. These monospecific stands occur especially in artificial wetlands, such as borrow pits or ponds. This alliance occurs on hydric soils in wetlands, ditches, ponds, lakes, and rivers, as well as on shorelines and streambanks. Inundation is commonly 3-6 dm (1-2 feet) in depth. These marshes have hydric soils and are flooded with water levels ranging from several centimeters to more than 1 m for a significant part of the growing season. Occurrences may display areas of open water, but emergent vegetation dominates (80% cover). Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils which support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Vegetative diversity and density is highly variable in response to water depth, water chemistry, and natural forces. Associated species vary widely; in the Midwest they include many sedges such as *Carex aquatilis, Carex rostrata, Carex pellita (= Carex lanuginosa)*, bulrushes such as *Schoenoplectus americanus (= Scirpus americanus), Schoenoplectus acutus (= Scirpus acutus)*, and *Schoenoplectus heterochaetus (= Scirpus heterochaetus)*, and broad-leaved herbs such as *Thelypteris palustris, Asclepias incarnata, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum, Hibiscus moscheutos*, and *Verbena hastata*. Floating aquatics such as *Lemna minor* may predominate in deeper zones.

Schoenoplectus pungens var. *pungens* - Juncus canadensis Herbaceous Vegetation (CEGL006935)

Common Threesquare - Canadian Rush Herbaceous Vegetation
Coastal Freshwater Marsh

ELEMENT CONCEPT
Summary: This non-tidal freshwater marsh of the coastal Northeast occupies flooded depressions and swales in coastal dunes. The substrate varies from sand to peat or muck, depending on hydrological regime. Water is present most of the year and does not typically exhibit a seasonal drawdown. The vegetation is dominated by *Schoenoplectus pungens var. pungens*, in association with *Hibiscus moscheutos ssp. moscheutos, Juncus canadensis, Juncus effusus, Eleocharis erythropoda, Osmunda regalis, Osmunda cinnamomea, Thelypteris palustris*, and *Triadenum virginicum*. *Typha latifolia* may be present, but generally only occurs at low cover. A diverse range of other forbs may also be associated with this community.
Environment: This non-tidal freshwater marsh of the coastal Northeast occupies flooded depressions and swales in coastal dunes. The substrate varies from sand to peat or muck, depending on hydrological regime. Water is present most of the year and does not typically exhibit a seasonal drawdown.

Vegetation: The vegetation is dominated by *Schoenoplectus pungens var. pungens*, in association with *Hibiscus moscheutos ssp. moscheutos, Juncus canadensis, Juncus effusus, Eleocharis erythropoda, Osmunda regalis, Osmunda cinnamomea, Thelypteris palustris*, and *Triadenum virginicum*. *Typha latifolia* may be present, but generally only occurs at low cover. A diverse range of other forbs may also be associated with this community. Shrubs may be present as sparsely distributed individuals, or more densely from the wetland edge. Typical shrubs include *Rosa rugosa, Vaccinium corymbosum*, and *Morella pensylvanica*.
Related Concepts:
Fresh marsh (Martin 1959b) ?
Classification Comments: New community described based on Gap Project sample sites ("FM1", "FM2", "FM4") at Island Beach State Park.

CONSERVATION RANKING
GRank: GNR (2000-11-8) **Reasons:**

ELEMENT DISTRIBUTION
Range: This association is known from Massachusetts and New Jersey but is likely to occur in other coastal states of the Northeast.
Subnations: MA, NJ, NY, QC
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC, 232Ab:CCC
Federal Lands: NPS (Cape Cod); USFWS (Monomoy)

ELEMENT SOURCES
References: Eastern Ecology Working Group n.d., Martin 1959b

Typha (angustifolia, latifolia) - (*Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153)

(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation
Eastern Cattail Marsh

ELEMENT CONCEPT
Summary: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia, Typha latifolia*, or their hybrid *Typha X glauca* dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita (= Carex lanuginosa), Carex stricta, Scirpus cyperinus*, and bulrushes, such as *Schoenoplectus americanus (= Scirpus americanus)* and *Schoenoplectus acutus (= Scirpus acutus)*, occur along with patchy grasses, such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Onoclea sensibilis, Symplocarpus foetidus, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum*, and *Verbena hastata*. Floating aquatics, such as *Lemna minor*, may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata*, and *Spiraea alba* are common. The invasive exotic plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences. This association is distinguished from other northeastern freshwater marshes by the strong dominance of *Typha* spp.
Environment: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This association is often found in impounded waters.
Vegetation: Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia, Typha latifolia*, or their hybrid *Typha*

X glauca dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita (= Carex lanuginosa), Carex stricta, Scirpus cyperinus*, and bulrushes, such as *Schoenoplectus americanus (= Scirpus americanus)* and *Schoenoplectus acutus (= Scirpus acutus)*, occur along with patchy grasses, such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Onoclea sensibilis, Symplocarpus foetidus, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum*, and *Verbena hastata*. Floating aquatics, such as *Lemna minor*, may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata*, and *Spiraea alba* are common. The invasive plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences.

Dynamics: This association is often found in impounded waters.

Similar Associations:

- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233)

Related Concepts:

- *Typha* (*angustifolia, latifolia*) - (*Scirpus* spp.) Herbaceous Vegetation (Clancy 1996) =
- Cattail Marsh (Thompson 1996) ?
- Cattail Marsh (Gawler 2002) =
- Cattail marsh (CAP pers. comm. 1998) ?
- Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979) ?
- Robust Emergent Marsh (Breden 1989) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

Classification Comments: *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* often occurs in pure stands and can colonize areas recently exposed by either natural or human causes.

CONSERVATION RANKING

GRank: G5 (1997-12-1) Reasons:

ELEMENT DISTRIBUTION

Range: This association occurs throughout the northeastern U.S. from Maine to North Carolina.

Subnations: CT, DC?, DE, MA, MD, ME, NC, NH, NJ, NY, PA, RI, VA, VT, WV

TNC Ecoregions: 48:C, 49:C, 51:C, 52:C, 58:P, 59:C, 60:C, 61:C, 62:C, 63:C, 64:C

USFS Ecoregions: 212Cb:CCC, 212Da:CCC, 212Db:CCC, 212Fa:CCC, 212Fb:CCC, 212Fc:CCC, 212Fd:CCC, 212Ga:CCC, 212Gb:CCC, 221Aa:CCP, 221Ab:CCC, 221Ae:CCC, 221Ai:CCC, 221Al:CCC, 221Ba:CCP, 221Bb:CCC, 221Bc:CCC, 221Bd:CCC, 221Da:CCC, 221Fa:CCC, 222Ib:CCC, 222Ic:CCC, 231:C, 232Ab:CCC, 232Ac:CCC, M212A:CP, M212Bb:CCC, M212C:CP, M212D:CC, M212Ea:CCC, M212Eb:CCC, M221Aa:CCC, M221Ab:CCC, M221Ac:CCC, M221Ad:CCC, M221Ba:CCC, M221Bb:CCC, M221Bc:CCC, M221Bd:CCC, M221Be:CCC, M221Bf:CCC, M221Da:CCC, M221Db:CCP, M221Dc:CCP, M221Dd:CCP

Federal Lands: NPS (Acadia, Appalachian Trail, Blue Ridge Parkway?, Boston Harbor Islands, C&O Canal, Cape Cod, Delaware Water Gap, Johnstown Flood, Minute Man, National Capital-East, Saint-Gaudens, Saratoga, Upper Delaware); USFS (Nantahala?, Pisgah?); USFWS (Aroostook, Assabet River, Carlton Pond?, E.B. Forsythe, Erie, Great Meadows, Great Swamp, Iroquois, Monomoy, Montezuma, Moosehorn, Nomans Land Island, Nulhegan Basin, Oxbow, Pondicherry?, Prime Hook)

ELEMENT SOURCES

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Grace and Wetzel 1981, Harrison 2004, Metzler and Barrett 2001, NRCS 2004a, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000

Phragmites australis Semipermanently Flooded Herbaceous Alliance (A.1431)

Common Reed Semipermanently Flooded Herbaceous Alliance

Alliance Summary: This alliance consists of non-tidal *Phragmites* marshes with semipermanently or, rarely, seasonally flooded hydrology, occurring either in depressions or along rivers with seasonal fluctuation in water level throughout the United States and adjacent Canada. This includes semipermanently flooded marshes, ditches, impoundments, etc., which are strongly dominated by essentially monospecific stands of *Phragmites australis*, which is rapidly spreading in disturbed areas and excluding native vegetation. Stands may be composed entirely of *Phragmites australis*, with few or no other vascular plants present.

Phragmites australis Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141)

Common Reed Eastern North America Temperate Semi-natural Herbaceous Vegetation
Eastern Reed Marsh

ELEMENT CONCEPT

Summary: This reed marsh type is found across the east-temperate regions of the United States and Canada. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc., that have often been disturbed by human activity. The vegetation is variable, as *Phragmites australis* will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis*, with few or no other vascular plants present.

Environment: Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

Vegetation: The vegetation is often variable, as *Phragmites australis* will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis*, with few or no other vascular plants present.

Similar Associations:

- *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187)
- Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)

Related Concepts:

- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Inland Emergent Marsh (Chapman et al. 1989) B
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

Classification Comments: This is not a native community but is the result of the invasion of alien *Phragmites australis* into natural or semi-natural vegetation. The vegetation has variable hydrology and, unless *Phragmites* is clearly dominant, is often treated as part of other marsh and meadow types. The geographic distribution of the type is arbitrarily limited to Bailey's Humid Temperate Domain in eastern North America (Bailey 1997, 1998). Stands in northern Minnesota and farther north in Canada may represent native stands. If so, they should be tracked as a different type. Tidal vegetation of the Gulf Coast of Louisiana and Texas dominated by *Phragmites australis* is classified in the *Phragmites australis* Tidal Herbaceous Alliance (A.1477).

CONSERVATION RANKING

GRank: GNA (invasive) (1997-11-23) **Reasons:** Although almost always occurring as a naturalized type that arises from human disturbance, some stands in northern Minnesota and further north in Canada may be native. If so, they should be tracked as a separate type.

ELEMENT DISTRIBUTION

Range: This reed marsh type is found across the east-temperate regions of the United States and Canada, ranging from Maine west to the eastern Dakotas and Manitoba, south to Texas and east to Florida.

Subnations: AL, AR, CT, DE, FL, GA, IA, IN, LA, MA, MD, ME, MI, MN, MS, NC, NH, NJ, NY, OH, ON, PA, QC, RI, SC, TX, VA, VT, WI, WV

TNC Ecoregions: 31:C, 40:C, 41:C, 42:P, 47:C, 48:C, 52:P, 53:C, 55:C, 56:C, 57:C, 59:C, 60:C, 61:C, 62:C

USFS Ecoregions: 212C:CP, 212Fc:CCC, 212Ho:CCC, 212Hw:CCC, 221Aa:CCP, 221Ab:CCC, 221Ae:CCC, 221Ai:CCC, 221Bc:CCC, 221Da:CCC, 222Ic:CCC, 222Jj:CCC, 231Fb:CCC, 232Ab:CCC, 232Ac:CCC, 232C:CC, 232Dc:CCC, 232E:CC, 232G:CC, 234A:PP, 255Dc:CCC, M212:C, M221:P

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Indiana Dunes, Minute Man, Saint Croix, Saratoga, Sleeping Bear Dunes, Upper Delaware, Voyageurs); USFWS (Alligator River, Aransas, Bon Secour, Brazoria, Cape May, E.B. Forsythe, Great Dismal Swamp, Great Meadows, Great Swamp, Matagorda Island, Monomoy, Montezuma, Nomans Land Island?, Oxbow, Parker River, Prime Hook, Supawna Meadows)

ELEMENT SOURCES

References: Bailey 1997, Bailey 1998, Bell et al. 2002, Chapman et al. 1989, Clancy 1993b, Harris et al. 1996, INAI unpubl. data, Metzler and Barrett 1992, Metzler and Barrett 2001, NRCS 2004a, Nelson 1986, Rawinski 1984, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

Schoenoplectus acutus - (Schoenoplectus tabernaemontani) Semipermanently Flooded Herbaceous Alliance (A.1443)

Hardstem Bulrush - (Softstem Bulrush) Semipermanently Flooded Herbaceous Alliance

Alliance Summary: This alliance is found in the midwestern and western United States and central Canada. Stands of this alliance are flooded for most or all of the growing season and can have water from 0 (exposed soil) to approximately 1.5 m deep, but usually is less than 1 m. Within a stand, water levels can vary by up to 1 m during the year. The water can be fresh to mildly saline throughout most of this alliance's range; however, in the Nebraska Sandhills, some stands occur in moderately alkaline water. Across the range of this alliance, soils are deep, poorly drained, muck, peat, or mineral. Vegetation is characterized by medium to tall graminoids which typically range from 1 to over 2 m. The vegetation is moderately dense to dense. Some stands are heavily dominated by one or two *Schoenoplectus* spp. (= *Scirpus* spp.), while others have several graminoids common throughout the stand. The most abundant species are typically *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus fluviatilis (= Scirpus fluviatilis)*, and *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*. Species composition and abundance can vary from year to year depending mostly on water level fluctuations. In most years, typical species include *Lemna* spp., *Phragmites australis, Schoenoplectus americanus (= Scirpus americanus)* (in alkaline stands), *Triglochin maritima* (in alkaline stands), *Typha latifolia*, and *Utricularia macrorhiza*. *Potamogeton* spp. often occur in the deeper parts of stands of this alliance and where emergent species are not densely packed. Shrubs, such as *Salix* spp., are not common but may become established in shallow water areas. During droughts, species more tolerant of low water, such as *Polygonum amphibium*, may invade and alter the species composition of stands of this alliance.

Schoenoplectus (tabernaemontani, acutus) Eastern Herbaceous Vegetation (CEGL006275)

(Softstem Bulrush, Hardstem Bulrush) Eastern Herbaceous Vegetation
Bulrush Deepwater Marsh

ELEMENT CONCEPT

Summary: These deepwater bulrush marshes occur across the northeastern United States and adjacent Canadian provinces. They are found in a variety of wetland settings, most commonly in quiet-water areas along the shores of ponds, lakes, rivers, and larger streams, but also in flooded basins and ditches. The vegetation occurs in deep water (usually 0.4-1 m deep) that is present in all but the driest of conditions. Seasonal spring flooding and heavy rainstorms provide nutrient input. The substrate is usually deep muck overlying mineral soil; where wave action is more prevalent, the mineral soil may be exposed. The vegetation is dominated by bulrushes and robust graminoids, with scattered emergent forbs. Trees and shrubs are absent. Dominant species are usually *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*, and/or *Schoenoplectus americanus (= Scirpus americanus)*. Associated herbs include *Scirpus cyperinus, Carex aquatilis, Carex pellita (= Carex lanuginosa), Carex utriculata, Thelypteris palustris, Typha latifolia, Asclepias incarnata, Impatiens capensis, Pontederia cordata, Sagittaria latifolia, Schoenoplectus fluviatilis (= Scirpus fluviatilis), Scutellaria lateriflora, Verbena hastata, Leersia oryzoides, Ludwigia palustris*, and others. Floating-leaved and submerged plants (such as *Potamogeton* spp., *Sparganium* spp., *Elodea canadensis, Ceratophyllum* spp.) may be scattered among the emergent plants. This association is distinguished from other northeastern standing-water marsh communities by the strong dominance of tall bulrush species.

Environment: These deepwater bulrush marshes occur across the northeastern United States and adjacent Canadian provinces. They are found in a variety of wetland settings, most commonly in quiet-water areas along the shores of ponds, lakes, rivers, and larger streams, but also in flooded basins and ditches. The vegetation occurs in deep water (usually 0.4-1 m deep) that is present in all but the driest of conditions. Seasonal spring flooding and heavy rainstorms provide nutrient input. The substrate is usually deep muck overlying mineral soil; where wave action is more prevalent, the mineral soil may be exposed.

Vegetation: The vegetation is dominated by bulrushes and robust graminoids, with scattered emergent forbs. Trees and shrubs are absent. Dominant species are usually *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*, and/or *Schoenoplectus americanus (= Scirpus americanus)*. Associated herbs include *Scirpus cyperinus, Carex aquatilis, Carex pellita (= Carex lanuginosa), Carex utriculata, Thelypteris palustris, Typha latifolia, Asclepias incarnata, Impatiens capensis, Pontederia cordata, Sagittaria latifolia, Schoenoplectus fluviatilis (= Scirpus fluviatilis), Scutellaria lateriflora, Verbena hastata, Leersia oryzoides, Ludwigia palustris*, and others. Floating-leaved and submerged plants (such as *Potamogeton* spp., *Sparganium* spp., *Elodea canadensis, Ceratophyllum* spp.) may be scattered among the emergent plants.

Similar Associations:
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225)
- *Schoenoplectus acutus - Carex lasiocarpa* Herbaceous Vegetation (CEGL006358)
- Schoenoplectus tabernaemontani Temperate Herbaceous Vegetation (CEGL002623)

Related Concepts:
- *Schoenoplectus (tabernaemontani, fluviatilis)* Eastern Herbaceous Vegetation (Clancy 1996) =
- Bulrush Bed (Gawler 2002) =
- Bulrush marsh (CAP pers. comm. 1998) ?
- Deep Rush Marsh (Thompson 1996) B
- Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979) ?
- Spring swamp (Hill 1923) ?

CONSERVATION RANKING

GRank: GNR (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This variable deepwater marsh community occurs in the northeastern United States and adjacent Canadian provinces.

Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, PA, QC, RI, VA?, VT, WV

TNC Ecoregions: 49:C, 58:?, 59:C, 60:C, 61:C, 62:C, 63:C, 64:C

USFS Ecoregions: 212B:CP, 212Cb:CCC, 212D:CC, 212Ed:CCC, 212Fa:CCC, 212Fb:CCC, 212Fc:CCC, 212Fd:CCC, 212Ga:CCC, 212Gb:CCC, 221Ab:CCC, 221Ah:CCC, 221Bd:CCP, 221Fa:CCC, 231:P, 232:C, M212Ea:CCP, M212Eb:CCP, M221Ab:CCC, M221Ba:CCC

Federal Lands: NPS (Acadia, Assateague Island); USFWS (Assabet River, Erie, Great Meadows?, Monomoy, Oxbow, Parker River?)

ELEMENT SOURCES

References: Bartgis 1983, Bowman 2000, Breden et al. 2001, Byers et al. 2007, CAP pers. comm. 1998, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Harrison 2004, Hill 1923, Northern Appalachian Ecology Working Group 2000, Sperduto 2000b, Swain and Kearsley 2000, Thompson 1996, Thompson and Sorenson 2000

V.A.5.N.n. Tidal temperate or subpolar grassland

Typha (angustifolia, domingensis) Tidal Herbaceous Alliance (A.1472)

(Narrowleaf Cattail, Southern Cattail) Tidal Herbaceous Alliance

Alliance Summary: Tidal marshes dominated by *Typha angustifolia* and/or *Typha domingensis*. Examples of this alliance are composed of a mixture of salt marsh and freshwater tidal marsh species. The vegetation is dense and characterized by tall graminoids such as *Typha angustifolia*, with associates including *Spartina cynosuroides, Phragmites australis* or *Schoenoplectus americanus (= Scirpus americanus), Pontederia cordata, Lilaeopsis chinensis, Hibiscus moscheutos (= Hibiscus palustris)*, and *Pluchea odorata*. Other characteristic species include *Hibiscus moscheutos, Spartina patens, Distichlis spicata, Schoenoplectus pungens (= Scirpus pungens), Lycopus americanus, Eleocharis palustris, Hydrocotyle umbellata, Eupatorium capillifolium, Ptilimnium capillaceum, Bidens* spp., and *Spartina alterniflora*. This community is typically a brackish tidal marsh occurring where water salinity ranges from 0.5-18.0 ppt. Brackish marshes are most extensive on large tidal rivers, but smaller marshes of this alliance also occur at the upper

limits of larger tidal creeks. The alliance occurs along the Atlantic coast from Maine through South Carolina and along the Gulf coast in Alabama and Texas. Alabama and Texas communities occur in oligohaline tidal marshes and are dominated by *Typha domingensis*. Further research is necessary to determine the classification, and thus the range, with confidence.

Typha angustifolia - *Hibiscus moscheutos* Herbaceous Vegetation (CEGL004201)

Narrowleaf Cattail - Eastern Rosemallow Herbaceous Vegetation
Cattail Brackish Marsh

ELEMENT CONCEPT

Summary: This community is a brackish marsh of the northern to central Atlantic coast, occurring along the margin of tidal rivers and at the upper margins of some high salt marshes and coastal salt ponds where water salinity ranges from 0.5-18.0 ppt. Brackish marshes are most extensive on large tidal rivers, but smaller marshes of this alliance also occur at the upper limits of larger tidal creeks and salt ponds. The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia*. *Phragmites australis* and/or *Typha latifolia* can be codominant. The *Phragmites australis* component is the native strain. Common associates include *Hibiscus moscheutos, Schoenoplectus pungens, Impatiens capensis, Amaranthus cannabinus, Peltandra virginica, Pontederia cordata*, and *Bidens* spp., plus *Spartina cynosuroides* in the south. Other infrequent associates include *Mikania scandens, Polygonum punctatum, Pluchea odorata, Eleocharis* spp., and *Schoenoplectus robustus*, plus *Schoenoplectus americanus* farther south. Species from adjacent high salt marsh may also be present. Substrate is muck or peat, and there is often an accumulation of *Typha* litter.

Environment: This association occurs in oligohaline to mesohaline areas of tidal marshes (0.5-18 ppt). In estuarine systems, it can occur in the uppermost zone of brackish marshes where there is freshwater influence; it receives diurnal tidal flooding of brackish water. In salt marshes behind barrier beaches it can occur in the upper reaches of larger tidal creeks within brackish areas and also at the upland border where there is significant freshwater input from the adjacent upland; here it receives irregular tidal flooding only during high spring tides. Substrate is muck or peat, and there is often an accumulation of *Typha* litter.

Vegetation: The vegetation of this tall grassland is a mixture of freshwater and saltmarsh species dominated by *Typha angustifolia*. *Phragmites australis, Typha latifolia, Spartina cynosuroides*, or *Schoenoplectus pungens* can codominate. The *Phragmites australis* component is the native strain (Saltonstall 2002). Common associates include *Hibiscus moscheutos, Schoenoplectus pungens, Impatiens capensis, Amaranthus cannabinus, Peltandra virginica, Pontederia cordata*, and *Bidens* spp., plus *Spartina cynosuroides* in the south. Other infrequent associates include *Mikania scandens, Pluchea odorata, Polygonum punctatum, Eleocharis* spp., and *Schoenoplectus robustus*, plus *Schoenoplectus americanus* farther south. Species from adjacent high salt marsh may also be present.

Dynamics: Brackish marsh complexes commonly occur as mosaics of patches dominated by a single graminoid species. Patches dominated by *Typha angustifolia* tend to occur where there is more freshwater influence near the upper reaches of estuaries or at the upland border of high salt marshes where there is freshwater input from the surrounding upland. As the marsh becomes more brackish, *Schoenoplectus pungens* or *Spartina patens* can become dominant. As the marsh becomes less brackish, *Peltandra virginica, Pontederia cordata, Acorus calamus, Schoenoplectus tabernaemontani*, and *Zizania aquatica* can become more prevalent. The pattern of alternating dominance between *Typha angustifolia* and *Phragmites australis* that can occur in these environmental settings may reflect disturbance history of the site and of the surrounding watershed.

Similar Associations:

- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456)

Related Concepts:

- *Hibiscus* marsh (Cahoon and Stevenson 1986) ?
- *Typha (angustifolia, latifolia) - Hibiscus moscheutos* Herbaceous Vegetation (Harrison 2001) =
- *Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation (Bowman 2000) =
- *Typha angustifolia - Hibiscus palustris* community (Metzler and Barrett 1992) ?
- *Typha angustifolia* community (Good and Good 1975b) ?
- *Typha angustifolia* type (Ferren et al. 1981) ?
- *Typha* association (Shreve et al. 1910) =
- Brackish Tidal Marsh (Rawinski 1984) ?
- Brackish Tidal Marsh (Gawler 2002) B
- Brackish marsh (Sperduto 1994) ?
- Brackish tidal marsh (Reschke 1990) ?
- Brackish tidal marsh community (MENHP 1991) ?
- Brackish tidal marsh complex (Breden 1989) ?

- Cattail Community Type (Odum et al. 1984) ?
- Fresh-brackish marsh (Klotz 1986) ?
- Narrowleaf cattail type (McCormick and Ashbaugh 1972) ?
- Tidal Freshwater Marsh (Schafale and Weakley 1990) B
- Tidal Freshwater Marsh (Narrowleaf Cattail Subtype) (Schafale 2000) ?
- Tidal Oligohaline Marsh (Harrison 2004) B
- Tidal Oligohaline Marsh (Fleming and Coulling 2001) B
- Transitional fresh marsh (Hill 1986) B

Classification Comments: A non-tidal barrier wetland documented at the Cove Point Wetland, Calvert County, Maryland (Steury 1999), appears to fit this concept.

CONSERVATION RANKING

GRank: G4G5 (2006-1-19) **Reasons:** This common small-patch community occurs in the estuarine areas of up to 13 northeastern states, several of which rank this vegetation as S4. It is threatened by pollution and by encroachment of *Phragmites australis*.

ELEMENT DISTRIBUTION

Range: This association occurs along the Atlantic coast from Maine to Virginia and possibly to South Carolina.
Subnations: CT, DE, MA, MD, ME, NC, NH, NJ, NY, RI, SC?, VA
TNC Ecoregions: 56:?, 57:C, 58:C, 61:C, 62:C, 63:C
USFS Ecoregions: 212Cb:CCC, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CCC, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Cb:CCC, 232Ch:CCC, 232Ci:CCC
Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Saugus Iron Works); USFWS (Back Bay?, Cape May, Chesapeake Marshlands, Chincoteague, E.B. Forsythe, Monomoy?, Parker River?, Prime Hook, Supawna Meadows)

ELEMENT SOURCES

References: Bowman 2000, Breden 1989, Breden et al. 2001, Cahoon and Stevenson 1986, Coulling 2002, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ferren et al. 1981, Fleming 2001a, Fleming and Coulling 2001, Fleming and Moorhead 1998, Fleming et al. 2001, Gawler 2002, Good and Good 1975b, Harrison 2001, Harrison 2004, Hill 1986, Klotz 1986, MENHP 1991, McCormick and Ashbaugh 1972, Metzler and Barrett 1992, Metzler and Barrett 2001, Odum et al. 1984, Rawinski 1984, Reschke 1990, Saltonstall 2002, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 1997a, Sperduto 2000b, Steury 1999, Swain and Kearsley 2001

Phragmites australis Tidal Herbaceous Alliance (A.1477)

Common Reed Tidal Herbaceous Alliance

Alliance Summary: This alliance includes both natural and invasive fresh to brackish tidal marsh communities dominated by (often essentially monospecific) *Phragmites australis*. Although *Phragmites australis* rhizomes have been noted in salt marsh sediments exceeding 3000 years in age and it is thus a native component of salt marshes in some areas of North America, the growth habit of the species in its native condition was likely to have been significantly different than the dense monotypic, invasive stands documented in this alliance. Evidence suggests that a new, more invasive genotype of *Phragmites australis* was introduced to the U. S. from the Old World. This new genotype, along with a continued increase in and variety of disturbances, may explain the heightened invasiveness of this species. Evidence suggests that along the Gulf Coast of Louisiana and Texas, the genotype found in invasive communities differs from the genotype found in natural, stable communities. Although invasive and natural communities of *Phragmites australis* are difficult to differentiate, this can be accomplished by considering the degree of disturbance at a site and observing a given stand over time to determine the degree of invasiveness. Based on observations of this nature by individuals familiar with the coastal marshes of Louisiana and Texas, apparently stable, natural communities dominated by *Phragmites australis* are present. However, the dominance of *Phragmites australis* in many tidal wetlands today often indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates.

In many areas of the southeastern United States, it is well documented that *Phragmites* is recently introduced and spreading rapidly in tidal and non-tidal situations. In invasive communities, associated species are highly variable, depending on the vegetation that has been invaded. Spreading in large colonies, *Phragmites* may eventually dominate

disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera (= Myrica cerifera)* shrubs, *Kosteletzkya virginica, Calystegia sepium, Boehmeria cylindrica, Typha angustifolia, Apocynum cannabinum, Rosa palustris, Polygonum* sp., and *Mikania scandens*. Vines of *Toxicodendron radicans* are also frequent, but typically occur at low cover.

In areas where *Phragmites australis* is highly invasive, if *Phragmites australis* is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that vegetation type. In these same areas, if *Phragmites australis* cover is so high that native species have been excluded and the original community is no longer recognizable, then the occurrence falls within an invasive association within the *Phragmites australis* Tidal Herbaceous Alliance (A.1477). In natural communities, associated species may include *Sagittaria platyphylla, Spartina alterniflora, Schoenoplectus americanus (= Scirpus americanus), Vigna luteola, Typha* spp., and others.

Phragmites australis Tidal Herbaceous Vegetation (CEGL004187)

Common Reed Tidal Herbaceous Vegetation
Reed Tidal Marsh

ELEMENT CONCEPT

Summary: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity. It is characterized by dense stands of *Phragmites australis*, a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera (= Myrica cerifera)* shrubs, *Kosteletzkya virginica, Calystegia sepium, Boehmeria cylindrica, Typha angustifolia, Apocynum cannabinum, Rosa palustris, Polygonum* sp., and *Mikania scandens*. Vines of *Toxicodendron radicans* are also frequent, but typically occur at low cover. This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.

Environment: This community is a dense tall grassland indicative of disturbance. It occurs in a range of tidal wetland habitats from fresh to brackish in salinity.

Vegetation: This community is a broadly defined reed-grass marsh. It is characterized by dense stands of *Phragmites australis*, a species which tends to grow in colonies of tall, stout, leafy plants often to the exclusion of all other vascular plant species. Associated species are highly variable, depending on the community that has been invaded. Spreading in large colonies, *Phragmites* eventually dominates disturbed areas at coverage up to 100%. More typically, though, scattered individuals of other species may occur, such as sparse *Morella cerifera (= Myrica cerifera)* shrubs, *Kosteletzkya virginica, Calystegia sepium, Boehmeria cylindrica, Typha angustifolia, Apocynum cannabinum, Rosa palustris, Polygonum* sp., and *Mikania scandens*. Vines of *Toxicodendron radicans* are also frequent but typically occur at low cover.

Similar Associations:

- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891)
- *Phragmites australis Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141)*

Related Concepts:

- *Phragmites australis* Association (Fleming 1998) ?
- *Phragmites australis* Tidal Herbaceous Vegetation (Bowman 2000) =
- *Phragmites australis* community (Metzler and Barrett 1992) ?
- *Phragmites australis* tidal marsh association (Clancy 1993b) ?
- Brackish Tidal Marsh (Rawinski 1984) ?
- Salt Marsh Complex (Breden 1989) B
- Successional / Modified Estuarine Herbaceous Vegetation (Fleming et al. 2006) ?

Classification Comments: Although *Phragmites australis* rhizomes have been noted in salt marsh sediments exceeding three thousand years in age (Niering and Warren 1977) and is thus a native component of salt marshes in some areas in North America, the growth of the species in its native condition was likely to have been significantly different than the dense monotypic stands that characterize this community in parts of its range today. The invasive, non-native strain has been labeled haplotype M (Saltonstall 2002). The presence of the *Phragmites australis* community in wetlands today generally indicates human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates. Historically, without alteration, these sites would generally be more saline. In New England, *Phragmites* tends to invade behind artificial/man-made levees where regular salt input is

blocked, making the sites more brackish and less saline than prior to levee construction and anthropogenic modification. In cases where *Phragmites australis* is a significant component of the vegetation but the vegetation retains sufficient species composition to retain its identity, the site is considered an unhealthy or degraded example of that original community. Where *Phragmites australis* cover is so high that native species have been excluded and the original community is no longer recognizable, the occurrence is then treated as an example of *Phragmites australis* Tidal Herbaceous Vegetation (CEGL004187).

CONSERVATION RANKING
GRank: GNA (invasive) (1997-11-22) **Reasons**:

ELEMENT DISTRIBUTION
Range: This community has a broad geographic range, including coastal areas of the eastern and southeastern United States and Canada.
Subnations: AL, CT, DC?, DE, FL, GA, LA, LB?, MA, MD, ME, MS, NC, NF?, NH, NJ, NS?, NY, PA, PE?, QC, RI, SC, TX, VA
TNC Ecoregions: 53:C, 56:C, 57:C, 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC, 232Dc:CCC
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Colonial, Fire Island, Gateway, George Washington Birthplace, George Washington Parkway, National Capital-East, Saugus Iron Works); USFWS (Back Bay, Bon Secour, Cape May, Chesapeake Marshlands, E.B. Forsythe, Monomoy, Supawna Meadows)

ELEMENT SOURCES
References: Bell et al. 2002, Bowman 2000, Breden 1989, Clancy 1993b, Edinger et al. 2002, Fleming 1998, Fleming et al. 2006, Harrison 2001, Metzler and Barrett 1992, Metzler and Barrett 1996, Metzler and Barrett 2001, NRCS 2001b, Nelson 1986, Niering and Warren 1977, Odum et al. 1984, Rawinski 1984, Saltonstall 2002, Schafale and Weakley 1990, Schotz pers. comm., Southeastern Ecology Working Group n.d., Swain and Kearsley 2001

Spartina patens - (Distichlis spicata) Tidal Herbaceous Alliance (A.1481)

Saltmeadow Cordgrass - (Inland Saltgrass) Tidal Herbaceous Alliance

Alliance Summary: This alliance comprises "high salt marsh" vegetation dominated or codominated by *Spartina patens* along the Gulf and Atlantic coasts from Maine to Texas. The high salt marsh is irregularly flooded by tides and forms at slightly higher elevations than regularly flooded low marshes; they establish where peat accumulation raises the marsh surface above mean high tide. Landward the vegetation can transition to brackish marsh or upland vegetation. Vegetation of this alliance also occurs in mesohaline zones along lower reaches of tidal rivers.

Variation in codominant species occurs across the geographic range. From the Canadian maritime provinces south to Delaware (discontinuously south to Virginia), this alliance is characterized by the dominance of *Spartina patens, Distichlis spicata*, and *Juncus gerardii* and the presence of more northerly distributed marsh species such as *Puccinellia fasciculata, Plantago maritima*, and *Triglochin maritima*. In brackish reaches of tidal rivers, this alliance includes *Spartina patens*-dominated vegetation that may also be characterized by the presence of *Agrostis stolonifera, Festuca rubra, Symphyotrichum novi-belgii (= Aster novi-belgii), Hierochloe odorata, Carex paleacea*, or *Spartina pectinata*.

From Delaware south to Florida, this high salt marsh coastal community is dominated by *Spartina patens*, forming meadows at slightly higher elevations in relation to the adjacent *Spartina alterniflora* Tidal Herbaceous Alliance (A.1471). Diagnostic species for this community are *Spartina patens, Distichlis spicata, Borrichia frutescens, Kosteletzkya virginica*, and *Pluchea odorata*. Shrub seedlings such as *Baccharis halimifolia* and *Morella cerifera (= Myrica cerifera)* may also be present. The associated *Juncus roemerianus* Tidal Herbaceous Alliance (A.1475) often occurs as discrete patches which may reach substantial size.

This alliance also includes mesohaline to oligohaline marshes of the Gulf Coast of Texas and Louisiana. In these associations, *Spartina patens* may strongly dominate, *Distichlis spicata, Spartina alterniflora*, and *Spartina patens* may codominate, *Distichlis spicata* may form pure stands, *Paspalum vaginatum* may strongly dominate, or *Spartina patens* and *Vigna luteola* may codominate. Other characteristic species include *Juncus roemerianus, Spartina spartinae, Spartina cynosuroides* (within its range), *Schoenoplectus robustus, Schoenoplectus americanus, Sagittaria lancifolia, Phragmites australis*, and *Eragrostis* spp. Here, this alliance forms mosaics with *Spartina spartinae* and *Spartina alterniflora* marshes and saline herbaceous vegetation.

Western states have a different alliance for inland situations dominated by *Distichlis spicata,* the *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332).

Schoenoplectus pungens - Eleocharis parvula Herbaceous Vegetation (CEGL006398)

Common Threesquare - Dwarf Spikerush Herbaceous Vegetation
Coastal Salt Pond Marsh

ELEMENT CONCEPT

Summary: This association encompasses the brackish marshes of coastal salt ponds of the northeastern Atlantic Coast. Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens, Eleocharis parvula*, and/or *Spartina patens, Spartina pectinata*, or *Panicum virgatum*. Where salinity is less *Typha angustifolia* can be common. Mudflat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula, Eleocharis halophila, Eleocharis flavescens, Schoenoplectus maritimus, Crassula aquatica, Spergularia salina (= Spergularia marina), Cyperus filicinus*, or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum, Spartina patens*, or *Spartina pectinata* can be characteristic, plus *Schoenoplectus smithii, Echinochloa walteri, Cladium mariscoides, Distichlis spicata*, or *Chenopodium* spp. Species found farther south include *Ptilimnium capillaceum, Pluchea odorata, Schoenoplectus americanus, Hibiscus moscheutos*, plus scattered individuals of *Iva frutescens* or *Baccharis halimifolia*. Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima, Stuckenia pectinata (= Potamogeton pectinatus), Potamogeton perfoliatus*, or *Zannichellia palustris*, plus some marine algal species. Several associations may be warranted in these highly variable systems; collection of further data will likely support the division of more associations.

Environment: Coastal salt ponds are ponds separated from the ocean by a barrier beach. They generally form when a lagoon or bay is closed off from regular tidal flooding by a sand spit or other barrier. However, some ponds have a permanent, often artificially maintained, inlet/outlet and thus have regular saltwater exchange. Salinity depends on the length of time since enclosure of the lake/pond; freshwater input from precipitation and overland flow dilutes the enclosed seawater resulting in meso- to oligohaline conditions. Depending on the distance from the ocean, saltwater input is infrequent and a result of tidal breaches or storm overwash, although there can be some saltwater seepage across the barrier beach. Shorelines usually have gentle slopes that magnify gradients of salinity and saturation. Depending on local water balance, ponds can draw down to a certain degree exposing mud or sand flats. Substrate ranges from sand to mud to peat. These ponds occur in glaciated areas in moraine or outwash deposits.

Vegetation: Vegetation of coastal salt ponds is highly variable both spatially and temporally given the variable nature of the habitat and processes affecting it. Although not constant, vegetation zonation often occurs along shores of coastal salt ponds along gradients of salinity and flooding or saturation. Dominant species can be variable depending on local conditions but are generally characterized by *Schoenoplectus pungens, Eleocharis parvula*, and/or *Spartina patens, Spartina pectinata*, or *Panicum virgatum*. Where salinity is less *Typha angustifolia* can be common. Mud flat habitat can develop in lower areas that tend to be exposed later in the season with *Eleocharis parvula, Eleocharis halophila, Eleocharis flavescens, Schoenoplectus maritimus, Crassula aquatica, Spergularia salina (= Spergularia marina)*, or others. In higher zones, vegetation can be similar to high salt marsh habitat; *Panicum virgatum, Spartina patens*, or *Spartina pectinata* can be characteristic, plus *Schoenoplectus smithii, Echinochloa walteri, Cladium mariscoides, Distichlis spicata*, and *Chenopodium* spp. Species found farther south include *Ptilimnium capillaceum, Pluchea odorata, Schoenoplectus americanus, Hibiscus moscheutos*, plus scattered individuals of *Iva frutescens* or *Baccharis halimifolia*. Ponds often support aquatic plants that are tolerant of brackish/saline conditions, such as *Ruppia maritima, Stuckenia pectinata (= Potamogeton pectinatus), Potamogeton perfoliatus*, or *Zannichellia palustris*, plus some marine algal species.

Dynamics: Coastal salt ponds are adjacent to ocean shores and result from the enclosure of a lagoon or bay by a sand spit or barrier. Salinity fluctuates relative to the proportion of freshwater input from precipitation and overland flow and

saltwater input from tidal breaches and storm overwash. Fluctuations can be a gradual lessening of salinity with time since enclosure where there is sufficient and continual freshwater influence or a gradual increase in salinity following evaporative concentration. Rapid changes in salinity can result from storm breaches or overwash.

Similar Associations:

- *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL006150)
- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188)
- *Spartina patens* - Eleocharis parvula Herbaceous Vegetation (CEGL006342)

Related Concepts:

- Brackish Tidal Marsh (Gawler 2002) B
- Coastal Salt Pond (Rawinski 1984) ?
- Coastal Salt Pond Marsh (Rawinski 1984) ?

Classification Comments: This association encompasses a highly variable and shifting vegetation mosaic in a variable and dynamic habitat. Several associations may be warranted; collection of further data will likely support the division of this type into more associations.

CONSERVATION RANKING

GRank: GNR (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: Coastal salt ponds occur in a limited geomorphological setting in New Hampshire, Massachusetts, Rhode Island, and Long Island, New York.

Subnations: MA, ME, NH, NJ, NY, RI

TNC Ecoregions: 62:C

USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ad:CCP, 221Ak:CCC, 232Aa:CCC, 232Ac:CCC

Federal Lands: NPS (Boston Harbor Islands, Cape Cod, Gateway); USFWS (Monomoy)

ELEMENT SOURCES

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Elliman 2003, Gawler 2002, Island Alliance 2001, Karanaukas 2001, Lundgren 1998, Lundgren 2000, NRCS 2001b, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Swain and Kearsley 2001, Thorne-Miller et al. 1983, Zaremba 1999

Spartina patens - *Distichlis spicata* - *(Juncus gerardii)* Herbaceous Vegetation (CEGL006006)

Saltmeadow Cordgrass - Inland Saltgrass - (Black-grass) Herbaceous Vegetation
North Atlantic High Salt Marsh

ELEMENT CONCEPT

Summary: This high salt marsh vegetation dominated by *Spartina patens* or codominated by *Distichlis spicata* forms distinct "cowlicked" meadows above low salt marsh communities. This high marsh association generally occurs behind barrier beaches along the north Atlantic coast from the Canadian maritime provinces south to New Jersey. It occupies the irregularly flooded zone extending from mean high tide landward to the limit of spring tides. The substrate is peat overlying sand, silt, or bedrock. Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens, Distichlis spicata*, or *Juncus gerardii*. Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium (= Aster tenuifolius), Limonium carolinianum, Solidago sempervirens, Symphyotrichum subulatum (= Aster subulatus), Polygonum ramosissimum, Argentina anserina (= Potentilla anserina), Atriplex patula, Lythrum lineare*, and *Panicum virgatum*. Salt pannes are often a prominent feature within this association.

Environment: This high salt marsh association generally occurs behind barrier beaches, but also in the outer reaches of estuaries, occupying the zone extending from mean high tide landward approximately to the limit of spring tides. They are often adjacent to low salt marshes dominated by *Spartina alterniflora* (tall form), which are regularly flooded by diurnal tides. *Spartina patens*-dominated high marshes form very dense peat with high organic matter content. Peat forms over sand, silt or bedrock.

Vegetation: Vegetation of this marsh community occurs in mosaics of patches generally dominated by a single graminoid species, *Spartina patens, Distichlis spicata*, or *Juncus gerardii*. Other characteristic associates that occur in low abundance include *Symphyotrichum tenuifolium (= Aster tenuifolius), Limonium carolinianum, Solidago sempervirens, Symphyotrichum subulatum (= Aster subulatus), Polygonum ramosissimum, Argentina anserina (= Potentilla anserina), Atriplex patula, Lythrum lineare*, and *Panicum virgatum*.

Dynamics: Vegetation of this association occurs as a shifting mosaic of patches dominated by a single graminoid species. Species composition at a particular site results from the interaction of hydroperiod, nutrient availability, salinity gradients, soil oxygen, concentrations of growth inhibitors in the soil, and interspecific competition. As sedimentation increases marsh elevation, vegetation may shift to upland border communities dominated by *Panicum virgatum* and *Juncus gerardii*. Local disturbance, i.e., from ice scouring, can cause invasion by *Spartina alterniflora*, or can lead to the formation of salt pannes.

Similar Associations:

- *Spartina patens - Agrostis stolonifera* Herbaceous Vegetation (CEGL006365)
- *Spartina patens* - Distichlis spicata - (Juncus roemerianus) Herbaceous Vegetation (CEGL004197)

Related Concepts:

- *Spartina patens - Distichlis spicata* Herbaceous Vegetation (Harrison 2001) I
- Salt Marsh (Rawinski 1984) ?
- Salt marsh complex, high marsh (Breden 1989) ?
- *Spartina* Saltmarsh (Gawler 2002) B

Classification Comments: This community is differentiated from *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197) to the south by the importance of *Juncus gerardii, Plantago maritima*, and *Triglochin maritima* and absence or relatively infrequent occurrence of species of southern distribution such as *Borrichia frutescens, Kosteletzkya virginica, Fimbristylis castanea*, and *Lythrum lineare*.

CONSERVATION RANKING

GRank: G5 (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This high salt marsh association occurs from the Canadian maritime provinces south to Delaware.
Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, RI
TNC Ecoregions: 62:C, 63:C
USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CCC, 221Ak:CCC, 221Dc:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC
Federal Lands: NPS (Acadia, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Sagamore Hill); USFWS (Cape May, E.B. Forsythe, Monomoy, Moosehorn, Muskeget Island?, Parker River?, Prime Hook)

ELEMENT SOURCES

References: Bell et al. 2002, Bertness et al. 1992, Breden 1989, Breden et al. 2001, Coulling pers. comm., Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Gawler 2001, Gawler 2002, Harrison 2001, Hill 1923, Metzler and Barrett 2001, Nixon 1982, Rawinski 1984, Reschke 1990, Soil Conservation Service 1987, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001

Spartina alterniflora Tidal Herbaceous Alliance (A.1471)

Smooth Cordgrass Tidal Herbaceous Alliance

Alliance Summary: This alliance includes various tidal marshes dominated by *Spartina alterniflora*. The hydrology is usually regularly tidally flooded. In the northern part of its range, southern Maine to Cape Hatteras, North Carolina, this alliance is generally limited to the zone between mean sea level and the mean high water level. The habitat occurs in protected inlets behind barrier beaches or in drowned river valleys. Peat depth ranges from a few feet, if the community formed over a mudflat, to 24 m (80 feet) in drowned river valleys. *Spartina alterniflora* is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm). This community is commonly known as "low salt marsh," occurring as a tall grassland strongly dominated by *Spartina alterniflora*. There is little variation in vascular plant species composition across the range. It occurs in nearly pure stands, with occasional low growing species such as *Spergularia salina (= Spergularia marina), Salicornia* spp., *Suaeda maritima*, and seaweeds such as *Ulva lactuca* and other algae such as *Fucus vesiculosus* and *Ascophyllum nodosum*, which grow at the bases of the *Spartina* plants. Herbs of *Salicornia virginica* and *Salicornia bigelovii* can be quite common mixed in with the *Spartina*, often becoming more apparent later in the growing season. *Limonium carolinianum* is another characteristic herb, but only as scattered individuals. More detailed information is needed on the variability of the alliance in the southern parts of its range.

Spartina alterniflora / (Ascophyllum nodosum) Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192)

Smooth Cordgrass / (Yellow Tang) Acadian/Virginian Zone Herbaceous Vegetation
North Atlantic Low Salt Marsh

ELEMENT CONCEPT

Summary: This tall grassland dominated by *Spartina alterniflora* forms the low salt marsh of the north and mid-Atlantic coast. It is diurnally flooded by tides, occurring in the intertidal zone between mean high tide and mean sea level in protected inlets behind barrier beaches or in the seaward reaches of drowned river valleys. It forms a coarse peat over sandy substrate. The low salt marsh occurs elevationally between high marsh that occurs landward and subtidal communities that occur seaward. *Spartina alterniflora* is limited to the low marsh zone by interspecific competition and by moderate salinity; it can withstand longer submergence than other salt marsh grasses but still requires periodic exposure of the substrate. *Spartina alterniflora* forms nearly monotypic stands with little variation across the geographic range of the community. Tall form *Spartina alterniflora* occurs adjacent to salt water and colonizes unvegetated flats. This association also grades into short form *Spartina alterniflora* landward. Associated species occur in low abundance and commonly include *Limonium carolinianum, Salicornia virginica, Salicornia bigelovii, Spergularia maritima, Spergularia canadensis*, and *Suaeda maritima*. Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum, Fucus vesiculosus, Enteromorpha* spp., and *Ulva* spp. Macroalgae associates may be sparse or absent at the southern edge of the range. This community occurs from Nova Scotia to Cape Hatteras, North Carolina. Low marshes at the northern edge of the geographic range are far less extensive in size than those farther south due to differences in geomorphology and time since last glaciation.

Environment: This low salt marsh community occurs in the regularly flooded intertidal zone, approximately from mean high tide to mean sea level; it is diurnally flooded by tides and classified as polyhaline (18-30 ppt). This low marsh occurs in areas sheltered from direct wave action, such as behind barrier beaches, as pocket marshes at the heads of bays, or in the outer reaches of estuaries. Low salt marshes occur landward of intertidal flats and subtidal communities and seaward of high salt marsh communities. Low salt marshes dominated by *Spartina alterniflora* generally occur on mucky silt to silty coarse fibrous peat, often with high organic matter content. However, peat in the low marsh is generally less dense than farther landward (Bertness 1988). Peat depth ranges from a few feet, if the community formed over a mudflat, to 80 feet in drowned river valleys at the mouths of estuaries.

Vegetation: This community is a tall grassland dominated by *Spartina alterniflora* occurring in regularly flooded intertidal zones. *Spartina alterniflora* dominates this physically stressful zone due to limited competition and its ability to tolerate salinity and flooding. It also requires moderately high levels of iron (7-15 ppm) (Adams 1963). *Spartina alterniflora* is strongly dominant, forming a nearly monotypic tallgrass layer. There is little variation in vascular plant composition across the range. Tall-form *Spartina alterniflora* occurs adjacent to saltwater and colonizes unvegetated flats. This association also grades into short-form *Spartina alterniflora* landward where tidal range is more restricted. Common associates, occurring in low abundance, include *Limonium carolinianum, Salicornia virginica, Salicornia bigelovii, Spergularia maritima, Spergularia canadensis*, and *Suaeda maritima*. *Distichlis spicata, Agalinis maritima, Symphyotrichum tenuifolium (= Aster tenuifolius)*, and *Spartina patens* can also sporadically occur, but are more common in the high salt marsh. Brown algae can form extensive mats at the bases of the grass culms, especially *Ascophyllum nodosum, Fucus vesiculosus*, and *Ulva* spp. *Enteromorpha* spp. can occur early in the growing season. Macroalgae associates may be sparse or absent at the southern edge of the range. Microscopic algae, especially diatoms, can be abundant on the marsh surface (Teal 1986).

Dynamics: Salt marshes are dynamic habitats. *Spartina alterniflora* readily colonizes soft sediments off the seaward edge of the salt marsh (Bertness 1988). Grass culms and algal mats trap sediments brought in by the tides and begin the process of marsh peat accumulation. As peat development raises marsh elevation, low marsh succeeds to high marsh communities; *Spartina alterniflora* performance declines as peat accumulates and becomes more dense. Flotsam and jetsam brought in by tides can smother local patches of vegetation and form unvegetated to sparsely vegetated pannes, a phenomenon that occurs regularly on high marshes. Tidal creeks form sinuous patterns throughout the low marsh draining the diurnal tides.

Similar Associations:

- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation (CEGL006586)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190)
- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191)

Related Concepts:
- *Spartina alterniflora* Herbaceous Vegetation (Clancy 1996) =
- *Spartina alterniflora* Tidal Herbaceous Vegetation (Harrison 2001) =
- *Spartina alterniflora* community (Metzler and Barrett 1992) ?
- *Spartina alterniflora* salt marsh (Clancy 1993b) ?
- Cordgrass saltmarsh community (MENHP 1991) ?
- Low salt marsh (Enser 1993) ?
- Low salt marsh (Reschke 1990) ?
- Low salt marsh community (Sperduto 1994) ?
- Mixed Graminoid - Forb Saltmarsh (Gawler 2002) B
- Salt Marsh (Rawinski 1984) ?
- Salt Marsh (Schafale and Weakley 1990) B
- Salt Marsh (Virginian Subtype) (Schafale 2000) ?
- Salt marsh (Higgins et al. 1971) B
- Salt marsh community (Hill 1986) B
- Salt marsh complex, low marsh (Breden 1989) ?
- Tidal Mesohaline / Polyhaline Marsh (Fleming and Coulling 2001) B
- Tidal Mesohaline Marsh (Harrison 2004) B

Classification Comments: The northern limit of this type occurs where there is a slower accumulation of silt and corresponding absence of algal species (Chapman 1937). The southern limit corresponds with the southern limit of the Virginian province of the American Atlantic Temperate Region, a transitional area harboring animal species of both southern and northern affinities (Gosner 1979, Cowardin et al. 1979). Southern occurrences, where *Ascophyllum nodosum* (yellow tang) may be sparse or absent, are placed within this type because of the associated characteristic faunal assemblage, including *Uca pugnax* (Atlantic marsh fiddler), *Littorina saxatilis* (rough periwinkle), *Littorina obtusata* (smooth periwinkle), and *Brachidontes demissus* (ribbed mussel). Analogous low salt marsh associations in other geographic areas include *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191) and *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190) for the Atlantic Coast of the southeastern U.S. (Cape Hatteras, North Carolina, to Florida) and the Gulf Coast (Florida to Texas), respectively [see Cowardin et al. (1979) for regional boundaries]. *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193) is a *Spartina alterniflora*-dominated association occurring in the mid-tidal range of tidal rivers that have a minimum tidal range of one meter.

CONSERVATION RANKING

GRank: G5 (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This association occurs along the Atlantic coastline from Nova Scotia and New Brunswick south to Cape Hatteras, North Carolina.

Subnations: CT, DE, MA, MD, ME, NB, NC, NH, NJ, NS, NY, QC, RI, VA

TNC Ecoregions: 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212Cb:CCC, 212Db:CCC, 212Dc:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CCC, 232Ae:CCC, 232Br:CCC, 232Bt:CCC, 232Bx:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC

Federal Lands: NPS (Acadia, Assateague Island, Boston Harbor Islands, Cape Cod, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay?, Cape May, Chesapeake Marshlands, E.B. Forsythe, Monomoy, Moosehorn?, Muskeget Island, Parker River, Prime Hook)

ELEMENT SOURCES

References: Adams 1963, Bell et al. 2002, Bertness 1988, Bowman 2000, Breden 1989, Breden et al. 2001, Chapman 1937, Clancy 1993b, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Enser 1999, Fleming and Coulling 2001, Fleming et al. 2001, Gawler 2001, Gawler 2002, Gosner 1979, Harrison 2001, Harrison 2004, Higgins et al. 1971, Hill 1986, MENHP 1991, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, NRCS 2001b, Rawinski 1984, Reschke 1990, Schafale 2000, Schafale 2003b, Schafale and Weakley 1990, Soil Conservation Service 1987, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1979, Swain and Kearsley 2001, Teal 1986

V.B.2.N.g. Tidal temperate perennial forb vegetation

Sarcocornia pacifica - (*Distichlis spicata*, *Salicornia* spp.) Tidal Herbaceous Alliance (A.1704)

Swampfire - (Inland Saltgrass, Saltwort species) Tidal Herbaceous Alliance

Salicornia (virginica, bigelovii, maritima) - *Spartina alterniflora* Herbaceous Vegetation (CEGL004308)

(Virginia Glasswort, Dwarf Saltwort, Slender Grasswort) - Smooth Cordgrass Herbaceous Vegetation
Salt Panne (Salicornia Type)

ELEMENT CONCEPT

Summary: This association represents tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs, including *Salicornia virginica, Salicornia bigelovii, Salicornia maritima*, and stunted *Spartina alterniflora*, that occur in salt marshes of the Atlantic Coast. Vegetation of this association tends to develop in shallow depressions within high or salt marshes where drainage is poor. The depressions are regularly to irregularly flooded by high tides, but as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Formation of the pannes may result from ice-scouring, rafting flotsam, peat compaction, mosquito ditch levees, or erosion of tidal creek banks, which create small, sparsely vegetated to unvegetated impoundments. Bare peat and/or mucky soils are prevalent (up to 85% bare soils). Total vegetative cover is variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica, Salicornia bigelovii, Salicornia maritima, Sarcocornia pacifica*, or *Spartina alterniflora* (short form). Common associates include *Limonium carolinianum, Plantago maritima var. juncoides, Triglochin maritima, Spartina patens, Suaeda maritima*, and *Atriplex* spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. Diagnostic species include *Salicornia bigelovii* and *Salicornia virginica*.

Environment: Vegetation of this association tends to develop in shallow depressions in salt marshes where drainage is poor. They tend to occur more frequently on the high marsh but occur within low marsh as well. Pannes form in depressions that range from 2-30 cm lower than the elevation of the marsh. The depressions are regularly to irregularly flooded by tides, and as the water evaporates during low tide, the salinity concentration increases forming "salt pannes." Substrate is soft, silty muck or peat of variable density.

Vegetation: This association includes tidally flooded hypersaline flats or very shallow depressions (pannes) dominated by halophytic herbs. Total vegetative cover is quite variable in pannes, from near total absence of vascular plants to a dense cover of *Salicornia virginica, Salicornia bigelovii, Salicornia maritima, Sarcocornia pacifica*, or *Spartina alterniflora* (short form). Common associates include *Limonium carolinianum, Plantago maritima var. juncoides, Triglochin maritima, Spartina patens, Suaeda maritima*, and *Atriplex* spp. Algal mats are characteristically present, visible even in densely vegetated pannes. Blue-green algae are an important component of these mats, in some cases contributing significantly more biomass to the community than do vascular species. The following algae were noted to occur in association with *Spartina alterniflora* in the littoral zone of a Massachusetts salt marsh: *Oscillatoria subuliformis, Oscillatoria amphibia, Lyngbea* spp., *Microcoleus chthonoplastes, Nodularia harveyana, Hydrocoleum lyngbyaceum*, and *Symploca* spp. (Webber 1967).

Dynamics: Salt pannes are part of the shifting mosaic of plant communities of the salt marsh complex. They tend to occur more frequently on the high marsh, but are present in the low marsh as well. Pannes are variable in shape and likely variable in origin. Formation can result from ice scouring or rafting flotsam that scrapes away or smothers existing vegetation, or from peat compaction, mosquito ditch levees, or tidal creek bank erosion that blocks or impedes drainage. Lack of vegetation decreases local sedimentation, which also maintains lower micro-relief (Redfield 1972). Evaporation from these poorly drained shallow depressions leads to hypersaline conditions (Bertness et al. 1992, Niering and Warren 1980). Gradients of salinity and standing water depth and duration correlate to vegetative cover and composition. The lowest portions of pannes tend to be wetter and more saline and can have little or no vegetation. As duration of wetness and salinity decreases across the micro-relief, forb-dominated species assemblages tend to dominate followed by mixed graminoid-forb assemblages at the outer, higher edges (Redfield 1972). Pannes can be ephemeral features on the marsh, and vegetation cover and composition can vary from year to year. Unvegetated, soft-bottomed pannes generally have plentiful worm and crab burrows (Godfrey et al. 1978).

Similar Associations:
- *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278)
- *Spartina alterniflora - Distichlis spicata Tidal Herbaceous Vegetation (CEGL006586)*

Related Concepts:
- *Salicornia - Bassia* salt flat (Harvill 1965) =
- *Salicornia europaea - Spartina alterniflora* community (Metzler and Barrett 1992) =
- *Salicornia virginica* Tidal Dwarf Shrubland (VDNH 2003) =
- *Salicornia* tidal flat (Clovis 1968) =
- *Salicornietum ambiguae* (Conard 1935) =
- *Sarcocornia perennis - (Distichlis spicata, Spartina alterniflora)* Dwarf-shrubland (Bartgis 1986) =
- *Spartina alterniflora / Salicornia europaea* community (Clancy 1993b) =
- Pan (Nichols 1920) =
- Panne (Good 1965) =
- Panne marsh (Baumann 1978b) =
- Pans (Higgins et al. 1971) =
- Pans (Hill 1986) =
- Salt Flat (Schafale and Weakley 1990) =
- Salt Flat (Schafale 2000) =
- Salt Flat (Fleming and Coulling 2001) B
- Salt Marsh (Rawinski 1984) ?
- Salt Panne (Harrison 2004) B
- Salt Panne (Clancy 1996) =
- Salt marsh complex, pannes (Breden 1989) =
- Salt pan (Klotz 1986) =
- Salt panne (Miller and Egler 1950) =
- Salt panne (Clancy 1993b) =
- Salt panne (Reschke 1990) =
- Spartina Saltmarsh (Gawler 2002) B
- Stunted *Spartina alterniflora* community (Miller and Egler 1950) =
- Tidal Mesohaline / Polyhaline Marsh (Fleming and Coulling 2001) B

Classification Comments: This community occurs in coastal salt marshes from Nova Scotia to the Carolinas, north of the range of *Batis maritima*. Salt pannes can potentially be classified based on morphology, salinity gradients, or substrate (Godfrey et al. 1978), which may elucidate further variation.

CONSERVATION RANKING

GRank: G5 (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This association occurs along the Mid- and North Atlantic Coast from the Canadian maritime provinces south to North Carolina and possibly South Carolina and Georgia.

Subnations: CT, DE, GA?, MA, MD, ME, NB, NC, NH, NJ, NS, NY, QC, RI, SC?, VA

TNC Ecoregions: 56:P, 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212C:PP, 212D:PP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Ad:CC?, 232Bx:CCC, 232Bz:CCC, 232Ce:CCP, 232Ci:CCC

Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Lookout, Fire Island, Fort Frederica?, Gateway); USFWS (Cape May, E.B. Forsythe, Monomoy, Parker River, Prime Hook)

ELEMENT SOURCES

References: Bartgis 1986, Baumann 1978b, Bell et al. 2002, Berdine 1998, Bertness et al. 1992, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Fleming and Coulling 2001, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Good 1965, Harrison 2004, Harvill 1965, Higgins et al. 1971, Hill 1986, Klotz 1986, Metzler and Barrett 1992, Metzler and Barrett 2001, Miller and Egler 1950, NRCS 2001b, Nichols 1920, Niering and Warren 1980, Peet et al. unpubl. data, Rawinski 1984, Redfield 1972, Reschke 1990, Schafale 2000, Schafale and Weakley 1990, Sperduto 2000b, Swain and Kearsley 2001, VDNH 2003, Webber 1967

Salicornia bigelovii - Triglochin maritima Herbaceous Vegetation (CEGL006369)

Dwarf Saltwort - Seaside Arrow-grass Herbaceous Vegetation
Salt Flat

ELEMENT CONCEPT

Summary: This sandy tidal flat is characterized by *Salicornia bigelovii, Triglochin maritima, Plantago maritima, Agalinis maritima*. Other associates include *Salicornia virginica (= Salicornia europaea), Limonium carolinianum (= Limonium nashii), Juncus gerardii, Spartina patens, Argentina anserina (= Potentilla anserina)*. Peat is drier and more shallow than that of other salt marsh panne vegetation types, and vegetation cover averages 50%.

CONSERVATION RANKING

GRank: GNR (1998-4-14) **Reasons:**

ELEMENT DISTRIBUTION

Subnations: MA, NH
TNC Ecoregions: 62:C
USFS Ecoregions: 221Ab:CCC, 221Ak:CCC
Federal Lands: USFWS (Monomoy)

ELEMENT SOURCES

References: Breeding et al. 1974, Eastern Ecology Working Group n.d., Gawler 2002

V.C.2.N.a. Permanently flooded temperate or subpolar hydromorphic-rooted vegetation

Nymphaea odorata - Nuphar spp. Permanently Flooded Temperate Herbaceous Alliance (A.1984)

American White Water-lily - Yellow Pond-lily species Permanently Flooded Temperate Herbaceous Alliance

Alliance Summary: This alliance, common throughout most of the eastern and central United States and adjacent Canadian provinces, contains vegetation which may occur in a variety of slow-moving water bodies, including rivers, millponds, blackwater rivers, streams, shallow ponds or lakes, or on shores of deeper water bodies including freshwater tidal areas. Stands of this alliance are permanently to semipermanently flooded, and water depth is generally greater than 0.5 m and up to 2 m. Stands are dominated by hydromorphic-rooted aquatic plants, typically *Nuphar* sp. (any of the North American taxa), with or without *Nymphaea odorata*. Emergent vegetation is less than 25%, and typically plant species diversity is low. Other species present may include *Utricularia* spp., *Potamogeton* spp., and others. In the north, *Brasenia schreberi* may be locally dominant. Other characteristic northern species include *Nymphaea tetragona* and *Potamogeton amplifolius*. Associates found in the Midwest include *Polygonum amphibium*. In the Southeast, examples may include the floating or emergent "pad-leaved" species *Nelumbo lutea* or *Nymphoides aquatica*. Submerged aquatic species which may be present include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*.

Nuphar advena - Nymphaea odorata Herbaceous Vegetation (CEGL002386)

Broadleaf Pond-lily - American White Water-lily Herbaceous Vegetation
Water-lily Aquatic Wetland

ELEMENT CONCEPT

Summary: This rooted aquatic or open marsh community occupies shallow-water depressions, oxbow ponds, backwater sloughs of river floodplains, slow-moving streams, ponds, and small lakes throughout the central and eastern United States. It is dominated by rooted, floating-leaved aquatic species, with both submergent and emergent aquatics also present. *Nuphar advena (= Nuphar lutea ssp. advena)* and *Nymphaea odorata* are dominants, either in combination together, or each singly. Other species present include *Brasenia schreberi*, various *Potamogeton* and *Stuckenia* spp., *Eleocharis robbinsii* and other *Eleocharis* spp., *Polygonum amphibium, Polygonum amphibium var. emersum (= Polygonum coccineum), Sparganium americanum, Lemna* spp., *Spirodela polyrrhiza, Typha latifolia*, and *Saururus cernuus*. Submerged aquatics more common in the southern part of the range include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*.

Environment: This community occupies shallow-water depressions, oxbow ponds, sluggish streams, and backwater sloughs of river floodplains, ponds (natural and artificial), and small lakes. In pools and slow-flowing stretches of river, at Obed River (TN), *Nuphar lutea ssp. advena* is rooted in sandy substrate (Schmalzer and DeSelm 1982).
Vegetation: This community is dominated by rooted, floating-leaved aquatic species, with both submergent and emergent aquatics also present. *Nuphar advena (= Nuphar lutea ssp. advena)* and *Nymphaea odorata* are dominants, either in combination together, or each singly. Other species present include *Brasenia schreberi*, various *Potamogeton* and *Stuckenia* spp., *Eleocharis robbinsii* and other *Eleocharis* spp., *Polygonum amphibium, Polygonum amphibium var. emersum (= Polygonum coccineum), Sparganium americanum, Lemna* spp., *Spirodela polyrrhiza, Typha latifolia*, and *Saururus cernuus* (Anderson 1982, G. Fleming pers. comm.). Submerged aquatic species more common in the southern part of the range include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*. This broadly conceived type may include ponds, or zones of ponds, dominated by *Nymphaea odorata*, with or without *Nuphar advena*.
Similar Associations:
- *Equisetum fluviatile - (Eleocharis palustris)* Herbaceous Vegetation (CEGL005258)
- *Nuphar advena* Tidal Herbaceous Vegetation (CEGL004472)
- *Nuphar polysepala* Herbaceous Vegetation (CEGL002001)
- Semipermanent Impoundment (CEGL006581)

Related Concepts:
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (Clancy 1996) =
- Delmarva Bay (Harrison 2004) B
- Floodplain Pond / Pool (Fleming and Coulling 2001) B
- Freshwater Marsh (Nelson 1985) B
- Inland Emergent Marsh (Chapman et al. 1989) B
- L5D2aI1a. *Nuphar lutea* (Foti et al. 1994) ?
- New England coastal plain pondshore (Rawinski 1984) ?
- Open Water/Aquatic Bed Veg., Natural Impoundment Pond (Ambrose 1990a) B
- Open water marsh with floating-leaved plants (NAP pers. comm. 1998) ?
- Small Depression Pond (Schafale and Weakley 1990) B
- Water-lily - Macrophyte Aquatic Bed (Gawler 2002) B

Classification Comments: Can occur in mostly natural ponded wetlands as well as artifactual ones such as borrow pits. On the Conecuh National Forest (Alabama), vegetation of this association occurs in Gum Pond and Open Pond as a mix of *Nymphaea odorata* and *Nuphar advena*.

CONSERVATION RANKING
GRank: G4G5 (2002-10-15) **Reasons:** The dominant species in stands of this vegetation are widespread across the eastern and central United States and adjacent Canada. This is not a rare or imperiled vegetation type, even though its occurrence is poorly documented. Stands may occur in natural lakes and ponds or in artificial impoundments.

ELEMENT DISTRIBUTION
Range: This rooted aquatic community occupies shallow, quiet waters throughout the central and eastern United States, extending from Maine to Ontario and Minnesota, south to Oklahoma and east to Georgia.
Subnations: AL, AR, CT, DE, FL, GA, IA, IL, IN, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NH, NJ, NY, OH, OK, ON, PA, RI, SC, TN, TX, VA, VT, WI, WV
TNC Ecoregions: 31:C, 32:P, 36:C, 37:C, 39:C, 40:P, 41:C, 42:C, 43:C, 44:C, 45:C, 46:C, 47:C, 48:C, 49:C, 50:C, 51:C, 52:C, 53:C, 55:P, 56:C, 57:C, 58:C, 59:C, 60:C, 61:C, 62:C, 63:C
USFS Ecoregions: 212Aa:CCC, 212Ba:CCC, 212Bb:CCC, 212Ca:CCC, 212Cb:CCC, 212Da:CCC, 212Db:CCP, 212Dc:CCC, 212Fa:CCP, 212Fb:CCP, 212Fc:CCP, 212Fd:CCP, 212Ga:CCP, 212Gb:CCP, 212Hb:CPP, 212Ja:CCP, 212Jb:CCP, 212Jc:CCP, 212Je:CCP, 212Jf:CCP, 212Jj:CCP, 212Jl:CCP, 212Jm:CCC, 212Ka:CPP, 221Aa:CCP, 221Ab:CCC, 221Ah:CCC, 221Ai:CCC, 221Al:CCC, 221Am:CCC, 221Bd:CCP, 221Da:CCC, 221Db:CCC, 221Ea:CCC, 221Ed:CC?, 221Ef:CCC, 221Fa:CCC, 221Hc:CCC, 221He:CCC, 222Ch:CCC, 222Db:CCC, 222Gc:C??, 222Ha:CCC, 222Ja:CCC, 222Jb:CCC, 222Ji:CCC, 222Jj:CCC, 222Kf:CCC, 222Kg:CCC, 222Kh:CCC, 222Kj:CCC, 222L:CC, 231Bc:CCC, 231Bd:CCC, 231Ga:CCC, 231Gb:CCC, 231Gc:CCC, 232Bf:CCC, 232C:CC, 232D:CC, 234Aa:CCC, 234Ac:CCC, 234Ad:CCC, 234Af:CCC, 234Ag:CCC, 234Ai:CCC, 234Al:CCC, 234Am:CCC, 234An:CCC, 251Cf:CCC, 251Dd:CCC, 251Dg:CCC, 251Eb:CCC, M212Af:CCC, M212Bb:CCC, M212Bc:CCC, M212Bd:CCC, M212Cb:CCC, M212Cc:CCC, M212Ea:CCP, M212Eb:CCP, M221Aa:CCC, M221Ab:CCC, M221Ac:CCC, M221Ad:CCC, M221Ba:CCC, M221Bb:CCC, M221Bc:CCC, M221Bd:CCC, M221Be:CCC, M221Bf:CCC, M221Da:CCC, M221Dc:CCC

Federal Lands: DOD (Fort Benning); NPS (Acadia, C&O Canal, Carl Sandburg Home, Effigy Mounds, George Washington Parkway, Indiana Dunes, Minute Man, Natchez Trace, Obed River, Ozark Riverways, Saint Croix, Saint-Gaudens, Shiloh); USFS (Angelina, Chequamegon, Chequamegon-Nicolet, Conecuh, Davy Crockett, Kisatchie, Nicolet, Ocala, Ozark, Sabine, Sam Houston?, Talladega, Talladega (Oakmulgee), Talladega (Talladega)); USFWS (Back Bay, Erie, Great Swamp, Monomoy, Reelfoot)

ELEMENT SOURCES

References: Ambrose 1990a, Anderson 1982, Breden et al. 2001, Chapman et al. 1989, Clancy 1996, FNAI 1990, Fike 1999, Fleming and Coulling 2001, Fleming et al. 2001, Foti et al. 1994, Gawler 2002, Harrison 2004, Hoagland 2000, Hop et al. 2005, INAI unpubl. data, Midwestern Ecology Working Group n.d., NAP pers. comm. 1998, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 1985, Peet et al. unpubl. data, Penfound 1953, Rawinski 1984, Schafale and Weakley 1990, Schmalzer and DeSelm 1982, Schotz pers. comm., Sperduto and Nichols 2004, Swain and Kearsley 2001, TDNH unpubl. data, Thompson and Jenkins 1992, WNHIP unpubl. data, Zanoni et al. 1979

V.C.2.N.b. Permanently flooded - tidal temperate or subpolar hydromorphic-rooted vegetation

Ruppia maritima Permanently Flooded - Tidal Temperate Herbaceous Alliance (A.1769)

Beaked Ditch-grass Permanently Flooded - Tidal Temperate Herbaceous Alliance

Alliance Summary: This alliance includes communities of submerged, rooted aquatic vegetation occurring in tidal creeks, pools, and coves with brackish waters. The substrate is often mud-bottomed but may also include sand. Characteristic species include *Ruppia maritima, Vallisneria americana*, and *Stuckenia pectinata (= Potamogeton pectinatus)*. This is the most widely distributed seagrass alliance in eastern North America. It ranges around the entire Atlantic and Gulf coasts, from New England to Texas. This vegetation is patchily distributed along the Texas coast, where *Ruppia maritima* often occurs mixed with *Halodule wrightii*. *Ruppia maritima* is the only seagrass capable of growing in freshwater and is therefore often found in the oligohaline to mesohaline upper reaches of estuaries and lower reaches of tidal creeks, bayous and rivers. Because it often behaves as an annual, the distribution and abundance of *Ruppia maritima* is often shifting both spatially and temporally.

Ruppia maritima Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167)

Beaked Ditch-grass Acadian/Virginian Zone Temperate Herbaceous Vegetation
Northern Atlantic Coast Beaked Ditch-grass Bed

ELEMENT CONCEPT

Summary: This brackish/saline tidal community of the central and northern Atlantic coast is dominated by *Ruppia maritima*. It occurs in large beds in estuarine bays as well as small patches within brackish tidal creeks. Substrates are sand or muck, and salinity is generally brackish. *Ruppia maritima* has a wide range of salinity tolerance and overlaps with other species, although generally not in the same locations. Common associates include *Zannichellia palustris, Stuckenia pectinata (= Potamogeton pectinatus)*, and *Potamogeton perfoliatus* in brackish/fresh areas or *Zostera marina* as waters get deeper and more saline. There can also be a diverse array of macroalgae.

Environment: This association occurs in habitats that are continuously flooded by brackish water; it occurs in subtidal situations, deepwater pools and pannes, tidal creeks, and flats within salt marshes, or along tidal rivers. It also occurs in coastal salt ponds with polyhaline to mesohaline salinity levels. Except in pannes or pools, which are more irregularly flooded, water levels fluctuate with diurnal tides and are generally less than 2 m deep at low tide, although certain areas may be exposed at extremely low tides. Substrate varies from sand to mud.

Vegetation: *Ruppia maritima* is strongly dominant in this association. It has a wide range of salinity tolerance and overlaps with other species, although generally not in the same locations. Common associates include *Zannichellia palustris, Stuckenia pectinata (= Potamogeton pectinatus)*, and *Potamogeton perfoliatus* in brackish to fresh areas and *Zostera marina* as waters get deeper and more saline. There can also be a diverse array of macroalgae. This association grades into eelgrass beds as salinity increases. As salinity decreases, *Ruppia maritima* becomes less prominent, and the community grades into fresh/brackish subtidal associations.

Dynamics: In several habitats, this association occurs where water levels and salinity can fluctuate with daily tides.

Similar Associations:
- *Ruppia maritima - Stuckenia pectinata* Herbaceous Vegetation (CEGL006370)
- *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398)
- *Stuckenia pectinata - Potamogeton perfoliatus - (Zannichellia palustris)* Tidal Herbaceous Vegetation (CEGL006027)
- *Zostera marina* Herbaceous Vegetation (CEGL004336)

Related Concepts:
- *Ruppia maritima* Acadian-Virginian Zone Temperate Herbaceous Vegetation (Bartgis 1986) =
- *Ruppia maritima* Herbaceous Vegetation (Bowman 2000) =
- *Ruppia maritima* Semipermanently Flooded - Tidal Herbaceous Vegetation (Fleming et al. 2006) =
- *Ruppia* Community (Moore et al. 2000) ?
- Polyhaline subtidal aquatic bed (Breden 1989) ?
- Southern New England & Gulf of Maine Saline/ Brackish Subtidal Estuarine Community (Rawinski 1984) ?
- *Spartina* Saltmarsh (Gawler 2002) B
- Tidal Mesohaline - Polyhaline Aquatic Bed (Harrison 2004) B
- Tidal Mesohaline / Polyhaline Aquatic Bed (Fleming and Coulling 2001) B

Classification Comments: *Ruppia maritima* tends to occur in shallower and slightly less saline waters than *Zostera marina* (Orth and Moore 1988). The range of this type is consistent with the "Virginian Province" and "Acadian Province" of Cowardin et al. (1979).

CONSERVATION RANKING

GRank: GNR (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION

Range: This association occurs along the mid- and north Atlantic coast from Maine to North Carolina.

Subnations: CT, DE, MA, MD, ME, NC?, NH, NJ, NY, RI, VA

TNC Ecoregions: 57:?, 58:C, 62:C, 63:C

USFS Ecoregions: 212Db:CCP, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ae:CCP, 221Af:CCC, 221Ak:CCC, 221Ba:CCP, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CC?

Federal Lands: NPS (Assateague Island, Cape Cod); USFWS (Back Bay?, Cape May, Monomoy?, Parker River?)

ELEMENT SOURCES

References: Bartgis 1986, Bowman 2000, Breden 1989, Breden et al. 2001, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2006, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Metzler and Barrett 2004, Moore et al. 2000, Orth and Moore 1988, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001, Thayer et al. 1984

Zostera marina Permanently Flooded - Tidal Herbaceous Alliance (A.1766)

Seawrack Permanently Flooded - Tidal Herbaceous Alliance

Alliance Summary: This alliance includes subtidal aquatic beds characterized by *Zostera marina*. These communities usually occur in quiet waters below the lowest tide level and where fluctuations in salinity are minor. Substrate ranges from soft mud to coarse sand. Light availability is the primary limiting factor in occurrences of this alliance, within the geographic, temperature, and salinity range (10-30 ppt) of *Zostera marina*. The long leaves of *Zostera marina* provide substrate for epiphytic organisms such as macroalgae, bay scallops, and other marine invertebrates, as well as nursery and/or adult habitat for fin fish. Characteristic associate nonvascular plants (algae) include *Ulva lactuca, Enteromorpha* spp., and *Polysiphonia* spp.

Zostera marina Herbaceous Vegetation (CEGL004336)

Seawrack Herbaceous Vegetation
North Atlantic Eel-grass Bed

ELEMENT CONCEPT

Summary: These aquatic beds occur in the subtidal zone along the north Atlantic coast, south to North Carolina. *Zostera marina* is dominant and occurs most often in nearly pure stands. *Ruppia maritima* can occur sporadically in this association, especially as waters become less saline. Additional associated species include macroalgae, especially *Ulva lactuca, Enteromorpha* spp., *Cladophora* spp., and *Polysiphonia* spp. Where water is less saline, *Enteromorpha, Chaetomorpha, Gracilaria, Agardhiella, Ectocarpus*, and *Pilayella* can occur. Elevation/depth of the beds is determined by low tide level at the upper end and light penetration at the lower end, the latter being a function of water depth and turbidity. The beds generally occur in areas with only moderate wave action where salinity fluctuations are minor. Eel-grass beds tend to stabilize and enrich substrate and provide habitat for epiphytes and other marine organisms.

Environment: These aquatic beds occur in the subtidal zone of coastal habitats on substrate ranging from soft mud to coarse sand. Elevation/depth of the beds is determined by low tide level at the upper end and light penetration at the lower end, the latter being a function of water depth and turbidity. The beds generally occur in areas with only moderate wave action where salinity fluctuations are minor, and salinity levels are in the mid to high range (Thayer et al. 1984).

Vegetation: *Zostera marina* is dominant and occurs in nearly pure stands. *Ruppia maritima* can occur sporadically in this association, especially as waters become less saline. Additional associated species are macroalgae, especially *Ulva lactuca, Enteromorpha* spp., *Cladophora* spp., and *Polysiphonia* spp. Where water is less saline, *Enteromorpha, Chaetomorpha, Gracilaria, Agardhiella, Ectocarpus*, and *Pilayella* can occur.

Dynamics: Eel-grass beds tend to stabilize and enrich substrate and provide habitat for epiphytes and other marine organisms.

Similar Associations:

- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167)--may co-occur in some regions of the Atlantic coast, but grows almost exclusively in brackish water.

Related Concepts:

- *Zostera* Community (Moore et al. 2000) ?
- Coastal Salt Pond (Rawinski 1984) ?
- Polyhaline subtidal aquatic bed (Breden 1989) ?
- Southern New England & Gulf of Maine Saline/ Brackish Subtidal Estuarine Community (Rawinski 1984) ?
- Tidal Mesohaline - Polyhaline Aquatic Bed (Harrison 2004) B
- Tidal Mesohaline / Polyhaline Aquatic Bed (Fleming and Coulling 2001) B

Classification Comments: According to Thayer et al. (1984) *Zostera marina* has a range of approximately 3090 km along the North American Atlantic coast which may be represented as 4 smaller subregions. The bulk of the southern range corresponds with the Virginian Zone of Cowardin et al. (1979). *Zostera marina* is extirpated from Delaware.

CONSERVATION RANKING

GRank: G4G5 (2006-1-19) **Reasons:** This vegetation has a wide distribution, in coastal waters from Maine to North Carolina. It occurs in large patches in sheltered near-shore estuarine waters. This vegetation is vulnerable to pollution from coastal run-off as well as oil spills off the coast.

ELEMENT DISTRIBUTION

Range: This community occurs in subtidal habitat along the north and mid-Atlantic coast.

Subnations: CT, MA, MD, ME, NC, NH, NJ, NY, RI, VA

TNC Ecoregions: 57:C, 58:C, 62:C, 63:C

USFS Ecoregions: 212Db:CCC, 212Dc:CCC, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 221Ba:CCP, 232Aa:CCC, 232Ab:CCC, 232Ad:CCP, 232Af:CCC, 232Br:CCC, 232Bx:CCC, 232Bz:CCC, 232Ci:CCC, 232Cj:CCC

Federal Lands: NPS (Assateague Island); USFWS (Monomoy)

ELEMENT SOURCES

References: Berdine 1998, Bowman 2000, Breden 1989, Breden et al. 2001, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fleming 2001a, Fleming and Coulling 2001, Fleming et al. 2001, Harrison 2004, Harrison and Stango 2003, Metzler and Barrett 2001, Metzler and Barrett 2004, Moore et al. 2000, Orth and Moore 1988, Rawinski 1984, Reschke 1990, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001, Thayer et al. 1984

VII. Sparse Vegetation

VII.C.1.N.a. Dunes with sparse herbaceous vegetation

Herbaceous Dunes Sparsely Vegetated Alliance (A.1855)

Herbaceous Dunes Sparsely Vegetated Alliance

Alliance Summary: This is technically not an alliance. It is a placeholder for a group of sparsely vegetated associations that do not have adequate vegetation descriptions, but do share certain substrate characteristics.

VII.C.2.N.a. Sand flats

Cakile edentula Sparsely Vegetated Alliance (A.1861)

American Searocket Sparsely Vegetated Alliance

Alliance Summary: Annual-dominated sand flats on island end flats and upper ocean beaches, within the reach of storm tides and extreme lunar tides. This alliance has less perennial species than the related *Cakile constricta* Sparsely Vegetated Alliance (A.1860), since the Atlantic Coast shoreline is a higher-energy system, and the alliance is more dynamic and more frequently disturbed. Vegetative cover is variable, depending on the amount of exposure to wave and wind action, but on average is sparse; no species can be considered dominant. Annual or biennial species more or less restricted to beach habitats are characteristic of this alliance, including *Cakile edentula ssp. edentula*, as well as *Salsola kali ssp. kali (= Salsola caroliniana), Chamaesyce polygonifolia, Honckenya peploides, Cenchrus tribuloides, Amaranthus retroflexus, Chenopodium album, Erechtites hieraciifolia*, and *Atriplex cristata (= Atriplex arenaria)*. Associated species include *Ammophila breviligulata, Chamaesyce polygonifolia, Salsola kali ssp. kali*, and *Triplasis purpurea*. At Assateague Island National Seashore, this alliance is sparsely vegetated with *Cakile edentula ssp. edentula*, covering approximately 1% of the area. Other associated species in this alliance are just as sparse and generally adapted to a low growth form, given the exposed windy conditions of their environment. The South Atlantic Coast phase of this alliance occupies the upper portion of ocean beaches in the southern part (Cape Hatteras, North Carolina, to Cape Romain, South Carolina) of the microtidal region (barrier islands with coastal geomorphology dominated by hurricane overwash rather than tidal energy). Other characteristic species include mostly annual herbs, such as *Chamaesyce polygonifolia, Chamaesyce bombensis, Sesuvium portulacastrum, Salsola kali ssp. kali*, and the rare *Amaranthus pumilus*. In addition to the two associations in the Southeast, there is also an association in the Great Lakes; in this association the dominant plant is *Cakile edentula var. lacustris*.

Cakile edentula ssp. *edentula* - *Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400)

American Searocket - Northern Seaside Spurge Sparse Vegetation
North Atlantic Upper Ocean Beach

ELEMENT CONCEPT

Summary: This is a sparsely vegetated upper beach community occurring on unstable sands and often gravels and cobbles just above mean high tide on maritime beaches and foredunes along the middle and northern Atlantic coast. This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. They are irregularly flooded by spring or storm tides. Vegetation cover is variable, depending on the amount of exposure to wave and wind action, but is generally sparse and characterized by annuals and biennials. Species composition can change dramatically from year to year but frequently includes *Cakile edentula ssp. edentula*, as well as *Salsola kali ssp. kali (= Salsola caroliniana), Chamaesyce polygonifolia, Honckenya peploides, Cenchrus tribuloides, Amaranthus retroflexus, Chenopodium album, Erechtites hieraciifolia, Xanthium strumarium*, and *Atriplex cristata (= Atriplex arenaria)*. Globally rare species such as *Polygonum glaucum* and *Amaranthus pumilus* occur in this habitat. Sparse *Ammophila breviligulata* can occur sporadically as a common associate, colonizing from the adjacent beachgrass community. Diagnostic species are *Cakile edentula ssp. edentula, Salsola kali ssp. kali, Atriplex cristata (= Atriplex pentandra)*, and *Chamaesyce polygonifolia*. This community occurs in maritime coastal areas from southern Maine to Cape Hatteras, North Carolina.

Environment: This association occurs on unstable sands and often gravels and cobbles just above mean high tide on beaches and foredunes washed over by spring and storm tides and impacted by wind erosion.

Vegetation: This is a sparsely vegetated association characterized by annuals and biennials. Species composition is variable, but frequently includes *Cakile edentula ssp. edentula, Honckenya peploides, Salsola kali (= Salsola caroliniana), Atriplex patula, Cenchrus tribuloides, Chamaesyce polygonifolia, Atriplex cristata (= Atriplex arenaria, = Atriplex pentandra), Xanthium strumarium*, and *Chenopodium* spp. Globally rare species such as *Polygonum glaucum* and *Amaranthus pumilus* occur in this habitat. *Ammophila breviligulata* can occur sporadically, colonizing from the adjacent beachgrass community. Additional infrequent species can include *Chenopodium rubrum, Chenopodium album, Chenopodium berlandieri var. macrocalycium, Cyperus filicinus, Triplasis purpurea*, and *Sesuvium maritimum*. Bare substrate can comprise greater than 95% cover in this association.

Dynamics: This association occurs at the wrack line; there is regular deposition of wave-deposited flotsam. It is irregularly flooded by very high tides, scoured by storm tides, and is constantly reworked by wind. Species composition is dominated by annuals and biennials and can change dramatically from year to year. If the habitat is protected from regular disturbance, perennial-dominated dune grass communities tend to develop.

Similar Associations:

- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162)
- *Cakile edentula ssp. edentula - Mertensia maritima* Sparse Vegetation (CEGL006106)
- *Cakile edentula* ssp. harperi Sparse Vegetation (CEGL004401)

Related Concepts:

- *Cakile edentula - Chenopodium album* community (Metzler and Barrett 1992) =
- *Cakile edentula ssp. edentula* Sparse Vegetation (Clancy 1996) ?
- *Cakile edentula* ssp. *edentula - Salsola caroliniana* Sparse Vegetation (Bartgis 1986) =
- *Cakiletum edentula* (Conard 1935) =
- Beach (Higgins et al. 1971) =
- Beach (McDonnell 1979) =
- Beach (Fender 1937) =
- Beach Strand (Gawler 2002) B
- Beach community (Baumann 1978b) =
- Beach community (Johnson 1985b) ?
- Beach community (Hill 1986) =
- Beach strand community (MENHP 1991) =
- Beach vegetation (Moul 1973) =
- Coastal Beach and Overwash Flat (Harrison 2004) B
- Coastal beach strand (Sperduto 1994) =
- Coastal beach strand community (Rawinski 1984) ?
- Dune and swale community (Stalter 1990) B
- Dune community (Jenkins 1974) =
- Dune-strand area (Clovis 1968) =
- Embryo dune (Klotz 1986) =
- Marine intertidal gravel/sand beach community (Breden 1989) =
- Marine sandy beach (Clancy 1993b) =
- Maritime beach (Reschke 1990) =
- Middle beach (Shreve et al. 1910) =
- Middle beach (Nichols 1920) =
- Pioneer beach community (Boule 1979) =
- Sea-strand vegetation, beach formation (Harshberger 1900) =
- Upper Beach (Schafale and Weakley 1990) B
- Upper Beach / Overwash Flat (Fleming and Coulling 2001) B

Classification Comments: This community is common on maritime dunes of the Northeast but is vulnerable to development and shifting wave action due to jetties. J. Harrison (pers. comm. 2006): "In the Chesapeake Marshlands, in Maryland, a small patch of this vegetation was observed on South Marsh Island [see Observation Point CM-15]. Please note many of the associated "maritime" species are not present in the refuge. Although not as well-developed in estuarine environments, consider expanding concept to include narrow sandy shorelines on bay islands."

CONSERVATION RANKING
GRank: G4G5 (1997-12-1) **Reasons:**

ELEMENT DISTRIBUTION
Range: This association ranges from southern Maine to North Carolina.
Subnations: CT, DE, MA, MD, ME, NC, NH, NJ, NY, RI, VA
TNC Ecoregions: 57:C, 58:C, 62:C
USFS Ecoregions: 221Ab:CCC, 221Ac:CCC, 221Ak:CCC, 232Aa:CCC, 232Ab:CCC, 232Ac:CCC, 232Bz:CCC, 232Ch:CCC, 232Ci:CCC
Federal Lands: NPS (Assateague Island, Boston Harbor Islands, Cape Cod, Cape Hatteras, Fire Island, Gateway, Sagamore Hill); USFWS (Back Bay, Cape May, Chesapeake Marshlands, E.B. Forsythe, Monomoy, Muskeget Island, Parker River)
Element Sources
References: Bartgis 1986, Baumann 1978b, Berdine 1998, Boule 1979, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Clovis 1968, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fender 1937, Fleming and Coulling 2001, Fleming et al. 2001, Gawler 2001, Gawler 2002, Godfrey et al. 1978, Harrison 2004, Harshberger 1900, Higgins et al. 1971, Hill 1986, J. Harrison pers. comm., Jenkins 1974, Johnson 1985b, Klotz 1986, MENHP 1991, McDonnell 1979, Metzler and Barrett 1992, Metzler and Barrett 2001, Moul 1973, Nichols 1920, Rawinski 1984, Reschke 1990, Schafale and Weakley 1990, Shreve et al. 1910, Sperduto 1994, Sperduto 2000a, Sperduto 2000b, Stalter 1990, Swain and Kearsley 2001

Dune Blowout

ELEMENT CONCEPT
Summary: Dune blowouts are unvegetated depressions on active coastal sand dunes where high winds have removed significant portions of sand. They can be ephemeral landscape features that become revegetated, but can also persist and even grow in size if exposure to high winds persists.
Environment: This feature occurs on unstable sands of foredunes or backdunes.

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Appendix D

USFWS

Red knot

Findings of Appropriateness and Compatibility Determinations

Findings of Appropriateness and Compatibility Determinations

Finding of Appropriateness—Beach Use (Sports, Kite Flying, Grilling, and Shade Tents) . . . D-3
Finding of Appropriateness—Bicycling . . . D-5
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This appendix reflects our evaluation of what uses to allow or not allow under the Service-preferred alternative B of the draft comprehensive conservation plan (CCP) and environmental impact statement (EIS).

The first table below (table D.1) lists the uses for which the refuge has existing, completed findings of appropriateness (FOAs) and compatibility determinations (CDs). These existing FOAs and CDs were approved prior to the development of this draft CCP/EIS. For each of these uses, we list its current status (e.g., compatible or not compatible) and compare that to our proposal under alternative B. For example, some uses we would continue to allow under alternative B, while other existing uses may be modified or not allowed.

The second table (table D.2) lists other uses that the refuge does not have an existing, completed FOA and/or CD for and indicates our proposal for those uses under alternative B.

Following this table, we provide the full FOAs and CDs for all of these uses under alternative B.

Table D.1. Uses with existing, completed compatibility determinations for Monomoy Refuge*

Use	Previously Determined Compatible	Previously Determined Not Compatible	Changes proposed under Alternative B (Service-preferred)
Beachcombing	X		Completed FOA to accompany an updated CD. Use is found appropriate and compatible.
Birding, Natural and Cultural History Tours of Monomoy Islands	X		New FOA and CD titled " Commercial Tours, Ferry Service, Guided Trips, and Outfitting." Includes concessionaire operations and/or others under special use permit. Uses found appropriate and compatible with stipulations.
Commercial Ferry Service	X		Combined use with new FOA and CD titled "Commercial Tours, Ferry Service, Guided Trips, and Outfitting." Uses found appropriated and compatible with stipulations.
Hiking\Backpacking	X		Combined backpacking with FOA for camping and found it not appropriate. A new FOA and CD is titled "Hiking or Walking" and both are appropriate and compatible.
Horseshoe Crab Harvesting		X	New FOA found use not appropriate.
Jogging/Walking	X		Combined jogging and walking with hiking in new FOA and CD titled "Hiking, Walking, and Jogging." Found walking and hiking appropriate and compatible. Found jogging appropriate and compatible on Morris Island only.
Mosquito Control	X		Added "monitoring" to name of CD and completed FOA. Found appropriate and compatible with stipulations.
Pet Walking	X		New FOA finds use not appropriate.
Photography	X		Prepared separate commercial photography FOA and CD and combined recreational photography with wildlife observation in separate CD. Uses found appropriate and compatible with stipulations.
Picnicking	X		New FOA finds use "organized picnicking" not appropriate.
Recreational Fishing	X		New CD titled "Fin Fishing" covers surf fishing, fishing in freshwater ponds, and all other fishing outside of the refuge's open water. Found compatible.
Shellfishing (hand harvest of softshell clams)	X		New CD finds use compatible on refuge, but only for hand harvest of subterranean clams. Use found compatible with stipulations.
Shorebird research	X		Completed new FOA and CD titled "Research Conducted by Non-Service Personnel" which includes broader research program and not a single project. New CD finds use appropriate and compatible with stipulations.
Snowshoeing	X		Not addressed due to lack of weather conditions conducive to snowshoeing.

Use	Previously Determined Compatible	Previously Determined Not Compatible	Changes proposed under Alternative B (Service-preferred)
Stage Island Parking	X		FOA for parking and dinghy storage at Stage Island found uses to be not appropriate.
Swimming/Beach Use	X		Completed FOA to accompany updated CD. Use is found appropriate and compatible.
Whimbrel Research on North Monomoy	X		Completed new FOA and CD titled "Research Conducted by Non-Service Personnel" which includes broader research program and not a single project. New CD finds use appropriate and compatible with stipulations.
Wildlife Observation	X		Expanded CD to include recreational photography. New CD finds uses compatible.

***Notes:**

"Existing completed" refers to compatibility determinations that are current as of December 2013.
CD = compatibility determination; FOA= finding of appropriateness

Table D.2. Uses without existing compatibility determinations for Monomoy Refuge that are addressed in this CCP (proposed actions under alternative B (Service-preferred alternative))

Use	Proposed Not Appropriate	Proposed Compatible	Comments
Beach Use (sports, kite-flying, grilling, and shade tents)	X		
Bicycling	X		
Camping	X		
Fisheries Harvest Using Bottom Disturbing Gear and Techniques	X		
Mussel Harvesting	X		
Fires	X		
Fireworks	X		
Jet Skiing	X		
Kiteboarding	X		
Over Sand Vehicles	X		
Motorized and Nonmotorized Boat Launching		X	Also completed FOA.
Virtual Geocaching and Letterboxing		X	Also completed FOA.
Outdoor Ceremonies and Events		X	Also completed FOA.
Waterfowl Hunting		X	
Commercial Wildlife and Landscape Photography		X	New FOA and CD applies to commercial use, distinguishing it from recreational photography.
Environmental Education and Interpretation		X	

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Beach Use (Sports, Kite Flying, Grilling, and Shade Tents)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Beach Use (Sports, - Kite Flying, Grilling and Shade Tents)

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Beach sports include, but are not limited to, volleyball, football, soccer, frisbee, baseball, surfing, and skim boarding. Kite-related activities include kite flying, kite surfing, and kite boarding. These activities are determined to be inappropriate because they can disturb wildlife. These uses do not contribute to quality wildlife-dependent recreational uses nor do they support the purpose for which the refuge was established.

Grilling can result in the intentional or unintentional deposition of food waste on the refuge which could be eaten by refuge wildlife. This could result in an increase of gulls or mammals who can also act as mammalian predators on bird eggs and unfledged chicks.

These uses are more appropriate in a park setting and would, if allowed, detract from the purpose of the refuge which is to protect migratory birds and provide opportunities for recreational wildlife-dependent public use. When conducted in designated wilderness, all these activities, including the use of shade tents in the wilderness area, detract from the wilderness character of the refuge. Activities which are generally done in groups, such as beach sports and grilling, can also negatively impact the quality of solitude which is to be preserved in wilderness.

There are insufficient refuge facilities to accommodate these uses on Morris Island. Allowing these uses to occur on Morris Island would increase parking pressure on the small parking lot at refuge headquarters. This could result in less parking for visitors who are coming to the refuge to engage in wildlife-dependent public uses such as fishing and birding.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Bicycling

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?		✔
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Bicycling

NARRATIVE:

Monomoy NWR includes the Morris Island tract, which contains refuge administration and visitor facilities, a parking lot, and the ¾ mile Morris Island Interpretive Trail. Visitors are allowed to access the refuge by bicycle, but then must park the bicycle and proceed on foot. The Morris Island Trail traverses a variety of coastal habitats, including a sandy beach and salt marshes, and is not conducive to bicycling. The rest of the refuge is made up of North Monomoy Island, South Monomoy (a former island that connected to the mainland in 2006), smaller islands such as Minimoy, and extensive tidal flats. The majority of these lands are nationally designated wilderness. Bicycling is not allowed within wilderness areas because mechanized transport, including anything with wheels, is prohibited in order to maintain wilderness character.

Bicycling on Morris Island has the potential to directly impact the quality experience of individuals engaging in priority wildlife-dependent activities such as bird watching, fishing, and photography. Bicycling also has the ability to disrupt priority migratory birds and other wildlife on the beach. Access by bicycle is not necessary to provide the visitor an opportunity to see wildlife throughout the refuge. Pedestrian access is sufficient to provide the public with opportunities to observe wildlife and enjoy the natural conditions on the refuge. Given the difficult cycling conditions, the potential impacts to priority wildlife-dependent recreation, the potential impacts to priority wildlife, and the prohibition of mechanized transportation within the nationally designated wilderness area, bicycling is not an appropriate recreational use for Monomoy National Wildlife Refuge.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Boat Moorings

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Boat Moorings

NARRATIVE:

The town of Chatham administers and enforces regulations for moorings (anchors, chains, hawsers, bridles, etc.) and vessel or other object anchoring within all town of Chatham waters through the Chatham Harbormaster, using a fee-based permit system. All vessels berthed within Chatham for two consecutive weeks or longer are required to obtain a mooring permit from the Chatham Harbormaster, with all permits expiring on December 31 each calendar year. Currently, there are no mooring permits issued by Chatham within the Monomoy National Wildlife Refuge boundary as defined by the Declaration of Taking for the refuge. The refuge maintains several moorings within the refuge boundary, which are necessary for effective and efficient refuge operations.

Mooring permits must be renewed annually, are not transferrable, and if not renewed by February 28 are forfeited. Chatham's mooring fee-schedule is based upon a taxpayer/residency status, private, or commercial mooring use, and vessel length. Several popular mooring fields within Chatham, including Stage Harbor consistently experience many more applicants than there are moorings available (mooring saturation), and consequently Chatham maintains a waiting list. Mooring permit applicants are required to pay an annual "waiting list" renewal fee per boat to retain their "place" on the waiting list because of the "shortage" of mooring space relative to the demand for moorings. For example, the waiting list time for a new "unprotected" mooring for a vessel up to 27 feet in Stage Harbor was 10-14 years as of December 31, 2013.

The town mooring regulations specify the type of mooring inspection requirements and mooring tackle required for different sized vessels and "exposure" environments, with the heaviest mooring tackle required for the most exposed areas. These regulations prohibit new concrete block moorings within "protected areas," requiring that concrete block systems be replaced with alternative (more environmentally "friendly") mooring systems over time. The high demand for additional mooring space, especially for larger commercial fishing vessels that have difficulty maneuvering safely within a congested Stage Harbor, could prompt future requests for new moorings near or even within the refuge boundary west of North Monomoy. The "high exposure" of this location would require the heaviest of mooring tackle for the larger vessels most likely to want to use the area, resulting in rather large radius "sweep" areas around the mooring blocks.

The University of Massachusetts, Urban Harbors Institute recently (2013) completed a comprehensive assessment of conservation moorings in coastal Massachusetts. The two most common types of conventional mooring are mushroom or pyramid anchors and gravity anchors. Mushroom type moorings are designed to anchor into the sediment while gravity anchors rely on the weight of the mooring to keep the boat in place. A heavy bottom chain runs from the mooring to the mooring ball. "The heavy chain moves along the seafloor as the boat moves, disrupting the living organisms in its path (Hastings, et al., 1995; Betcher et al, undated; MER Assessment Corporation, 2008; Terramar Environmental Services, Inc., 2011). Bare space around a traditional mooring is referred to as a "mooring scar." The degree of scarring and the extent of the scar are dependent upon factors such as the length and weight of chain and the nature of vessel movement (e.g., currents, tidal range, prevailing wind, storm exposure). While the mooring scar from the chain sweep is the primary impact on eelgrass in terms of areal extent of impact, the method of anchoring a mooring can also negatively affect eelgrass beds. During storms, anchors such as mushroom moorings, can become dislodged from the sediment, and may drag through eelgrass beds, destroying plants as they move. Additionally, the presence of large deadweight anchors, such as concrete and granite blocks, can lead to significant scouring around a mooring."

Eelgrass meadows have a complex structure that provides habitat for a diverse community of microorganisms, algae, and marine mammals. Eelgrass plants contribute to the overall productivity of the marine ecosystem by using the energy of sunlight to produce organic matter in the form of roots, rhizomes, and plant leaves.

Eelgrass meadows support a diverse assemblage of marine invertebrates, including species of marine worms, crustaceans (e.g., barnacles, crabs, shrimp, copepods, amphipods) hydroids, bryozoans, and mollusks (e.g., mussels, snails, and clams). Eelgrass meadows are widely recognized as important fish habitat. Most fishes using eelgrass extensively are young-of-year, juveniles, or adults of species that are small in size. Eelgrass is an important food source for waterfowl such as Atlantic brant, black duck, canvasback duck, and Canada goose. Scouring from moorings could also impact other benthic communities, outside of eelgrass beds.

The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) identifies six uses of wildlife refuges as priority public uses; environmental education, interpretation, hunting, fishing, wildlife observation and wildlife photography. These recreational uses are dependent upon healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses in planning and management.

The Service has statutory authority under the National Wildlife Refuge System Administration Act of 1966 to regulate activities that occur on water bodies within refuge units. In addition, the nearshore open waters and subtidal bottoms within the Declaration of Taking boundary are owned by the United States as the property owner.

Boat mooring placement is not a priority public use nor will the use facilitate any of the priority public uses. Boat moorings can degrade eelgrass beds through substrate disturbance (Neckles 2005) and disturb the bottom and disrupt benthic communities even in areas where seagrass beds are not located. Additionally, the refuge does not have adequate resources and staffing to administer moorings. Staffing time spent on administering a moorings (e.g., reviewing, approving, and issuing special use permits, visiting proposed mooring sites to ensure they are not in sensitive areas, and monitoring impacts of moorings on refuge resources) would reduce time available for managing refuge habitats and providing opportunities for priority public uses. In light of the above policies and impacts, these activities do not support the purposes of the Monomoy National Wildlife refuge (migratory bird and wilderness preservation) or the mission of the National Wildlife Refuge System. Therefore, placement of boat moorings is determined to be not appropriate.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Camping

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?		✔
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Camping

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Camping, including backpacking, is not consistent with Service policy on secondary uses. Resources needed to manage an overnight, primitive camping program that adequately provides for public and employee sanitation and safety, without disturbing or harming focal wildlife species, would divert existing and future resources from accomplishing priority refuge tasks. Primitive "backcountry" camping on Monomoy presents unacceptable levels of risk from the potential escape of campfires to wildfires and the possible disturbance to nesting shorebirds, seabirds, wading birds, and breeding northeastern beach tiger beetles. The use does not support the refuge's purpose in carrying out the national migratory bird program. This use is also not consistent with any approved refuge management plan. There would be some added benefit for the visitor to observe or photograph wildlife, or participate in nature study or recreational fishing. The remoteness of interior portions of South Monomoy within the Monomoy Wilderness does offer a rare, outstanding opportunity for solitude, especially at night through backcountry camping. However, these priority uses and wilderness experience can be adequately provided for through daylight-hour day use and without overnight camping. Allowing camping on the refuge, given the lack of staff and financial resources to manage the use, the conflict it would cause with other users, as well as the impact on refuge plant and wildlife resources, makes this an inappropriate use for Monomoy National Wildlife Refuge.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fires

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?		✔
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fires

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Fires are not necessary for visitors to engage in any of the approved public uses on the refuge, including the priority public uses. Fires can disturb nesting and staging shorebirds, seabirds, and wading birds that use the refuge. Fires also have the potential to spread and endanger plants, wildlife, and public safety. Fires are associated with non-wildlife dependent forms of recreation, some of which have been found to be not appropriate. Furthermore, the refuge does not have the resources needed to manage this activity, and any increases in staff would be targeted to enhance population and habitat management, priority public uses, and resource and visitor safety. The use does not support the refuge's establishing purpose to provide for migratory birds.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fireworks

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?		✔
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes _____ No ___✔___.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fireworks

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Fireworks are not an appropriate use on the refuge. Fireworks pose significant impacts to wildlife and habitat, especially during the summer and early fall when shorebirds, seabirds, and wading birds nest and stage on the refuge. In addition, fireworks are a public safety risk that could start wildfires or cause injury to refuge visitors. This use does not support the refuge's establishing purpose to provide habitat for migratory birds.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fisheries Harvest Using Bottom Disturbing Gear and Techniques on Submerged Lands

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Fisheries Harvest Using Bottom Disturbing Gear and Techniques on Submerged Lands

NARRATIVE:

The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) identifies six uses of wildlife refuges as priority public uses; environmental education, interpretation, hunting, fishing, wildlife observation, and wildlife photography. These recreational uses are dependent upon healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses in planning and management.

Fisheries harvest using bottom disturbing gear and techniques occurs in nearshore in subtidal open waters and in intertidal waters, in accordance with Federal, State (and local) regulations, within the refuge's Declaration of Taking boundary, primarily along North Monomoy Island and the western shore of South Monomoy Island. Bottom otter trawling for fin fish and scallop dredging are the most common bottom disturbing fishing conducted within the Monomoy Declaration of Taking area during the 1995 to 2001 period (Stevenson et al 2004). A fixed weir is also placed some years in open waters within the refuge boundary. Fish weirs are temporary fish traps that are jetted into the bottom substrate for stabilization and to secure the fish weir. Hand-operated, long-handled "bull rakes" are also used to harvest soft shell clams and quahogs from shallow, unvegetated subtidal areas, but are believed to have very limited impacts on those bottom or submerged vegetation.

Stevenson et al (2004) provided a useful summary of available scientific information on physical and biological impacts for different gear and bottom types on the Essential Fish Habitat (EFH) around Monomoy refuge. The greatest EFH vulnerability concern was for mobile bottom-tending gear, including various bottom otter trawls, New Bedford-style scallop dredges, and hydraulic clam dredges. Impacts of hydraulic or mechanical shellfish dredges (such as rakes, plungers, or shovels) on intertidal bottom structure and benthic invertebrates are typically greater and longer lasting than those from hand harvest (Ferns et al. 2000, Piersma et al. 2001, MacKenzie and Pikanowski 2004, Verhulst et al. 2004, Munari et al. 2006, Kraan et al. 2007, and Peterson and Estes in press). Depending on the spatial scale involved, changes in bottom topography can have profound effects on benthic infauna (Ray 2005). Dernie et al. (2003) showed that a difference of only 10 centimeters in the amount of material removed during mechanized shellfish harvest from a sand flat in Wales, UK resulted in a substantial decrease in benthic fauna recovery rate. Plots where 20 cm of sediment were removed required 208 days for infaunal community reestablishment, whereas plots with only 10 cm removed recovered in 64 days.

Fisheries harvest using bottom disturbing gear and techniques can degrade eelgrass beds through substrate disturbance (Neckles 2005). Eelgrass meadows have a complex structure that provide habitat for a diverse community of microorganisms, algae, and marine mammals (CT DEP and DA 2007). Eelgrass plants contribute to the overall productivity of the marine ecosystem by using the energy of sunlight to produce organic matter in the form of roots, rhizomes, and plant leaves (CT DEP and DA 2007). Eelgrass meadows support a diverse assemblage of marine invertebrates, including species of marine worms, crustaceans (e.g., barnacles, crabs, shrimp, copepods, amphipods) hydroids, bryozoans, and mollusks (e.g., mussels, snails, and clams). Eelgrass meadows are widely recognized as important fish habitat. Most fishes using eelgrass extensively are young-of-year, juveniles, or adults of species that are small in size. Eelgrass is an important food source for waterfowl such as Atlantic brant, black duck, canvasback duck, and Canada goose.

The Service has statutory authority under the National Wildlife Refuge System Administration Act of 1966 to regulate activities that occur on water bodies within refuge units. The intertidal waters, nearshore open

waters, and subtidal bottoms within the Declaration of Taking boundary are owned by the United States and are not subject to the Massachusetts Colonial Ordinance allowing fishing, fowling and navigation.

Several refuge policies also apply to this use:

16USC668dd, 50 CFR 27.97, "Private Operations. Soliciting business or conducting a commercial enterprise on any national wildlife refuge is prohibited except as may be authorized by special permit."

16USC668dd, 50 CFR, Subpart A, 29.1, Allowing Economic Uses on National Wildlife Refuges

"We may only authorize public or private economic use of the natural resources of any national wildlife refuge, in accordance with 16 U.S.C. 715s, where we determine that the use contributes to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission…"

In light of the above policies, these activities do not support the purposes of the Monomoy National Wildlife refuge (migratory bird and wilderness preservation) or the mission of the National Wildlife Refuge System. Therefore, fisheries harvest using bottom disturbing gear and techniques is therefore determined to be Not Appropriate.

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Dernie, K. M., Kaiser, M. J., Richardson, E. A., and Warwick, R. M. 2003. Recovery of soft sediment communities and habitats following physical disturbance, Journal of Experimental Marine Biology and Ecology :285-286, 415-434.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Horseshoe Crab Harvesting

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

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JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Horseshoe Crab Harvesting

NARRATIVE:

The Atlantic States Marine Fisheries Commission has implemented a fishery management plan to regulate the harvest of horseshoe crabs with the goal of ensuring sustainable population levels. The science, quotas, and harvest regulations of horseshoe crab management are not the primary issues that the U.S. Fish and Wildlife Service (USFWS) must address. Policy and law requires that "uses" taking place on national wildlife refuge lands and waters must be determined to be both "appropriate" and "compatible" with the primary purposes for which the refuge was established and the National Wildlife Refuge System (NWRS).

Horseshoe crab harvesting is not identified as a priority public use of the NWRS under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

The horseshoe crabs' reproductive strategy makes them vulnerable to overharvest. Horseshoe crabs are slow to mature and are easily collected in large quantities during spawning periods. Horseshoe crabs collected from the subtidal areas of Monomoy NWR during spawning are likely adults, and because horseshoe crabs do not mature for nearly a decade, a heavily exploited population will recover slowly (Loveland et al.1996 [AR, 5A, 411-418]).

Declines in horseshoe crab populations have been observed in Massachusetts. A recent study in Bourne, Massachusetts, found that the population had declined by more than 80 percent and spawning activity decreased by 95 percent from 1984 to 1999. In addition, the spawning period had shortened from 56 to 11 days. Researchers also found a substantial decrease in the number of spawning individuals at Stage Harbor, Chatham, Massachusetts, over a 5-year period, suggesting that the decline of horseshoe crab populations on Cape Cod may be widespread (Widener and Barlow 1999 [AR, 5A, 578-579]).

Studies have documented the importance of horseshoe crab eggs to the survival of many shorebird species in Delaware. Many of the shorebird species that use Monomoy during migration have been documented feeding on horseshoe crab eggs in other areas, such as Delaware Bay. These species are present on Monomoy during horseshoe crab spawning periods, or soon enough after spawning that horseshoe crab eggs would be an available food item (Veit and Petersen 1993, USFWS 2001, S. Koch personal communication, S.F. Marino personal communication). Further, the United States Shorebird Conservation Plan considers many of these shorebird species to be species of high concern (Brown et al. 2001).

In 2002, after extensive analysis and research demonstrating that refuge shorebirds eat horseshoe crab eggs, the harvesting of horseshoe crabs from the waters of Monomoy refuge was found to be not compatible. Based on policy preventing the take or disturbance of wildlife on a refuge, continued documented declines in horseshoe crab populations, new information about the length of time that red knots are staging at Monomoy refuge during migration, and the importance of horseshoe crabs in general to priority migratory bird species, horseshoe crab harvesting is not appropriate on Monomoy NWR.

Monomoy NWR was established under the Migratory Bird Conservation Act "…for use as an inviolate sanctuary or for any other management purpose, for migratory birds" (16 U.S.C. § 715d). The harvesting of horseshoe crabs would directly contribute to a decline of spawning horseshoe crabs on the refuge. A decline

in horseshoe crabs, and in particular horseshoe crab eggs, would adversely impact use of the refuge by shorebirds.

This use would not contribute to the achievement of the national wildlife refuge purposes or the NWRS mission. A compatibility determination does not need to be prepared to find this an incompatible use, as it has already been found to be incompatible and, by virtue of this document, is now found to be inappropriate.

LITERATURE CITED:

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Loveland, R. E., M. L. Botton and C. N. Shuster, Jr. 1996. Life history of the American horseshoe crab *(Limulus polyphemus*) in Delaware Bay and its importance as a commercial resource. In Proceedings of the horseshoe crab forum, status of the resource. University of Delaware, Lewes, Delaware. [AR, 5A 411-418].

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Jet Skiing (Personal Watercraft)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?		✔
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes _____ No ___✔___.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Jet Skiing (Personal Watercraft)

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Personal watercraft are small vessels that use an inboard motor to power a water jet pump as the primary source of power. These machines are operated by persons sitting, standing, or kneeling on the vessel. Jet Ski is a commonly used trademark name for one type of personal watercraft. Personal watercraft are different from conventional boats in terms of design, operation, and use; their shallow draft design allows them to be operated at high speeds in shallow waters and close to shore. They are highly maneuverable and capable of speeds exceeding 75 mph. Common operating practices such as weaving between vessels, jumping wakes, spinning doughnuts, and radically changing course. Some personal watercraft that have a two-stroke engine have a fuel efficiency rating of one to five miles per gallon of unleaded fuel.

This type of watercraft is increasing in numbers during the summer months. This corresponds with the time of year thousands of migratory birds, including the federally threatened piping plover and the federally endangered roseate tern, use the Monomoy Islands to nest, rest, and feed. It is critical that the refuge takes action to minimize disturbance to this important habitat, which includes minimizing disturbance within the intertidal zone. The intertidal zone, also known as the littoral zone, is the land on a coastline that is above the water at low tide and underwater at high tide. Animals and organisms that live in the intertidal zone are an important food source for migratory birds.

Since the shallow draft of a personal watercraft allows it to operate in as little as one foot of water, this allows operators to penetrate nesting areas and enter shallow feeding areas within the intertidal zone. Studies have revealed that the noise caused by the engine, along with the movements and spray associated with the operation of personal watercraft, cause disturbance to feeding and resting wildlife. It had also been documented that, when operating in shallow waters, the jet engines can damage submerged aquatic vegetation, a food source for some ducks and geese and other wildlife.

Nearly half (47 percent) of the refuge, and most (86 percent) of the land lying above mean low water is congressionally designated wilderness, including much of the intertidal lands and waters on the refuge. Operating personal watercraft within wilderness is not allowed due to the restriction on mechanized transport within wilderness areas. Additionally, personal watercraft use would have an adverse effect on this pristine natural area because of the level of air, water, and noise pollution personal watercraft emit. Jet ski use and other personal watercraft use would have a negative impact on the wilderness character at Monomoy Refuge. Personal watercraft are not allowed in the Declaration of Taking area or the wilderness areas.

For impacts to refuge wildlife and to wilderness, the use of Jet Skis and other personal watercraft is not appropriate. This use does not contribute to quality wildlife-dependent recreational use nor does it support the purpose for which the refuge was established.

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02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Kiteboarding

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Kiteboarding

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Kiteboarding is a surface water sport that has been described as combining wakeboarding, windsurfing, surfing, paragliding, and gymnastics into one extreme sport. The terms kiteboarding and kitesurfing are interchangeable. Kiteboarding harnesses the power of the wind to propel a rider across the water on a small surfboard or a kiteboard. Large controllable kites ranging in size from .7 square meters to 24 square meters are used to propel the rider and the board across the water. Some riders perform acrobatic stunts as they are being propelled, such as gaining altitude from the surface of the water and jumping objects such as waves and small land masses. Any location with consistent, steady side-onshore winds (10 to 35+ knots), large open bodies of water, and good launch areas is suitable for kiteboarding. Most kiteboarding takes place along ocean shores, usually off beaches. Since kiteboarding relies heavily on favorable, consistent wind conditions, certain locations tend to become popular and sought out by kiteboarders. Several of these locations have been identified off the west and east sides of Monomoy National Wildlife Refuge (refuge), specifically the barrier islands of North Monomoy Island, South Monomoy, and Minimoy Island. These areas within and adjacent to the refuge have favorable winds and adequate water. The refuge is also attractive to kiteboarders as they have access to nearby dry land to stage their gear and equipment and take a rest from the physically demanding activity. Websites provide information about great kiteboarding locations in Chatham, including areas that are along and within the intertidal waters of the refuge *(http://voices.yahoo.com/shared/print.shtml?content_type=article&content_type_id=1201941,* accessed 7/31/2012).

These refuge islands provide important resting, breeding, and feeding habitat for migratory birds, including the federally threatened piping plover and the federally endangered roseate tern. The intertidal zone of these refuge lands are also an important feeding and resting area for migratory birds. Nearly half (47 percent) of the refuge, and most (86 percent) of the land lying above mean low water is congressionally designated wilderness, including much of the intertidal lands and waters on the refuge. This 1970 designation has limited a broad range of human activity within its boundaries. Additionally, the refuge establishes seasonal closures in several locations to protect the habitat and minimize disturbance to wildlife populations. These closures start in early spring when migratory birds arrive and continue through the fall for staging migratory birds. Kiteboarding occurs frequently during the summer months in areas adjacent to many of the closures on both the east and west sides of the refuge islands (Kate Iaquinto 2013 personal communication).

Refuge staff have observed increasing numbers of kiteboarders utilizing the refuge since 2006. This activity has a negative impact on the ability of refuge staff to provide areas undisturbed by human activity for the benefit of migratory birds. Kiteboarders arrive at the refuge with their gear by motorboat and anchor just off shore or directly on the refuge beach including the intertidal zone, often within or adjacent to areas closed for wildlife. The actions of the kiteboarders maneuvering in concentrated areas on top of the water column adjacent to the beach/intertidal zone negatively affect the behavior of birds engaged in feeding, nesting, or

resting. The large sail on the kiteboard has potential to indirectly affect eggs of nesting birds by casting a shadow from the sail on the kiteboard down on the nesting habitat. The nesting birds will leave their nests in an effort to lure the perceived predator (gull/raptor) away from the now exposed eggs. The eggs will not survive long exposed to the summer sun. The birds will continue to leave the nests exposed until the threat is gone. Due to the concentration of kiteboarders in the area, the perceived threat remains until it is too late to ensure survival of the eggs. This defensive behavior is commonly found among several species of birds including the federally endangered piping plover. Refuge staff have observed kiteboarders utilizing areas near Minimoy Island and between North and South Monomoy in the last few years and have several times witnessed kiteboarders causing the tern colonies in these areas to flush (K. Iaquinto 2013 personal communication). In addition to their impact on tern colonies on the refuge, research on the effects of human disturbance at Cape Hatteras National Seashore found that plovers responded more strongly to kite-flying than other forms of human disturbance (Hoopes 1993). Both kite flying and kiteboarding are restricted on Cape Cod National Seashore. Kite flying is prohibited within 656 feet (200 meters) of shorebird nesting areas, and kiteboarding is prohibited on Cape Cod Bay-side beaches and Cape Cod Bay Waters except for the town of Wellfleet Duck Harbor Beach on Cape Cod Bay. The kite surfing/boarding closure on CACO is in effect from April 1 until the last plover chicks have fledged in the area (NPS 2012).

Kiteboarding close to refuge lands comes with its own set if risks. Winds are unpredictable and have the potential to carry a kiteboarder on land resulting in potential injuries to the rider and further disturbance to wildlife.

Kiteboarding is not one of the priority public uses of the Refuge System, nor does the use facilitate the priority public uses of wildlife observation, wildlife photography, environmental education, interpretation, or fishing. Kiteboarding within and adjacent to the designated wilderness area detracts from the wilderness character and the experience of solitude.

LITERATURE CITED:

Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. Unpublished M.S. thesis. University of Massachusetts, Amherst, Massachusetts. 106 pp.

National Park Service. 2012. Cape Cod National Seashore Superintendent's Compendium. April 23, 2012.

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02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Mussel Harvesting

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Mussel Harvesting

NARRATIVE:

The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) identifies six uses of wildlife refuges as priority public uses: environmental education, interpretation, hunting, fishing, wildlife observation, and wildlife photography. These recreational uses depend on healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration above other uses in planning and management. Recreational mussel harvesting is considered a priority public use, i.e., fishing; however, commercial mussel harvesting is not a priority public use.

Mussel harvesting occurs in nearshore open waters, in accordance with State and local regulations, along North Monomoy and the western shore of South Monomoy, within the Refuge's Declaration of Taking boundary. Mussel harvesting is not consistent with goals and objectives in any refuge management plan.

Mussels are an important food source for many migratory birds. We would be providing additional protection for priority wildlife species by not allowing harvest of this species. For example, blue mussels are the most important food item during the winter for common eiders, a Service focal species, congregating in Nantucket Sound (MA DFG 2006). Mussel spat is one of the most important food items of southward migrating red knots (proposed for listing as a threatened species under the Endangered Species Act) using Cape Cod from July through October (Harrington et al. 2010). Mussels are also a common food of American oystercatchers, which typically visually sight these prey in slightly submerged shellfish beds *(http://amoywg.org/american-oystercatcher/food-habits/;* accessed March 2013).

The most common harvest techniques for non-subterranean shellfish (such as dragging and mechanical and hydraulic dredging) are so efficient that mussel beds can be depleted very quickly. Dragging can have severe impacts on subtidal habitat structure by removing large areas of vegetation, such as eelgrass (Neckles 2005).

The Service has statutory authority under the National Wildlife Refuge System Administration Act of 1966 to regulate activities that occur on water bodies within refuge units. In addition, the nearshore open waters and subtidal bottoms within the Declaration of Taking boundary are owned by the United States.

Commercial mussel harvesting as practiced around Monomoy National Wildlife Refuge is considered an economic use of a national wildlife refuge and is guided by the following policies:

16USC668dd, 50 CFR 27.97, "Private Operations. Soliciting business or conducting a commercial enterprise on any national wildlife refuge is prohibited except as may be authorized by special permit."

16USC668dd, 50 CFR, Subpart A, 29.1, Allowing Economic Uses on National Wildlife Refuges

"We may only authorize public or private economic use of the natural resources of any national wildlife refuge, in accordance with 16 U.S.C. 715s, where we determine that the use contributes to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission…"

Mussel harvesting is therefore determined to be not appropriate.

LITERATURE CITED:

American Oystercatcher Working Group. 2011-12. *http://amoywg.org/american_oystercatcher/food-habits/* Accessed March 2013.

Harrington, B.A., S. Koch, L.K. Niles, and K. Kalasz. 2010. Red knots with different winter destinations: differential use of an autumn stopover area. Watervirds 33(3): 357-363.

Neckles, H.A., F.T. Short, S. Barker, and B.S. Kopp. 2005. Disturbance of eelgrass *Zostera marina* by commercial mussel *Mytilus edulis* harvesting in Maine: dragging impacts and habitat recovery. Marine Ecology Progress Series. 285: 57-73.

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FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Recreational Over-sand Vehicle Use

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?		✔
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Recreational Over-sand Vehicle Use

NARRATIVE:

The majority of Monomoy National Wildlife Refuge uplands were included in the Monomoy Wilderness designated in 1970 (P.L. 91-504) as part of the National Wilderness Preservation System. The Wilderness Act of prohibits the use of motorized equipment and mechanized transport within designated wilderness. An exception for the use of aircraft and motorboats in areas where that use was previously established and deemed desirable by the Secretary to continue does apply to Monomoy NWR, but does not extend to motorized vehicles. The Wilderness Act does allow provide an exception for emergencies involving the health and safety of persons within the wilderness area.

At Monomoy, visitors wishing to use over-sand vehicles (OSV) would travel both on the beach and through the inland portion of the refuge. This would be potentially damaging to four main groups of wildlife; nesting and roosting shorebirds and seabirds, northeastern beach tiger beetle adults and larvae, and marine mammals, all of which use the beach and intertidal areas as a critical part of their habitat. More specifically, the use of OSVs on Monomoy NWR is not consistent with the Piping Plover, Northeastern Beach Tiger Beetle, and Roseate Tern Recovery Plans.

The piping plover is a federally endangered species that relies on Monomoy's beaches for nesting. Off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Hoopes 1993, Goldin 1993). The plan also notes that the magnitude of the threat from off-road vehicles is particularly significant, because vehicles extend impacts to remote stretches of beach where human disturbance would otherwise be very slight (USFWS 2009, USFWS 1996). The common tern colony on the refuge is very sensitive to human disturbance as well, and intrusion into the colony by OSVs would result in temporary and/or permanent nest abandonment and direct mortality of unfledged chicks or unhatched eggs.

The northeastern beach tiger beetle recovery plan also sites impacts to beetles, particularly in the larval stage, from OSVs. The plan states that vehicles may physically compact the beach substrate and/or disrupt thermal and moisture microhabitat gradients that are important for larvae (Schultz 1988). In a survey on Assateague Island, Maryland (Knisley and Hill 1992), tiger beetle adults and larvae of Cicindela dorsalis media were absent from a section of beach that received heavy ORV use, but present on either side of the ORV zone (USFWS 1994). The extirpation of the northeastern beach tiger beetle from most of its range has been attributed primarily to destruction and disturbance of natural beach habitat from shoreline developments, beach stabilization structures, and high recreational use, all of which are thought to affect the larval stage (Knisley et al. 1987). In addition, extensive surveys completed prior to listing indicated that this tiger beetle was rarely found on beaches with heavy public use or OSV access. Studies have also shown that mortality of early instars increases in direct proportion to the level of human use, including foot traffic (USFWS 1994).

OSVs also pose a threat to staging roseate terns that use South Beach and South Monomoy Island in large numbers. The 2010 5-Year Review of the Caribbean Roseate Tern and North Atlantic Roseate Tern (Sterna dougallii dougallii) Recovery Plan states, "Although they generally congregate at the ends of barrier beaches or at other sites that are relatively remote from human activity, they are regularly disturbed there by pedestrians, dogs and vehicles (Trull et al. 1999; MAS and J. Spendelow, unpubl. data). They do not allow such close approach at the staging sites as they do at the breeding sites, and consequently spend much time flying, especially at high tides when space is limited for both birds and humans."

Seals that are loafing on the beach are subjected to harassment and will abandon their resting sites upon the approach of an OSV. This would be a violation of the Marine Mammal Protection Act.

The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) identifies six legitimate and appropriate uses of wildlife refuges; environmental education, interpretation, hunting, fishing, wildlife

observation and wildlife photography. These priority public uses are dependent upon healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses in planning and management. All other recreational uses are now considered general uses. As noted in the Appropriate Use Policy: "General public uses that are not wildlife-dependent recreational uses (as defined in the Improvement Act) and do not contribute to the fulfillment of refuge purposes, or goals, or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from the responsibilities to protect and manage fish, wildlife, and plants and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Allowing the use of OSVs on the refuge is not a priority public use, but a general use. This use does not, as a standalone activity, contribute to the fulfillment of refuge purposes, and would detract from the refuge staff's responsibilities to protect and manage fish, wildlife, and plants and their habitats, as well as detract from administering priority uses. The use of over-sand vehicles is not consistent with two executive orders, E.O. 11644 and E.O. 11989, which require that refuges promote safety, minimize conflicts among users, monitor effects of off–road vehicles use if allowed, and close areas to use of OSVs if they will cause adverse effects on soil, vegetation, wildlife, habitat or cultural or historic resources. Potential impacts include: soil compaction and erosion, trampling and mortality of fragile plant communities, habitat loss/deterioration, a shift in plant communities along trails, wildlife disturbance, and a concern for safety due to excessive speed of OSV users. This use is not consistent with any approved refuge management plan and would divert existing and future resources from accomplishing priority tasks. We do not believe it would contribute to public appreciation or understanding of refuge resources and we believe it could cause conflicts with priority public uses. It would be a violation of the National Wilderness Preservation Act as well. The refuge does not have the facilities or staff to manage this use. Therefore, the general use of OSVs is determined to be inappropriate and will not be allowed on Monomoy NWR.

LITERATURE CITED:

Goldin, M.R. 1993. Piping plover (Charadrius melodus) management, reproductive ecology, and chick behavior at Goosewing and Briggs Beaches, Little Compton, Rhode Island, 1993. The Nature Conservancy, Providence, Rhode Island.

Hoopes, E.A. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. M.S. Thesis. University of Massachusetts. 106 pp.

Knisley, C.B., J.I. Luebke, and D. R. Beatty. 1987. Natural history and population decline of the coastal tiger beetle, *Cicindela dorsalis dorsalis* Say (Coleoptera: Cicindelidae). Virginia Journal of Science 38: 293-303

Knisley, C.B. and J.M. Hill. 1992. Effects of habitat change from ecological succession and human impact on tiger beetles. Virginia J. Sci. 43: 133-142.

Schultz, T.D. 1988. Destructive effects of off-road vehicles on tiger beetle habitat in central Arizona. Cicindela 20: 25-29

Trull, P., S. Hecker, M.J. Watson, and I.C.T. Nisbet. 1999. Staging of roseate terns *Sterna dougallii* in the post-breeding period around Cape Cod, Massachusetts, United States. Atlantic Seabirds 1: 145 to 158.

USFWS. 1994. Northeastern Beach Tiger Beetle *(Cicindela dorsalis dorsalis*). Recovery Plan. September 1994. Hadley, MA.

USFWS. 1996. Piping Plover *(Charadrius melodus).* Atlantic coast population revised recovery plan. May 1996. Hadley, MA.

USFWS. 2009. Piping Plover *(Charadrius melodus).* Five-Year Review: Summary and Evaluation. September 2009. Hadley, Massachusetts.

USFWS. 2010. Caribbean Roseate Tern and North Atlantic Roseate Tern *(Sterna dougallii dougallii)* 5-Year Review: Summary and Evaluation. September 2010. Concord, New Hampshire.

Wheeler, N.R. 1979. Effects of off-road vehicles on the infauna of Hatches Harbor, Cape Cod National Seashore, Massachusetts. University of Massachusetts/ National Parks Service Cooperative Research Unit Report No. 28. 47 p.

Zonick, C.A. 2000. The winter ecology of the piping plover *(Charadrius melodus)* along the Texas Gulf Coast. Ph.D. Dissertation. University of Missouri, Columbia, Missouri.

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02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Pets

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Pets

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System."

Pets are any considered any domesticated animal either accompanied or not accompanied by an owner. This includes, but is not limited to, dogs, cats, pigs, ferrets, parrots, snakes, and horses. In the past, dogs on leash were allowed on the Morris Island portion of the refuge. Numerous documented violations of the leash requirement occurred annually. Failure of pet owners to comply with refuge regulations is part of the justification for discontinuing pet walking on the refuge. Additionally, it has been demonstrated that dogs and other pets can have a significant impact on wildlife. Jones and Stokes (1977) demonstrated that domesticated dogs have serious detrimental impacts on local concentrated nesting bird populations. Studies have demonstrated that dogs can, and do, flush incubating birds from nests with possible serious consequences to declining bird populations (Yalden and Yalden 1990, Soluri 1994, Gill 1994). Further, the presence of domesticated dogs can disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Other studies have shown that even when dogs are restrained on leash, they have the ability to displace native migratory bird species from natural habitats and cause a depauperate local bird fauna (Banks and Bryan 2007).

Additionally, a study of shorebird disturbance from humans and dogs found that gulls recovered faster from disturbance than did smaller shorebird species (Burger et al. 2007). This rapid recovery time could give competitive advantage to gulls for prime habitat over other shore birds that are a focus of refuge management goals. In winter, the energy expenditure used by birds to avoid dogs, which are seen as potential predators, is unnecessary and avoidable and could contribute to reduced survivability. Dog waste is unsightly for refuge visitors, and can transmit diseases that may threaten the health of some wildlife and other domesticated animals. The refuge does not provide receptacles for animal waste, which if left along the refuge's single small trail, diminishes the quality of the visitor's wildlife recreational experience. Domestic dogs can potentially introduce various diseases (distemper, parvovirus, rabies) and transport parasites into wildlife habitats (Sime 1999). Additionally, not all refuge visitors are pet friendly, and unrestrained dogs can disturb refuge visitors.

The Town of Chatham prohibits dog use from town beaches from April 1 through September 15 but allows dog walking the remainder of the year. These town beaches provide more land for public dog walking and play than does the 46-acre Morris Island tract on the refuge, and allow pet recreationalists to disperse over a greater area, decreasing the likelihood that an individual pet will disrupt wildlife or have a negative interaction with wildlife-dependent recreationists. To ensure the protection of wildlife and habitat, provide quality wildlife-dependent recreation opportunities, and support the refuge's establishing purpose for migratory birds and endangered species, the refuge has determined the presence of pets to be not appropriate on Monomoy National Wildlife Refuge.

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Organized Picnicking

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✔
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✔

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Organized Picnicking

NARRATIVE:

Service policy does not encourage picnicking, although it is recognized to occur incidentally to the priority public uses described in the Refuge System Improvement Act of 1997. The refuge does not provide amenities for any large-scale or organized gatherings for this activity. Allowing this activity would enable visitors to bring a picnic meal and eat, while not participating in wildlife-dependent recreation. Introducing food to the beach ecosystem would encourage scavengers and likely impact the natural balance of the food chain, potentially causing harm to priority species the refuge seeks to protect. This use could have potentially significant adverse impacts on refuge wildlife and habitat and would require monitoring by refuge staff above refuge resource capacity. In addition, the use is expected to detract from the mission of the National Wildlife Refuge System and potentially diminish the purpose for which the refuge was established. For these reasons, organized picknicking is found to be not an appropriate use.

This finding for organized picnicking should not be read as banning all food and drink on the refuge. We understand that those engaged in most permitted uses of the refuge will bring food and drink, as appropriate, for consumption while engaged in those uses, and we take this into account in analyzing the impacts of those uses. The refuge is a leave-no-trace, carry-in-carry-out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

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02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Stage Island Parking and Dinghy Storage

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?		✔
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?		✔
(h) Will this be manageable in the future within existing resources?		✔
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___✔___ **Appropriate** _____

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Stage Island Parking and Dinghy Storage

NARRATIVE:

Tract 7b is a small (100 foot x 75 foot lot with a 20-foot-wide right-of-way) waterfront parcel located on Stage Harbor in Chatham. Access to this small parcel for vehicle parking and dinghy storage on Stage Harbor has been granted to private individuals (by permit only) since at least 1984. Tract 7b access to Stage Harbor is controlled by a chain gate with combination padlock. The Stage Harbor lot is predominantly a non-vegetated, improved gravel parking lot (maximum capacity - 8 vehicles) that grades gently down to a narrow strip of unimproved, natural sand beach and intertidal zone fronting 75 feet on Stage Harbor.

Dinghy storage, launching and landing, and associated vehicle parking at Stage Harbor Lot 7b are not priority public uses of the Refuge System, nor do they facilitate the priority public uses of wildlife observation, wildlife photography, environmental education, interpretation, or fishing. Hunting is not permitted on Monomoy NWR.

Use of this parcel for vehicle parking and dinghy storage provides an economic benefit to a small, select group of private individuals. Several commercial shellfish harvesters have renewed their permits annually to access the Stage Harbor waterfront or their nearby boat moorings (locations assigned by the Town of Chatham Harbormaster). The remaining permit holders are property owners in the Stage Island and Quitnesset neighborhoods who have boats moored near the Stage Harbor lot. The economic benefit to these permittees comes largely in the form of time and fuel savings when accessing their private boats and moorings. Economic uses of the refuge by private individuals must contribute to the purposes of the refuge. No benefits to the refuge wildlife or wilderness stewardship purposes are provided by allowing this use to continue beyond the small revenue from permit fees. The $35 annual permit fee collected from 5 to 10 permits annually falls well short of refuge costs for administering and enforcing the permit system.

Monomoy National Wildlife Refuge currently receives no funding for managing wildlife-dependent recreational uses and has no positions dedicated to managing such uses, law enforcement, or continuing to administer the permit system employed in recent years. Providing for this use is not possible within the available budget or staffing now or into the future with existing refuge resources. Approximately $2,000 in refuge funds and 8 days of staff time annually must be diverted from refuge projects intended for managing migratory birds and other federally listed endangered or threatened species to administer a permit system that benefits 5 to 10 individuals per year. This administrative burden on refuge resources impairs rather than benefits refuge natural and cultural resource management.

Refuge staff require unencumbered access to the waterfront and the entire Stage Harbor lot for daily operational refuge management purposes. Our use of this lot has increased with the siltation of the Morris Island Channel. Having privately owned parked vehicles and dinghies stored on this small parcel results in congestion and potential safety conflicts between refuge vehicles, boats, equipment, and personnel and private vehicles and waterfront storage space. This conflict is avoidable by eliminating all private use of this refuge parcel. Alternative public and private boat access, storage, and vehicle parking sites are available off refuge lands along the shoreline of Stage Harbor at Stage Harbor Marine near the Mitchell River Bridge, at the Town of Chatham Harbormaster's offices, and for carry-in boat access from the Morris Island Road Causeway.

Stage Island parking and dinghy storage is found to not be an appropriate use.

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02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Beachcombing

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Beachcombing

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System." Beachcombing is not specifically identified as a priority public use in the National Wildlife Refuge System Improvement Act of 1997, but beachcombing often leads to wildlife observation and interpretation, which are priority public uses.

Beachcombing must be conducted in accordance with refuge regulations, including seasonal closures. Beachcombing would be limited to the collection of small amounts of seashells and stones. The collection of living plants or animals or shells that have living organisms in them would not be allowed. Allowing visitors to pick up shells and beach debris and take home a small amount of shells and stones from the refuge will encourage an appreciation for the beach and marine environment. While this activity can have negative impacts on wildlife and habitat, as invertebrates that are a food source for shorebirds are at times attached to shells and other pieces of marine debris, it will not be conducted in areas being used by resting, nesting, or feeding wildlife. Visitor use will be restricted in time and place to minimize disturbance to wildlife, if the number of people engaged in this activity exceeds our relatively low expectation.

Allowing visitors to collect small amounts of shells and stones while beachcombing will contribute to public appreciation of Monomoy NWR. Costs associated with administering these uses and likely visitor impacts are both minimal. These uses will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of Monomoy NWR. Therefore, it is the determination of the Service that beachcombing is a compatible use of the refuge.

COMPATIBILITY DETERMINATION

USE:

Beachcombing

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (P.L. 88-577 §2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?
This use involves walking along the beach and picking up shells, plants, wildlife, and other refuge resources. The collection of small amounts of shells and stones can also occur.

(b) Is the use a priority public use?
Beachcombing is not specifically identified as priority public uses in the National Wildlife Refuge System Improvement Act of 1997, but beachcombing often leads to wildlife observation and interpretation, which are priority public uses.

(c) Where would the use be conducted?
Beachcombing could occur on any areas of Monomoy NWR that are open to public access. Public access is dictated by wildlife use and presence of sensitive vegetation. In general, much of the intertidal area through the dune system is open for much of the year. Some areas of beach berm are closed seasonally to protect seals,

nesting shorebirds, and seabirds. Visitors should contact Monomoy NWR staff for up-to-date information on seasonal closures. Information about closures will also be available on the refuge Web site.

(d) When would the use be conducted?
Beachcombing could occur any time of the year in any areas open to public access during regular refuge hours. Use for these activities is likely to be highest in the summer and early fall. Monomoy NWR is open daily from ½ hour before sunrise to ½ hour after sunset, year-round. The Morris Island non-wilderness portion of the refuge is open for recreational saltwater fishing 24 hours daily.

(e) How would the use be conducted?
Beachcombing must be conducted in accordance with refuge regulations, including seasonal closures. Beachcombing would be limited to the collection of small amounts of seashells and stones mainly done during the low tide cycle. The collection of living plants or animals or shells that have living organisms in them would not be allowed.

(f) Why is this use being proposed?
Beachcombing has historically occurred on Monomoy NWR. Affording opportunities for public enjoyment by collecting small amounts of shells and stones through beachcombing will increase visitor appreciation and foster a greater awareness of the importance of this site to the National Wildlife Refuge System.

AVAILABILITY OF RESOURCES:

Beachcombing is often one of many incidental activities that refuge visitors engage in when on the refuge. As such, we do not anticipate refuge costs associated with this activity alone.

ANTICIPATED IMPACTS OF THE USE:

The proposed use is anticipated to have the same level of impacts as priority public uses, because the access and activities are very similar. These activities occur only in open areas of the refuge, therefore, natural resource and wilderness character impacts of beachcombing will likely be minimal if conducted in accordance with refuge regulations. Possible impacts include disturbing wildlife, trampling of plants, littering, and vandalism. Beachcombing may intermittently interrupt the feeding habits of a variety of shorebirds, gulls, and terns. The removal of shells, wrack, and other natural debris from the beach may indirectly affect wildlife by reducing food availability and microhabitat used by invertebrates, which are preyed upon by shorebirds. Seals could be flushed into the water from their loafing spots on the beach, which could result in a slight increase in energy expenditure by the seals.

Pedestrian travel has the potential of impacting seals, shorebird, waterfowl, and other migratory bird populations feeding and resting on beaches during certain times of the year. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. In studying waterbird response to human disturbance, Klein (1993) found that, as intensity of disturbance increased, avoidance response by the birds increased, and found out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of

recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects on birds of recreation using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreational activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al.1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

Beachcombing will be restricted to minimize disturbance through beach closures or allowing the use during certain hours of the day. Although some disturbance to migratory birds will occur, it should be minimal due to the location of the activity. Much of the beach area would not be impacted and closures are in place to protect nesting, resting, and foraging piping plovers, other shorebirds, staging terns, and other waterbirds. In the event of persistent disturbance to habitat or wildlife, these activities will be further restricted or discontinued.

Pedestrians are required to observe a 150-foot buffer around all seals. At Monomoy NWR, seal haulout locations regularly change; given the amount of shoreline accessible to seals, it is not practical to erect symbolic fencing to separate visitors from the seals. Compliance with the buffer, which was established to protect the seals under the Marine Mammal Protection Act, will decrease impacts to seals.

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of walking are likely to be minimal if conducted in accordance with refuge regulations. We will manage refuge closures to minimize pedestrian disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed depending on bird activity and results of further disturbance studies. The refuge is a leave-no-trace, carry-in-carry-out facility. All food containers, bottles,

and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the visible and invisible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

Beachcombing is consistent with the enjoyment and preservation of wilderness, as long as only small amounts of seashells and stones are collected. Beachcombing does not alter the natural, scenic condition of the land and will not occur at a scale big enough to diminish the environment for native plants and animals. Beachcombing is usually conducted in a solitary manner or in a very small group. It specifically provides opportunities for individuals to connect with nature and wildlife. Given the few number of visitors at the refuge who engage in beachcombing within the wilderness area, no negative impacts on wilderness character are anticipated.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Beachcombing will only be allowed on sections of the beach that are open for public use. The beach is subject to seasonal closures for staging and breeding plovers, other shorebirds, seabirds, and seals. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.

Occasional law enforcement patrol and regular staff or partner presence should minimize potential violations. Refuge regulations will be posted and enforced.

Visitors will be provided information to ensure that they understand the value of shells, wildlife, stones, and plants on the refuge, particularly in the wrack line. Visitors will be informed to collect only small amounts of shells and stones. The collection of plants, living animals, and archaeological and historical artifacts will not be permitted.

Periodic evaluations will be done to ensure that visitors are not causing unacceptable adverse impacts. Areas open to these uses will be evaluated on an annual basis depending on geomorphology and wildlife use.

JUSTIFICATION:

Allowing visitors to collect small amounts of shells and stones while beachcombing will contribute to public appreciation of Monomoy NWR. Costs associated with administering these uses and likely visitor impacts are both minimal. These uses will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of Monomoy NWR. Therefore, it is the determination of the Service that beachcombing is a compatible use of the refuge.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Commercial Tours, Ferry Service, Guided Trips, and Outfitting

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

603 FW 1
Exhibit 1
Page 2

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Commercial Tours, Ferry Service, Guided Trips, and Outfitting

NARRATIVE:

Commercial guiding and outfitting, and natural and cultural history guide and tour activities generally support refuge purposes and have positive effects on the overall interpretive, environmental education, and wildlife observation programs of the refuge. Some of these commercial services will occur within the Monomoy wilderness. Commercial services may be allowed in wilderness areas, per the Wilderness Act (Public Law 88-577), if they support recreational or other wilderness purposes of the wilderness area. The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Guided natural history tours are a public use management tool intended to develop a resource protection ethic within society. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management, ecological principles and communities, and wilderness values and ethics. A secondary benefit of this use is that it instills an ownership or stewardship mentality in visitors, which helps reduce vandalism, littering, and poaching; it also strengthens Service visibility in the local community. Cultural history activities allow visitors to learn about the artifacts left in an area and gain an appreciation for the lands involved and the refuge purpose.

Issuing special use permits and concession permits for commercial guiding and outfitting does not significantly impact biological resources for which the refuge was established and requires no additional facilities. The administrative requirement is minimal. This activity has a positive effect on the overall interpretive, environmental education, and wildlife observation programs of the refuge, reaching a much larger audience. This use would contribute to the mission of the refuge by increasing the audience that receives the message of the Service, producing a greater appreciation of wildlife resources in participants, and building relationships between the refuge and area businesses.

Shifting channels, bars, and shoals, and strong ocean currents make boat travel between the Monomoy Islands and the mainland a challenge for even the most experienced mariner. Commercial ferries provide a safe alternative for visitors to explore beyond the mainland portion of the refuge. Visits to the islands occur during daylight hours only, particularly midday when migratory bird activity is diminished, and ferry service is offered May through September only. Guided tours for recreational saltwater fishing enhance the experience of many anglers, particularly those who are not familiar with Monomoy NWR and the Monomoy wilderness or do not have the means to get to prime fishing spots on their own. Ferry service provided by a concession or an off-site ferry provider facilitates several priority public uses and allows visitors to access certain locations on the refuge that are otherwise challenging to get to on foot.

We do not expect pedestrian access to materially interfere with or detract from the mission of the National Wildlife Refuge System or diminish the purpose for which the refuge was established. It will not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden. For these reasons, commercial guides, tours, outfitting, and ferry use are appropriate uses on Monomoy NWR.

COMPATIBILITY DETERMINATION

USE:

Commercial Tours, Ferry Service, Guided Trips, and Outfitting

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…" 16 U.S.C. § 715d (Migratory Bird Conservation Act).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?
This use is any fee-based service providing recreational, educational, or interpretive enjoyment of refuge lands and waters to the visiting public such as transportation, interpretation, educational materials, and programs. The services must aim to enhance the refuge visitor's knowledge and enjoyment of the key natural resources, including wilderness, and the mission of Monomoy National Wildlife Refuge (Monomoy NWR; refuge) and the U.S. Fish and Wildlife Service, or other uses otherwise determined appropriate and compatible with the purposes for refuge establishment, including guided wildlife observation or photography, natural history or cultural history tours; transport of individual or groups (most commonly by boat) to or from refuge lands for recreational fishing, wildlife observation or photography, nature study or interpretation, and other wildlife-oriented activities, or hiking or walking to experience the naturalness or solitude of the Monomoy Wilderness; and guiding and outfitting other compatible outdoor activities on refuge lands such as, but not limited to, birding or recreational fishing and associated transportation (typically by boat) and accommodations. Some of

these typically commercial services will occur within the Monomoy wilderness, and if so, they are determined to be necessary for realizing the recreational or other wilderness purposes of the Monomoy wilderness. The use may be conducted by a Service conservation partner, concessionaire, or private concern but will fall under the general heading of eco-tourism. In all cases, participants pay a fee to the individual guide, business, or a nonprofit organization for the unique skills, equipment, and expertise of the leader who enhances the experience of the participating individual or party on refuge lands.

(b) Is the use a priority public use?
Commercial tours and ferry services conducted by a concessionaire, guide, or outfitter are not priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). While not a priority use, this use does support several wildlife-dependent priority uses including waterfowl hunting, fishing, wildlife observation and photography, environmental education, and interpretation. The use constitutes a commercial enterprise within wilderness, however commercial services may be allowed in wilderness areas, per the Wilderness Act (Public Law 88-577), if they support recreational or other wilderness purposes.

(c) Where would the use be conducted?
The use would occur on any refuge lands or waters within the Declaration of Taking boundary that are open to public access, including the Monomoy wilderness. Certain areas on Monomoy NWR are seasonally closed to public access, at the refuge manager's discretion, to protect sensitive habitats or species of concern, minimize conflicts with other refuge activities, or respond to human health and safety concerns. All commercial touring, ferry operations, guiding and outfitting activities will be restricted from access to sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and will be conducted in a manner that minimizes impacts to nesting birds or other breeding, feeding, or resting wildlife. Commercial ferry service, tours, guides, and outfitters transporting visitors to designated landing sites on North Monomoy Island and South Monomoy would originate from designated facilities either on the refuge (Morris Island), or from one or more off-refuge locations such as Outermost Harbor, Stage Harbor, Chatham Harbor, or Harwichport.

(d) When would the use be conducted?
The use will be largely seasonal and dictated by weather, and would occur during daylight hours when weather is appropriate generally from May through November. Monomoy NWR is open daily from ½ hour before sunrise to ½ hour after sunset, year-round. The Morris Island portion of the refuge is open for licensed recreational, saltwater fishing 24 hours daily.

(e) How would the use be conducted?
Guided tours typically consist of an individual or group including a leader or guide walking on established trails or open refuge areas learning about plant and wildlife species, natural processes and wetlands, and cultural history such as the Monomoy Point Lighthouse and keeper's residence. For offshore tours, participants are ferried by boat to designated boat landing sites, and then hike to one or more intended destinations. Commercial guides may provide intensive, individual guidance to refuge visitors most often engaged in birding and recreational saltwater fishing, as the refuge is a prime birding, surf fishing, and fly fishing location. Guides may also be employed by individuals or groups to enhance priority public use experiences, including photography or bird watching. In all cases, participants pay a fee for the professional expertise, a unique skill or equipment, and transportation to refuge lands and waters. Tours are generally offered on a seasonal basis (seal and boat tours). Nonmotorized eco-tour outings to Monomoy via kayak, catamaran (sailing), or backpacking offer future expansion potential to more fully realize recreational and other wilderness purposes, while preserving wilderness character.

All guides and tour operators would be required to obtain a permit (concession or special use), and comply with all refuge regulations and with State and Federal guidelines for terns, piping plovers, marine mammals, and coastal dune protection. Special use permits are required for trips originating from offsite locations. A concession contract would be required for trips involving any exclusive use of refuge land and facilities for organizations, outfitters, and individual guides conducting tour activities on Monomoy NWR. All Monomoy NWR visitors are expected to stay apprised of and respect all closures and regulations. Information on annual, seasonal, and daily closures, known hazards, and other regulations will be disseminated from the Morris Island headquarters, and closures will be well-marked with informational signs or symbolic fencing.

(f) Why is this use being proposed?
Monomoy NWR is a world-renowned birding destination, a destination for seal and whale watching tours (and potentially great white shark tours), as well as the only coastal barrier complex unit in the National Wilderness Preservation System in New England, and remains a popular destination for recreational saltwater angling. A viable, local wildlife-fish tour and charter boat ecotourism industry emerged in the Chatham vicinity and established itself over the past two decades, with Monomoy as a focal point. The private sector stands willing and able to provide such services for a reasonable fee.

The refuge historically receives requests from one to five commercial operators and nonprofit organizations annually for permits to transport and guide individuals or groups of visitors on trips to Monomoy and surrounding waters within the Declaration of Taking boundary. Two of the permits issued annually go to operators whose trips originate from nearby, off-refuge locations. However, one of the first commercial seal tour and ferry services established in the area has operated continuously from refuge facilities under a special use permit (fee) that includes access to parking, public restrooms, interpretive trails, and waterfront access on Morris Island (headquarters and visitor contact station). Visitation to the Morris Island site has grown as the popularity of both Monomoy NWR and the seal tour has increased over nearly two decades. Current refuge parking no longer accommodates the demand for spaces on most days during June through August, resulting in considerable traffic congestion at the Morris Island site and nearby private roadways, increased risk of vehicle-pedestrian accidents, and complaints from neighboring private property owners. There is no further opportunity to expand parking at the refuge Morris Island site. Overflow parking along the east public shoulder of Morris Island Road, while permitted by the Town of Chatham, is not without hazards for motorists, pedestrians, bicyclists, and emergency responders.

Guided tours, outfitters, and ferry services are a way during daylight hours to get wildlife-dependent and fish-dependent recreation users to and from refuge destinations that are not otherwise accessible by foot. The Monomoy Wilderness offers areas with outstanding opportunities for unconfined, primitive, outdoor, day-use recreation and solitude, and the proposed use would aid wilderness users to realize those opportunities not otherwise possible. Tours and individual guided sessions will help visitors experience and engage and connect with the key resources of the refuge, including an enduring resource of wilderness. Allowing the use is expected to increase visitor understanding and appreciation of the refuge and its resources and compliance with refuge regulations. Limiting the use of refuge facilities at the headquarters site to a concessionaire will reduce congestion and provide more opportunity for other refuge visitors to find parking.

AVAILABILITY OF RESOURCES:

The following breakdown shows the estimated amount of funds needed annually to administer the refugewide tour and ferry fee permits.

GS-11 Visitor Services Manager - permit issuance (concession solicitation/award and special use permit processing	120 hours	$5,400
Total new costs		**$5,400**
GS-09 Visitor Services Assistant - permit administration, oversight and compliance checks	40 hours	$1,500
GS-9 Biological Staff – use impact monitoring	40 hours	$1,500
Facility Maintenance		$2,000
Materials		$1,000
Total recurring annual cost		**$6,000***

* Permit/concession fees will partially/wholly offset agency costs to administer the use.

ANTICIPATED IMPACTS OF THE USE:

Commercial Tours, Guides, and Outfitting

The access and activities resulting from the proposed use are virtually identical to those under the primary public uses, especially environmental education and interpretation, and the same levels of impacts are expected. Because the use will occur in accordance with refuge regulations and only in refuge areas open to the public,

the impacts of commercial tours, ferry services, guides, and outfitters on natural resource and wilderness character will likely be minimal when conducted in accordance with refuge regulations. Possible wildlife and fisheries impacts include disrupting nesting migratory bird populations, disrupting terns, shorebirds, and other bird populations feeding and resting near the trails during certain times of the year, trampling vegetation and soil, disrupting threatened larval northeast beach tiger beetle populations, disturbing seals, and harvesting fish.

On Monomoy NWR, area closures are created to protect priority nesting migratory tern and shorebird species. Although these closure areas are designed to minimize human impacts, the potential exists for impacts to unobserved nesting animals. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of suboptimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or the eggs can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreational activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al.1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of commercial tours, guides, and outfitters are likely to be minimal if conducted in accordance with refuge regulations. The refuge will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or decreased as needed, depending on bird activity and results of further disturbance studies. The refuge is a leave-no-trace, carry-in-carry-out facility. We encourage all outfitters and guides to pack in and pack out all food containers, bottles, wrappers, trash, and other waste and refuse. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

Foot travel for commercial tours, guides, and outfitting group trips occurs on old beach buggy trails, deer trails, and around designated closed areas for the purpose of studying plant or animal life. Trampling of some vegetation is likely.

Unmanaged hiking or walking has the potential to damage or kill plants and lead to new, unwanted, impromptu trails on the refuge that become shortcuts through more ecologically sensitive sites. Heavy use of designated, managed, or unmanaged pedestrian travel routes can ultimately lead to areas devoid of vegetation (McDonnell 1981, Vaske et al 1992) and potentially destabilize dunes and interdunal wetlands, which are difficult to stabilize and restore to a naturally functioning condition (Kucinski and Einsenmenger 1943, Cole 2002, Goldsmith 2002, Grady 2002, O'Connell 2008).

Trampling has three initial effects: abrasion of vegetation, abrasion of surface soil organic layers, and soil compaction (Cole 2002). Plants can be crushed, sheared off, bruised, and even uprooted by trampling, leading to reduced vigor and reproduction, reduced or altered plant species composition and structure, and reduced biomass and cover (Cole 2002). Of these, abrasion of vegetation is the most common and noticeable effect observed in coastal dune communities, where little or no surface organic layer exists on the sandy soil substrate that naturally resists compaction (Fletcher 1993). All three impacts can commonly occur, however, within coastal marsh habitats where reduced wave energy allows significant accumulation of surface organic layers that are vulnerable to compaction (Fletcher 1993), which increases surface soil bulk density and reduces permeability. Increased ponding and muddy conditions tend to promote wider vegetative and soil impact zones along trails through wet areas (Cole 2002). McDonnell (1981) analyzed long-term human trampling, ranging from low to high intensity, on coastal dune vegetation at Parker River National Wildlife Refuge in Massachusetts. All levels of trampling significantly lowered species diversity, and heavy trampling caused a drastic reduction in species diversity and total vegetation cover. Moderate trampling reduced species diversity but not cover. This was probably because moderate trampling favored some species, such as beach grass, over other, more sensitive species, such as beach-heather *(Hudsonia tomentosa)*. Trampling may result in changes in plant communities by preventing succession in interdune and backdune areas and favoring disturbance-tolerant foredune species like beach grass.

The harsh growing conditions and environment in the coastal barrier system can make for slow vegetative recovery even after pedestrian traffic is eliminated at trampled sites (Fletcher 1993). The gradient from no vegetation to normal cover levels is very narrow along refuge trails and other footpaths where trampling is more concentrated, and is wider at traditional boat landings where trampling is more dispersed. Hiking and walking are among the most primitive forms of recreation, and the trails themselves encourage users to confine their hiking or walking to narrow corridors radiating or looping outward from user focal areas such as beach access points or boat landings. Localized impacts concentrated near a small number of the most popular destinations do not pose any serious disruption to the barrier ecosystem composition, structure, and function, and are not evident at large spatial scales on Monomoy NWR.

Once established, the trails themselves are clear evidence of human presence that detracts from some users' perceptions of an otherwise untrammeled, undeveloped, or natural appearing landscape (Hendee and Dawson 2002) within the Monomoy Wilderness. Bare, exposed sand (dune areas) and potentially compacted (tidal marsh segments) trail treads and narrow zones of disturbed vegetation on either side of refuge foot trails and boat landings will be readily evident, but when trail standards are kept minimal, trails tend to be accepted or even expected by most, though not all, wilderness users (Stankey and Schreyer 1987, Cole 2002, Hendee and Dawson 2002). The majority of the Monomoy Wilderness will remain essentially unvisited and virtually undisturbed by hiking and walking. Pedestrian footpaths are not expected to substantially compromise the perception of naturalness of the Monomoy Wilderness landscape or the wilderness user's experience (Cole 2002, Hendee and Dawson 2002).

Wilderness visitors' experiences are most strongly affected by social conditions, such as other visitors and their actions, than by their perception of naturalness or ecological conditions (Hendee and Dawson 2002). Although hiking and walking are among the most primitive forms of recreation, the trails themselves tend toward promoting a confining rather than an unconfined user experience (Hendee and Dawson 2002). With typically long sight distances across Monomoy's rolling nearly treeless coastal barrier landscape, too many individuals encountered or observed hiking or walking during visits by other Monomoy Wilderness users likely detracts from the sense of solitude experienced by wilderness users (Stankey and Schreyer 1987, Hendee and Dawson 2002). However, hiking and walking use is still currently very light in the more remote, interior portions of South Monomoy open to public use, where outstanding opportunities for solitude and unconfined, primitive, outdoor recreation can be experienced by other Monomoy Wilderness users.

Vegetation trampling and soil compaction impacts are a direct function of group size, which can be managed through permit or concession contract requirements. Participant safety and potential for excessive disturbance to disturbance-sensitive wildlife species also becomes more difficult for group leaders to control as the group size increases per guide or leader. The number and type of encounters by wilderness users with other users, which in part determines wilderness experience quality and solitude, also increases with increasing group size and as commercial tours, guides, and outfits gain popularity. The numbers of tours offered annually will be reviewed, evaluated, and restricted if necessary. At this time, the frequency of guided tours does not adversely impact the wilderness character of the Monomoy Wilderness.

Individuals hiking on South Monomoy could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced hunting time for the inhabiting individual. We will continue to survey to determine the location and extent of larval beetle occurrence and habitat, and use closures and re-route trails to avoid larval habitats.

Pedestrian use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. We will enforce the 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Ferry Service

The approach of a ferry, typically a 20- to 25-foot boat with an outboard engine, to pick up and discharge passengers creates a temporary disturbance to migratory birds feeding or loafing on the beach nearby. Ferry boat landing sites are designated outside of areas used heavily by nesting, feeding, and roosting terns, shorebirds, and colonial waterbirds. Any energy expended by migratory birds to avoid disturbance associated with beaching a ferry and loading and unloading passengers is negligible.

North and South Monomoy make up the Monomoy Wilderness. The untrammeled environment and solitude of the Monomoy Wilderness, accessible only by boat or lengthy hike along the barrier beach, make it unique among the protected areas on Cape Cod. Motorized boats operated by tour, ferry, charter guides, or outfitters approach and depart the designated shoreline landing sites through the shallows very slowly, which has the added effect of reducing engine noise and boat wake. Monomoy has an unusually low absorption capacity for human impacts. Lack of topographic relief and low vegetation mean that intrusions, including seeing and hearing other people, are often observable from a long distance. Providing visitors with a convenient way to get out to the islands may result in a diminished degree of solitude for some wilderness users, but should not adversely affect the overall wilderness character of the Monomoy Wilderness. There should be a negligible impact to fisheries as a result of commercial guiding and the fish they are harvesting.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- A fee greater than or equal to $250 will ordinarily be charged for special use permits, but may be fully or partially waived by the refuge manager. Concession contract fees will be the greater of a fixed franchise fee greater than or equal to $5,000 per year, or a percent of gross receipts greater than or equal to 5 percent and less than or equal to 20 percent.

- All hiking or walking will be done only in areas that are open to the public. Several beaches and interior areas on the Monomoy Islands are seasonally closed to all public use to prevent disturbance to nesting and migrating birds. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site. Ferry operators will inform unguided ferry passengers of closed areas before they are left on their own to explore the island.

- Tour, ferry, and guide boat operators will use only designated boat landing sites.

- Ferries will not operate at night or in dense fog conditions (¼-mile visibility or less) when a visitor could easily become disoriented and unknowingly violate a posted closed area. Regulations to ensure the safety of all participants will be included with permits or concession contracts; specific conditions that may apply to the requested activity will be addressed through the special use permit or concession contract.

- All pedestrians must maintain a 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act. Boat operators will adhere to the Northeast Seal Watching Guidelines and other NOAA marine mammal viewing guidelines.

- Groups may be scheduled so as to avoid time or space conflicts with critical wildlife activities and each other. Currently, there is no restriction on the number of tour groups or visitors allowed on Monomoy at any one time. Refuge staff monitor public use and document any associated serious impacts.

- Refuge visitor information services and products will emphasize the importance of staying on trails and out of areas that are seasonally closed, along with providing "leave no trace" principles, practices and hiking tips. No physical items, including litter, will be placed or left on the refuge. No items will be removed from the refuge. Take only photos, leave only footprints.

- Refuge staff or volunteers will periodically qualitatively and photographically document pedestrian impacts to vegetation and soils to footpaths, boat landings, and other known user concentration points for use in drafting or updating a Monomoy Wilderness Stewardship Plan. If public use causes unacceptable environmental degradation or wildlife disturbance, we will implement appropriate limits on visitor numbers and tours.

- Tour routes will be monitored for impacts on wildlife or habitat and will be rerouted. Closed areas for wildlife sensitive to disturbance will be clearly posted, and tour group leaders will be provided with maps of the closures and refuge regulations.

- All activities conducted in wilderness will be subject to a minimum requirements analysis (see part II of appendix E, Wilderness Review)

JUSTIFICATION:

Natural and cultural history activities and the ferry service that supports these activities generally support refuge purposes. The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Guided natural history tours are a public use management tool intended to develop a resource protection ethic within society. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management, ecological principles, and communities. A secondary benefit of this use is that it instills a sense of ownership or stewardship in visitors, which helps reduce vandalism, littering, and poaching; it also strengthens Service visibility in the local community. Cultural history activities allow visitors to learn about the artifacts left in an area and also gain an appreciation for the lands involved and the refuge purpose. In addition, by allowing educational tours to occur on the islands, the Service is able to fulfill its obligation to maintain the Monomoy Point Light Station.

Issuing special use permits and concession permits for commercial guiding and outfitting does not significantly impact biological resources for which the refuge was established and requires no additional facilities. The administrative requirement is minimal. This activity has a positive effect on the overall interpretive, environmental education, and wildlife observation programs of the refuge, reaching a much larger audience. It would also produce a greater appreciation of wildlife resources in participants, and building relationships between the refuge and area businesses.

We do not expect pedestrian access to materially interfere with or detract from the mission of the National Wildlife Refuge System, nor diminish the purpose for which the refuge was established. It will not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden. These uses would contribute to achieving refuge purposes and the Refuge System mission because they facilitate wildlife observation and photography and provide compatible recreational opportunities for visitors to observe and learn about wildlife and habitats firsthand.

Shifting channels, bars, and shoals, and strong ocean currents make boat travel between the Monomoy Islands and the mainland a challenge for even the most experienced mariner. Commercial ferries provide a safe alternative for visitors to explore beyond the mainland portion of the refuge. Visits to the islands occur during daylight hours only, particularly midday when migratory bird activity is diminished, and ferry service is offered May through September only. This activity as conducted on Monomoy NWR does not adversely affect the purposes for which this refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Commercial Wildlife and Landscape Filming and Photography

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Commercial Wildlife and Landscape Filming and Photography

NARRATIVE:

Although commercial filming and photography is not a priority public use, it supports the wildlife photography and interpretation priority, wildlife-dependent, public uses identified by the 1997 Refuge Improvement Act. Limited commercial photography will support the mission of the National Wildlife Refuge System by promoting an understanding and appreciation of natural and cultural resources and their management within a national system of refuges. Commercial filming and photography will reach many segments of the public to expand support for the refuge system, including those who may never actually be able to visit the refuge. Individual refuge programs will be consistent with, and fully support, the goals and objectives in the Monomoy NWR Comprehensive Conservation Plan.

Service Wilderness policy generally prohibits commercial photography in wilderness areas unless we determine it is necessary to provide educational information about wilderness uses and values and does not degrade the wilderness character of the area. In cases where we allow such photography as a commercial service, we first evaluate it for appropriateness and compatibility, and we manage the use through an audiovisual productions permit. At the Monomoy NWR due to its vastness and difficulty for the general public to access the more remote sections of the refuge, limited commercial filming and photography access will directly support the interpretation and education of the resources managed on the refuge as well as promoting wilderness character.

We do not expect limited commercial photographer access to materially interfere with or detract from the mission of the National Wildlife Refuge System, nor diminish the purpose for which the refuge was established. It will not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden.

Commercial filming and photography will have little to no affect on wilderness character when conducted in accordance to wilderness requirements, such as no motorized equipment or mechanical transport. This activity does not alter the natural, scenic condition of the land and will not occur at a scale large enough to diminish the environment for native plants and animals. The most probable wilderness impact will be to other visitors whose solitude could be impacted by commercial photographers.

For these reasons, commercial wildlife and landscape filming and photography, both still and motion, are appropriate uses on Monomoy NWR.

COMPATIBILITY DETERMINATION

USE:

Commercial Wildlife and Landscape Filming and Photography

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is commercial photography, filming (including videography), and audio recording (collectively called "recording" for the purposes of this compatibility determination). This use has occurred in the past and future requests are expected to remain steady or increase slightly. The use typically involves filming scenes for a movie, television show, public education program or commercial, taking still photographs, or recording natural sounds for commercial purposes. The primary focus of the production at times may or may not be wildlife-related or educational in nature. In the latter instance, the refuge may be used as a natural background for the production. The final creation would be produced for sale as a commercial product. The refuge is a popular location for recording for multiple purposes as it's one of the most pristine natural areas on the Atlantic coast, yet close in proximity to Boston, a major media center. This use is regulated by Refuge Manual (RM) Part 8, Chapter 16 and the Code of Federal Regulations (CFR), Title 43, Subtitle A, Section 5.1. This is not a priority

public use (National Wildlife Refuge System Improvement Act of 1997; Public Law 105-57); however, it may support and enhance the priority public use of wildlife photography. The recordings produced may also support the priority public uses of environmental education and interpretation.

(b) Where would the use be conducted?
This use will occur in areas of the refuge specified in the special use permit. The use will generally take place in areas that are open to visitors including Morris Island Trail, and seasonally allowable access areas on North and South Monomoy and Minimoy. Visitors engaged in commercial photography will be required to use temporary or portable blinds to minimize disturbance to wildlife and to ensure wilderness character is not impacted.

(c) When would the use be conducted?
The use may occur during daylight hours during the year, unless otherwise specified in special use permit.

(d) How would the use be conducted?
Commercial filming will be managed on the refuge through the special use permit process to minimize the possibility of damage to cultural or natural resources or interference with other visitors to the area. Requests must be submitted in writing to the refuge manager no less than 60 days prior to the requested date(s). Each request will be reviewed on a case-by-case basis and will require a special use permit. There is a fee for issuance of commercial photography special use permits; the fee is adjusted on a case-by-case basis depending on the specific details of each permit.

(e) Why is this use being proposed?
Monomoy National Wildlife Refuge and its designated wilderness is an incredibly scenic and beautiful landscape with tremendous opportunities for commercial filming and commercial still photography. The refuge provides an ideal setting for filmmakers and photographers. Each year the refuge staff receives requests to conduct commercial filming or commercial still photography on the refuge. Each request is evaluated on an individual basis, using a number of Department of the Interior, U.S. Fish and Wildlife Service, and National Wildlife Refuge System policies (for example, 43 CFR Part 5, 50 CFR Part 7, 8 RM 16). In addition, much of the refuge is designated wilderness area. A minimum-requirements decision guide will be completed for all commercial filming activities proposed in Monomoy Wilderness. This process involves determining if an essential task should be conducted in the wilderness area, and then determining the combination of methods, equipment, or administrative practices necessary to successfully and safely administer the refuge and accomplish wilderness management objectives. The use includes access by groups or individuals to areas open to the general public. In rare cases, access to areas closed to the general public may be permitted through the special use permit process. These activities will contribute to enhancing awareness of conservation and recreational opportunities at the refuge.

AVAILABILITY OF RESOURCES:

In general, the refuge will normally incur no expense except administrative costs for review of applications, issuance of a special use permit, and staff time to conduct compliance checks. Commercial filming and photography would need to be managed in coordination with the existing staff, which is anticipated to be sufficient for the expected permitting workload.

Recurring annual costs:			
GS-11 Visitor Services Manager	1 staff	40 hours	$1,800
GS-9 Visitor Services Specialist	1 staff	20 hours	$ 750
GS-11 Law Enforcement	1 staff	10 hours	$ 450
Total recurring annual costs:			**$3,000**

ANTICIPATED IMPACTS OF THE USE:

Public uses, such as commercial photography, can produce short-term, negative, direct or indirect impacts on wildlife or habitats. However, we believe the long-term benefits from the conservation nature of the products could be greater. Projects will be conducted at the appropriate time of year and conditions to minimize disturbances and incorporate other best management practices.

The majority of the impact from commercial photography will be disturbance caused to resting, feeding, or nesting migratory birds and resting seals or the handling of horseshoe crabs in the waters off Morris Island. There will be some trampling of vegetation. On Morris Island, with use restricted to designated trails and other refuge structures, we predict the impacts will be confined to small areas and in areas already affected.

Service Wilderness policy generally prohibits commercial photography in wilderness areas unless we determine it is necessary to provide educational information about wilderness uses and values and does not degrade the wilderness character of the area. In cases where we allow such photography as a commercial service, we first evaluate it for appropriateness and compatibility, and we manage the use through an audiovisual productions permit. At the Monomoy NWR due to its vastness and difficulty for the general public to access the more remote sections of the refuge, limited commercial filming and photography access will directly support the interpretation and education of the resources managed on the refuge as well as promoting wilderness character.

Permittees may be authorized to utilize new structures located outside the Monomoy Wilderness. These structures will be located to minimize the long-term consequences and cumulative impacts to wildlife and habitats. Most of the new structures proposed, e.g., kiosks, observation platforms, photography blinds, would each result in habitat losses of less than ¼ acre.

Permittees engaged in commercial filming and photography have a vested interest in minimizing disturbance to the wildlife they wish to observe and photograph. However, photographers are known to disturb wildlife in an attempt to get closer looks or higher quality images of their subjects. Any special use permits issued by the refuge manager will clearly state the parameters of access and, if these conditions are found to be violated, the permit will be immediately voided and the permittee denied any future permits. On North Monomoy Island and South Monomoy in particular, pedestrians have the potential of impacting shorebird, waterfowl, and other migratory bird populations feeding and resting on beaches and tidal flats. Pedestrians can also impact seals resting on the beach if they get too close. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. In studying waterbird response to human disturbance, Klein (1993) found that, as intensity of disturbance increased, avoidance response by the birds increased, and found out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects on birds of recreation using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential of intermittently interrupting the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. Refuge staff will manage public and permittee access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Permit holders could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling; for the inhabiting individual, this results in excess energy expenditure and reduced time hunting.

Commercial filming and photography also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. A 150-foot buffer around all seals is required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast to those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans visitors do not remain. Preserving wilderness character requires that we maintain both the tangible and intangible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, or primitive and unconfined outdoor recreation, for risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

Commercial filming and photography will have little to no affect on wilderness character. This activity does not alter the natural, scenic condition of the land and will not occur at a scale large enough to diminish the environment for native plants and animals. The most likely wilderness impact will be to other visitors who may be momentarily disturbed when witnessing professional photography use occurring. Since the refuge will be utilizing a special use permit process for all commercial filming and photography, the manager may revoke or deny any permits or applications if there is any question on disturbance to wildlife or if a permittee violates permit stipulations.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Stipulations are listed as "Special Conditions" in the SUP.

Commercial filming and photography is administered through a SUP issued on a case-by-case basis. A fee will be charged and must be paid before the SUP will be issued. Prior to issuing a special use permit, the refuge manager is required to submit an audiovisual production permit request through the Service's regional office.

Sites for photo shoots will be submitted in advance and approved by the refuge manager.

All permit holders must follow refuge regulations.

All activities must comply with 8 RM 16 and 43 CFR, Subtitle A, Section 5.1 and may require completion of a Commercial Audio-Visual Production Application and posting of a bond.

A minimum-requirements decision guide will be completed for all commercial filming activities proposed in Monomoy Wilderness. This minimum requirements process involves determining if the activity can only be conducted in wilderness, and then to determine the combination of methods, equipment, or administrative practices that representing the minimum necessary to preserve wilderness character and safely administer the refuge.

Prior to recording, the permittee will provide the refuge manager with a copy of their current liability insurance policy. The refuge must be named as an additional insured on the policy for the duration of the production.

Permittee must have the SUP in their possession at all times while on the refuge. A copy of the permit must also be prominently displayed on the dash of permittee's vehicle(s) at all times while on the refuge. The permit must be presented to refuge officials upon request.

The permit is not transferable.

Access to the refuge in areas and at times not permitted to the general public may be granted in the SUP depending upon the needs of the production, the availability of suitable location(s), and refuge operations and resources. All areas and times not specifically permitted are off-limits for recording. Permittees must follow

the conditions outlined in the permit, which normally includes notification of refuge personnel each time any activity occurs in closed areas. Use of a closed area will be heavily restricted to reduce disturbance to wildlife.

Blinds will be required for all areas that are not open to the public.

No sound-making or lighting devices will be permitted.

Only commercial filming and photography in support of conservation, refuge purposes, the National Wildlife Refuge System Mission, or for educational and interpretive purposes will be permitted.

A special use permit will be required upon approval of an audiovisual permit from the refuge's regional office per Service policy.

All commercial filming and photography activities will avoid sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and will be designed to minimize impacts to nesting birds or other breeding, feeding, or resting wildlife. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures could extend from March 15 to October 30, but will vary year to year based on wildlife use and habitat conditions.

Access for commercial filming and photography activities will be on foot or by ferry, boats, or paddling. No motorized equipment or mechanized transport will be allowed in the refuge's wilderness areas.

Activities will be held on designated sites where only minimal direct and short-term impacts are predicted.

Periodic evaluations will be done to insure that visitors are not causing unacceptable adverse impacts. If evidence of unacceptable impacts occur, access would be modified or curtailed as deemed necessary by the refuge manager.

Occasional law enforcement patrol and regular staff presence should minimize potential violations. The refuge is open ½ hour before sunrise to ½ hour after sunset for wildlife photography. These restrictions will be maintained, unless otherwise specified in permit. Refuge regulations will be posted and enforced.

The refuge is a leave-no-trace, carry in-carry out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

JUSTIFICATION:

Although commercial filming and photography is not a priority public use, it supports the wildlife photography and interpretation priority, wildlife-dependent public uses identified by the 1997 Refuge Improvement Act. Limited commercial photography will support the mission of the National Wildlife Refuge System by promoting an understanding and appreciation of natural and cultural resources and their management within a national system of refuges. Commercial photography will reach many segments of the public to expand support for the refuge system, including those who may never actually be able to visit the refuge. Individual refuge programs will be consistent with, and fully support, the goals and objectives in the Monomoy NWR Comprehensive Conservation Plan.

We do not expect commercial filming and photography access to materially interfere with or detract from the mission of the National Wildlife Refuge System, nor diminish the purpose for which the refuge was established. It will not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden. These uses would contribute to achieving refuge purposes and the Refuge System mission because they facilitate wildlife photography and interpretation and promote compatible recreational opportunities for visitors to observe and learn about wildlife and habitats firsthand and secondhand.

This program as described is determined to be compatible. Any potential negative impacts of commercial wildlife and nature photography activities on refuge resources will be minimized by the restrictions included in the conditions of the special use permit. In addition, the activities associated with commercial photography will be regulated and monitored by refuge staff.

The Service permits commercial filming and photography where it would further outreach, education, or public understanding of the natural environment, refuge resources and management, or the Refuge System and Service's missions. No approvals for a permit would occur until the refuge manager can insure those benefits would result.

As such, all approved commercial wildlife and nature filming and photography will contribute to the goals of the refuge and Refuge System, and will not materially interfere with or detract from the mission of the Refuge System or the purposes for which the refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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COMPATIBILITY DETERMINATION

USE:

Environmental Education and Interpretation

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
Environmental education and interpretation are priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Both environmental education and interpretation activities seek to increase public knowledge and understanding of fish and wildlife resources and the value of habitat protection and management in protecting and conserving these resources. Environmental education is curriculum-based and typically includes teacher or staff-guided onsite field trips, offsite programs in classrooms, and nature study such as teacher and student workshops. Interpretation consists of guided natural or cultural history programs, special events such as the Chatham Fourth of July

parade, interpretative signs, self-guided nature trails, lectures, and kiosks that serve as a source of information for refuge visitors. Interpretation includes developing and publishing brochures, managing a refuge Web site, using social media such as Facebook and Twitter, and installing information signs. Interpretation occurs both onsite and offsite.

(b) Where would the use be conducted?
The majority of this use will be conducted on the Morris Island part of Monomoy NWR and offsite in classrooms and local community facilities. Brochures and informational signs could be placed offsite within the Town of Chatham, at Cape Cod National Seashore, or at other locations accessible to local residents or potential refuge visitors. Both uses can occur in any area open to the public, although permanent structures are generally not allowed in wilderness areas, so no interpretative panels and only minor information signs will be located in the Monomoy Wilderness. Certain areas on Monomoy NWR are seasonally closed to public access at the refuge manager's discretion to protect sensitive habitats or species of concern, minimize conflicts with other refuge activities, or respond to human health and safety concerns. All environmental education and interpretation activities will avoid sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and will be designed to minimize impacts to nesting birds or other breeding, feeding, or resting wildlife.

Refuge environmental education and interpretation will primarily occur on Morris Island, generally on the shoreline and beach, within 50 meters of existing trails, and at other facilities such as the refuge headquarters and visitor contact station and viewing platforms. Self-guided interpretation could occur in the Monomoy Wilderness, as could interpretative tours. Due to logistical constraints, fewer environmental education opportunities will occur on North Monomoy Island or South Monomoy.

We will provide interpretation of habitat and wildlife values at the Morris Island Trail trailhead kiosks and along the trail. We will continue to maintain a seasonally staffed refuge visitor contact station at the existing headquarters until a new off-refuge visitor contact station can be established. Additional off-site locations for providing brochures or interpretative panels could be established in conjunction with partners or local businesses. Some possible locations for delivering interpretive information could include the Morris Island Road causeway overflow parking, other visitor satellite parking lots and transit stops, the Marconi Maritime Museum, local boat ramps and marinas, the Chatham Fish Pier, Cape Cod Rail Trail parking lots, Chatham Bars Inn and Resort, Cape Cod Natural History Museum, Wellfleet Bay Sanctuary, Cape Cod National Seashore's Salt Pond Visitor Center, and the Lighthouse Beach overlook.

(c) When would the use be conducted?
Environmental education will occur year-round during daylight hours when the refuge is open; however, most of the field programs would be associated with the fall and spring school terms.

Interpretive activities will be conducted year-round, primarily during daylight hours when the refuge is open. Occasional staff-led or volunteer-led night programs would occur during the year. Interpretive activities would increase during the summer months, when the refuge receives peak visitation and has summer interns.

(d) How would the use be conducted?
Refuge staff, local teachers, volunteers, and conservation partners will conduct environmental education and interpretation on and off the refuge. Most curriculum-based environmental education programs at Monomoy NWR are conducted by others, such as the Friends of Monomoy, Massachusetts Audubon Society, Cape Cod Natural History Museum, and local school districts, primarily at Morris Island. Teacher-led school group trips also occur on the refuge with several of the teacher-leaders already serving as refuge volunteers. Onsite refuge activities will primarily include teacher-led or staff-guided field trips exploring topics requested by teachers, teach-the-teacher workshops, or more structured curriculum-based programs specifically designed for use on the refuges. Students will learn about nature from designated refuge trails, viewing platforms on Morris Island, and in the Monomoy Wilderness. Environmental education activities could utilize interpretive infrastructure such as kiosks, sign panels, and displays in the visitor contact station.

Interpretation activities on Monomoy NWR will be both self-guided and staff-led or volunteer-led. Interpretive information will be delivered through kiosks at refuge trailheads, refuge trail guides, brochures, interpretive panels at observation platforms and self-guided tour stops on trails, and interpretive displays in the refuge

visitor contact station and at local community special events. Staff-led and volunteer-led programs would, over time, become more diverse and allow for more interaction with visitors. A significant amount of interpretive information will also be available through the Internet.

Offsite activities will primarily include offering refuge staff assistance to local partners who are interested in working with the Service to expand our efforts into local classrooms and the occasional refuge attendance at special events, such as a career day.

Environmental education and guided interpretation conducted in the wilderness area on North and South Monomoy can provide information about the Monomoy Wilderness to ensure activities are conducted appropriately and raise awareness about the National Wilderness Preservation System. We will conduct a minimum requirements analysis for proposed environmental education and interpretation activities held within the Monomoy Wilderness. Access for environmental education and interpretation activities would be on foot, or by boat or kayak. Motorized equipment is not allowed within the Monomoy Wilderness, which includes the majority of the lands comprising the refuge.

(e) Why is this use being proposed?
The 1997 Refuge Improvement Act states that priority, wildlife-dependent public uses should receive enhanced consideration in planning and be facilitated on refuges to the extent they are compatible.

Environmental education and interpretation promotes public understanding and appreciation of the National Wildlife Refuge System, the National Wilderness Preservation System, and the Monomoy refuge. The migratory birds, threatened and endangered species, other Service trust resources and habitats on which they depend, and wilderness values within the Monomoy Wilderness will benefit from Service efforts to cooperate with environmental education partners to educate the public on the impacts to native salt marsh and dune vegetation and harmful wildlife disturbance from inappropriate public uses.

AVAILABILITY OF RESOURCES:

Environmental education and interpretation are currently provided on a small scale by existing refuge staff. The refuge manager and two biological staff each dedicate approximately 0.2 FTE to these public use programs. For the environmental education and interpretation to be more fully realized, additional visitor services staff would be needed to plan, implement, and monitor the public use programs on Monomoy NWR, including administration of the refuge visitor contact station. New and recurring costs to conduct an environmental education and interpretation program are presented below.

New construction and renovation estimated costs:			
Construct and install two new kiosks on Morris Island			$6,000
Construct and install one new accessible platform on Morris Island			$15,000
Construct and install one new photography blind on Morris Island			$ 3,000
Renovate Morris Island trail for handicapped accessibility			$100,000
Renovate exhibits in existing visitor contact station			$250,000
Renovate or construct new off-site visitor contact station			$250,000 to $5,000,000
Total new costs:			**$374,000 to $5,124,000**
Recurring annual costs:			
GS-9 Visitor Services Specialist	1 staff	200 hours	$7,500
GS-11 Law Enforcement	1 staff	40 hours	$2,000
GS-9 Law Enforcement	1 staff	100 hours	$4,500
Ferry service to islands and bus transportation to refuge			$5,000
Regular maintenance of visitor centers			$25,000
Regular maintenance of kiosks, platforms, photo blinds,trails, public restrooms			$15,000
Equipment, vehicles, and supplies (including brochures/trail guides			$22,000
Total recurring annual costs:			**$81,000**

ANTICIPATED IMPACTS OF THE USE:

Impacts of environmental education and interpretation will be minimal if conducted in accordance with refuge regulations and policies. Possible impacts include disturbing and displacing wildlife, removing or trampling vegetation, littering, and vandalism. Overall, we expect the adverse impacts to be short-term and confined.

New structures will be sited outside the Monomoy Wilderness, with consideration of the long- term consequences and cumulative impacts to wildlife and habitats. Most of the new structures proposed, e.g. kiosks, observation platforms, photography blinds, would each result in habitat losses of less than ¼ acre. Placement of kiosks, interpretative panels, blinds, and observation platforms may impact small areas of vegetation. Kiosks will be placed where minimal disturbance will occur from both the structures and visitors using them.

Pedestrian travel has the potential to impact shorebird, waterfowl, and other migratory bird populations feeding and resting near the trails and on beaches during certain times of the year. Pedestrians can also impact seals resting on the beach if they get to close. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that non-vehicle based activities were more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993.

The Delaware Natural Heritage Program, Division of Fish and Wildlife and the Department of Natural Resources and Environmental Control prepared a document, *The Effects of Recreation on Birds: a Literature Review*, completed in April 1999. The following information was reference from this document.

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1995, 1997; Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always have at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981,1986; Klein 1993; Burger et al. 1995; Klein et al.1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). The findings reported in these studies are summarized in terms of visitor activity and avian response to disturbance.

> Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981; Klein et al. 1995; Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993).
Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981; Burger et al. 1995; Knight and Cole 1995a; Rodgers and Smith 1995, 1997).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986; Klein 1993; Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential of intermittently interrupting the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. Refuge staff will manage visitor access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of walking are likely to be minimal if conducted in accordance with refuge regulations. We will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies. The refuge is a leave-no-trace, carry-in-carry-out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

Construction or renovation of a new visitor contact station off Morris Island will result in short-term noise and air pollution. Debris from the construction site will be recycled to the extent possible, with the remainder placed in a landfill. There could be traffic congestion at the visitor contact station site from visitors. If an alternative transportation system is established with parking at the visitor contact station for shuttle access, the number of cars travelling to the refuge headquarters on Morris Island could decrease, reducing vehicle emissions and noise.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the tangible and intangible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and will "leave them unimpaired for future use and enjoyment as wilderness."

Environmental education and interpretation will not affect wilderness character. These activities do not alter the natural, scenic condition of the land and will not occur at a scale large enough to diminish the environment for native plants and animals.

Large groups have the potential to negatively infringe on the wilderness experience for those visitors who come to the refuge specifically to have a wilderness experience. This will generally be a short-term impact to a wilderness visitor.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

All environmental education and interpretation activities will avoid sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and will be designed to minimize impacts to nesting birds or other breeding, feeding, or resting wildlife. Access for environmental education and interpretation activities will be on foot. Access by kayak and canoe or boat will be necessary to get to North Monomoy Island and South Monomoy.

Activities will be held on designated sites where only minimal direct and short-term impacts are predicted, and adverse long-term, cumulative impacts are not anticipated. Self-guided and guided interpretive activities in the wilderness can occur anytime when the refuge is open, except in areas that are seasonally closed to protect wildlife.

Occasional law enforcement patrol and regular staff and conservation partner presence should minimize potential violations. We will maintain the current refuge hours (open one-half hour before sunrise to one-half hour after sunset) and restrict entry after daylight hours. We will post and enforce refuge regulations.

Periodic evaluations will be done to insure that visitors and programs are not causing unacceptable adverse impacts. Areas open to these uses will be evaluated on an ongoing basis to ensure visitor safety, compliance with State and Federal tern and plover guidelines, compliance with National Marine Fisheries Service marine mammal regulations, and to minimize impacts on vegetation and wildlife. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.

JUSTIFICATION:

Environmental education and interpretation are priority, wildlife-dependent, public uses identified by the 1997 Refuge Improvement Act. These activities have been determined appropriate by law and, when compatible, are to be facilitated on refuges. These programs support the mission of the National Wildlife Refuge System by promoting an understanding and appreciation of natural and cultural resources and their management within a national system of refuges. Our programs will reach out to all segments of the public to expand support for the refuge system. Individual refuge programs will be consistent with, and fully support, the goals and objectives in the Monomoy NWR Comprehensive Conservation Plan.

Environmental education activities generally support refuge purposes, and impacts can largely be minimized. The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by

educating present and future generations about refuge resources. Environmental education is a public use management tool to develop a resource protection ethic within society. While it targets school-aged children, it is not limited to this group. This tool allows us to educate visitors about endangered and threatened species management, wildlife management, and ecological principles and communities. A secondary benefit of environmental education is that it can instill stewardship in visitors that most likely reduces vandalism, littering, and poaching. Environmental education also strengthens Service visibility in the local community.

Providing additional interpretative and educational brochures and materials may result in increased knowledge of the refuge and its resources. This awareness and knowledge may improve the willingness of the public to support refuge programs and resources and comply with regulations. Environmental education and interpretation activities that identify and explain wilderness should increase understanding and appreciation of, and compliance with, wilderness principles and policies.

We do not expect visitors engaged in environmental education or interpretation to materially interfere with or detract from the mission of the National Wildlife Refuge System or diminish the purpose for which the refuge was established. These activities do not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden.

Additional funding will be needed to administer a fully developed environmental education and interpretation program. These uses will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of Monomoy NWR. Therefore, it is the determination of the Service that these uses, at the discretion of the refuge manager, are compatible uses and contribute to the purposes for which Monomoy NWR was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

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COMPATIBILITY DETERMINATION

USE:

Fin Fishing

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and… the preservation of their wilderness character…" (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is recreational fin fishing, which includes saltwater fly fishing, surf fishing, rip fishing, and fishing in the refuge's freshwater ponds. This CD covers recreational fin fishing occurring outside the open waters lying above the submerged lands within the Declaration of Taking—fishing occurring in this open water area will be regulated by the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries. Fishing events, including Service "Take Me Fishing" programs designed to educate anglers new to the sport of fishing, will be held on the refuge. Fishing is a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(b) Where would the use be conducted?
This CD only covers recreational fin fishing occurring outside the open waters lying above the submerged lands within the Declaration of Taking—fishing occurring in this open water area will be regulated by the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries. Areas covered by this CD

include the refuge shoreline, refuge's freshwater ponds on South Monomoy Island, and intertidal areas when these areas are open to public access. All fishing on the refuge occurs in accordance with Federal, State, and local regulations.

South Monomoy: The most productive surf fishing location is at the very southern tip of South Monomoy where there is a tidal rip. However, the nearest safe anchorage for boats is in the vicinity of Powder Hole; the walk one-way to the rip is more than ½ mile. As a result of the long walk, there is very little surf fishing from this location. Most anglers opt to fish from their boats in the rip area. Surf fishing occurs concurrently with family day-use of the beach. Most of this activity occurs on the safe anchorage and boat beaching points on the west side of South Monomoy.

North Monomoy: There is rarely any surf fishing conducted from this island. The majority of the island and most of the east shoreline is seasonally closed to protect nesting and roosting areas. This seasonal closure will vary year to year based on wildlife use and habitat conditions. Shallow water precludes surf fishing from the west side. Even though surf fishing is limited, fly fishing in the shallow water on the flats has been very popular in the past.

Morris Island: Because of the connection of the Morris Island to the mainland and easy vehicular access, this portion of the refuge receives the largest number of surf fishing visits. However, this area is rarely crowded with anglers. A major limiting factor to the one-time use by anglers is the 35-car parking lot at refuge headquarters. Personal observations by staff over the years have noted that there are rarely more than four anglers using the 1-mile refuge shoreline at any one time. Fishing is allowed 24 hours per day. Fish typically caught by anglers include striped bass, bluefish, flounder, and pollock. Most refuge fishing events would be held on Morris Island due to ease of access, and help minimize impacts on refuge seals, terns, plovers, and other shorebirds and seabirds.

(c) When would the use be conducted?
Monomoy NWR is open to the public from ½ hour before sunrise to ½ hour after sunset. Surf fishing is permitted 24 hours a day on Morris Island only. The gate and parking lot are open and no permit is required to fish after the refuge is closed. This is the only activity allowed at night on Monomoy NWR. Refuge fishing events would be held at times and on areas of the refuge that minimize impact to seals, terns, plovers, and other shorebirds and seabirds.

(d) How would the use be conducted?
Recreational fin fishing must be conducted in accordance with Federal and State regulations and refuge specific policies, including seasonal closures. Walking, kayaks, private motorboats, and paid access via the commercial ferry or a future concessionaire will be the most common means of access for anglers using Monomoy NWR. Refuge staff may partner with organizations to sponsor a fishing tournament designed to introduce more people to fishing on the refuge.

(e) Why is this use being proposed?
Recreational fishing is a priority, wildlife-dependent public use. The 1997 Refuge Improvement Act states that priority, wildlife-dependent, public uses should receive enhanced consideration in planning and be facilitated on refuges to the extent they are compatible.

Monomoy NWR is a premier destination for fishing and attracts visitors from across the country. A rip current at the end of South Monomoy Island makes for excellent fishing. Recreational fin fishing offers opportunities to observe wildlife at Monomoy NWR and increases visitor appreciation and awareness of the importance of this site to the National Wildlife Refuge System. Working with partners to hold fishing events will increase the number of people participating in this priority public use on the refuge.

AVAILABILITY OF RESOURCES:

Little effort is spent in providing opportunities for fin fishing on the refuge. Refuge staff prepare a closed area map each spring that guides all visitors to the refuge, including anglers. Signs are posted and removed each year to delineate plover, tern, and waterfowl nesting areas. Signs may be retained or relocated to protect major staging sites on the refuge. Signs and posts need to be replaced occasionally. There are expenses involved with the use of refuge boats to move equipment and conduct law enforcement to ensure compliance with refuge regulations. These expenses, for all refuge recreational uses, are approximately $40,000 per year. For fishing, this is prorated to $5,000 per year.

The cost of law enforcement patrol to conduct fishing compliance (license, creel limits), ensure visitor safety, and maintain the integrity of the closed areas will be approximately $10,000 per year.

Total recurring annual cost	**$15,000**

ANTICIPATED IMPACTS OF THE USE:

Potential impacts from fin fishing include disturbing and displacing wildlife or trampling vegetation, including salt grass, when anglers get too close to roosting birds or resting seals or when they enter closed areas. This has been a particular problem in the closed areas off North Monomoy Island. Incidences of littering and vegetation removal have occurred. Some disturbance to roosting and feeding shorebirds occurs (Burger 1981) but this is minimized when closed areas are respected. Discarded fishing line and other fishing litter can entangle migratory birds and marine mammals and cause injury and death (Gregory 1991). Litter also impacts the visual experience of other refuge visitors (Marion and Lime 1986). Conflicts with seals over fish could occur, especially if anglers are not observing the 150 foot buffer distance from seals required by the Marine Mammal Protection Act. Several enforcement issues may result from this use, including trampling vegetation following trespass into closed areas, illegal taking of fish (undersized, over limit), illegal fires, and disorderly conduct. Overall, we expect the adverse impacts to be short-term and confined to small areas.

There are impacts to refuge wildlife, vegetation, and soils from pedestrian access for visitors engaged in fishing. Pedestrian travel has the potential to impact shorebird, waterfowl, and other migratory bird populations feeding and resting near the trails and on beaches during certain times of the year. Pedestrians can also impact seals resting on the beach if they get too close. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreational activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al.1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential to intermittently interrupt the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. To address the impacts posed by pedestrians, refuge staff will manage angler access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Visitors accessing Monomoy Island from Chatham town beaches could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual. We will continue to survey to determine the location and extent of larval beetle occurrence and habitat, and use closures and re-route trails to avoid larval habitats.

Visitor use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year round. We will enforce or implement the 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. The refuge is a leave-no-trace, carry-in-carry-out facility. We encourage all outfitters and guides to pack in and pack out all food containers, bottles, wrappers, trash, and other waste and refuse. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

There should be little impact from anglers fishing in the wilderness area. Anglers fishing from shore or just offshore within the intertidal area tend to be solitary and quiet. Carts will not be allowed to carry gear in the wilderness area. Refuge fishing events will most likely be held on Morris Island, so there would be little impact to wilderness. If an event is held in the Monomoy wilderness, group size will be limited and the event will be short-term, thereby minimizing impacts to other wilderness visitors. Additionally, any event held within the Monomoy wilderness will undergo a minimum requirements analysis to ensure compliance with wilderness regulations and policies, and help ensure impacts to wilderness character are minimal.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.

Carts or other wheeled equipment may not be used within the wilderness area on North Monomoy Island and South Monomoy.

Occasional law enforcement patrol and regular staff and partner presence should minimize potential violations of refuge closures and curtail illegal fires, littering, and disorderly conduct. Periodic evaluations will be done to ensure that activities associated with the use are not causing unacceptable adverse impacts to the natural resources. Unacceptable levels of violations or disturbance may result in eliminating or restricting public fishing. Occasional law enforcement patrols and regular refuge presence should minimize potential violations of refuge closures and other regulations, e.g., prohibition of dogs.

Public meetings with local fishing clubs and interested parties will facilitate voluntary compliance of regulations. Recreational fishing events will be held only with the sponsorship of the Service and at times, in places, and with methods deemed to comply with State and Federal wildlife regulations and other refuge regulations.

The refuge is a leave-no-trace, carry-in-carry-out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 CFR 27.93.94.

JUSTIFICATION:

Recreational fishing is a priority public use identified in the National Wildlife Refuge System Improvement Act of 1997, and facilitates other priority public uses such as wildlife observation and photography. Monomoy NWR is world-renowned for its offshore fish resources and allowing this use will not pose significant adverse effects on refuge resources, nor interfere with other public uses of the refuge. Area closure limitations outlined in this determination provide maximum protection to prime nesting habitat for piping plovers and terns, and minimize disturbance to staging terns and resting seals. Recreational fishing will foster a greater awareness and appreciation of the importance of this site to the National Wildlife Refuge System. Costs associated with administering public fishing and likely visitor impacts are minimal. This use will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of Monomoy NWR. Therefore, it is the determination of the Service that recreational fishing, at the discretion of the refuge manager, is a compatible use and contributes to the purposes for which Monomoy NWR was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Hiking, Walking, and Jogging

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Hiking, Walking, and Jogging

NARRATIVE:

The Service and the National Wildlife Refuge System maintain the goal of providing opportunities to view wildlife and take part in interpretation. Allowing the use of refuge areas already open to the public, including one trail system on Morris Island, to persons hiking, walking and jogging supports this goal. Hiking, walking, and jogging are not priority public uses. Hiking and walking do facilitate priority public uses by providing visitors with the chance to view wildlife and engage in wildlife photography and interpretation, which promote public appreciation of the conservation of wildlife and habitats. Joggers are not likely to be observing wildlife but they might stop to read interpretative signs or passively observe wildlife while jogging. Hiking, walking and jogging would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose for which the refuge was established.

Hiking, walking, and jogging are anticipated to have the same level of impacts as the primary public uses because the access and activities are very similar. Refuge staff will regulate these activities through area closures, so impacts of hiking, walking, and jogging will likely be minimal if conducted in accordance with refuge regulations. For these reasons, hiking, walking, and jogging are appropriate uses on Monomoy NWR.

COMPATIBILITY DETERMINATION

USE:

Hiking, Walking, and Jogging

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?
The use is hiking, walking or jogging.

(b) Is the use a priority public use?
This use is not a priority public use of the National Wildlife Refuge System; however, it supports priority public uses since it can contribute to wildlife observation, wildlife photography, and interpretation.

(c) Where would the use be conducted?
All hiking and walking will be conducted only in areas that are open to the public, including the Morris Island trail system and designated areas on Monomoy Island. Jogging will be conducted only in refuge areas that are open to the public on Morris Island. Certain areas on Monomoy NWR are seasonally closed to public access at the refuge manager's discretion to protect sensitive habitats or species of concern, minimize conflicts with

other refuge activities, or respond to human health and safety concerns. Hiking and walking have historically been concentrated along and limited to perimeter beaches, the Morris Island Trail and other traditional footpaths on Morris Island and the North Monomoy Corridor; on South Monomoy, hiking and walking occur on the connection to South Beach, the trail to access the Monomoy Light Station and keeper's house, and the trail between the lighthouse and Powder Hole.

(d) When would the use be conducted?
Individuals would be able to hike, walk, or jog throughout the year during regular refuge hours, unless otherwise posted by the refuge. Monomoy NWR is open daily from ½ hour before sunrise to ½ hour after sunset, year-round.

(e) How would the use be conducted?
Hiking, walking, and jogging tend to be self-regulating, with signs indicating trailheads and appropriate routes of travel, as well as seasonally closed areas. Visitors are encouraged to contact Monomoy NWR staff for up-to-date information on seasonal closures. Information about closures is also available on the refuge Web site or at the visitor center, when staffed.

(f) Why is this use being proposed?
Hiking, walking, and jogging are not priority public uses. However, hiking and walking facilitate priority public uses on the refuge. Although hiking, walking are classified as non-wildlife activities, most visitors use the refuge for the wildland experience it provides. Hiking or walking in designated areas of the refuge allows visitors to engage in priority public uses such as wildlife observation, wildlife photography, or interpretation. Joggers are not likely to be observing wildlife but they might stop to read interpretative signs or passively observe wildlife while jogging.

AVAILABILITY OF RESOURCES:

The refuge has an existing, self-guided, interpretive loop trail on Morris Island and a short trail bisecting North Monomoy, traversing from the designated boat landing on the east to the salt marsh and tidal flats on the west side. Both areas are maintained for safe hiking or walking and qualitatively monitored by existing refuge staff and volunteers for natural resource impacts at a relatively low annual cost. Allowing hiking or walking within areas otherwise open to the public, and jogging only on Morris Island, will not substantially increase the maintenance or operational needs of the refuge. No entrance fees are collected.

The following breakdown shows the estimated amount of funds needed annually to administer hiking, walking, and jogging refuge wide, including the Monomoy Wilderness.

WG-6 Maintenance Worker - trail/road maintenance	1 week	$1,200
GS-9 Visitor Services Specialist - hiking information	1 week	$1,500
GS-9 Law Enforcement Officer	1 week	$1,800
Fact sheets/materials		$1,000
Total annual cost		**$5,500***

* Refuge areas that are open to the public are maintained for a variety of activities. Costs shown are a percentage of total costs for trail/road maintenance on the refuge and are reflective of the percentage of trail/road use for this activity. Volunteers account for some hiking information and trail maintenance hours and help reduce overall cost of the program.

ANTICIPATED IMPACTS OF THE USE:

The proposed use is anticipated to have the same level of impacts as the priority public uses because the access and activities are very similar. The impacts to natural resource and wilderness character from hiking, walking, or jogging will likely be minimal if conducted in accordance with refuge regulations and only in areas otherwise open to public access. Possible wildlife and fisheries impacts include disruption of nesting migratory bird populations, terns, shorebirds, and other bird populations feeding and resting near the trails during certain times of the year, impacts to larval threatened northeastern beach tiger beetle populations, and disruption of local seal populations.

On Monomoy NWR, area closures are created to protect priority nesting migratory tern and shorebird species. Although these closure areas are designed to minimize human impacts, the potential exists for impacts to unobserved nesting animals. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Activities where humans move quickly (e.g., jogging) or make loud noises (e.g., landscaping) cause birds to flush more than fishermen, clammers, sunbathers, and some pedestrians. The latter groups tend to move more slowly or stay in one place for longer periods, and birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of hiking, walking, or jogging are likely to be minimal if conducted in accordance with refuge regulations and only in areas otherwise open to public access. Jogging is not suitable on North and South Monomoy Islands including Nauset/South Beach because of the use of these

areas by nesting and staging birds and seals. We will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies.

Individuals hiking, walking, or jogging to Monomoy NWR could potentially impact the larval stage of the threatened northeastern beach tiger beetle on South Monomoy Island including Nauset/South Beach. The recovery plan for this species describes human impacts such as habitat alteration and recreational activities that threaten many of the species' habitats (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time spent foraging by the inhabiting larva.

Pedestrian use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year round. A 150-foot buffer around all seals is required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Unmanaged hiking, walking, or jogging has the potential to damage or kill plants and lead to new, unwanted, impromptu trails on the refuge that become shortcuts through more ecologically sensitive sites. Heavy use of designated, managed, or unmanaged pedestrian travel routes can ultimately lead to areas void of vegetation (McDonnell 1981, Vaske et al 1992) and potentially destabilize dunes and interdunal wetlands, which are difficult to stabilize and restore to a naturally functioning condition (Kucinski and Einsenmenger 1943, Cole 2002, Goldsmith 2002, Grady 2002, O'Connell 2008).

Trampling has three initial effects: abrasion of vegetation, abrasion of surface soil organic layers, and soil compaction (Cole 2002). Plants can be crushed, sheared off, bruised, and even uprooted by trampling, leading to reduced vigor and reproduction, reduced or altered plant species composition and structure, and reduced biomass and cover (Cole 2002). Of these, abrasion of vegetation is the most common and noticeable effect observed in coastal dune communities, where little or no surface organic layer exists on the sandy soil substrate that naturally resists compaction (Fletcher 1993). All three impacts can commonly occur, however, within coastal marsh habitats where reduced wave energy allows significant accumulation of surface organic layers that are vulnerable to compaction (Fletcher 1993), which increases surface soil bulk density and reduces permeability. Increased ponding and muddy conditions tend to promote wider vegetative and soil impact zones along trails through wet areas (Cole 2002). McDonnell (1981) analyzed long-term human trampling, ranging from low to high intensity, on coastal dune vegetation at Parker River National Wildlife Refuge in Massachusetts. All levels of trampling significantly lowered species diversity, and heavy trampling caused a drastic reduction in species diversity and total vegetation cover. Moderate trampling reduced species diversity but not cover. This was probably because moderate trampling favored some species, such as beach grass over other, more sensitive species, such as beach-heather (*Hudsonia tomentosa*). Trampling may result in changes in plant communities by preventing succession in interdune and backdune areas and favoring disturbance-tolerant foredune species like beach grass.

The harsh growing conditions and environment in the coastal barrier system can make for slow vegetative recovery even after pedestrian traffic is eliminated at trampled sites (Fletcher 1993). The gradient from no vegetation to normal cover levels is very narrow along refuge trails and other footpaths where trampling is more concentrated, and is wider at traditional boat landings where trampling is more dispersed. Hiking and walking are among the most primitive forms of recreation, and the trails themselves encourage users to confine their hiking or walking to narrow corridors radiating or looping outward from user focal areas such as beach access points or boat landings. Such localized impacts, concentrated near a small number of the most popular destinations, do not pose any serious disruption to the barrier ecosystem composition, structure, and function and are not evident at large spatial scales on Monomoy NWR.

Once established, the trails themselves are clear evidence of human presence that detracts from some users' perceptions of an otherwise untrammeled, undeveloped, or otherwise natural appearing landscape (Hendee and Dawson 2002) within the Monomoy Wilderness. Bare, exposed, sand dune areas, potentially compacted tidal marsh segments, trail treads, and narrow zones of disturbed vegetation on either side of refuge foot trails and boat landings will be readily evident, but when trail standards are kept minimal, trails tend to be accepted or even expected by most, though not all, wilderness users (Stankey and Schreyer 1987, Cole 2002, Hendee and Dawson 2002). The majority of the Monomoy Wilderness will remain essentially unvisited and virtually undisturbed by hiking and walking. Pedestrian footpaths are not expected to substantially compromise the

perception of naturalness of the Monomoy Wilderness landscape or the wilderness user's experience (Cole 2002, Hendee and Dawson 2002).

Wilderness visitors' experiences are most strongly affected by social conditions, such as other visitors and their actions, than by their perception of naturalness or ecological conditions (Hendee and Dawson 2002). The trails themselves tend toward promoting a confining rather than an unconfined user experience (Hendee and Dawson 2002). With typically long sight distances across Monomoy's rolling nearly treeless coastal barrier landscape, too many individuals encountered or observed hiking or walking during visits by other Monomoy Wilderness users likely detracts from the sense of solitude experienced by wilderness users (Stankey and Schreyer 1987, Hendee and Dawson 2002). However, hiking and walking use is still currently very light in the more remote, interior portions of South Monomoy open to public use, where outstanding opportunities for solitude can be experienced by other Monomoy Wilderness users.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- All hiking, walking, and jogging will be done only in areas that are otherwise open to the public. Jogging may only be done on refuge lands on Morris Island otherwise open to public access.
- All individuals hiking, walking, or jogging must adhere to area closures and understand that certain destinations may not be available year-round. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.
- No physical items, including litter, will be placed or left on the refuge. The leave-no- trace principles and practices (e.g., pack it in and pack it out) will be implemented on a refugewide basis, including the Monomoy Wilderness.
- Dogs and other pets are not allowed on the refuge.
- No items will be removed from the refuge. Take only photos, leave only footprints.
- All hikers, walkers, and joggers must maintain a 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.
- Refuge visitor information services and products will emphasize the importance of staying on trails and out of seasonal closure areas, along with providing leave-no-trace hiking tips.
- Refuge staff or volunteers will periodically qualitatively and photographically document pedestrian impacts to vegetation and soils to footpaths, boat landings, and other known user concentration points for use in drafting or updating a Monomoy Wilderness Stewardship Plan.

JUSTIFICATION:

The Service and the National Wildlife Refuge System maintain the goal of providing opportunities to view or photograph wildlife and to take part in interpretation. Allowing the use of refuge areas that are already open to the public including, but not limited to, one interpretive trail on Morris Island, the North Monomoy Corridor; on South Monomoy, hiking and walking occur on the connection to South Beach, the trail to access the Monomoy Light Station and keeper's house, and the trail between the lighthouse and Powder Hole. Jogging will be conducted only in areas that are open to the public on Morris Island. Although hiking or walking are not priority public uses, they facilitate priority public uses, providing visitors with the chance to view or photograph wildlife and engage in interpretation and recreational fishing, thereby promoting public appreciation of the conservation of wildlife and habitats. Hiking, walking, or jogging at current and expected levels of use, and subject to the stipulations listed above will not materially interfere with or detract from preserving wilderness character in the Monomoy Wilderness, the fulfillment of the National Wildlife Refuge System mission, or the purpose for which the refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Mosquito Monitoring and Control

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✔
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Mosquito Monitoring and Control

NARRATIVE:

Mosquito management includes population monitoring and control, if warranted. Mosquito surveillance monitoring and control, when necessary, will be conducted in several small pools, or pannes, within a 5-acre salt marsh on the Morris Island portion of the refuge. Mosquito and mosquito-borne disease management is not a priority public use of the National Wildlife Refuge System (NWRS) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act.

Mosquito population monitoring and control would be conducted by the Cape Cod Mosquito Control Project (CCMCP) following the protocols and best management practices identified in the Massachusetts Arbovirus Surveillance and Response Plan (Massachusetts Department of Public Health 2012) and in compliance refuge-specific regulations. In general, we allow populations of native mosquito species to function unimpeded unless they cause a wildlife or human health threat. Mosquitoes are a natural component of most wetland ecosystems but may also represent a threat to human, wildlife, or domestic animal health. Refuges are to collaborate with Federal, State, or local public health authorities and vector control agencies to identify refuge-specific health threat categories that represent increasing levels of health risks and are based on monitoring data.

Mosquito-associated health threats will be addressed using an integrated pest management (IPM) approach, including when practical, compatible, non-pesticide actions that reduce mosquito production. Treatment options will be chosen based on our IPM policy (569 FW 1) and our NWRS Biological Integrity Diversity and Environmental Health policy (601 FW 3), and will emphasize human safety and environmental integrity, effectiveness, and cost factors. We will use human, wildlife, or domestic animal mosquito-associated health threat determinations, combined with refuge mosquito population estimates, to determine the appropriate refuge mosquito management response. We will allow pesticide treatment to control mosquitoes on refuge lands only after evaluating all other reasonable IPM actions, based on monitoring data for the relevant mosquito life stage and only when necessary to protect human or wildlife health, when mosquitoes are detrimental to refuge management goals and objectives, and control does not interfere with achieving management goals and objectives. We will use current monitoring data for larval, pupal, and adult mosquitoes to determine the need for larvicides, pupacides, and adulticides, respectively. We will allow the use of adulticides only when there are no practical, effective alternatives to reduce a health threat during a declared public health emergency.

COMPATIBILITY DETERMINATION

USE:

Mosquito Monitoring and Control

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…
16 U.S.C. § 715d (Migratory Bird Conservation Act)

…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness)

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is mosquito management, which includes population monitoring and, if warranted, control. Mosquito and mosquito-borne disease management is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

The Cape Cod Mosquito Control Project (CCMCP) will conduct mosquito population monitoring and control, following the protocols and best management practices identified in the Massachusetts Arbovirus Surveillance and Response Plan (Massachusetts Department of Public Health 2012. The Service recognizes that mosquitoes are a natural component of most wetland ecosystems but may also represent a threat to human, wildlife, or domestic animal health. Refuges are to collaborate with Federal, State, or local public health authorities and

vector control agencies to identify refuge-specific health threat categories that represent increasing levels of health risks and are based on monitoring data. Refuges will not conduct mosquito monitoring or control, but may allow these activities under special use permits.

(b) Where would the use be conducted?
Mosquito surveillance monitoring and control, if necessary, will be conducted in several small pools within a 5-acre salt marsh on the Morris Island portion of the refuge. The refuge lies within the jurisdiction of the CCMCP, which has conducted mosquito control activities on Morris Island (both on and off-refuge) since the CCMCP was organized in 1930. The CCMCP controlled larval mosquitoes in these small pools from at least 1983 until August 2001, when the practice was suspended pending review of the Service's new compatibility process. In July 2003, the Service found mosquito surveillance and limited mosquito control to be compatible, and the CCMCP resumed surveillance and larvicidal mosquito control of select mosquito species.

(c) When would the use be conducted?
Surveillance activities associated with this use would be conducted on the Morris Island portion of the refuge from April through October by CCMCP staff under the conditions of this compatibility determination and a special use permit (SUP). Known sites of mosquito development on the refuge will be visited for monitoring and surveillance during periods of mosquito production. The timing and frequency of monitoring is based on a number of factors, including history of mosquito production, tidal cycles, precipitation levels, and available resources, but could occur as frequently as weekly throughout the season.

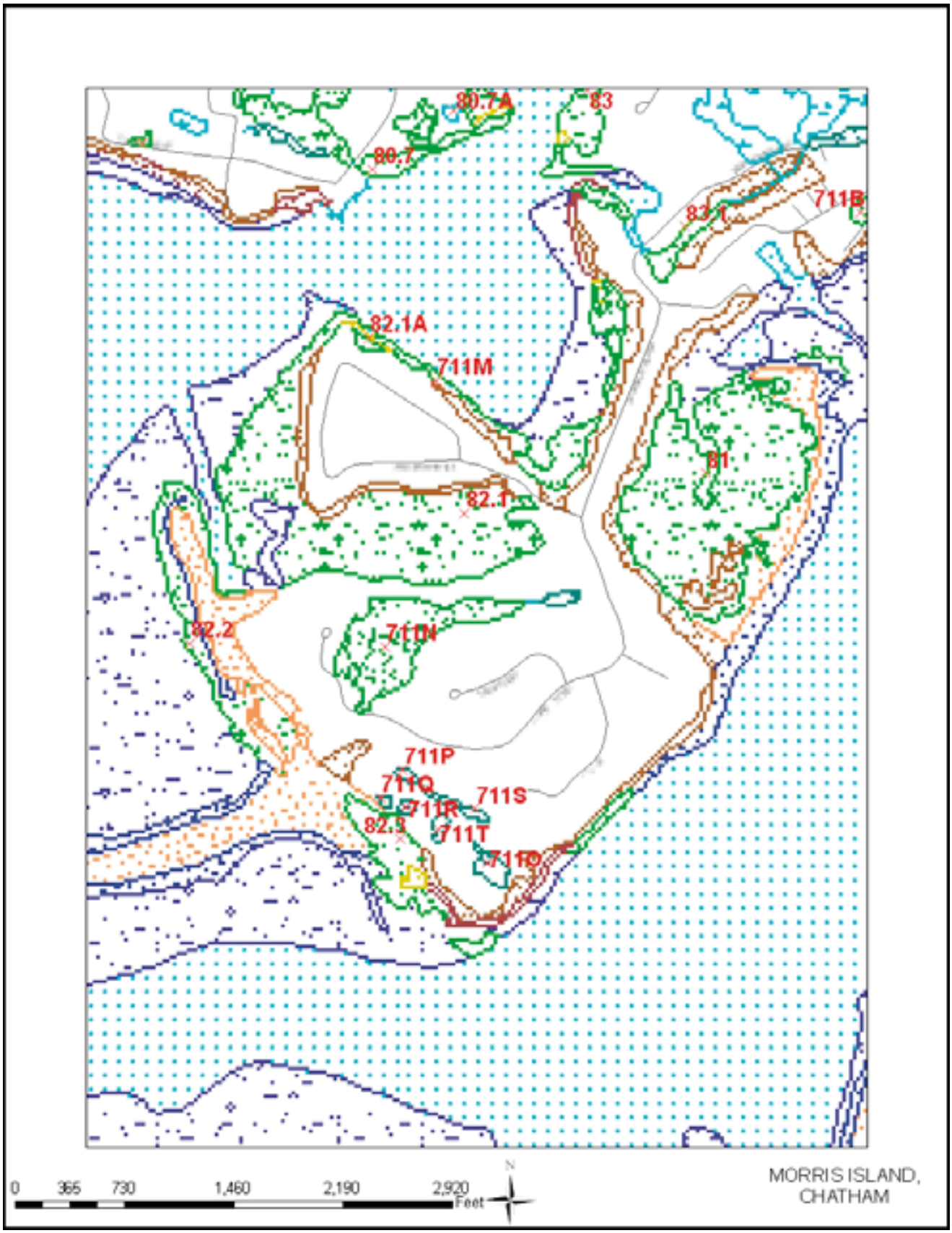
Mosquito control occurs irregularly when necessary to protect the health and safety of humans, wildlife, or domestic animals. Any mosquito control activities will be conducted on the basis of surveillance data. CCMCP treatment of refuge marshes using larvicides would occur only after the CCMCP has provided the refuge manager with data that shows that mosquito larvae populations are widespread within the salt marsh, and after monitoring indicates *O. cantator* and *O. sollicitans* larval counts exceed an average of 10 larvae per standard (350 ml) dipper. Other factors used to determine whether treatment would be allowed include marsh hydrology (drying versus flooding), rainfall, temperature, instar larval stages, and spray history.

Pupacides or adulticides will only be used when large numbers of mosquitoes are considered an immediate threat to human health and thresholds developed by the appropriate public health authority are met or exceeded, i.e., there is active transmission of mosquito-borne disease on the refuge from refuge-based mosquitoes.

(d) How would the use be conducted?
Mosquito-associated health threats will be addressed using an integrated pest management (IPM) approach including, when practical, compatible, non-pesticide actions that reduce mosquito production. We will choose treatment options based on our IPM policy (569 FW 1) and our Biological Integrity Diversity and Environmental Health policy (601 FW 3). We will base the choice on, in order of preference: human safety and environmental integrity, effectiveness, and cost. We will use human, wildlife, or domestic animal mosquito-associated health threat determinations combined with refuge mosquito population estimates to determine the appropriate refuge mosquito management response. We will consider allowing pesticide treatment to control mosquitoes on refuge lands after we evaluate all other reasonable IPM actions. Based on monitoring data, we will determine the most appropriate pesticide treatment options for the relevant mosquito life stage. We will use current monitoring data for larval, pupal, and adult mosquitoes to determine the need for larvicides, pupacides, and adulticides, respectively. Mosquito and arbovirus surveillance, monitoring, and treatment within the refuge have historically focused on several small pools within the salt marsh along the northwest refuge boundary on Morris Island. This is shown as area 81 on map D.1. Treatment areas will be based on surveillance and monitoring results. Specific areas treated and the extent of treatment would vary from year to year depending on mosquito populations, the mosquito vector flight distance, and environmental conditions. We will allow the use of adulticides only when there are no practical, effective alternatives to reduce a health threat. We will not allow pesticide treatments for mosquito control on the refuge without current mosquito population data indicating that such actions are warranted. We require an approved pesticide use proposal (PUP) prior to an application of a pesticide on refuge lands.

In Massachusetts, mosquito control activities and work are performed pursuant to the provisions of chapter 252 of the Massachusetts General Laws (*http://www.mass.gov/agr/mosquito*). The CCMCP, as one of the nine mosquito control projects authorized under chapter 252, monitors larval and adult mosquitos on the refuge *http://ccmcp.net* and adheres to the Massachusetts Arbovirus Surveillance and Response Plan (Massachusetts Department of Public Health 2012). Additionally, the CCMCP will conduct surveillance, monitoring, and if necessary, control measures under the conditions contained in a SUP that will be issued by the refuge manager.

Map D.1. Mosquito Harboring Locations on Morris Island and Vicinity, Chatham, Massachusetts



Baseline mosquito management actions on Monomoy NWR will involve monitoring and surveillance of mosquito vector populations. Annual surveillance monitoring on refuge lands for arbovirus incidence in adult mosquito vectors and wildlife (especially birds) will be allowed. Mosquito vector monitoring on the refuge will document mosquito species composition to genus or species level, and estimate population size and distribution across refuge wetland habitats during the breeding season, using standard methods employed by mosquito control professionals.

Mosquito population monitoring objectives are to:

- Establish baseline data on species and abundance.
- Map breeding and harboring habitats.
- Estimate relative changes in population sizes and evaluate associated health risks.
- Use this information to guide integrated pest management of mosquito populations.

All sites identified as potential mosquito habitat have been logged and recorded in the CCMCP GIS system. Throughout the mosquito season, CCMCP crews conduct larval surveys on two- week rotations. The CCMCP checks all sites known to harbor mosquitoes for mosquito larvae using a standard (350 ml) dipper, and may search for new larval habitats, i.e., artificial containers, on or adjacent to refuge lands. Carbon dioxide light traps are placed on the Morris Island portion of Monomoy NWR. When the traps are deployed, adult mosquitoes are collected from them weekly, taken back to the lab, identified to the species level, and counted. Landing rates of adult mosquitoes are also noted. Monitoring will be conducted by the CCMCP, primarily on foot. Use of motorized vehicles on refuge lands is not authorized unless escorted by refuge staff. To avoid harm to wildlife or habitats, access to traps and sampling stations will comply with the Stipulations Necessary to Ensure Compatibility included in this determination.

Refuge staff will work with the CCMCP to develop a mosquito management plan that will provide specifics on how and when the refuge will allow, if necessary, control of mosquitoes on refuge lands, using predetermined threat levels and mosquito vector population densities. A phased approach will be used to guide appropriate control response up to and including the use of adulticides. That will occur when Federal and State public health officials, using arbovirus monitoring and surveillance data, have determined that the refuge is in a high-risk area for mosquito-borne disease transmission, and it has been demonstrated through surveillance that refuge-based mosquitoes have been shown to carry specific diseases. A high-risk determination indicates an imminent risk of serious human disease or death.

Pesticide treatment may not be used on Monomoy NWR solely for nuisance mosquito relief, but may be considered when there is a demonstrated human or wildlife health risk, mosquitoes are detrimental to refuge goals and objectives, and mosquito management actions will not interfere with refuge goals and objectives. Only pesticides identified in the special use permit and for which a pesticide use proposal (PUP) has been submitted and approved will be used on the refuge. The preferred larvicide treatments for use on the refuge are *Bacillus thuringiensis israelensis* (Bti) or *Bacillus sphaericus* (Bs), because of the bacterium's limited non-target effects. Due to specificity of the effects of Bti on the insect order Diptera, Aquabac is deemed compatible for use, under the stipulations prescribed at the end of this compatibility determination. Bti is the preferred chemical control option and will be used under appropriate conditions before methoprene is considered. We favor using the larvicide that would have the least adverse impacts on non-target invertebrates, produce fewer disruptions to food webs critical for migratory birds, and reduce lethal effects on natural mosquito predators, such as larval forms of odonates, hemipterans, and coleopterans. CCMCP will conduct post-larvicide monitoring to determine effectiveness.

Treatment regimens will vary annually, depending on the current threat level; the process for determining the threat level will be clearly delineated in the Monomoy NWR Mosquito Management Plan. Because disease threat levels vary from year to year, mosquito management on the refuge is unlikely to include all phases in any given year. Action thresholds that trigger chemical interventions will incorporate various factors listed in Service Policy 601 FW 7, Exhibit 3, as developed with refuge staff, State mosquito control section, public human health services, and vector control agencies. Thresholds must be genus and life-stage specific and be related to the refuge decision-making response matrix.

We will rarely allow CCMCP staff to undertake targeted larvicide applications (Aquabac granular Bti) to protect human safety if the mean number of *O. cantator* or *O. sollicitans* mosquito larvae is less than the threshold that is established in consultation with public human health personnel. At a minimum, the threshold will be 10/dip, with at least 10 dips taken on the same day within each source pool across the 5-acre site; this is subject to change depending on the results of future coordination with public health officials. Mosquito vector

populations below this level will not be treated. The CCMCP will coordinate with the refuge manager prior to surveillance, monitoring, and control activities on the refuge.

Variations in annual permit restrictions may be necessary to accommodate wildlife breeding, roosting, and feeding activity, endangered species, administrative needs, public use management, research, or monitoring protocols. Other conflicts that may arise will be incorporated into the annual permit to ensure there are no significant adverse impacts on refuge wildlife and habitats. Because mosquito management takes place only on Morris Island, there is no need to develop restrictions or stipulations to protect wilderness character.

The CCMCP is required to provide the refuge manager with an annual quantitative summary of refuge mosquito monitoring and surveillance results, control activities on the refuge (e.g., type of pesticides applied, amount of pesticides applied, locations of application, method of application), and regional disease surveillance. All surveillance and control activities would be spatially referenced as technologies develop at CCMCP, e.g., use of global positioning satellites (GPS) and geographic information systems (GIS). Comparisons of mosquito management within and among years should be presented to permit analysis of patterns that may indicate success of habitat management efforts or suggest the need for a new management approach.

(e) Why is this use being proposed?
The use is proposed to minimize health risks to humans and wildlife from mosquito-borne disease. Two mosquito-borne viral diseases are currently endemic in Massachusetts: eastern equine encephalitis and West Nile virus. Mosquito population monitoring is necessary to detect changes that indicate increased human or wildlife health risks. In addition, surveillance for incidence of mosquito-borne disease by testing wildlife, especially birds, and adult mosquitoes for pathogens is needed to help characterize the level of health risk. There is a documented history of human West Nile virus infections in Barnstable County and eastern equine encephalitis focused in eastern Massachusetts, just west of Cape Cod in Barnstable County, which warrant continuing to annually monitor mosquitoes for the foreseeable future. The goal of early mosquito larvae monitoring is rapidly detection of relative and absolute changes in population size that can indicate an increased short-term risk to human, wildlife, or domestic animal health.

CCMCP surveillance on Morris Island in Chatham since 1991 has documented the occurrence of several primary and bridge vector mosquito species associated with eastern equine encephalitis and West Nile virus transmission to humans. Some of these mosquitoes are bridge vectors, meaning these species feed on birds and other animals, thereby enhancing the risk of disease transmission to people. The following table shows the presence of disease-carrying mosquitoes on the refuge. We have some historical records that show these species have been found on the refuge, with *Ochlertatus sollicitans* and *Ochlerotatus cantator* being the most common.

Table 1. Arbovirus Mosquito Vectors and Flight Ranges found on Monomoy NWR

Mosquito Vector	EEEV	WNV Vector	Number of years present out of 13 years for which we have data	Flight Range
Culiseta morsitans	X Birds		1	
Coquillettidia perturbans	X Bridge	X Bridge	2	5 km
Ochlerotatus canadensis	X Bridge	X Bridge	5	2 km
Aedes vexans	X Bridge	X Bridge	1	>25 km
Culex pipiens	X Bridge	X Birds	4	2 km
Culex restuans	X Bridge	X Birds	1	2 km
Culex salinarius	X Bridge	X Bridge	2	10 km
Ochlerotatus excrusians			4	
Ochlerotatus sollicitans (Formerly *Aedes sollicitans*)	X Bridge	X Bridge	6	>25 km
Ochlerotatus cantator (Formerly *Aedes contator*)	X Bridge	X Bridge	6	>10 km
Ochlerotatus triseriatus	X Bridge	X Bridge	3	0.2 km

West Nile virus was first detected in birds, mosquitoes, and humans in Barnstable County in 2003, and in mosquito pools in 2003 to 2006 (towns of Falmouth and Barnstable) and 2008 and 2009 (towns of Barnstable and Bourne). West Nile virus was detected in dead birds (primarily corvids) in Barnstable County in 2005 (3 positive samples, including 1 from Harwich) and 2006 (9 positive samples, including 2 each from Dennis and Brewster) before testing of dead birds was discontinued in 2009. Two human West Nile virus cases were documented in the Town of Barnstable, one case in 2003 and another in 2007. There have been no human West Nile virus cases documented for Chatham or surrounding communities (Harwich, Dennis, Brewster, or Orleans), and West Nile virus has not yet been detected from humans, dead birds, or mosquito pools in Chatham.

Periodic outbreaks of eastern equine encephalitis with an epicenter in southeastern Massachusetts just west of Cape Cod are also documented. The majority of human eastern equine encephalitis cases have occurred in Norfolk, Bristol, and Plymouth counties, although some cases are documented for Middlesex County, Essex County, and as far west as Worcester County. Although the historic eastern equine encephalitis epicenter lies just to the north and west, Cape Cod and the Islands (Martha's Vineyard and Nantucket) have no documented human eastern equine encephalitis cases or deaths. The first documented incidence of eastern equine encephalitis isolated from a Cape Cod mosquito pool was collected in Nickerson State Park in Brewster in August 2012.

Refuge pools on Morris Island are known to harbor the brown salt marsh mosquito *Ochlerotatus cantator* and the eastern salt marsh mosquito *O. sollicitans*, which are both bridge vectors for the transmission of both West Nile virus and eastern equine encephalitis to humans. These pools have been treated in the past, although it appears the threshold for treatment can be raised given the low risk of disease occurrence on Cape Cod. According to Kilpatrick (2005), West Nile virus transmission risk from *O. sollicitans* in Suffolk and Rockland counties, New York, was only 0.07 percent; 80 percent of the West Nile virus transmission was from *Culex pipiens* and *Culex restuans*. *O. cantator* was not even identified as a risk species for West Nile virus in these salt marshes. Despite the incidence and spread of West Nile virus and eastern equine encephalitis in southeastern Massachusetts, and the potential for spread of other mosquito-borne diseases, portions of Monomoy National Wildlife Refuge are still viewed as a low-remote potential mosquito-borne disease reservoir.

AVAILABILITY OF RESOURCES:

The CCMCP will conduct monitoring and control, coordinated with the refuge manager on an annual basis through the issuance of an special use permit. Existing funds are available to support the refuge manager and other staff in coordinating this use (table 2). As funding becomes available, refuge staff will take an active and, in most cases, a lead role in planning and implementing tidal circulation enhancement and wetland restoration projects aimed at improving wildlife habitat while reducing mosquito production on non-wilderness portions of Monomoy NWR. Developing a mosquito management plan for the refuge will be a one-time effort that is likely to take 0.20 of a full-time employee (FTE). A notice of intent needs to be submitted to the Environmental Protection Agency for the use of pesticides in the salt marsh, and it will be the responsibility of the CCMCP to draft a notice of intent and either acquire the permit, or provide all the information needed so the Service can obtain the permit. This will be listed as a condition for issuing a special use permit for mosquito control.

Table 2. Staffing needs to conduct use of Mosquito Management on Monomoy NWR

Position	Involvement	FTE	Cost
Refuge Manager	General oversight	0.02	$2,500
Wildlife Biologist	Field visits, mosquito management plan review and implementation; preparation of pesticide use proposal, special use permit, and pesticide use report; oversight of mosquito-borne disease monitoring, vector control activities. Involvement in coordination and oversight of mosquito monitoring activities.	0.05	$3,375
Total FTES and Staffing Costs		0.07 FTE	$5,875

ANTICIPATED IMPACTS OF THE USE:

Direct impacts of monitoring and control include temporary disturbance to habitat and possible direct effects to non-target wildlife. Areas of vegetation may be crushed underfoot, with impacts ranging from temporary in nature to loss of habitat over time. Invasive weeds may be introduced or spread by foot. Indirect effects associated with mosquito control include reducing mosquito populations and other non-target species that serve as the base of food chains for wildlife species.

Impacts to birds as a result of physical access (trampling of vegetation, nests) for mosquito management could occur, but are unlikely, as these actions would not significantly affect bird populations of the refuge given the small size and limited bird habitat that the areas receiving mosquito management provide.

Chemical Treatment Effects on Target Mosquito Populations

The use of mosquito larvicides generally is considered preferable to the use of adulticides because larvicides prevent the appearance of the blood feeding adults; larvicides can provide up to a month of control, rather than the few hours provided by fogging with adulticides; the commonly used larvicides are less toxic than the adulticides and the application method greatly reduces human exposure; and larvicides generally are applied to smaller areas than are adulticides.

A natural soil bacterium, *Bacillus thuringiensis var. israelensis* (Bti), like other varieties of *Bacillus thuringiensis* (Bt), is a stomach poison that must be ingested by the larval form of the insect in order to be effective. Bti is an EPA toxicity class III general use pesticide and is practically non-toxic to animals (Extoxnet 1996). Bti is specific to certain primitive dipterans, especially mosquitoes, black flies, and some chironomid species (Boisvert and Boisvert 2000), and is not known to be directly toxic to non-dipteran insects; there are no toxic inert ingredients included in Bti products (Extoxnet 1996). Bti produces protein endotoxins, activated in the alkaline mid-gut of target insect species, that bind to protein specific receptors of dipteran larvae species, resulting in mortality. Bti must be ingested by the target insect to be effective and is most effective on larval salt marsh mosquito instar stages 1 and 2; it is considerably less effective against instar stages 3 and 4. Bti has no effect on pupae or adult mosquitoes.

Methoprene is a contact insecticide that does not need to be ingested like Bti (Tomlin 1994); it ranks as a toxicity class IV, and is considered slightly to practically nontoxic (EPA 2001). Methoprene compounds like Altosid Liquid Concentrate and Altosid Single-Brood Granule all mimic the action of an insect growth hormone and interfere with the normal mosquito maturation process, acting as an insect growth regulator (IGR) preventing mosquito larvae from pupating and reaching the adult stage.

Adulticides appear to effectively control adult mosquito populations and spread of mosquito- borne disease such as West Nile virus (Carney et al 2008), but only for a brief time, and are therefore only recommended during a disease event to break the disease transmission cycle (*http://www.townofsilvercity.org/vector/scienceofvector.html*). Adulticides kill only mosquitoes that contact insecticide droplets. The fog soon dissipates. Although the local mosquito population is reduced for a few days, fogging does not prevent mosquitoes from re-entering the sprayed area. Adulticides will be considered only in the case of a declared public health emergency. Focused timing and location of adulticide application to control mosquito disease vector source populations is essential for effectiveness (*http://wildpro.twycrosszoo.org/s/00man/WNVOverviews/wnvindtech/wnvcontrolaerialadulticides.htm*).

Only the pyrethroid adulticide sumithrin (Anvil 10+10) has seen recent use in Massachusetts, although Monomoy NWR was not included in that application. Neither Naled (organophosphate) nor Malathion (or any other oxon derivative) has been used for adult mosquito control at Monomoy NWR, nor do we expect they will be used.

The Ecotoxnet database (*http://extoxnet.orst.edu/*) includes the following summary of how pyrethroids act as insecticides.

"Human-made pyrethroids are based on natural pyrethrins in chrysanthemums, which is a neurotoxic chemical to insects. Pyrethroids act by inhibiting the nervous system of insects. This occurs at the sodium ion channels in the nerve cell membrane. Some type II pyrethroids also affect the action of a neurotransmitter called GABA. Pesticide products containing pyrethrins usually contain a synergist (such as piperonyl butoxide). Synergists work by restricting an enzyme that insects use to detoxify the pyrethrins. A synergist allows the insecticide to be more effective. These products are dissolved in petroleum-based products."

Pesticide Toxicity and Other Effects to Non-target Organisms

The few small refuge sites receiving pesticide application for the purpose of mosquito management typically provide limited habitat for native wildlife and plants. These areas are mostly shallow swales within the intertidal marsh plain (4 to 6 feet) that hold water for extended periods (e.g., following high tides); the area lacks tidal channels that permit drainage. These characteristics result in poor tidal hydrology and, in turn, lower biotic productivity for a variety of plant and wildlife species relative to other refuge areas with better tidal flushing. Bti (EPA 1998) and methoprene (EPA 2001) are non-toxic to vegetation.

Giving full consideration to the protection and integrity of non-target organisms and communities, the greatest concerns the Service has with chronic mosquito control chemical use are the subsequent degradation of biological integrity and diversity, and disruption of vital food webs. Aquatic invertebrates play important roles in wetland ecology. They aid in the breakdown of fresh and salt marsh-derived organic matter and provide important food resources for different life stages of fish, breeding and migrating birds, and other wildlife. As such, they are critically important and directly linked to the future conservation and management of refuge-specific resources of concern listed in CCP goals and habitat objectives.

Impacts to birds, mammals, reptiles, or amphibian may occur as a result of ground access. However, bird and mammal impacts are considered limited because areas that need mosquito management are small in size, and provide only limited habitat. The use of pesticides for the purpose of mosquito management may directly or indirectly affect resident and migratory bird, mammal, reptile or amphibian populations of the Refuge. Direct effects may occur from direct contact with the pesticides. Indirect effects are related to the potential reduction in the invertebrate food supply. Pesticide effects on reptiles and amphibians may occur through reductions in insects that serve as a food source (Hoffman et. al. 2008), through direct individual effects from pesticide application, or from trampling of individuals or habitat. Birds are often used as a surrogate for effects on reptiles, and fish as a surrogate for amphibians (Hoffman et al. 2008). Bti has practically no acute or chronic toxicity to mammals, birds, fish, or vascular plants (EPA 1998).

Migratory birds that depend on invertebrate food resources may not be mobile enough to seek alternative feeding sites, post-treatment, particularly during the breeding season. Precocial young seek food items on their own. Since they are flightless, food items must be available within a relatively small home area. Reduction of invertebrate food resources within even a small geographic area may be detrimental to breeding wetland birds and precocial young.

Altricial birds, those with young that are relatively helpless and restricted to a discrete nest site during the first few weeks of life, are solely dependent upon the parents for food. When invertebrate foods are scarce, parents may have to make more extended feeding forays and be less able to provide sufficient nutrition to all offspring, potentially resulting in increased chick mortality. Adults making extended flights into less familiar territory may be more likely to suffer predation or to experience inter- or intra-specific competition. Young subjected to extended periods at the nest without parental attention may be more likely to suffer predation or weather-related stress.

The use of larvicides and pupacides for the purpose of mosquito management is not likely to directly affect native mammal populations of the refuge. Adverse effects on mammals from Bti, methoprene, and Agnique (monomolecular film) are not expected when applied according to the label instructions. Extensive acute toxicity studies indicated that Bti is virtually innocuous to mammals (Siegel and Shadduck 1992). These studies exposed a variety of mammalian species to Bti at moderate to high doses and no pathological symptoms, disease, or mortality were observed. Methoprene is not considered toxic to mammals. Impacts to the mammalian community as a result of reduced invertebrate populations are not expected because most mammal species that inhabit wetlands of the refuge are herbivorous and invertebrates are not a primary component of their diet. Insectivorous shrews experiencing reduced arthropod food availability may be reduced over the short-term post-treatment. Negative effects on fish populations are not expected from proposed larvicides and pupacides.

Using larvicides can adversely affect non-target insects, especially non-biting midges (Chironominae), and Bti concentration is important with regard to impacts on non-target organisms such as ecologically important non-biting midge larvae. Chironomid larvae are often the most abundant aquatic insects in freshwater, brackish and salt marsh wetland environments and represent a major component in food webs for many wetland-dependent wildlife species (Miller 1987, Euliss et al 1991, Helmers 1992, Skagen and Oman 1996, MacKenzie 2005). Chironomids also frequently make up the largest proportion of wetland invertebrate biomass (Elridge 1992, Rehfisch 1994, Davis and Smith 1998, MacKenzie 2005).

The effect on local populations of invertebrate species over time with periodic and continued use of Bti is unknown but potential for negative effects is a possibility. Host range and effect on non-target organisms indicates that Bti is relatively specific to the Nematocera suborder of Diptera, in particular filter-feeding mosquitoes (Culicidae) and blackflies (Simuliidae) (Glare and O'Callaghan 1998). Bti is pathogenic to some species of midges (Chironomidae) and Tipulidae, although to a lesser extent than to mosquitoes and biting flies; it is not reported to affect a large number of other invertebrate species (Glare and O'Callaghan 1998). Other factors, such as temperature, water depth, aquatic vegetation, and suspended organic matter, may act to reduce its toxicity to chironomids in the environment (Charbonneau et al. 1994; Merritt et al 1989, Lacey and Merritt 2004). Negative impacts on chironomid density and biomass could have deleterious effects on wetland and wildlife food webs and could lower biodiversity. The effects of a single Bti application are difficult to predict because of documented differences in toxicity based on formulation, potency, application rate, and timing. Published studies (Hershey et al. 1998, Niemi et al. 1999) have examined the long-term, non-target effects of Bti. In Minnesota, 27 wetlands were sampled for macroinvertebrates over a 6-year period with no effects observed on the bird community (Niemi et al. 1999). In judging the potential for adverse ecological effects of Bti applications, one should consider the non-target aquatic organisms of concern that would be impacted from the potential loss of both mosquito and chironomid larvae.

Methoprene is considered practically non-toxic to birds (Extoxnet 1996, EPA 2001) at EPA- approved application rates. Methoprene products are more toxic than Bti products, killing a wider range of non-target larval insects. This makes methoprene more likely to cause disruptions to invertebrate food webs. Using short-term residual methoprene formulations and avoiding Briquets and other extended residual products would maintain concentrations at the low end, and mitigate any adverse impacts to non-targets in higher concentration scenarios. Altosid was found to have very little effect, if any, on 35 species of exposed non-target organisms, including earthworms, waterfleas, damselflies, snails, tadpoles, and mosquito fish when used at lower larviciding concentrations (Extoxnet 1996b). Some studies have suggested methoprene impacts other organisms that may form part of the food base for birds. McKenney and Celestial (1996) noted significant reductions in number of young produced in mysid shrimp at 2 ppb. Sub-lethal effects on the cladoceran, *Daphnia magna*, such as reduced fecundity, increased time to first brood, and reduced molt frequency, have also been observed at concentrations as low as 0.1 ppb (Olmstead and LeBlanc 2001).

As with Bti, concerns over methoprene use include potential negative impacts on chironomid larvae due to their importance in food webs. As with any pesticide, toxicity is a function of dose plus exposure. At mosquito control application rates, methoprene is present in the water at very low concentrations (4 to 10 ppb, initially). With regard to exposure, chironomid larvae occur primarily in the benthos, either within the sediments or within cases constructed of silk and detritus. Differences may exist with regard to exposure to methoprene between chironomid and mosquito larvae, as the latter occur primarily in the water column. The published literature on the effects of methoprene to chironomids is not as extensive as that for Bti. However, evidence is found for potential toxicity to chironomid and other aquatic invertebrates from methoprene treatments.

Methoprene is likely to be lethal to non-target terrestrial invertebrates, including pollinating species, in their larval stages if they come into direct contact with this chemical. Lepidopterans (butterflies and moths) may be highly susceptible. However, larval stages that develop in tree tissues or underground are unlikely to come in contact with methoprene. Methoprene and Bti both also have the potential to negatively affect the local chironomid (midge) population. The extent to which the use of Bti and methoprene will limit the food resources for individual birds or local avian populations is unknown. Though often discounted as inefficient pollinators, some researchers have suggested that the efficiency of pollinating flies (dipterans), mosquitoes (dipterans) and midges can exceed that of bees (*http://eol.org/pages/421/entries/24921263/details#relevance_to_humans_and_ecosystems*). Further, dipterans appear to be crucial for the pollination of certain flowers in some habitats.

Monomolecular films are not known to cause direct chronic or acute toxicological effects to birds, but are potentially lethal to any aquatic insect that lives on the water surface or requires periodic contact with the air-water interface to obtain oxygen; this may result in a negative impact to the avian food base, e.g., Chironomid invertebrates (USFWS 2005). The film interferes with larval orientation at the air-water interface or increases wetting of tracheal structures, suffocating the organism. As the film spreads over the water surface, larvae tend to concentrate, which may increase mortality from crowding stress (Dale and Hulsman 1990).

Pyrethroid insecticides are subject for review as potential developmental neurotoxicants because of their mode of action on voltage-sensitive sodium channels (Lu et al. 2006). Permethrin, the most widely used pyrethroid insecticide, is suspected to be an endocrine-disrupting chemical and was classified as a potential carcinogen at high exposure levels (EPA 2006). Pyrethroids may also have a suppressive effect on the immune system and may cause lymph node and spleen damage. Pyrethroids are reported to degrade rapidly in the environment

and to be broken down to nontoxic products. However, Tyler et al. (2000) and Hong Sun et al. (2007) argue that products of the metabolism of permethrin are potentially far more potent as endocrine disruptors than the parent compound because of their ability to interact with steroid hormone receptors. Pyrethrins have a slight toxicity to bird species (National Pesticide Information Center 1998, Extoxnet 1994). Non-target effects to birds from pyrethrin application may also occur as a result of a reduced food base (e.g., Chironomid invertebrates) if non-target invertebrate populations are significantly reduced.

The application of adulticides has the potential to adversely affect fish and aquatic invertebrate populations. Pyrethrins are considered highly toxic to fish and invertebrates (EPA 2006).

Because pyrethrins are broad-spectrum insecticides, they are potentially lethal to most insects. All adulticides are very highly toxic to aquatic invertebrates in concentrations as low as one part per billion (Milam et al. 2000). Pyrethrins are known to cause acute toxicological effects to benthic invertebrates at rates used for mosquito abatement (EPA 2006). Because most adulticides can be applied over or near water when used for mosquito control, risks to aquatic invertebrates from direct deposition and runoff of the pesticides exist.

The pyrethroid insecticides are extremely toxic to fish, with 96-hour LC50 values generally below 10 ug/l. Corresponding LD50 values in mammals and birds are in the range of several hundred to several thousand mg/kg. Fish sensitivity to the pyrethroids may be explained by their relatively slow metabolism and elimination of these compounds. The half-lives for elimination of several pyrethroids by trout are all greater than 48 hours, while elimination half-lives for birds and mammals range from 6 to 12 hours. Generally, the lethality of pyrethroids to fish increases with increasing octanol/water partition coefficients. The pyrethroid resmethrin is slightly toxic to birds and highly toxic to fish and to bees. Its LD50 in California quail was greater than 2,000 mg/kg; the LC50 in mosquito fish is 0.007 ppm. The LC50 for resmethrin synergized with piperonyl butoxide in red swamp crawfish, *Procambarus clarkii*, is 0.00082 ppm. The LC50 in bluegill sunfish is 0.75 to 2.6 ug/l, and 0.28 to 2.4 ug/l in rainbow trout. DeMicco et al. (2010) found a dose-dependent increase in zebrafish embryo mortality and pericardial edema, which was consistent with mammalian studies that demonstrated slight teratogenesis at high doses. Resmethrin is highly toxic to bees, with an LD50 of 0.063 ug/bee. Adulticides (pyrethrins) may adversely affect amphibians such as tadpoles that occur within seasonal freshwater wetlands of the refuge (Gunasekara 2005).

De Guise et al. (2005) studied a die-off of lobsters following mosquito spraying with resmethrin; they found that adult lobsters are no more sensitive than other aquatic species to the lethal effects, but are very sensitive to immune and endocrine endpoints tested (sublethal effects). Modulation in immune functions could result in increased susceptibility to infectious agents, contributing to mass mortality with sufficient exposure. Weston et al. (2005) examined toxicity of run-off sediments to an amphipod *Hyalella azteca* in creeks draining a Roseville, California, single-family subdivision. Nearly all creek sediments collected caused toxicity in laboratory exposures, and about half the samples caused nearly complete mortality. The pyrethroid bifenthrin was implicated as the primary cause of the toxicity, with additional contributions to toxicity from the pyrethroids cyfluthrin and cypermethrin originating from residential (structural) pest control by professional applicators or homeowner use of insecticides, particularly lawn care products.

The small scale and low frequency in past use of adulticides suggests that any future adulticide use on the refuge is unlikely to cause significant adverse effects to fish and invertebrate populations. Application would only occur in swales and not to channels, sloughs, or other open water areas. Application would only occur during low tides to avoid potential impacts to fish that may move into the tidal marsh plain during higher high or extreme tides. Oral exposure of mammals to pyrethrins could occur through consumption of plants or plant parts that have been sprayed. A terrestrial exposure model showed no acute or chronic risks to mammal or bird species (EPA 2006).

The Service recognizes that spray drift could enter the refuge from neighboring (Morris or Stage Island, or mainland Chatham) communities. The refuge has no jurisdiction over mosquito control on lands outside the refuge boundary; therefore, no SUP is required for off-refuge mosquito management. Since the State employs best management practices and follows the EPA-approved label, the Service expects impacts to refuge resources to be minimal.

Refuge habitat management actions that increase biological integrity, diversity, and environmental health (BIDEH) and avian diversity have the potential to provide a buffer against future disease outbreaks. Recent infectious disease models illustrate a suite of mechanisms that can lower incidence of disease in areas of higher

disease host-diversity (defined as the dilution effect). These models are particularly applicable to human zoonoses, i.e., infectious diseases of wildlife or domestic animals that spill over into human populations (Keesing et al 2006; Krasnov et al. 2007, Ostfeld and Kessing 2000) such as avian influenza, anthrax, Lyme disease, and West Nile virus.

Research conducted in the eastern U.S. in 2002 when the WNV outbreak was in full swing, found fewer incidences of West Nile virus in humans in areas with a diverse array of bird species (Swaddle and Calos 2008). This link between higher bird diversity and reduced human West Nile virus infection is attributed to the fact that crows, jays, thrushes, and sparrows are competent (amplifying) hosts of the West Nile virus, making them able to contract the disease and pass it on through a vector more efficiently. When bird diversity is low, competent host species tend to represent a higher proportion of the bird population, increasing the likelihood that a mosquito will encounter an infected bird and transmit the virus during its next bite. A diverse suite of bird species, with large numbers of incompetent hosts in the population, reduces the transmission rate to other birds or mammals, including humans. A similar study showed increased mammalian diversity decreased Lyme disease risk to humans (LoGiudice et al. 2003).

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

The following stipulations are required to ensure compatibility:

- The CCMCP must apply for and receive a special use permit annually from the refuge manager prior to conducting any mosquito and mosquito-borne disease surveillance and monitoring activities.
- The CCMCP will notify the refuge manager prior to monitoring and conducting disease surveillance. All personnel entering the wetlands will be oriented at the beginning of the surveillance period or escorted by refuge staff to avoid disturbance to endangered, threatened, or other sensitive species on the refuge.
- The CCMCP will be responsible for monitoring disease activity in reservoir hosts for pathogens or antibodies, and collecting adult mosquito samples in same-genus pools for virus or any other monitoring required to substantiate a high-risk disease situation on or near the refuge.
- The CCMCP will assume all monetary costs and perform all activities associated with mosquito monitoring, disease surveillance, and treatment. Service personnel may accompany CCMCP personnel to examine exact locations of heavy mosquito breeding problems to ascertain the presence of non-targets or mosquito predator species in these areas.
- Motorized access may only be used on non-wilderness portions of the refuge when escorted by refuge staff and no other practical means of conducting mosquito management exists.
- The CCMCP will limit the number of travel pathways used for mosquito management within the marsh.
- Caged sentinel chickens may not be used for reservoir host surveillance due to the risk of spreading disease to wild birds.

- The CCMCP will remove equipment and refuse resulting from operations on refuge lands daily, and will promptly repair all damage to government property that may result.
- All decisions for chemical interventions to control mosquitoes will be made by the refuge manager and will be based on meeting or exceeding predetermined mosquito abundance and disease thresholds.
- Current mosquito population data is necessary before mosquito larvicide treatments may be applied on the refuge.
- Only approved larvicides may be applied on refuge salt marshes within the prescribed area on Morris Island as identified in the special use permit.
- The refuge manager will be contacted at least 24 hours in advance of each larvicidal application.
- The CCMCP must provide a copy of the Clean Water Act NPDES permit from the Environmental Protection Agency prior to conducting any chemical treatment.
- Application of chemical mosquito control measures will be conducted in accordance with approved pesticide use proposals.
- Insecticide applications will avoid areas known to contain butterfly and moth host-plants in order to conserve and protect rare or specialist insect pollinators and also ensure that adequately buffered habitat around host plants or refugia is available during and after insecticide spraying.
- Application of pesticides will be in discrete, mosquito-producing areas of the refuge and at the lowest possible dilution rate (ultra-low volume) required for effectiveness.
- The CCMCP will minimize the use of pesticides on refuge lands, and continually investigate formulations and compounds that are least damaging to fish and wildlife populations.
- The CCMCP must provide the refuge manager with monitoring and disease surveillance data demonstrating that action thresholds have been reached or exceeded before pupacides are applied. Refuge manager approval must be obtained prior to CCMCP staff elevating to the next action or response threshold.
- Only the refuge manager, in consultation with the CCMCP and public health officials, may authorize application of mosquito adulticide and only when there is evidence of refuge-based mosquitoes contributing to a declared public health emergency.
- Immediately after any pesticide application, the CCMCP will monitor mosquito vector populations to assess the effectiveness of all pesticide treatments.
- Treatment in populated areas off-refuge will be considered first.
- General mosquito control will not be allowed during high tide events in order to avoid impacts to tidal marsh species. Unless permitted by the refuge manager, pesticide application should not occur within 100 feet of natural sloughs and channels.
- A final report of all monitoring and control activities conducted on the refuge must be provided to the refuge manager before the end of the calendar year.
- The CCMCP will meet with the refuge manager during the first quarter of each calendar year as a condition of the special use permit renewal for the upcoming year. Prior to that meeting, the CCMCP will review the previous year's pesticide proposals and submit to the refuge manager any changes in the pesticides or formulations of pesticides they expect to use in the upcoming year.

JUSTIFICATION:

Mosquitoes are a natural component of tidal wetlands but can pose a significant potential threat to human and wildlife health when refuge wetlands are within the known mosquito flight ranges of populated areas and refuge mosquitoes have been demonstrated to be infected with arboviruses. WNV and EEEV have been of particular concern across the United States and in the Cape Cod and Islands region. Mosquito species known as vectors of these diseases occur on the refuge.

The staff of Monomoy NWR and the CCMCP advocate an integrated approach to mosquito management that includes a range of tools to improve habitat conditions for estuarine wildlife while reducing threats to public health from mosquito species capable of transmitting disease to humans. With the continued existence of West Nile virus and eastern equine encephalitis and the potential for spread of other mosquito-borne disease, pressure is increasing to manage mosquito populations that occur on lands of the National Wildlife Refuge System, especially in populated areas such as the Cape Cod and Islands region. Understanding the actual risk of refuge-based mosquitoes to the spread of West Nile virus and eastern equine encephalitis is an important part of managing a mosquito control program on the refuge.

The use of larvicides and other pesticides, if necessary, will receive periodic compatibility review if future studies bring more information to light on the ecological impacts of mosquito control. In addition, new chemicals that may come to market in the future may be evaluated for potential use on Monomoy NWR.

The stipulations above address the Service's laws and Refuge System policies to maintain, enhance, and restore biological integrity, diversity, and environmental health, manage an IPM program, and protect the public from mosquito-borne health threats.

This activity will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose for which the refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Motorized and Nonmotorized Boating

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Motorized and Nonmotorized Boating

NARRATIVE:

Access to the Monomoy Islands is restricted to boat. Allowing the operation and landing of motorized and nonmotorized boats such as kayaks provides a safe means for visitors to access and explore Monomoy NWR beyond the Morris Island portion of the refuge. This access allows visitors to take part in priority wildlife-dependent recreation on the refuge, including wildlife observation, wildlife photography, and recreational fishing. Motorized and nonmotorized boat use will not interfere with the Service's work to protect and conserve natural resources. Motorized boats must land in designated areas to minimize potential impacts to wildlife. The level of use for these activities on the refuge is moderate, and the associated disturbance to wildlife is temporary and minor. Although motorized and nonmotorized boat uses are not priority public uses, they are not detrimental activities under the conditions described above. Boat access for waterfowl hunting, fishing, wildlife observation and photography, and environmental education and interpretation, which are priority uses, allows visitors to enjoy the outdoors and wild lands. Boating on Monomoy refuge will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

Nearly half (47 percent) of the refuge and most (86 percent) refuge land above mean low water is congressionally-designated wilderness, including much of the intertidal areas of the refuge. Motor boats are not generally allowed in wilderness. However, Public Law 91-504, which established the Monomoy wilderness, referenced the original Wilderness Act designation, thereby providing an exception to this prohibition, as the use of motorboats at Monomoy refuge had already been established and was deemed desireable.

For these reasons, the operation and landing of motorized and nonmotorized boats within Monomoy NWR is appropriate.

COMPATIBILITY DETERMINATION

USE:

Motorized and Nonmotorized Boating

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is the landing of motorized boats and the landing and launching of nonmotorized boats on Monomoy NWR. The majority of the boats will be privately owned motorboats, commercial ferries, canoes, and kayaks. The use is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). However, it does facilitate the priority public uses of wildlife observation, wildlife photography, environmental education, interpretation, waterfowl hunting, and fishing by allowing visitors to access the Monomoy Islands, including Nauset/South Beach.

(b) Where would the use be conducted?
Motorized boat access is allowed in designated landing sites on North and South Monomoy Islands, and nonmotorized boats are allowed to access any part of the refuge beach that is open to the public on both Monomoy Island and Morris Island. At this time, landing sites on Nauset/South Beach have not been

established but will if deemed necessary to protect wildlife or visitor safety. Public access is dictated by wildlife use. In general, much of the intertidal area is open to pedestrian traffic for most of the year. Some areas of beach are closed seasonally to protect nesting shorebirds and seabirds, and some intertidal areas are closed for loafing seals. Visitors should contact Monomoy NWR staff for up-to-date information on seasonal closures, or visit the refuge Web site.

(c) When would the use be conducted?
Monomoy NWR is open to the public from ½ hour before sunrise to ½ hour after sunset. Surf fishing is permitted on Morris Island 24 hours a day; this is the only activity allowed at night on Monomoy NWR. Motorized and nonmotorized boat use would be allowed during regular refuge hours.

(d) How would the use be conducted?
Motorized and nonmotorized boating will be allowed as a means to facilitate refuge public use programs, namely the priority public use programs of waterfowl hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The use would be conducted in a manner consistent with refuge and State regulations, with some additional restrictions to protect fish, wildlife, and habitat. Visitors can access Monomoy Island using motorboats; however, the refuge does not provide boat trailer access. Visitors can launch nonmotorized boats from cars in areas where the beach is open to public use. Additional opportunities to launch motorized and nonmotorized boats exist on nearby non-refuge lands.

(e) Why is this use being proposed?
Waterfowl hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the six priority public uses of the Refuge System. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses. Motorized and nonmotorized boating provides a means to facilitate the priority public uses. By allowing these uses, we are providing opportunities to visitors to access the Monomoy Islands and facilitating refuge programs that offer high-quality, wildlife-dependent recreation and maintain the current level of fish and wildlife values.

AVAILABILITY OF RESOURCES:

This use requires that staff provide information to visitors and conduct periodic law enforcement patrols, particularly to ensure that boaters stay out of closed areas. Costs are outlined below:

GS-9 Law Enforcement Officer—3 weeks	$5,400
Sign posting and maintenance	$2,000
Total annual costs	**$7,400**

ANTICIPATED IMPACTS OF THE USE:

Allowing motorized and nonmotorized access to the refuge will result in some impacts from visitors. The approach of motorized boats to pick up and discharge passengers creates a temporary disturbance to migratory birds feeding or resting on the beach nearby. However, motorized boat landing sites are located outside areas used heavily by nesting, feeding, and roosting terns, shorebirds, and colonial waterbirds. Any energy expended by migratory birds to avoid disturbance associated with beaching a boat and loading and unloading passengers is negligible. North and South Monomoy Islands make up the Monomoy Wilderness Area. The untrammeled environment and solitude of the Monomoy Wilderness Area, accessible by boat only, make it unique among wildland areas on Cape Cod. Motorized boating, not generally allowed in wilderness areas, is permitted at Monomoy NWR due to a provision in the National Wilderness Preservation Act and the legislation designating Monomoy wilderness. That said, Monomoy has an unusually low absorption capacity for human impacts. Lack of topographic relief and low vegetation mean that other people are often visible from a long distance. Providing visitors with a convenient way to get out to the islands will result in a diminished degree of solitude, but impacts to the wilderness character of the area will be temporary.

Access to the refuge beach and boat landing sites for the purpose of landing nonmotorized boats poses minimal impacts to plant and wildlife species. Access for kayaking is typically by individuals or small groups. Based on biological data, conservation management plans, unreasonable harassment of wildlife, or destruction of the habitat, the refuge manager may restrict the use or close some beaches and other areas from this and other public use, if it is determined that they could have negative impacts on the resources and bird-nesting activities.

Damage to habitat by walking or dragging a kayak to and from the launch sites is minimal and temporary. At current levels of use, we do not expect increased impacts from boating activities. Several enforcement issues may result from the use, including trampling vegetation, trespass into closed areas, illegal taking of fish (undersized, over limit), illegal fires, and disorderly conduct. Damage to submerged aquatic vegetation, such as eelgrass beds, can result from repeated passes by motorized propellers or boat anchors.

Popular boating seasons coincide in part with spring-early summer nesting and brood-rearing periods for many species of migratory birds. Boaters may disturb nesting birds by approaching nests too closely, causing nesting birds to flush. Flushing may expose eggs to predation or cooling, resulting in egg mortality. Both adult and flightless young birds may be injured or killed if struck by motorized boats operated at higher speeds. Some disturbance of roosting and feeding shorebirds probably occurs (Burger 1981), but will be minimized if closed areas are respected. We will continue to close refuge areas seasonally to all public use, including boating around sensitive nest sites, in conjunction with our conservation partners. We will also continue our public outreach and placement of warning signs.

Pedestrian travel has the potential of impacting shorebird, waterfowl, and other migratory bird populations feeding and resting near the trails and on beaches during certain times of the year. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increased energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1995, 1997; Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always have at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981; Klein et al. 1995; Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981; Burger et al. 1995; Knight and Cole 1995a; Rodgers and Smith 1995, 1997).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986; Klein 1993; Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

As detailed above, the proposed use has the potential of intermittently interrupting the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between boaters, pedestrians and migratory birds will be temporary. Refuge staff will manage access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Visitors accessing South Monomoy Island including Nauset/South Beach could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual. We will continue to survey to determine the location and extent of larval beetle occurrence and habitat. We will use area closures to reduce impacts, and re-route trails to avoid larval habitats.

Visitor use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. We will enforce a 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Litter also impacts the visual experience of visitors (Marion and Lime 1986). Refuge policy advocates leave-no-trace and wilderness stewardship. Impacts are likely to be minimal if conducted in accordance with refuge regulations.

Motorized boats generally anchor in the subtidal waters to avoid stranding on the intertidal flats with the outgoing tide and are therefore anchored outside the Monomoy Wilderness. Motorized boats operating just offshore but outside of the Monomoy wilderness impact the sense of quiet and solitude that some refuge visitors in the wilderness area seek; however, boaters coming to the refuge only temporarily impact quiet as they approach the island at slow boat speeds in order avoid running aground. Kayakers produce little noise and therefore have little impact on the solitude of the wilderness area.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Operating and landing of motorized boats will only be allowed in designated areas. Nonmotorized boats will be allowed on sections of the beach that are otherwise open for public use. All refuge lands and waters are subject to seasonal closures to public use, including boating, to protect sensitive wildlife and habitat.

Harassment of wildlife and excessive damage to vegetation is prohibited.

No boats, kayaks, or related equipment may be left overnight on the refuge unless the owner is surf fishing on Morris Island, which is the only authorized nighttime use.

Providing outfitting or commercial services for motorized and nonmotorized boating on the refuge requires a special use permit issued by the refuge (see Commercial Tours and Services compatibility determination).

Occasional law enforcement patrol and regular staff and conservation partner presence should minimize potential violations. Refuge regulations will be posted and enforced.

Periodic evaluations will be done to insure that visitors are not causing unacceptable adverse impacts. Areas open to these uses will be evaluated on an annual basis, depending on geomorphology and wildlife use.

The refuge is a leave-no-trace, carry-in-carry out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

JUSTIFICATION:

Access to Monomoy Island is restricted to boat. Allowing the operation and landing of motorized and nonmotorized boats provides visitors with a safe means to access and explore Monomoy NWR beyond Morris Island. This access allows visitors to take part in priority wildlife-dependent recreation on the refuge, including wildlife observation, wildlife photography, and recreational fishing. Motorized and nonmotorized boat use will not interfere with the Service's work to protect and conserve natural resources. Motorized boats must land in designated areas to minimize potential impacts to wildlife. The level of use for these activities on the refuge is moderate, and the associated disturbance to wildlife is temporary and minor. Although motorized and nonmotorized boat uses are not priority public uses, under the conditions described above, they are not detrimental activities. Boat access for waterfowl hunting, fishing, wildlife observation and photography, and environmental education and interpretation, which are priority uses, allows visitors to enjoy the outdoors and wild lands. Boating on Monomoy National Wildlife Refuge will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

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COMPATIBILITY DETERMINATION

USE:

Nonmechanized harvesting of subterranean shellfish (softshell clams, razor clams, and quahogs) without the aid of artificial extraction methods

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…
16 U.S.C. § 715d (Migratory Bird Conservation Act)

…wilderness areas…shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness)

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Publ. L. 105-57; 111 Stat. 1252).

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
This compatibility determination is for nonmechanized harvesting of subterranean shellfish and is limited to softshell clams, razor clams, and quahogs; these are the only shellfish species we allow to be harvested on refuge tidal flats and waters. Use of mechanized harvest equipment and artificial extraction methods such as salt or chlorine are not allowed and not considered further in this determination. This compatibility determination does not include other shellfish species, such as mussels or scallops, and does not include eels or marine worms that are defined as shellfish by the Town of Chatham. All clammers operating on the refuge must comply with the Town of Chatham shellfish regulations in addition to other requirements that may be imposed by the U.S. Fish and Wildlife Service (Service).

Fishing is a priority public use of the Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Shellfishing is a type of fishing and, therefore, a wildlife-dependent public use; however, we also consider it a refuge economic use, as per §50 CFR 25.12 and §50 CFR 29.1, which must contribute to the achievement of refuge purposes or the Refuge System mission.

(b) Where would the use be conducted?
The majority of shellfish harvesting in recent years (10+ years) on the refuge has occurred in intertidal habitat primarily on the western side of North Monomoy Island, especially the southern end, the northern end of South Monomoy, and the eastern side of Minimoy. It also very occasionally occurs in extreme shallow subtidal areas adjacent to intertidal habitat. Shellfish harvest also occurs intermittently within the Powder Hole area in the southwest portion of South Monomoy (see map D.2). This use can occur in any intertidal area of the refuge that supports harvestable populations of these shellfish species. Area closures may occur at any time on Monomoy Refuge based on the need to protect sensitive habitats or species of conservation concern. When these conditions exist, the refuge manager is responsible for ensuring these areas are closed to all public access, including shellfish harvesters. Harvest areas may also be closed to harvest, typically seasonally due to bacterial contamination, by action of the Town of Chatham.

(c) When would the use be conducted?
Shellfish harvesting takes place during daylight hours year-round, from ½ hour before sunrise to ½ hour after sunset, with the number of harvesters peaking during the summer tourism months. Additionally, the Town of Chatham prohibits any harvesting on dry ground or on shoal areas that may become dry on any days when the air temperature is below 30 degrees or does not reach 30 degrees by 11:00 a.m. (*http://www/chatham-ma.gov/public_documents/ChathamMa_shellfish/shellfishregulations120811.pdf*). Harvesters typically arrive around mid-tide on the falling tide (about 3 hours after high tide), and stay on the exposed flat for approximately 6 hours, until the midpoint of the incoming tide (about 3 hours after low tide) when their boats refloat. Arrival and departure times change approximately one hour daily, reflecting the normal daily change in tidal cycle range.

(d) How would the use be conducted?
Shellfish harvesters typically depart for the shellfish flats on and around Monomoy Refuge by boat from one or more off-refuge locations such as Outermost Harbor, Stage Harbor, Chatham Harbor, or Harwichport. Shellfish harvesters at the refuge usually land their boats as near to harvest areas as possible, anchor the boat, and let it ground out with the falling tide. Softshell clam harvesters in coastal New England and on Cape Cod typically use short hand rakes and spend most of their time bent over at the waist or on hands and knees harvesting patches of shellfish. They generally traverse the exposed mudflats only to move among patches of shellfish (Burger 1981, Leavitt and Fraser 2004). Harvesters can turn over approximately 40 m^2 of sediment in a low tide event (Leavitt and Fraser 2004). Quahog harvesters similarly move at a slow pace and generally work in localized patches, but in contrast to softshell clam harvesters, they are usually standing upright and scraping the sediment surface with a long-handled rake. Quahog harvesters generally harvest in water, but in some intertidal areas of Monomoy Refuge, quahog populations have established and can be harvested when the intertidal areas are exposed at lower tides. Hand harvest methods are defined in the Town of Chatham, Shellfish Rules and Regulations §306 (Shellfishing Devices) as those commonly known as the long-rake, scratcher, tong, or clam-hoe. Use of shovels, pitchforks, garden spades, etc., is prohibited. Use of basket rakes attached to a T-handle is also prohibited by town regulation in any areas that become dry at any time during the tidal cycle, e.g., intertidal or supra-tidal areas. Use of hydraulic pumping or other mechanized or motorized harvest methods, formerly permitted in subtidal areas within the Powder Hole area, was prohibited by town regulation in 2011 at the request of the Service. Use of a hand operated plunger is still permitted within the Powder Hole area under town regulations.

Town of Chatham regulations require all harvesters to obtain and have a shellfish permit in their possession while harvesting shellfish. Additionally, all shellfish harvesters must comply with all refuge regulations and with State and Federal guidelines for terns, piping plover, marine mammal, and coastal dune protection. Harvesters are expected to stay apprised of and respect all closures and regulations. Information on annual, seasonal, and daily closures, known hazards, and other regulations is disseminated from refuge headquarters, and closures are marked with informational signs or symbolic fencing.

Map D.2 Approximate Intertidal Areas Open to Clamming

Take limits are set by town regulation and the town provides oversight to ensure that clam populations are maintained. If the Service believes clams are being overharvested or the harvest of clams appears to be impacting refuge wildlife populations, the Service will collaborate with the Commonwealth, the town, or through refuge regulations to lower harvest levels on the refuge.

(e) Why is this use being proposed?
Shellfish harvest from intertidal areas for human consumption using simple hand methods has been practiced continuously since the earliest known human occupation of the area, and remains an important part of local culture and diet (Lotze and Milewski 2004, Lotze 2010). Hand harvesting of shellfish from intertidal areas was an established subsistence use in and around Monomoy Point well before the area was established as a national wildlife refuge in 1944, and it continued through the evaluation and designation of the Monomoy Wilderness in 1970. The use remains a popular and significant activity to local communities. The Town of Chatham began administering a traditional shellfishery in the early 1900s that still continues a century later.

The Service has consistently determined since refuge establishment that harvesting shellfish for human consumption from intertidal areas using traditional, hand harvest methods is a compatible use of the refuge. The environmental assessment for the 1988 refuge master plan included shellfish harvesting as part of the public use program, and acknowledged Monomoy Refuge's importance to local shellfishers as a source of softshell clams, quahogs, and surf clams. That 1988 master plan established an index to local shellfish harvest trends by summarizing town-issued shellfish harvest permits.

In a 1994 compatibility determination, the Service found that hand harvest of shellfish (softshell clams) from intertidal areas of the refuge, conducted in accordance with Town of Chatham and refuge regulations and closures, was compatible with the purposes for which Monomoy Refuge was established.

Shellfish harvesting using traditional hand raking methods has coexisted for decades with migratory birds and other wildlife species of conservation concern that use the expansive and dynamic intertidal flats around Monomoy NWR. Shellfish harvest using traditional hand raking methods within the Monomoy Wilderness can provide a rare, outstanding opportunity for solitude or primitive and unconfined type of recreation in a primarily natural, undeveloped coastal barrier system landscape. Nonmechanized shellfish harvest from intertidal refuge areas affords refuge visitors an opportunity to increase their understanding and appreciation of the refuge, its resources, resource management, and refuge regulations along with traditional, local cultural practices.

AVAILABILITY OF RESOURCES:

The Town of Chatham Shellfish Constable bears primary (full time) responsibility for sustainable shellfish stewardship and regulatory enforcement throughout the town, including Monomoy NWR. Demands on Service resources (staff time and funding) resulting from this use are limited to coordinating shellfish regulation or management concerns identified with the Town Shellfish Constable, Shellfish Advisory Committee, and other town officials, as well as biological monitoring and law enforcement compliance oversight. The following breakdown shows the estimated amount of funds needed annually to cover costs associated with managing the hand harvest of subterranean shellfish on the refuge.

Staff Time to Administer the Program

Identifier	**Cost**
GS-12 Refuge Manager—coordinate w/ Town of Chatham (4 person-days/year)	$2,000.00
GS-09/06 Law Enforcement Staff—compliance oversight(20 person-days/year)	$6,000.00
GS-11 Refuge Biological Staff—monitoring, proposing closures, producing maps, coordinating with the Town of Chatham (10 person-days/year)	$4,000.00
Total recurring annual cost	**$12,000.00**

ANTICIPATED IMPACTS OF THE USE:

Background/Introduction

The magnitude and duration of both beneficial and adverse impacts on the intertidal substrate and waters, invertebrate populations, and higher trophic-level organisms, are influenced by the frequency, intensity (areal extent and depth), and efficiency of harvest effort. Actual shellfish harvest impact stems from the spatial extent and degree that the pre-disturbance and post-disturbance intertidal environments differ (Beukema 1995, Ray 2005). Impacts of hydraulic or mechanical shellfish dredges on intertidal bottom structure and benthic invertebrates are typically greater and longer lasting than those from hand harvest (Ferns et al. 2000, Piersma et al. 2001, MacKenzie and Pikanowski 2004, Verhulst et al. 2004, Munari et al. 2006, Kraan et al. 2007, Peterson and Estes in press). However, those mechanical harvest methods are not allowed on the refuge, and are not considered further in this compatibility determination.

The following summaries of potential impacts from shellfish harvesting are focused on those derived from non-mechanical hand harvest. Harvesting shellfish can range from a single surface sediment turning event (low intensity-impact) by hand digging to a repetitive (high intensity-impact) excavation of the same location within a short (days to weeks) time period (Leavitt and Fraser 2004). For Monomoy NWR, intertidal sediment disturbance from hand digging occurs on an annual to bi-annual basis, rotating between different areas during post-harvest recovery intervals, and we deem it to be generally low intensity and low impact in nature.

The following impacts discussion focuses on potential and expected impacts from shellfish harvesting as they relate to the refuge's two establishment purposes and related physical and biological resources. Although the topics are interrelated, for ease of presentation we chose to organize this section into four main categories: substrate and water quality, benthic communities, migratory shorebirds and other species of conservation concern, and wilderness character.

We reference low, moderate, and high interest levels for shellfishing in our impacts discussion. Those levels are based on permit issuance data reported by the Town of Chatham in annual reports from 1989 to 2011. Low corresponds to 0 to 350, moderate corresponds to 350 to 500, and high corresponds to more than 500 permits issued annually by the town.

Substrate and Water Quality

Nonmechanized hand harvest methods addressed in this compatibility determination include the use of rakes to harvest shellfish and the use of hand plungers in Powder Hole, but only where at least 1 foot of water depth occurs at mean low tide. The potential concern is the disturbance to bottom sediments that, in turn, can affect water quality when the sediments become re-suspended during subsequent tidal cycles. These filter-feeding shellfish also can provide significant water purification services within nearshore estuarine systems (Burke 2009, see also *http://www.ct.gov/doag/cwp/view.asp?a=1367&q=478090;* last accessed 09/19/2013).

An individual softshell clam harvester in New England can turn over approximately 40 m^2 of sediment in a single low tide event (Leavitt and Fraser 2004). Clam rakes typically penetrate just the top 12 inches or less of substrate. If there are, on average, 200 tides (days) harvested annually, then each harvester potentially disturbs approximately 8,000 m^2 (0.8 hectares or 2 acres) annually to a depth of approximately 12 inches (2 acre-feet/year/harvester). Once an area is harvested, it generally takes 1 to 3 years before harvestable clams have repopulated the flat (Brown and Wilson 1997, Leavitt et al 2010). At historically low interest levels, approximately 250 permitted harvesters would impact 200 ha (494 acres), at moderate interest levels, approximately 450 permitted harvesters would impact 360 ha (889 acres), and at high interest levels, approximately 600 permitted harvesters would impact 480 ha (1,186 acres) of shellfish substrate throughout town-administered shellfishing beds. To put this level of potential impact into a local context, the State-designated shellfish harvest area surrounding Monomoy Island (SC47), which includes nearly 80 percent of the Town of Chatham's intertidal shellfish flats, encompasses 37,831 acres. Even if all shellfish permit-holders in Chatham harvested exclusively within SC47 during years of high interest (a worst-case scenario), only 3.1 percent (1,186 acres) of those 37,831 acres would be impacted annually. Current levels of interest are generally low, and there are 16 other State-designated shellfish harvest areas elsewhere in Chatham that receive some of the total annual shellfish harvest effort by residents and visitors.

When the incoming tide re-floods the exposed intertidal substrate, sediment can be re-suspended (Coen 1995, Ray 2005, Munari et al. 2006, Peterson and Estes in press). Observed effects are typically site-specific and

influenced by sediment grain size and type, hydrological conditions, faunal influences, currents, water mass size, and configuration (Hayes et al. 1984, LaSalle 1990, Barnes et al. 1991, Coen 1995). Although we are unaware of studies that specifically evaluate the impacts of nonmechanized shellfish harvesting on substrates and water quality, other studies do provide some evidence of possible impacts from sediment re-suspension.

Effects of sediment re-suspension can include reduced light available for photosynthesis, burial or smothering of benthic biota and spawning areas resulting in anoxic conditions, and negative effects on feeding and metabolic rates of intertidal organisms (Johnson 2002). Re-suspension may also impact nutrient budgets due to burial of fresh organic matter and exposure of deep anaerobic sediment, upward flux of dissolved nutrients in pore water, and changes in benthic infauna metabolism (Mayer et al. 1991, Pilskaln et al. 1998). However, the finer particles re-suspended are often quickly flushed back out of the area by tidal currents in dynamic, higher wave energy situations such as those of moderate energy on the refuge's intertidal flats, leaving behind only heavier and coarser particles that settle out of suspension more rapidly (Leavitt et al. 2010).

Undisturbed clam flats tend to progress from dynamic sand or sand-mud textures, which are indicative of higher wave energy situations and high softshell clam productivity, toward finer silt-like sediments higher in organics and indicative of lower wave energy and lower clam productivity (Rask 1986, Leavitt and Fraser 2004, Leavitt et al 2010). The flats surrounding Monomoy Refuge are currently at the sand or sand-mud and higher clam productivity end of this gradient. Wave energy alone helps retard the natural maturing of the clam flats surrounding Monomoy NWR. Over long time frames, as undisturbed substrate texture gets finer and the organic fraction increases and decomposes, consuming oxygen in the process, dissolved oxygen levels decline (hypoxia) and can eventually lead to anaerobic or anoxic conditions within the substrate. Once decomposition shifts to anaerobic conditions, hydrogen sulfide, a known toxin for many aquatic organisms is also produced. Also, undisturbed tidal sediments can tend toward a more compact condition (Rowell and Woo 1990, Leavitt and Fraser 2004). The finer sediment particles grow closer together over time, reducing interstitial spaces (Leavitt and Fraser 2004).

Periodic disturbance of the surface sediments, such as results from hand harvesting shellfish, aerates the surface sediments and can halt or retard this very long-term tendency toward anoxic conditions, loosening more compact (low clam productivity) substrate conditions. Such disturbances increase bottom roughness, decrease organic loading, and reduce compaction within the substrate (Leavitt and Fraser 2004).

Seston are minute living organisms and particles of nonliving matter floating in the water that contribute to turbidity. In their Maine intertidal study area, Kyte et al. (1975) found that ambient, natural seston levels (6.9 to 441 mg/1) where baitworm digging occurs using a method similar to hand raking, often met or exceeded the short-term maxima (turbidity level 584 mg/l) associated with shellfish harvesting.

Re-suspension of sediments occurs naturally during storms, or from other human activities such as operating boats in shallow estuarine areas. This relationship between naturally occurring and human-caused sediment suspension has not been studied on Cape Cod. However, Monomoy Refuge is characterized by a more dynamic system of tide- and wind-driven shifting sands than the area Kyte et al. (1975) studied. Water turbidity from suspended sediments is not commonly reported as a concern for the intertidal waters surrounding the refuge. It is therefore likely that, for the refuge, natural tide-driven and wind-driven sand movements cause more sediment re-suspension than shellfish harvesting activity does.

Benthic Community

The larger size-class shellfish sought by harvesters for human consumption are part of the available mature, breeding population for shellfish species that, like many other marine organisms, exhibit sporadic and somewhat unpredictable reproductive success. For the Monomoy intertidal areas, the interval required for softshell clams to attain harvestable size from larval recruitment is approximately 1.5 to 2 years (Leavitt and Fraser 2004, citing S. Moore personal communication), after which growth slows as energy intake is redirected to reproduction. The clams typically exhibit a patchy, uneven distribution across intertidal areas (Newell and Hidu 1986, Leavitt and Fraser 2004, Leavitt et al 2010). Once an area is harvested of legal-sized clams, harvesters move to a new location (Leavitt et al 2010).

Additionally, shellfish targeted by harvesters are but one component of a diverse marine invertebrate community. The invertebrate assemblage is at the base of a complex food web. Many other higher trophic

level organisms depend on the invertebrate fauna inhabiting intertidal flats are also valued by people or are otherwise of conservation concern. Direct and indirect mortality induced by shellfish harvest, recruitment or reproductive failures that delay population recovery, and shifts in species diversity toward smaller, short-lived and more mobile species can reduce the abundance of preferred prey items for higher trophic level predators such as amphipods, copepods, echinoderms, gastropods, crabs, fish, or birds (Piersma et al. 2001, Verhulst et al. 2004, Peterson and Estes in press). Therefore, in this section we consider impacts to non-target species.

Direct Harvest Impacts

Experienced hand harvesters routinely remove a majority (84 percent according to Dow and Wallace 1957) of the largest (legal-sized) clams from a given location during a single digging event. These larger individuals are the reproductively active adults on which future recruitment and shellfish resource sustainability depends. In their 2004 literature review, Leavitt and Fraser state that adult softshell clam removal permits increased larval recruitment (citing Pfitzenmeyer 1962 and Peterson et al. 1987), more rapid juvenile growth (citing Turner 1951), and reduced predation (citing Boulding and Hay 1984). Evidence indicates softshell clams can saturate intertidal habitat, reaching very high densities, with intense competition for food and growing space, and substantially reduced reproductive, larval recruitment, and growth rates (Leavitt and Fraser 2004, citing Belding 1930, Turner 1953, Dow and Wallace 1957, Goshima 1982, Newell and Hidu 1986, and Ellis 1998). The net result is a dense population of smaller-sized adult clams existing nearer the surface where they are more vulnerable to predation, combined with low recruitment rates. Older, less mobile adult clams at high densities are susceptible to die-off, burial from moving sediment, or anoxia from depleted dissolved oxygen, forming "clam graveyards" (Leavitt and Fraser 2004, citing Dow and Wallace 1957), bed compaction, and reduced larval recruitment (Leavitt and Fraser 2004, citing Kyte and Chew 1975).

Direct mortality or injury of residual, unharvested shellfish (generally sub-legal sized) can occur from harvesting rakes that contact shellfish, from trampling underfoot, or from rough handling by the harvester during measuring and sorting (Heffernan 1999, Ferns et al. 2000, Johnson 2002). During shellfish harvest activities, many invertebrates are discarded and left on the intertidal flats near where they were taken, alive and intact, injured, or dead. Reasonably intact live individuals rebury themselves within a few minutes, leaving only moribund ones on the surface (Ferns et al. 2000). Kaiser et al. (2001) found hand raking for cockles led to an initial three-fold increase in the damage rate of under-sized cockles compared with control plots. In contrast to hand harvesting, mechanical harvesters, e.g., escalators, typically produce less mortality to discarded target bivalve species because physical impact damage is less likely (Kyte and Chew 1975, Peterson et al. 1983, 1987). However, hand harvesters typically harvest much smaller total quantities than more efficient mechanical methods. Thin-shelled bivalves and soft-bodied invertebrates such as marine worms or starfish show higher damage than solid-shelled bivalves in fished areas (Rumohr and Krost 1991). Animals able to retract below the seafloor surface or living below the fishing gear penetration depth sustain less harvest damage than epibenthic organisms. McLaughlin et al. (2007) found hand raking did not affect the ability of cockles (*Cerastoderma edule*) to rebury themselves at Strangford Lough, Ireland, and small cockles had a faster mean burial rate than larger cockles (51.7 percent and 31.1 percent, respectively). The research of Savage (1974-1976) on Narragansett Bay, Rhode Island, hard clams showed that, in the warm summer temperatures it took 10 to 20 minutes to burrow into the bottom after being left on the surface, while it took an hour at 10°C (50° F). This means that between mid-November and early May when temperatures were cooler, clams left on the surface by rakes or transplantation were more vulnerable to predators because of their longer surface exposure.

Indirect Harvest Impacts

The initial impact of physical disturbance associated with shellfish harvesting on intertidal flats is a reduced standing crop of most non-target species within the disturbed area (Leavitt and Fraser 2004, Leavitt et al 2010). Many researchers have documented decreased infauna biomass following disturbance (Kyte et al. 1975, Hall et al. 1990, Hall and Harding 1997, Spencer et al. 1998, Engelhard and Withers 1999, Leavitt and Fraser 2004). Biomass loss can range from 40 percent (van den Heiligenberg 1987) to 100 percent (McLusky et al. 1983).

Benthic recovery following harvest disturbance depends on the intensity and frequency of disturbance, life history of the benthic organisms disturbed, and elapsed time since disturbance. Repopulation and recovery of disturbed areas results from migration, passive translocation from surrounding areas, and recruitment of new individuals from natural reproductive cycles (Leavitt and Fraser 2004, citing van den Heiligenberg

1987, Hall et al. 1990, Guenther 1992, Shull 1997). Large or hard-bodied organisms such as target and non-target shellfish, or sedentary bait worms such as lugworms *Arenicola* sp., may depend more on recruitment than immigration for post-disturbance recovery (Cryer et al. 1987, Leavitt and Fraser 2004). Due to annual periodicity of seasonal reproductive cycles, this can mean slower re-colonization of disturbed areas (Shull 1997, Leavitt and Fraser 2004).

Anoxia and hydrogen sulfide toxicity within the intertidal substrate results in the mortality of nearly all sedentary organisms, including shellfish and many other invertebrates (Evans 1967, Leavitt and Fraser 2004). Increasingly anoxic and more compact substrate conditions reduce softshell clam productivity (Leavitt and Fraser 2004). Cox (1991) noted that baitworm digging, similar to the hand harvest methods included in this compatibility determination, redistributed anaerobic sediment layers upwards to the surface, with losses of all invertebrate infauna except small species that are tolerant of anoxic conditions. Feeding invertebrates like crabs, bivalves, and crustaceans, along with marine worms and echinoderms with limited mobility, will die if oxygen is deprived for sustained periods (Peterson and Estes in press).

Organic fractions that may be re-suspended from the intertidal sediments during hand harvesting can increase food availability for filter feeding shellfish, thereby benefitting shellfish survival, growth, and reproductive output (Leavitt and Fraser 2004). Compaction of the substrate over time in undisturbed sediments can resist benthic fauna from anchoring or burrowing in the substrate. For example, newly settled softshell clam larvae attach and anchor themselves in the substrate by means of byssal threads, important for evading predation. Loosening and roughening of the surface sediment layers that results from hand harvesting can maintain more favorable conditions for recruitment of new individuals into the population, aiding post-harvest recovery (Turner 1951, Ellis 1998, Mullineaux et al.1999, Leavitt and Fraser 2004, Leavitt et al. 2010). However, this impact is likely more pronounced (shorter time scale) in finer texture, high organic fraction situations than the more naturally dynamic sand-dominated substrate conditions that exist around Monomoy Refuge.

Depending on the spatial scale involved, changes in bottom topography can have profound effects on benthic infauna (Ray 2005). Dernie et al. (2003) showed that a difference of only 10 cm in the amount of material removed during mechanized harvest from a sand flat in Wales, United Kingdom, resulted in a substantial decrease in benthic fauna recovery rate. Plots where 20 cm of sediment were removed required 208 days for infaunal community reestablishment; plots with 10 cm removed recovered in 64 days. While hand harvest as employed at the refuge does disturb some surface sediment in limited intertidal areas, the disturbed sandy sediment largely remains onsite, is reworked during subsequent tidal cycles, but is not removed from the site (Leavitt and Peters 2005).

In contrast, invertebrates may be inadvertently reburied at depths exceeding their ability to migrate upwards or extend filter-feeding structures into the water. Smothering with anoxic sediments during harvesting and backfilling can cause benthic invertebrate mortality (Cox 1991, Coen 1995). Logan (2005) found sediment turnover from clam hand digging in a mid-coast Maine intertidal mudflat can deposit *Corophium volutator* (an amphipod that is an important shorebird prey item) at greater depths below the sediment surface; without any connection to the sediment surface, mortality can result. In an upper Bay of Fundy intertidal mudflat, the overall density of *C. volutator* decreased by 38.8 percent in the first year of baitworm hand raking harvesting due to lower juvenile recruitment and direct mortality. Juveniles were particularly susceptible to disturbance (a 55 percent decrease), and because juveniles must overwinter to become the next year's potential breeders, this decrease compounds with each subsequent year of harvesting (Shepherd and Boates 1999). Some *C. volutator* are also killed during digging. The survivors may migrate (swim) and risk death in search of better habitat, likely because the loosening of sediment and increase in water content makes re-excavation of burrows difficult (Shepherd and Boates 1999). The mud substrate in the above referenced Bay of Fundy study area is much finer textured and higher in organic content than the sand-dominated substrate present around Monomoy Refuge (D. Brownlie, personal communication 2013). Bait worm harvest is also typically a more intensive and frequent disturbance than clam harvest around Monomoy Refuge (Leavitt et al. 2010).

In addition to depositing *C. volutator* at greater depths below the sediment surface, clam digging disturbance in a mid-coast Maine intertidal mud flat destroyed *C. volutator* tube dwellings. The subsequent high energy demands for tube reconstruction placed on surviving individuals potentially resulted in reduced growth and reproduction or eventual mortality (Logan 2005). Mean density of *C. volutator* ranged from 89.1 ± 179.6

individuals/m^2 for weekly disturbance, to 1,522.6 ± 378.8 individuals/m^2 for undisturbed controls. *C. volutator* abundance was reduced for all disturbance frequencies in relation to control conditions, even in plots that were only disturbed on day one of the experiment. This significant decrease in abundance suggests that *C. volutator* abundance, and potentially other amphipod abundance, can be significantly reduced even by low digging frequencies.

Many relevant studies have not shown long-term significant changes to benthic communities resulting from shellfish harvest, with the exception of changes in distribution of the target (harvested) species. Coen (1995) surmised that since many small benthic organisms, e.g., crustaceans, polychaetes, mollusks, have rapid generation times, high fecundities, and excellent re-colonization capacities, it is generally accepted that this benthic community effect is only short-term (Godcharles 1971, Peterson et al. 1987, Bennett et al. 1990, Hall et al. 1990). For example, MacKenzie and Pikanowski (2004) found little to no effect on benthic communities resulting from raking in sandy, subtidal substrates, and attributed this lack of effect to invertebrates' adaptation for survival in environments where sediments are naturally re-suspended by severe storms.

Sandy-bottom communities such as those around Monomoy, subjected to higher energy (more frequent natural disturbance), tend to exhibit relatively rapid rates of re-colonization and recovery compared to more sheltered, lower energy, finer textured or biogenic substrates (Munari et al. 2006, Peterson and Estes in press). Newell et al. (1998) point out that benthic assemblages in fine-grained sediments recover faster than those in coarse-grained sediments. Coen (1995) also cites other studies using hand and mechanical shellfish harvesting gear in diverse habitats in Florida (Godcharles 1971), Washington (Tarr 1977, Vining 1978, Goodwin and Shawl 1978, 1980), Maine (Kyte et al. 1975), North Carolina (Peterson et al. 1983, 1987), Rhode Island (Glude and Landers 1953), Scotland (Hall et al. 1990), and Canada (Adkins et al. 1983), and all found no discernible long-term effects on local infaunal populations, with the exception of the more sedentary harvested bivalve species (compare Kyte et al. 1975, Peterson et al. 1987, Hall et al. 1990). Similarly, Logan (2005) found sediment turnover from clam digging in a mid-coast Maine intertidal mudflat did not affect the abundance of 10 benthic macroinvertebrate species, including polychaetes, crustaceans, and bivalves. However, Heffernan (1999) references Spencer's (1996) observation that a single hand-raking clam harvest caused about 50 percent reduction in species diversity, with a time frame of 8 months for site recovery.

Repeated physical disturbance can decrease productivity of affected communities (Odum 1985, Gray 1989). The effects of a single passage of a rake as is typical around Monomoy Refuge may be relatively limited; chronic raking, atypical for the Monomoy Refuge vicinity, may produce long-term changes in benthic communities (Jennings and Kaiser 1998). If disturbance is routine, the post-disturbance benthic communities are likely to be less abundant and diverse than in undisturbed habitats (Ray 2005). Marinelli and Woodin (2002) demonstrated that disturbing the surface of soft sediments altered sediment chemistry, making it less attractive for recruiting infauna.

Although the rate of recovery from hand raking can be highly variable in space and time, low intensity traditional harvesting appeared to have little impact on benthic communities (Kaiser et al. 2001). Kaiser et al. 2001 found that benthic communities subjected to hand raking for cockles showed community changes, compared to control plots 14 days after the initial disturbance. The small raked plots had recovered 56 days after the initial disturbance whereas the large raked plots remained in an altered state. Even in sands, recovery can be delayed (100 days to over a year) so that frequent intense harvesting will maintain the resident benthic communities in a permanently disturbed state (Piersma et al. 2001, Peterson and Estes in press). Kaiser et al. (2001) concluded from benthic samples collected from plots over a year after hand raking for cockles that small-scale variations in habitat heterogeneity had been altered, suggesting that, while effects of hand raking may be significant within a year, they were unlikely to persist beyond that time scale unless larger, long-lived species are present within the community.

The ability of invertebrates to recolonize depleted areas is very variable, depending heavily on recruitment of young. Many polychaetes are highly mobile and capable of colonizing depleted areas of intertidal habitat quite rapidly, while mollusks that bury more deeply, e.g. *Macoma balthica,* or tube dwellers such as *Lanice conchilega,* are capable of much more limited movement. The fact that more complex and productive intertidal communities take longer to achieve stability after disruption is not surprising. Another recovery rate factor is the longevity of the species involved. Large species such as *Arenicola marina*, softshell clams and *Ensis*

sp. take several years to reach maturity and, therefore, take much longer to recover than smaller species (Beukema 1995).

Given the higher (moderate) wave energy, the dynamic sand-dominated intertidal sediments surrounding Monomoy Refuge, and an abundance of expansive flats allowing a relatively low intensity-frequency of disturbance events from hand raking for shellfish, post-harvest depletion of benthic fauna biomass is expected to be a relatively short 0.5 to 12 month duration (Leavitt et al. 2010). Benthic invertebrate faunal community recovery of small invertebrate prey for migratory shorebirds to pre-disturbance levels is expected at harvested sites well before the 1.5 to 2 years required for recruits in the target shellfish species in the Monomoy Refuge area to attain the minimum legal size harvesters seek (Leavitt and Peters 2005, citing S. Moore).

Migratory Shorebirds and Other Species of Conservation Concern

Migratory shorebirds and horseshoe crabs are among the predators of clams and other benthic invertebrates inhabiting the intertidal substrates around Monomoy NWR. These species benefit from abundant small-sized clams and other associated benthic invertebrates.

Protecting high-quality stopover sites, which shorebirds use while migrating long distances between breeding and non-breeding grounds, is a particularly important shorebird conservation concern (Senner and Howe 1984, Myers et al. 1987, Helmers 1992). High-quality stopover sites provide abundant food and a disturbance-free environment, allowing shorebirds to maximize foraging time, replenish energy reserves, and continue migration in good body condition (Myers et al. 1987, Helmers 1992, Brown et al. 2001). Lower-quality stopover sites may affect shorebirds' ability to reach breeding or non-breeding grounds, and may reduce survivorship (Pfister et al. 1998, Baker et al. 2004). Monomoy Refuge is an important stopover site, especially during the southbound (fall) shorebird migration.

Declining prey availability at Delaware Bay, a critical stopover site for northward shorebird migrants, has been implicated in reduced breeding success and annual survival of red knots (*Calidris canutus*) (Baker et al. 2004). Similarly, the annual return rate of semipalmated sandpipers (*Calidris pusilla*) at a southbound stopover site in Massachusetts was higher for birds with more body fat at time of departure (Pfister et al. 1998), suggesting body condition at departure was related to survival. Vulnerability to changes in habitat availability or suitability is likely amplified for migrating shorebirds because large concentrations of shorebirds rely on just a few sites (Myers 1983, Senner and Howe 1984, Myers et al. 1987). Coastal stopover sites, in particular, are increasingly subjected to development and human disturbance, and loss of high- quality stopover habitat is likely one factor contributing to declines in local abundance and overall populations of shorebirds in North America (Myers et al. 1987, Pfister et al. 1992, Brown et al. 2001).

Monomoy NWR was designated a Western Hemisphere Shorebird Reserve Network Site of Regional Importance in 1999, based on a maximum one-day fall count of approximately 21,000 shorebirds (WHSRN 2006). The refuge provides habitat for significant numbers of shorebird species that are listed as: highly imperiled or high concern by the U. S. Shorebird Conservation Plan (Brown et al. 2001), as highest or high priority within Bird Conservation Region 30, New England / Mid Atlantic Coast (Atlantic Coast Joint Venture 2005), and as birds of conservation concern in Region 5 (Maine to Virginia) by the Service (2008). Some species of shorebirds, such as American oystercatcher (*Haematopus palliates*) (Veit and Petersen 1993) and the federally threatened piping plover (*Charadrius melodus)* (Hecht 1997, unpublished memo), are also extremely dependent on Monomoy Refuge during the breeding season. Surveys conducted in 2006 and 2007 estimated relative abundance of all shorebird species at Monomoy Refuge (Koch and Paton 2009).

Human disturbance at stopover sites can reduce habitat quality through direct impacts that may displace shorebirds or alter their behavior, or indirect impacts that have an effect on prey populations (Brown et al. 2001).

Direct Impacts to Migratory Shorebirds

Human disturbance causing changes in foraging shorebird behavior and distribution of shorebirds at foraging and roosting sites has been well-documented. Sites with extensive disturbance caused by humans walking or jogging and the presence of dogs reduce foraging time for migrating common redshank (*Tringa totanus*)

and Eurasian curlew (*Numenius arquata*) (Fitzpatrick and Bouchez 1998), and decrease foraging rates for migrating snowy plover (*Charadrius alexandrinus*) and sanderling (*Calidris alba*), including sanderlings on non-breeding grounds (Burger and Gochfeld 1991, Lafferty 2001a, Thomas et al. 2003). Prolonged or intense human disturbance may also cause shorebirds to expend more energy to avoid disturbances (Helmers 1992), or completely abandon a site (Furness 1973, Burger 1986, Pfister et al. 1992). Pfister et al. (1992) suggested disturbance measured by vehicle counts as a potential factor in declining numbers of southward migrating red knots and short-billed dowitchers (*Limnodromus griseus*) roosting at a stopover site in Massachusetts between 1972 and 1989.

While shorebirds reduce their foraging rates, flush more easily, and abandon areas with increased human presence (Burger 1981, Burger and Gochfeld 1991, Lafferty 2001a, Thomas et al. 2003), the degree of shorebirds' response varies with different human activities (Burger 1981, Burger 1986, Pfister et al. 1992, Lafferty 2001b). At a non-breeding site in California, stationary people along the beach disturbed shorebirds less frequently, and for fewer birds overall for each disturbance, than mobile people, and joggers disturbed twice as many shorebirds as walkers during each disturbance event (Lafferty 2001b). Similarly, fast-paced activities involving rapid movements, such as jogging, were more likely to disturb waterbirds than slow-moving activities, such as worm and clam harvesting (Burger 1981).

Despite documented changes in behavior of shorebirds exposed to human disturbance, published research establishing empirically based buffer distances to minimize disturbance to migrating shorebirds is sparse. In 2006 and 2007, we conducted experimental research on the refuge to determine flushing distances of the 11 most common migrating shorebird species. We used these empirical data to establish buffer distances that we feel minimize disturbance to migrating shorebirds (Koch and Paton in prep), and will implement these buffers in areas where shorebirds congregate and human disturbance is prevalent.

Species	Buffer Distance Range (m)
Least sandpiper	61
Semipalmated sandpiper	76
Semipalmated plover	77
Sanderling	86
Dunlin	89
Short-billed dowitcher	97
Willet	113
Red knot	124
Ruddy turnstone	125
American oystercatcher	165
Black-bellied plover	186

Indirect Impacts to Migratory Birds

As previously discussed, shellfish harvesting can alter benthic communities or reduce prey availability for shorebirds that feed on benthic organisms. Burial or mechanical (vertical) redistribution of invertebrate infauna to deeper depths in the substrate may additionally reduce the availability of invertebrate prey to predators. Many worms and crustaceans are most active and closest to the surface when the tide just covers or uncovers the sediments. For example, sediment disturbance associated with commercial harvest of bloodworms (*Glycera dibranchiata*) in the Bay of Fundy negatively impacted populations of mud snails (*Llyanassa obsolete)*, the primary prey of southward migrating semipalmated sandpipers (Shepherd and Boates 1999). Many birds and fish rely on visual cues when foraging. Turbidity due to re-suspension of intertidal sediment can significantly reduce foraging efficiency for sight-feeding predators (Vinyard and O'Brien 1976, Gradall and Swenson 1982, Gregory 1990, Servizi 1990, Peterson and Estes in press). Decreased foraging efficiency by fall migrating semipalmated sandpipers may have been related to the obstruction of visual and tactile prey cues

caused by turning and loosening of the surface sediment from intensive hand-raking for baitworms (Shepherd and Boates 1999).

Observations at Monomoy Refuge in 2005 and 2006 suggested that some species of shorebirds remained farther from a standing person than from shellfish harvesters (Leavitt et al. 2010). Soft- shell clam harvesters in coastal New England typically use short hand rakes, spend most of their time bent over at the waist or on hands and knees harvesting patches of shellfish, and traverse the exposed mudflats only to move among patches (Burger 1981, Leavitt and Fraser 2004). Anecdotal observations of shorebirds congregating in recently shellfished areas at Monomoy Refuge (Leavitt et al. 2010) suggest that sediment turnover associated with softshell clam harvesting may expose additional prey that would normally be at depths unavailable to shorebirds, thereby providing a net benefit to some species of foraging shorebirds (Leavitt and Peters 2005). Our own anecdotal observations of shorebirds in 2005 and 2006 suggested that some species of shorebirds might be attracted to areas where shellfishing had recently occurred (Koch 2011). Aspinall (1992) notes that most forms of intertidal shellfish harvesting, including manual digging, provide some initial increased feeding opportunities for some birds. Other studies have also shown that discarded or injured invertebrates or shellfish are consumed by higher trophic species, including gulls, fish, crabs, echinoderms, and gastropods (Manning 1959, Caddy 1973, van der Veer et al. 1985, Eleftheriou and Robertson 1992, Hall 1994, and Kaiser and Spencer 1994). A possible immediate increase in prey availability of some species may be ephemeral (as in Ferns et al. 2000), or may be offset by negative impacts to other prey species that are subsequently buried (as in Emerson et al. 1990).

In 2007, we conducted surveys of shorebirds abundance and foraging behavior in areas that were and were not subjected to shellfish harvesting activity to determine if shellfish harvesting influenced shorebird abundance. Based on density estimates of shorebirds in the harvested and unharvested plots, shellfish harvesting activities appeared to have a positive influence on the mean density of American oystercatchers and ruddy turnstones. However, for most species of shorebirds we studied, shellfishing activity did not appear to affect the density of birds on study plots. We also did not detect any differences in the proportion of birds that were foraging in harvested and unharvested areas for all species, and generally, more than 90 percent of all birds were foraging on all plots, regardless of shellfishing activity. We did detect seven species, black-bellied plover, ruddy turnstone, semipalmated plover, sanderling, semipalmated sandpiper, dunlin, and short-billed dowitcher, actively foraging in shellfish holes or the remaining adjacent sediment piles (Koch and Paton in prep).

At Monomoy NWR, we do not anticipate any substantial direct adverse long-term impacts from nonmechanized shellfish harvesting on migratory shorebirds, species fundamental to fulfilling the refuge migratory bird purpose. Further, recent surveys of shorebird abundance and foraging behavior in harvested shellfish areas show an apparent beneficial influence on American oystercatcher and ruddy turnstone densities relative to unharvested areas. While no measureable beneficial effect was observed for any other shorebird species studied at Monomoy Refuge, shorebirds representing six additional species appear to receive short-term benefit in the form of foraging opportunities immediately following shellfish harvest disturbance, as they were observed actively foraging in shellfish holes or residual sediment piles.

Wilderness Character

North Monomoy Island and South Monomoy make up the Monomoy Wilderness. The untrammeled environment and solitude of the Monomoy Wilderness, accessible only by boat or lengthy hike along the barrier beach, make it unique among the protected areas on Cape Cod. Motorized boats operated by shellfish harvesters generally slowly approach and depart the intertidal flats through the adjoining shallows, which reduces engine noise and boat wake. Monomoy refuge has an unusually low absorption capacity for human impacts. Lack of topographic relief and low vegetation mean that intrusions, including seeing and hearing other people, are often detectable from a long distance. Shellfish harvesting on intertidal flats visible from elsewhere within the Monomoy Wilderness may result in a diminished degree of solitude for some wilderness users, but should not adversely affect the overall wilderness character of the Monomoy Wilderness.

The majority of the Monomoy Wilderness will remain essentially unvisited and virtually undisturbed by the current and expected low intensity intertidal shellfish harvesting taking place around Monomoy Refuge. Visible impacts from hand digging are temporary, generally lasting a few hours before the next tidal cycle

erases most traces of digging from a harvested area. These physical disturbances are most evident near shellfish harvest sites, but are not expected to substantially compromise the perception of naturalness of the Monomoy Wilderness landscape nor impact the wilderness user's experience (Cole 2002, Hendee and Dawson 2002).

Wilderness visitors' experiences are more strongly affected by social conditions, such as other visitors and their actions, than by their perception of naturalness or ecological conditions (Hendee and Dawson 2002). The wide and expansive intertidal flats and barrier beaches where most shellfish harvest takes place afford users an unconfined experience (Hendee and Dawson 2002). With typically long sight distances across the rolling, nearly treeless, intertidal and coastal barrier landscape, too many individuals encountered or observed during visits by other Monomoy Wilderness users likely detracts from the sense of solitude experienced by wilderness users (Stankey and Schreyer 1987, Hendee and Dawson 2002). However, intertidal shellfish harvest use is still relatively dispersed across those intertidal flats open to public use.

Many shellfishers use carts to move their harvested clams to their boats. Others use large netted bags to transport their harvested clams. The use of wheeled carts in the Monomoy Wilderness is not consistent with wilderness requirements, as mechanized transport is not allowed and wheels are considered to be mechanized transport. Eliminating the use of wheeled carts in the Monomoy Wilderness will maintain wilderness characteristics and enhance visitors' wilderness experiences.

The current and anticipated level of intertidal shellfish harvest does not and is not expected to impact the preservation of the existing wilderness character—untrammeled wildness, undeveloped, natural, outstanding opportunity for solitude or primitive and unconfined type of recreation—that provides an enduring wilderness resource in the Monomoy Wilderness.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- All intertidal subterranean shellfish harvest on refuge lands must continue to be in full compliance with all Town of Chatham Shellfish Rules and Regulations and refuge regulations and area closures. No items other than softshell clams, razor clams and quahogs, hand harvested in accord with town regulations, will be removed from the refuge.
- Only hand harvest methods will be employed on refuge intertidal lands that are open for public use.
- No carts or other mechanized equipment with wheels may be used to transport shellfish on, around, and from the flats within designated wilderness.
- Use of hydraulic pumping or other mechanized or motorized harvest methods or equipment is not permitted within designated wilderness. Hand plunging, as defined in the Town of Chatham regulations, is permitted within the Powder Hole non-wilderness area with at least 1 foot of water depth at mean low tide.

- Seasonal closures necessary to minimize human disturbance of migrating shorebirds at Monomoy Refuge will be implemented during peak migration periods if refuge staff determine they are necessary to meet our biological objective of providing high-quality stopover habitat. The necessity of these seasonal closures depends largely on the foraging quality of the intertidal flats, which is primarily determined by the natural forces of wind, tides, sediment transport patterns, erosion, and accretion. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.

- Refuge staff will annually meet with the Town of Chatham Shellfish Constable to review and summarize annual shellfish harvest reports, area closures, and current and planned shellfish stewardship measures, and discuss regulations and management actions with respect to Monomoy NWR intertidal areas needed to ensure the long-term sustainability of the shellfish resource and biological integrity and ecological health of intertidal habitats.

- Refuge staff, volunteers, or researchers may engage in research designed to determine shellfish harvesting impacts to migratory birds and other species of conservation concern. Should any public use, including shellfish harvest, cause unacceptable environmental degradation or wildlife disturbance, or degrade wilderness character, we will implement appropriate limits on user numbers.

- Refuge visitor information services and products will emphasize the importance of staying out of seasonal closure areas, along with providing leave-no-trace principles.

JUSTIFICATION:

The harvest of subterranean shellfish using traditional hand raking methods on and use by migratory birds of the expansive and dynamic intertidal flats around Monomoy Refuge have coexisted for decades under joint stewardship and regulation by the Town of Chatham and the Service. Shellfish harvesting is a form of fishing, which is a priority, wildlife-dependent, public use on the refuge that provides visitors with an opportunity to experience wilderness. Based on our current knowledge about potential impacts of traditional hand harvest of shellfish on priority wildlife resources and habitats, combined with the relatively low level of use distributed across a large area of intertidal habitat, effects from this activity are similar or even less than other forms of human use in the intertidal area. We will monitor disturbance impacts of human presence (fin fishers, shellfishers, birders, photographers, and walkers) and will implement seasonal closures to protect migrating shorebirds and staging terns when necessary to ensure we accomplish the migratory bird purpose of the refuge by providing high-quality habitat to these migratory bird species. We will also include new science as it becomes available and will continually evaluate potential impacts of shellfishing on refuge resources as funding becomes available.

We have documented a positive short-term benefit to American oystercatchers and ruddy turnstones in the form of increased food availability immediately following shellfish harvest disturbance of the intertidal substrate. Allowing continuation of low intensity, nonmechanized shellfish harvest also fulfills the Service's historical commitment to permit fishing, including clamming, to continue.

Allowing intertidal shellfish harvest using hand methods at current and anticipated harvest levels, in accordance with Town of Chatham and refuge regulations and closures, requires no additional facilities. The potential disturbance to migratory birds and other species of conservation concern can be addressed and mitigated through the Town of Chatham shellfish regulations and stewardship actions, and by refuge seasonal area closures (symbolic fencing and signs with available refuge resources and a minimal administrative requirement). Potential for over-exploitation of the shellfish resource and depletion of intertidal benthic infauna, as well as potential for human-caused disturbance to wildlife species of conservation concern, are manageable and will continue to be addressed through the Town of Chatham shellfish regulations and stewardship actions, and by refuge seasonal area closures (symbolic fencing and signs.

In justifying this use, we considered the preceding evaluation of impacts to intertidal substrates and water quality, benthic intertidal communities, migratory shorebirds and other species of conservation concern, and Monomoy wilderness character. We conclude that the use will not materially interfere with, or detract from, the Refuge System mission, refuge wilderness, or migratory bird purposes, and that it contributes to the refuge purposes as follows:

- Shorebirds using the refuge were observed at higher densities in harvested areas versus unharvested areas due to the increased foraging opportunities resulting from harvesting activities.
- Low intensity harvest results in a periodic disturbance to the substrate, which under certain conditions can improve shellfish productivity and recruitment and increase prey availability for shorebirds.
- Our observations and related research indicate negligible impacts to Federal trust resources, based on past and expected harvest levels.
- We have not observed any impacts to, nor heard concerns from, any other wildlife-dependent users.
- Refuge visitors can experience wilderness in a manner that protects wilderness character by allowing only the use of hand tools and eliminating the use of wheeled carts.
- Our coordination with the Town of Chatham eliminates any undue administrative burden to refuge staff.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Virtual Geocaching and Letterboxing

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Virtual Geocaching and Letterboxing

NARRATIVE:

Two of the priority public uses for national wildlife refuges–wildlife observation and interpretation–can be facilitated by geocaching. Geocaching can bring nontraditional visitors to the refuge, providing the opportunity to inform them about the mission of the U.S. Fish and Wildlife Service and the National Wildlife Refuge System. Virtual geocaching and letterboxing activities are not priority public uses; however, they can facilitate priority public uses on the refuge. When designed carefully, these activities can be used as a form of interpretation to educate the public about the Service, the Refuge System, and the refuge. Virtual geocaching involves walking or hiking, which is allowed in designated areas of the refuge. Although hiking is not a priority public use of the National Wildlife Refuge System and is classified as a non-wildlife activity, most visitors hike the refuge for the wildlands experience it provides. Hiking usually occurs on designated trails through most of the year, as would virtual geocaching. These opportunities advertised on appropriate public Web sites will build awareness of the National Wildlife Refuge System and will attract new visitors, many of whom might engage in other wildlife-dependent activities while at the refuge. Additionally, this use would encourge geocachers to stop at the visitor contact station to obtain refuge or wildlife viewing information. Letterboxing would only be allowed inside of refuge visitor contact stations and visitor centers. These activities will not materially interfere with or detract from fulfilling the National Wildlife Refuge System mission or the purpose for which the refuge was established.

These uses are anticipated to have similar impacts as other primary public uses such as interpretation and wildlife observation. Impacts of these uses will likely be minimal if conducted in accordance with refuge regulations.

For the reasons above, virtual geocaching and letterboxing is an appropriate use on Monomoy NWR.

COMPATIBILITY DETERMINATION

USE:

Virtual Geocaching and Letterboxing

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?
Geocaching is an outdoor activity in which the participants use a global positioning system (GPS) receiver, mobile device, or other navigational technique to find hidden containers called geocaches or caches. Geocaching has been described as a game of high-tech hide-and-seek. Variations on geocaching include virtual geocaching (e.g., Earthcaching, Trail Link, and GPS Adventure) and letterboxing. A description of each of these uses follows, based on the National Wildlife Refuge System Guidance on Geocaching.

Virtual Geocaching utilizes hand-held GPS devices, but the goal of the activity is different and the activity can be enjoyed without a physical cache. Virtual caching provides GPS coordinates to existing points of interest,

such as a facility, cultural feature, wayside exhibit, or object in public areas. For more information, visit *www.waymarking.com.*

Earthcaching is a type of virtual geocache. The Web site lists a number of virtual caches that are educational in purpose and judged for suitability by a team supported by the Geological Society of America. For more information, visit *www.earthcache.org.*

Trail Link is a partnership between Geocaching.com and the Rails to Trails Conservancy to collect mapping data for more than 15,000 miles of trails nationwide. Members of the Rails to Trails Conservancy are encouraged to capture GPS coordinates as they hike. The GPS coordinates can be supplemented with photos and other interpretive information about particular points along the trails. For more information about the program and its possible application to Refuge System trails, visit *www.geocaching.com/railstotrails/default.aspx.*

GPS Adventures incorporates lesson plans from a number of educational programs about geography, history, science, and technology. The program includes a GPS Adventures maze to provide students with hands-on exploration of the use of GPS technology in support of school programs. For more information, visit *http://www.gpsmaze.com/index.html.*

Letterboxing involves the placement of a cache containing a stamp and an inkpad that participants use to document that they have discovered a specific location. Participants find the location by following clues offered on the Web involving map coordinates or compass bearings. Letterboxing does not require leaving or removing caches as part of the challenge. For more information, visit *www.letterboxing.org.*

(b) Is the use a priority public use?
In their traditional form, these activities are not priority public uses. However, if these activities are designed and created under the guidance of appropriate refuge staff, they can be manipulated into forms of interpretation that are a priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(c) Where would the use be conducted?
Certain areas on Monomoy NWR are seasonally closed to public access at the refuge manager's discretion to protect sensitive habitats or species of concern, minimize conflicts with other refuge activities, or respond to human health and safety concerns. All geocaching activities would be only conducted in areas that are open to the public, including the Morris Island trail system, and designated areas on Monomoy NWR. Geocaching activities would avoid sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and would be designed to minimize impacts to endangered species, nesting birds or other breeding, feeding, or resting wildlife. Virtual geocaching could occur in areas open to the public throughout the refuge, including in wilderness areas. Because letterboxing requires a physical cache, it would only occur inside visitor contact stations or visitor centers.

(d) When would the use be conducted?
Monomoy NWR is open to the public from ½ hour before sunrise to ½ hour after sunset. Virtual geocaching would occur during regular refuge hours any time of the year in any areas open to public access. Use of the refuge for these activities is likely to be highest in late spring, summer, and early fall. Letterboxing would only occur when visitor contact stations or visitor centers are open.

(e) How would the use be conducted?
Virtual geocaching can be used as a tool to get people to visit the refuge and the wilderness areas. The use is primarily facilitated by pedestrian walking and hiking access, commercial ferry access, or by boat. Boats are allowed to land anywhere along the refuge shoreline, with the exception of posted tern colonies and piping plover nesting areas. The presence of hazardous currents and shoals encourages visitors to land their boats in only a few designated locations. Interpretive materials associated with geocaching give the general public an opportunity to learn about the refuge, the Refuge System, and the Service. The uses are self-regulating, with geocaching coordinates and clues designed to keep visitors on designated trails or within open public areas. Some geocaches may not be available year-round, depending on staffing and seasonal wildlife related closures. Appropriate refuge staff will approve all geocaches, and all areas where geocaching would be allowed are already managed by the refuge for other wildlife-dependent recreational activities.

(f) Why is this use being proposed?
Virtual geocaching and letterboxing are not priority public uses; however, they can facilitate priority public uses on the refuge. When designed carefully, this activity can be used as a form of interpretation to educate the public about refuge management challenges and goals, refuge missions, and priority public uses. Virtual geocaching involves hiking, which is allowed in designated areas of the refuge, and although hiking is not a priority public use of the National Wildlife Refuge System and is classified as a non-wildlife-dependent activity, most visitors hike the refuge for the wildlands experience it provides. Hiking usually occurs on designated trails or in the open areas of the wilderness area through most of the year, as would geocaching. Virtual geocaching opportunities advertised on appropriate public Web sites will build awareness of the National Wildlife Refuge System and attract new visitors, who will partake in wildlife-dependent activities while at the refuge. Additionally, geocachers and people engaged in letterboxing will likely stop at the visitor center to obtain refuge or wildlife viewing information.

AVAILABILITY OF RESOURCES:

The refuge has a single trail system on Morris Island in place to support public uses. Additionally, there are many areas on Monomoy NWR that are seasonally open to public uses when not closed to protect wildlife. The estimated costs of allowing geocaching within areas open to the public are fairly low because there little infrastructure is involved. Some staff time to develop and promote the activity will be needed, as well as the procurement of materials to conduct the program. The following breakdown shows the estimated amount of funds needed to administer the program.

GS-11 Visitor Services Manager	1 staff	40 hours	$1,800
GS-11 Law Enforcement Officer	1 staff	40 hours	$1,800
Materials			$ 500
Total recurring annual costs:			**$4,100**

ANTICIPATED IMPACTS OF THE USE:

The proposed use is anticipated to have the same level of impacts as primary public uses because the access and activities are very similar. Since refuge staff will supervise these activities, the impacts of geocaching will likely be minimal if conducted in accordance with refuge regulations. Possible impacts include disruption of nesting migratory bird populations, terns, shorebirds, and other bird populations feeding and resting near the trails during certain times of the year, impacts to larval threatened northeastern beach tiger beetle populations, and disruption of local seal populations.

On Monomoy NWR, area closures are created to protect priority nesting migratory tern and shorebird species. Although these closure areas are designed to minimize human impacts, the potential exists for impacts to unobserved nesting animals. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also negatively impacted by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreational activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of geocaching are likely to be minimal if conducted in accordance with refuge regulations. We will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies. The refuge is a leave-no-trace, carry-in-carry-out facility. We encourage all outfitters and guides to pack in and pack out all food containers, bottles, wrappers, trash, and other waste and refuse. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R. 27.93.94.

Individuals hiking to South Monomoy for geocaching activities could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual. We will continue to survey to determine the location and extent of larval beetle occurrence and habitat, and use closures and re-route trails to avoid larval habitats.

Pedestrian use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year round. We will enforce the 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Only virtual geocaching will be allowed on refuge, including in wilderness areas, thereby eliminating the erection of any signs or manmade structures to assist in the pursuit of the cache. Given the difficulty in accessing the wilderness area, lower numbers of individuals are expected to engage in virtual geocaching in the wilderness. There should be no diminishment of wilderness character or impact to other wilderness visitor if virtual geocaching is allowed in the wilderness area.

Unmanaged geocaching has the potential to damage or kill plants and lead to new, unwanted, impromptu trails on the refuge that become shortcuts through more ecologically sensitive sites. Heavy use of designated, managed, or unmanaged pedestrian travel routes can ultimately lead to areas void of vegetation (McDonnell 1981, Vaske et al 1992) and potentially destabilize dunes and interdunal wetlands, which are difficult to stabilize and restore to a naturally functioning condition (Kucinski and Einsenmenger 1943, Cole 2002, Goldsmith 2002, Grady 2002, O'Connell 2008).

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the visible and invisible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

This use will not affect wilderness character. These activities do not alter the natural scenic condition of the land and will not occur at a scale large enough to diminish the environment for native plants and animals. In fact, virtual geocaching could be used to enhance a visitor's understanding and appreciation of wilderness.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__X__ Use is compatible with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- No geocache will be created or posted on public Web sites without the permission of appropriate refuge staff.
- Geocaches will be created only in areas where there is already a designated trail or in areas that are open to the public.
- Only virtual geocaches will be allowed in the wilderness area.
- All individuals taking part in geocaching must adhere to area closures and understand that certain geocaches may not be available year-round. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.
- Appropriate notification must be listed on public Web sites when a geocache is not available as a result of area closures.
- No physical item will be placed or left on the refuge.
- Letterboxing would only be allowed within visitor contact stations or visitor centers.
- Appropriate notification about the availability of letterboxes based on staffing and visitor contact station open hours will be posted on all public Web sites.

JUSTIFICATION:

The Service and the National Wildlife Refuge System maintain the goal of providing opportunities to view wildlife and engage in interpretation. Allowing the use of refuge areas that are already open to the public, including one trail system on Morris Island, to persons participating in geocaching supports this goal. Geocaching would provide visitors with the chance to view wildlife and take part in interpretation about the refuge, promoting public appreciation of the conservation of wildlife and habitats. Geocaching activities are not priority public uses; however, they facilitate priority public uses on the refuge, and in some cases can be used as a form of interpretation, which is a priority public use. Virtual geocaching and letterboxing activities would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose for which the refuge was established.

In 2009, the Service developed final guidance on geocaching. This policy can be found in at *http://www.fws.gov/ridgefieldrefuges/ridgefield/pdf/Friends%202010/Recreational%20Geocaching%20Guidance.pdf*; accessed March 2012.

The Service's wilderness management policy (610 FW 2) does not prohibit the use of GPS units within refuge wilderness areas. However, managers need to make sure that wilderness character is considered when evaluating the appropriateness of GPS recreational activities. Service policy (610 FW 2, 2.31) does state that competitive public events or contests are prohibited in wilderness, such as a large organized GPS geocaching event.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Outdoor Events and Ceremonies

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✔
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes _____ No ___✔___.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Outdoor Events and Ceremonies

NARRATIVE:

The Service policy on Appropriate Refuge Uses (603 FW 1) states, "General public uses that are not wildlife-dependent recreational uses (as defined by the Improvement Act) and do not contribute to the fulfillment of refuge purposes or goals or objectives as described in current refuge management plans are the lowest priorities for refuge managers to consider. These uses are likely to divert refuge management resources from priority general public uses or away from our responsibilities to protect and manage fish, wildlife, and plants, and their habitats. Therefore, both law and policy have a general presumption against allowing such uses within the Refuge System." Outdoor events and ceremonies are not considered priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 68dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997, but this activity will not materially interfere with or detract from the mission of the National Wildlife Refuge System or purposes for which Monomoy NWR was established.

Outdoor events and ceremonies are group gatherings conducted by non-Service individuals or organizations. These uses are not outlined in an approved plan; however, there may be instances in which they can be conducted in a time, place, and manner that do not conflict with refuge goals and objectives. Although this use is not typically undertaken to promote or benefit refuge natural or cultural resources, it can expose the public to the refuge and provide an opportunity to appreciate the refuge's natural and cultural resources. Fundraising events are not allowed unless the U.S. Fish and Wildlife Service receives 100 percent of the funds raised by the event. Additionally, we will not allow events at which people receive an appearance fee or a prize of more than nominal value. Organizers may charge a slight fee to recoup the cost of the event, but may not make a profit on the event. Anything in excess of recouped costs will be given to the refuge.

Each event has different logistics, therefore, each will be evaluated for impacts to the refuge mission. A special use permit must be issued with appropriate stipulations, including limitations on the number of people attending, parking restrictions, etc. We will not allow events and ceremonies found to be detrimental to the refuge mission. A fee will be charged for each permit. When necessary, we will develop stipulations for permits to ensure that events do not create an unacceptable impact on wildlife or cultural resources, do not disrupt visitors engaged in priority wildlife-dependent public uses, do not unreasonably disrupt the atmosphere of peace and tranquility, and do not create an unsafe or unhealthy environment for visitors or employees. Events may not be held in areas closed to the public to protect wildlife, and events may not be held that result in the closure of an area that would otherwise be open to the public. Any event held within the Monomoy Wilderness will undergo a minimum requirements analysis to ensure both compliance with wilderness regulations and policies, and that impacts to wilderness character are minimal.

COMPATIBILITY DETERMINATION

USE:

Outdoor Events and Ceremonies

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (P.L. 88-577 §2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?
The use is group gatherings at outdoor events and ceremonies conducted by non-Service individuals or organizations. Fundraising is only allowed when 100 percent of the proceeds are given to the U.S. Fish and Wildlife Service. Additionally, we will not allow events conducted at which people receive an appearance fee or a prize of more than nominal value. Organizers may charge a slight fee to recoup the cost of the event, but may not make a profit on the event. Anything in excess of recouped costs will be given to the refuge.

(b) Is the use a priority public use?
Outdoor events and ceremonies are not considered priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

(c) Where would the use be conducted?
Outdoor events and ceremonies will be allowed in any area open to the public under terms specified in a special use permit. The use will not be allowed in environmentally sensitive areas such as the dunes or in any area managed for habitat conservation or wildlife protection. Activities would most likely be held on the Morris Island portion of the refuge, primarily on the beach or along the Morris Island Trail. Activities could also be held in areas of North Monomoy Island or South Monomoy that are open to the public.

(d) When would the use be conducted?
Monomoy NWR is open to the public from ½ hour before sunrise to ½ hour after sunset. Morris Island is open for fishing 24 hours a day. Outdoor events and ceremonies could occur any time of the year in any areas open to public access. Use of the refuge for these activities is likely to be highest in late spring, summer, and early fall. Pedestrian closures may prevent holding a scheduled event.

(e) How would the use be conducted?
Permission to hold an outdoor event or ceremony must be requested in writing by the organizer a minimum of 60 days in advance of the event. Each request must be submitted to the refuge manager at the Monomoy NWR headquarters in Chatham, Massachusetts. The request must provide details of who, what, where, when, why, and how the event will be conducted. Further, the request must indicate how people will travel to the part of the refuge where the event would be held (e.g., on foot or by boat). Each request has different logistics and will be evaluated for impacts to the refuge mission. A special use permit will be issued provided there are no significant negative impacts to natural resources or visitor services, and no violations of refuge regulations. The special use permit will outline the framework in which the event or ceremony can be conducted. A fee is required to pay for staff time and expenses necessary to monitor the event and ensure compliance with permit stipulations, and will be assessed on a case-by-case basis. Costs associated with processing the application may be required even if the request is subsequently denied.

(f) Why is the use being proposed?
Monomoy NWR staff receives occasional requests to conduct outdoor events or ceremonies, and other events have occurred on the refuge without notification by the organizers or permission from refuge staff. While the number of requests we anticipate receiving is low, we want to be able to review each request and issue a special use permit if we determine that we can regulate the event so it has minimal impact to refuge resources and visitors. Although outdoor events and ceremonies may not directly contribute to the achievement of the refuge purposes or the National Wildlife Refuge System mission, such events can contribute to the public's understanding and appreciation of the refuge's natural resources.

AVAILABILITY OF RESOURCES:

Permitting this use is generally within the resources of the existing staff. Staff costs are incurred to review each request, coordinate with the applicant, and process the special use permit. Refuge staff or refuge law enforcement officers will monitor the special use permit to ensure compliance with its conditions. Law enforcement staff from the refuge complex will need to be reimbursed for travel expenses and time worked.

Total initial cost of program			**$0**
Review request and process SUP	2 staff	20 hours	$2,000
Biological on-site staff	1 staff	20 hours	$1,000
Law enforcement presence	1 staff	20 hours	$1,000
Travel costs			$1,000
Total annual cost of program			**$5,000***

* Travel costs would be reimbursed by permittee; assumes two events annually.

Refuge staff time and resources are needed to ensure that delineation of bird nesting and staging areas, seal haul-out areas, and otherwise closed areas is accomplished on time and sufficiently maintained to provide maximum protection for biological resources. Refuge law enforcement will be needed to ensure permit compliance.

ANTICIPATED IMPACTS OF THE USE:

Impacts to refuge resources will be minimal if conducted in accordance with refuge regulations and conditions of the special use permit. Possible impacts include disturbing wildlife, trampling plants, littering, vandalism, and entering closed areas. Events will be structured to be held only in areas open to the public and the amount of disturbance is expected to be minimal, occasional and short-term in nature, and conducted in a manner that does not interfere with other visitors' enjoyment of the refuge or natural environment. If significant negative impacts from this use cannot be avoided, a special use permit will not be issued. Events held in wilderness areas will be managed to protect wilderness values.

Visitors engaged in outdoor events and ceremonies may impact refuge wildlife, vegetation, and soils. Pedestrian travel has the potential to impact shorebird, waterfowl, and other migratory bird populations feeding and resting near trails and on beaches during certain times of the year. Pedestrians can also impact seals resting on the beach if they get too close. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increased energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993.

The Delaware Natural Heritage Program, Division of Fish and Wildlife and the Department of Natural Resources and Environmental Control prepared a document, *The Effects of Recreation on Birds: a Literature Review*, completed in April 1999. The following information was reference from this document.

Several studies have examined the effects of recreation on birds using shallow- water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1995, 1997; Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981; Klein et al. 1995; Burger & Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981; Burger et al. 1995; Knight and Cole 1995a; Rodgers and Smith 1995, 1997).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986; Klein 1993; Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential of intermittently interrupting the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. To address pedestrian impacts listed above, we will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies.

Pedestrian use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. We will enforce the 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of walking are likely to be minimal if conducted in accordance with refuge regulations. The refuge is a leave-no-trace, carry-in-carry-out facility. All food containers, bottles, and other waste and refuse must be taken out. Littering, dumping, and abandoning property are prohibited by Federal regulationat 50 C.F.R. 27.93.94.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the visible and invisible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

Outdoor events and ceremonies are generally not consistent with the enjoyment and preservation of wilderness. However, outdoor events or ceremonies can be held to celebrate wilderness. Additionally, visitation to the wilderness parts of the refuge is low, so it is unlikely the infrequent outdoor event or ceremony that might be held on the refuge would affect the natural scenic condition of the wilderness. Attendance at these events provides opportunities for individuals to connect with nature and wildlife. We do not anticipate negative impacts on wilderness character, considering the small number of events likely to be held in the wilderness area, given the difficulties of accessing this area and the limitations on any event proposed for the refuge and within a wilderness.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Special use permits are required for organizations wishing to hold an outdoor event or ceremony or individuals wishing to hold a ceremony on the refuge.

The refuge manager must receive a written application for a special use permit no later than 60 days before the event. The written request must provide clear and concise information about the nature of the event (who, what, where, when, why and how), including the estimated number of attendees. The refuge manager will not consider incomplete requests that do not provide full details of the event.

Each application will be evaluated for impacts to the refuge, its wildlife, and visitors. Refuge staff will use professional judgment to ascertain the proposed impacts of the event. As long as there are minimal impacts to refuge resources and visitors, a special use permit will be issued outlining the framework in which this use can be conducted.

The Service may recover from the permittee all agency costs incurred in processing the application for a special use permit and monitoring the permitted activity if the request is approved. Costs associated with processing the application may be required even if the request is subsequently denied. A fee may be charged for the special use permit, particularly if the permittee is not a conservation partner and there is a need for law enforcement presence to ensure compliance with refuge regulations and permit conditions.

Events may take place only while the refuge is open, which is one-half hour before sunrise to one-half hour after sunset. Activities may take place only in areas open to the public; refuge regulations will be posted and enforced. Beach sports, kites, and dogs are not allowed at any time. The refuge manager may impose additional restrictions.

The refuge manager will make the final decision about where and when events may be held on the refuge.

The permittee will comply with all pedestrian closures on the refuge. These may prevent holding a scheduled event.

The refuge manager may limit the number of attendees. There is only a small parking area at the refuge headquarters, and permittees may not conduct events that prevent, even inadvertently, authorized public access for priority, wildlife-dependent public use.

Events held on Morris Island may be catered, with tables, tents, and chairs. Tents must be set up in an area that avoids disturbing refuge resources and visitors. All tents must be set up and taken down the same day as the event and within regular hours the refuge is open to the public. No tents will be allowed in the wilderness area.

Alcohol may be served outdoors. Permittees will inform the refuge manager in advance if alcohol is going to be consumed, and will ensure that event and ceremony attendees are not inebriated on the refuge. Being inebriated on refuge lands is against refuge regulations (50 C.F.R. 27.81)

There will be no electric amplification of musical instruments or voices during any ceremonies or events.

All trash must be removed from site for proper disposed by the end of each day. The site must be left clean and unimpaired.

All access to events or ceremonies held in the wilderness area will be on foot only. No vehicles or over-sand vehicles will be allowed to transport people or materials needed for the event.

On Morris Island, permittees must provide portable toilets to be used by attendees of the event. The portable toilets must be delivered no earlier than 24 hours before the event and must be removed no later than 24 hours after the event. The permittee will be responsible for any cleanup associated with the use of portable toilets, including vandalism caused by a refuge visitor who was not an attendee at the permitted event.

In most cases, permittees will be required to carry commercial general liability insurance. Depending on the event, the refuge manager may require additional coverage, such as proof of automobile liability insurance or special coverage if alcohol is served.

All permittees must provide attendees with information about the refuge, our mission, and purpose. Permittees are responsible for their attendees' compliance with refuge regulations.

No permittee may create a safe or unhealthy environment for other visitors or employees.

No event may result in the closure of an area normally open to the public.

Failure to comply with refuge regulations or special use permit conditions will result in a denial of special use permits by the permittee for future events.

JUSTIFICATION:

Special outdoor events or ceremonies may not directly contribute to the achievement of the refuge purposes or the National Wildlife Refuge System mission, but can contribute to the public's understanding and appreciation of the refuge's natural resources. Therefore, a group event is compatible as long as it is conducted safely within the confines of open public use areas and does not conflict with a priority public use. It is deemed this activity will not materially interfere with or detract from the mission of the National Wildlife Refuge System or purposes for which Monomoy NWR was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Research Conducted by Non-Service Personnel

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Research Conducted by Non-Service Personnel (We reserve the right to make appropriateness findings for any specialized research project by non-Service personnel request on a case-by-case basis)

NARRATIVE:

Research conducted by non-Service personnel is not identified as a priority public use of the National Wildlife Refuge System (Refuge System) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. This use is not a priority public use of the Refuge System. However, research by non-Service personnel is often conducted by colleges, universities, Federal, State, and local agencies, non-governmental organizations, and qualified members of the general public. Research on Monomoy National Wildlife Refuge (NWR, refuge) would further the understanding of the natural environment and could be applied to management of the refuge's wildlife.

The Service encourages and supports research and management studies on refuge lands that will improve and strengthen decisions on managing natural resources. Research by other than Service personnel adds greatly to the information base for refuge managers to make proper decisions. The refuge manager encourages and seeks research that clearly relates to approved refuge objectives, improves habitat management, and promotes adaptive management. Priority research addresses information to better manage the refuge's biological and wilderness resources, or addresses management issues at Monomoy. We will generally support research that addresses important management issues or demonstrates techniques for managing species or habitats that are important to agencies of the Department of the Interior, the National Wildlife Refuge System, and state fish and game agencies. Much of the refuge is designated national wilderness, so some constraints on how or where research is conducted may be necessary.

All research proposals are evaluated for their benefits to the refuge and the Refuge System mission. The refuge manager will issue a special use permit for all approved research projects. All research projects require the principal investigator to provide summary reports of findings and acknowledge the refuge for their participation. At the time of request, a determination will be made by refuge staff whether the proposed research benefits the understanding of the natural environment and will contribute useful information to the Service and Refuge System. The entire refuge may be open and available for scientific research. The research location will be limited to those areas of the refuge that are absolutely necessary to conduct of the research project. The timing of each individual research project will be limited to the minimum required to complete the project. The refuge reserves the right at any time to find a specific request for a research project by non-Service personnel to be inappropriate or incompatible with the refuge's purposes, Service mission or the refuge's conservation management goals and objective established in the CCP and any stepped down management plan, based on each individual review and assessment of each project's research details.

Not all research may be appropriate. Some research may affect fish, wildlife, and plants in a manner neither consistent with refuge management plans nor compatible with refuge purposes or the Refuge System mission. Some research may interfere with or preclude refuge management activities, appropriate and compatible public uses, or other research. Some research may be appropriate off the refuge, but not on the refuge. Therefore, we must evaluate each research proposal independently and may deny a request for a special use permit because we find the proposal to be inappropriate or incompatible.

No additional equipment, facilities, or improvements will be necessary to allow research by non-Service personnel. Staff time would be required to review research proposals and oversee permitted projects. We expect that conducting these activities will require less than one-tenth of a work-year for one staff member.

Non-Service organizations and personnel conducting research on the refuge will be required to provide the Service with all data collected and/or reports. The research organization/agency or personnel in conjunction with the Service will retain the use and ownership of all data/reports.

Disturbance to wildlife and vegetation by researchers could occur through observation, sampling, or accessing the study area. It is possible that direct mortality could result as a by-product of research activities.

Negligible impacts will occur when research projects which are previously approved in the compatibility determination are carried out according to the stipulations stated in the special use permit issued for each

project. Overall, however, allowing well designed and properly reviewed research to be conducted by non-Service personnel is likely to have very little impact on refuge wildlife populations. If the research project is conducted with professionalism and integrity, potential adverse impacts are likely to be outweighed by the knowledge gained about a species, habitat, or public use.

After evaluating research by non-Service personnel under Service policies, we conclude that the activity is appropriate as it contributes to and supports refuge management, purposes, and goals, and the mission of the Refuge System.

COMPATIBILITY DETERMINATION

USE:

Research Conducted by Non-Service Personnel

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The use is the conduct of scientific research on the refuge by students, universities, and other non-Service personnel. Research conducted on the refuge by non-Service personnel is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(b) Where would the use be conducted?
The location of the research will vary depending on the individual research project being conducted. The entire refuge is available for scientific research. An individual research project is usually limited to a particular habitat type, plant, or wildlife species. On occasion, research projects will encompass an assemblage of habitat types, plants, or wildlife, or may span more than one refuge or include lands outside the refuge. The research location will be limited to those areas of the refuge necessary to achieve the research objectives and that do not

create a significant negative impact to refuge operations and wildlife use. Because of the need to close parts of the refuge spatially or temporally to protect refuge wildlife, some research may not be able to be conducted on the refuge. Much of Monomoy NWR is included in the Monomoy Wilderness, which could impact where or how we allow research to be conducted.

(c) When would the use be conducted?
The timing of the research will depend entirely on the individual research project's approved design. Scientific research will be allowed to occur on the refuge throughout the year, unless it conflicts with the protection of seals, terns, plovers, other migratory shorebirds and seabirds, invertebrates, or plants of management priority or degrade wilderness character. An individual research project could be short- term in design, requiring one or two visits over the course of a few days. Other research projects could be multiple year studies that require daily visits to the study site or staying overnight on South Monomoy. The timing of each individual research project will be limited to the minimum required to complete the project.

(d) How would the use be conducted?
The methods of the research will depend entirely on the individual research project conducted. The methods and study design of each research project will be reviewed and scrutinized before the project will be allowed to occur on the refuge. No research project will be allowed if it does not have an approved scientific method, if it negatively affects endangered species, marine mammals, or migratory birds, if it cannot be conducted consistent with wilderness preservation, or if it compromises public health and safety.

Access to Morris Island is primarily facilitated by pedestrian (walking) access, with access to the rest of Monomoy refuge being primarily by boat. Both these means of access are used by Service staff when conducting biological surveys, roving interpretation, and natural and cultural history tours.

(e) Why is this use being proposed?
Research by non-Service personnel is conducted by colleges, universities, Federal, state, local agencies, non-governmental organizations, and qualified members of the public to further the understanding of the natural, physical, and wilderness refuge environments and improve management of refuge natural and wilderness resources. Research is therefore an important part of the adaptive management process that often results in improved management of refuge habitats and wildlife populations or wilderness character. Much of the information generated by the research is applicable to management on and near the refuge.

The Service will encourage and support research and management studies on refuge lands that improve and strengthen natural resource and wilderness management decisions. The refuge manager will encourage and seek research related to approved refuge objectives that clearly improves land management and promotes adaptive management. Priority research addresses information that is important to agencies of the Department of the Interior, U.S. Fish and Wildlife Service, National Wildlife Refuge System, state fish and game agencies and other agencies responsible for managing natural resources.

The refuge will also consider research for other purposes that may not be directly related to refuge-specific objectives, but will contribute to the broader enhancement, protection, use, preservation and management of native populations of fish, wildlife, and plants, and their natural diversity within the region or flyway. These proposals must comply with the Service's governing laws, regulations, and policies.

The refuge will maintain a list of research needs that will be provided to prospective researchers or organizations upon request. Refuge support of research directly related to refuge objectives may take the form of funding, in-kind services such as housing or use of other facilities, direct staff assistance in the form of collecting data, providing historical records, conducting management treatments, or other assistance as appropriate.

AVAILABILITY OF RESOURCES:

The cost for research is incurred in staff time to review research proposals, coordinate with researchers, write and administer special use permits, and, in some instances boat support and fuel. At an hourly rate of approximately $50.00 for a GS-09 step 6, this totals about $11,000 annually for resources spent on outside research.

Research program administration	1 staff	160 hours	$ 8,000
Boat support	1 staff	40 hours	$ 2,000
Boat fuel and maintenance			$ 1,000
Total annual costs:			**$11,000**

ANTICIPATED IMPACTS OF THE USE:

The Service encourages approved research to further the understanding of natural resources. Research by other than Service personnel adds to the best available information base supporting management decisions. Disturbance to wildlife and vegetation by researchers could occur through direct or remote observation, telemetry, capture (mist-netting, canon netting), banding, and accessing the study area by foot or by boat. These impacts could be exacerbated by multiple concurrent research projects. It is possible that direct mortality could result as a by-product of research activities. Mist-netting, for example, can cause stress, especially when birds are captured, banded and weighed. There have been occasional mortalities to birds, when predators reach the netted birds before researchers do. Temporary installations (e.g., telemetry receivers, remote cameras or acoustic sensors, solar panels) or the visible presence of research personnel to other wilderness users can impact the sense of solitude or untrammeled wildness experienced by wilderness visitors.

Minimal impact will occur when research projects that have been approved are carried out according to the stipulations stated in the special use permit issued for each project. Overall, allowing well-designed and properly reviewed research to be conducted by non-Service personnel is likely to have very little impact on refuge wildlife populations, wilderness user experiences, or wilderness character. If the research project is conducted with professionalism and integrity, potential adverse impacts are likely to be outweighed by the knowledge gained about an entire species, habitat, or public use.

Because Service or partner staff will supervise this activity, impacts of research will likely be minimal if conducted in accordance with refuge regulations, and minimum requirements analyses if within the Monomoy Wilderness. In the event of persistent disturbance to habitat or wildlife, or to wilderness character, the activity will be further restricted or discontinued.

Potential Pedestrian Impacts

Potential Direct Impacts

Pedestrian travel has the potential to impact shorebird, waterfowl, and other migratory bird populations feeding and resting near the trails and on beaches during certain times of the year. Pedestrians who get too close can also impact seals resting on the beach. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Code National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1995, 1997; Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential of intermittently interrupting the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. Refuge staff will manage researcher access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Researchers accessing Monomoy from Chatham town beaches could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual.

Researcher use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. A 150-foot buffer around all seals is recommended by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Pedestrian Indirect Impacts

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of research are likely to be minimal if conducted in accordance with refuge regulations.

Potential Impacts to Wilderness Character

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we

maintain both the tangible and intangible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing outstanding opportunities for solitude or primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that preserves their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

There are some aspects of the wilderness character that could be affected by research conducted on the refuge. Wilderness visitors' experiences are most strongly affected by social conditions, such as other people and their actions, than by their perception of naturalness or ecological conditions (Hendee and Dawson 2002). With typically long sight distances across Monomoy's rolling nearly treeless coastal barrier landscape, too many individuals or structures encountered during visits likely detracts from the sense of solitude experienced by wilderness users (Stankey and Schreyer 1987, Hendee and Dawson 2002).

Research may need to be conducted in areas of the island that are less traversed by wilderness users. This could lead to the establishment of new trails. Once established, the trails themselves are clear evidence of human presence that detracts from some users' perceptions of an otherwise untrammeled, undeveloped, or natural appearing landscape (Hendee and Dawson 2002) within the Monomoy Wilderness. Bare, exposed, sand dune areas, potentially compacted tidal marsh segments, trail treads, and narrow zones of disturbed vegetation on either side of refuge foot trails and boat landings will be readily evident, but when trail standards are kept minimal, trails tend to be accepted or even expected by most, but not all, wilderness users (Stankey and Schreyer 1987, Cole 2002, Hendee and Dawson 2002).

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

_____ Use is not compatible

__**X**__ Use is compatible with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

All researchers will be required to submit a detailed research proposal following Service Policy (FWS Refuge Manual Chapter 4 Section 6, as may be amended), as well as a completed National Wildlife Refuge System Special Use Research and Monitoring Application and Permit. This can be found at *http://www.fws.gov/forms/3-1383-R.pdf.* The application can be submitted to the refuge manager via email or by fax. The refuge must be given at least 45 days to review and decide whether to approve proposals before initiation of research. If collection of wildlife is involved, the refuge must be given 60 days to review and decide whether to approve the proposal. The Service cannot guarantee that it will review or approve proposals not submitted within these timeframes.

In order to preserve wilderness character, research proposed to be conducted in the Monomoy Wilderness will require extra scrutiny using the minimum requirements decision guide to ensure the methods proposed are the minimum necessary for achieving the refuge purpose. Researchers may be asked to draft minimum requirement analyses to expedite review and issuance of conditions designed to protect wilderness. Proposals will be prioritized and approved based on need, benefit, compatibility, and funding required.

Research proposals are reviewed by refuge staff and conservation partners, as appropriate, for approval. Evaluation criteria currently include, but are not limited to, the following:

- Research that will contribute to specific refuge management issues will be given higher priority over other research requests.
- Research that will conflict with other ongoing research, monitoring, or management programs will not be permitted.
- Research projects that can be accomplished off-refuge are less likely to be approved.
- Research that causes undue disturbance or is intrusive will likely not be permitted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
- If staffing or logistics make it impossible for the refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

Special use permits will be issued for all research conducted by non-Service personnel. The permit will list all conditions necessary to ensure compatibility and will identify a schedule for periodic progress reports and submittal of a final report or scientific paper. The regional refuge biologists, other Service divisions, and Massachusetts State agencies may be asked to review and comment on proposals. All reports, presentations, posters, articles or other publications will acknowledge the Refuge System and Monomoy NWR as partners in the research. Non-Service organizations and personnel conducting research on the refuge will provide the Service with all data collected and/or reports. The research organization/agency or personnel in conjunction with the Service will retain the use and ownership of all data/reports.

All researchers will be required to obtain appropriate State and Federal permits.

Any research project may be terminated at any time for non-compliance with the conditions of the special use permit, or modified, redesigned, relocated, or terminated upon determination by the refuge manager that the project is causing unanticipated adverse impacts to wildlife, wildlife habitat, wilderness character, approved priority public uses, or refuge resources of staff time, equipment, or funding. Where appropriate, some areas may be temporarily or seasonally closed so that research would be permitted when impacts to wildlife and habitat or wilderness character are less of a concern.

All work with endangered species will require the proper permits from Federal or State government. Researchers may also need State and Federal collection permits and may need to provide an assurance of animal care form or an institutional animal approval form, if applicable.

JUSTIFICATION:

This program as described is determined to be compatible. Any potential negative impacts of research activities on the resources of the refuge will be minimized by the restrictions included in the special use permit special conditions. In addition, the research study design and researcher activities will be regulated and monitored by refuge staff.

The Service encourages approved research to further our understanding of refuge natural resources. Research by non-Service personnel, guided by the stipulations listed above, adds greatly to the information base for refuge managers to make proper refuge management decisions. This use will potentially contribute to the refuge's concurrent purposes in carrying out migratory bird management and preserving wilderness character. While some research activities may cause minimal disturbance to wildlife or result in the loss of specific individuals, this impact will be offset by the value of the research to managers and future generations.

In accordance with 50 CFR 26.41, research conducted by non-Service personnel as described in this compatibility determination, will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Sunbathing and Swimming

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✔	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✔	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✔	
(d) Is the use consistent with public safety?	✔	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✔	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✔	
(g) Is the use manageable within available budget and staff?	✔	
(h) Will this be manageable in the future within existing resources?	✔	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✔	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✔	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ___✔___ No ____.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ **Appropriate** ___✔___

Refuge Manager: _____ Date: _____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Monomoy National Wildlife Refuge

Use: Sunbathing and Swimming

NARRATIVE:

Although Service policy does not specifically encourage sunbathing and swimming, these activities often facilitate priority uses such as wildlife observation and photography. The use is a traditional refuge activity that attracts many visitors, especially during the summer and early fall, which increases the refuge's ability to provide opportunities for the priority public uses described in the Refuge System Improvement Act of 1997. The use is not expected to have adverse impacts on refuge wildlife and habitat. Mainland refuge beaches are submerged for approximately 3 hours during high tide, making them inaccessible for approximately 6 hours per day. For this reason, it is unlikely that swimming and sunbathing will increase significantly as a primary public use. Extremely limited visitor parking, lack of facilities on the islands, and often rough boating conditions will also limit the numbers of visitors who go out solely for beach use, especially when there are several other local beaches that offer similar recreational opportunities and are much easier to access. Areas used heavily by migratory birds for feeding, roosting, or nesting are closed April through September, so this activity represents only a minimal disturbance factor.

Allowing swimming and sunbathing will contribute to public appreciation of Monomoy NWR. Costs associated with administering these uses and likely visitor impacts are both minimal. These uses will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of the Monomoy NWR. Therefore, it is the determination of the Service that swimming and sunbathing use, at the discretion of the refuge manager, is a compatible use of the Monomoy NWR.

COMPATIBILITY DETERMINATION

USE:

Sunbathing and Swimming

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
Sunbathing and swimming are not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). However, it is a traditional use at the refuge, mainly from June through August. Visitors engaged in this use may also find themselves observing wildlife on the refuge.

(b) Where would the use be conducted?
Although Service policy does not encourage such use, many summer visitors come to the refuge for the primary purpose of sunbathing and swimming. Popular areas include Morris Island and, when open to the public, the east side of North Monomoy, the sandbars between the islands, and the beach just west of Powder Hole.

Certain areas on Monomoy NWR are seasonally closed to public access at the refuge manager's discretion to protect sensitive habitats or species of concern, minimize conflicts with other refuge activities, or respond to human health and safety concerns. All sunbathing and swimming would be conducted only in areas that are open to the public and do not impact sensitive wildlife or vegetation.

(c) When would the use be conducted?
Monomoy NWR is open daily to the public from ½ hour before sunrise to ½ hour after sunset. Individuals would be able to sunbathe and swim during regular refuge hours, unless otherwise posted by the refuge.

(d) How would the use be conducted?
The use must be conducted in accordance with refuge regulations, including seasonal closures.

The use is primarily facilitated by pedestrian walking and hiking access, commercial ferry access, or boat. Boats are allowed to land anywhere along the refuge shoreline, with the exception of posted tern colonies and piping plover nesting areas. The presence of hazardous currents and shoals encourages visitors to land their boats in only a few designated locations.

In general, sunbathing and swimming are self-regulated, with signs indicating closed areas. All visitors should contact Monomoy NWR staff for up-to-date information on seasonal closures. Information about closures will also be available on the refuge Web site or at the visitor contact station, when staffed.

(e) Why is this use being proposed?
Visitors come to the beaches at Monomoy NWR for a number of reasons, including sunbathing and swimming. However, these are not expected to become the primary reason for public visitation due to the lack of parking at the refuge headquarters, the limited number of hours that the beach at Morris Island is available, high tides, the lack of facilities on North Monomoy Island and South Monomoy, the amount of beach closed during the summer, and the inconvenience of getting to the islands. Most visitors will come to observe seals, shorebirds, and seabirds, see the Monomoy Point lighthouse, and fish. Families will come with diverse interests, and swimming and sunbathing will often be secondary to the primary reason for the family visit. The ability to sunbathe and swim will increase the number of visits by entire families, and may prolong the amount of time visitors spend on the refuge. Affording opportunities for public enjoyment by allowing this type of beach use will increase visitor appreciation and foster a greater awareness of the importance of this site to the National Wildlife Refuge System.

AVAILABILITY OF RESOURCES:

Few additional resources are needed to facilitate sunbathing and swimming. The estimated costs of allowing these uses are minimal because little infrastructure is involved and the administration of these uses is done in conjunction with other uses. The costs include all beach activities, including beachcombing, and costs associated with signs, law enforcement, and visitor services contacts are common to these uses.

There are labor costs for annually posting closed plover, tern, and waterfowl nesting areas; there are replacement costs for posts and signs. There are also prorata shares of the annualized cost for special open beach signs, prorata shares of administrative costs, and prorata shares of vehicle, boat, motor, and other specialized equipment costs.

Law Enforcement patrol would be necessary to ensure integrity of the closed nesting areas, especially for piping plovers.

Recurring annual costs:			
Sign replacement and posting			$5,000
Coordination with public and media			$2,000
GS-9 Law Enforcement	1 staff	40 hours	$1,800
Boat fuel, boat maintenance, etc.			$2,500
Total recurring annual costs:			**$11,300**

ANTICIPATED IMPACTS OF THE USE:

Boats are allowed to land anywhere along the refuge shoreline, with the exception of posted tern colonies and piping plover nesting areas, but the presence of hazardous currents and shoals encourages visitors to land their boats in only a few designated locations. During the peak visitation period - weekends and holidays in June through September - opportunities for solitude on the beaches of the Monomoy Wilderness Area are diminished as boaters and beach users concentrate at these sites. A possible impact of sunbathing and swimming is a temporary interruption of feeding or roosting behavior of migratory birds at the approach of beachgoers on foot or by boat. Once visitors get settled in their chosen spot on the beach, however, they tend to remain sedentary for long periods of time and migratory birds usually resume their activities just a short distance away. Other possible impacts of these activities include disrupting larval threatened beach tiger beetle populations, disrupting local seal populations, removing or trampling plants, creating new trails, littering, vandalism, and entering closed areas. Beach tents will not be allowed on North and South Monomoy, as their use in wilderness areas detracts from the wilderness experience that other visitors may be seeking.

On Monomoy Island, area closures are created to protect priority nesting migratory tern and shorebird species. Although these closure areas are designed to minimize human impacts, the potential exists for impacts to unobserved nesting animals or the unlawful entry of visitors into closed areas.

Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981; Burger 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1995, 1997; Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986; Klein 1993; Burger et al. 1995; Klein et al. 1995; Rodgers and Smith 1997; Burger and Gochfeld 1998). The findings reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting piping plovers and least terns or roosting shorebirds. Impacts of sunbathing and swimming are likely to be minimal if conducted in accordance with refuge regulations. We will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies

Beachgoers accessing Monomoy Island from Chatham town beaches could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual.

Pedestrian use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. A 150-foot buffer around all seals is required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Sunbathing and swimming have the potential to lead to new unwanted trails on the refuge, and concentrated numbers of individuals increase the chances for beach littering and vandalism. Beachgoers could choose to take shortcuts to get to destinations rather than use the marked trail or the designated pedestrian travel corridors. Frequent use of alternative routes could lead to vegetation trampling, and ultimately, areas void of vegetation where the new travel route exists.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the tangible and intangible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use

and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

Swimming and sunbathing will not detract from the character of wilderness, as long as beach tents and radios are not used in the wilderness area. Swimmers and sunbathers will not alter the natural scenic condition of the land and the use will not occur at a scale large enough to diminish the environment for native plants and animals. These activities can help individuals connect with nature and with wildlife. Given the few number of visitors at the refuge who engage in swimming and sunbathing within the wilderness area, we anticipate no negative impacts on wilderness character.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

- All sunbathing and swimming will be done only in areas that are open to the public. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.
- Beach tents will only be allowed on Morris Island.
- Loud radios will not be allowed on the refuge.
- Beaches will be monitored for signs of overuse and sections will be closed as needed.
- No physical items, including litter, will be placed or left on the refuge.
- Fires may not be set anywhere on the refuge, including beaches.
- All beach users must maintain a 150-foot buffer around all seals as required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

JUSTIFICATION:

Allowing swimming and sunbathing will contribute to public appreciation of Monomoy NWR. Costs associated with administering these uses and likely visitor impacts are minimal. These uses will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purpose of the Monomoy NWR. Therefore, it is the determination of the Service that swimming and sunbathing use, at the discretion of the refuge manager, is a compatible use of the Monomoy NWR.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 10 YEAR RE-EVALUATION DATE: _____

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COMPATIBILITY DETERMINATION

USE:

Waterfowl Hunting

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

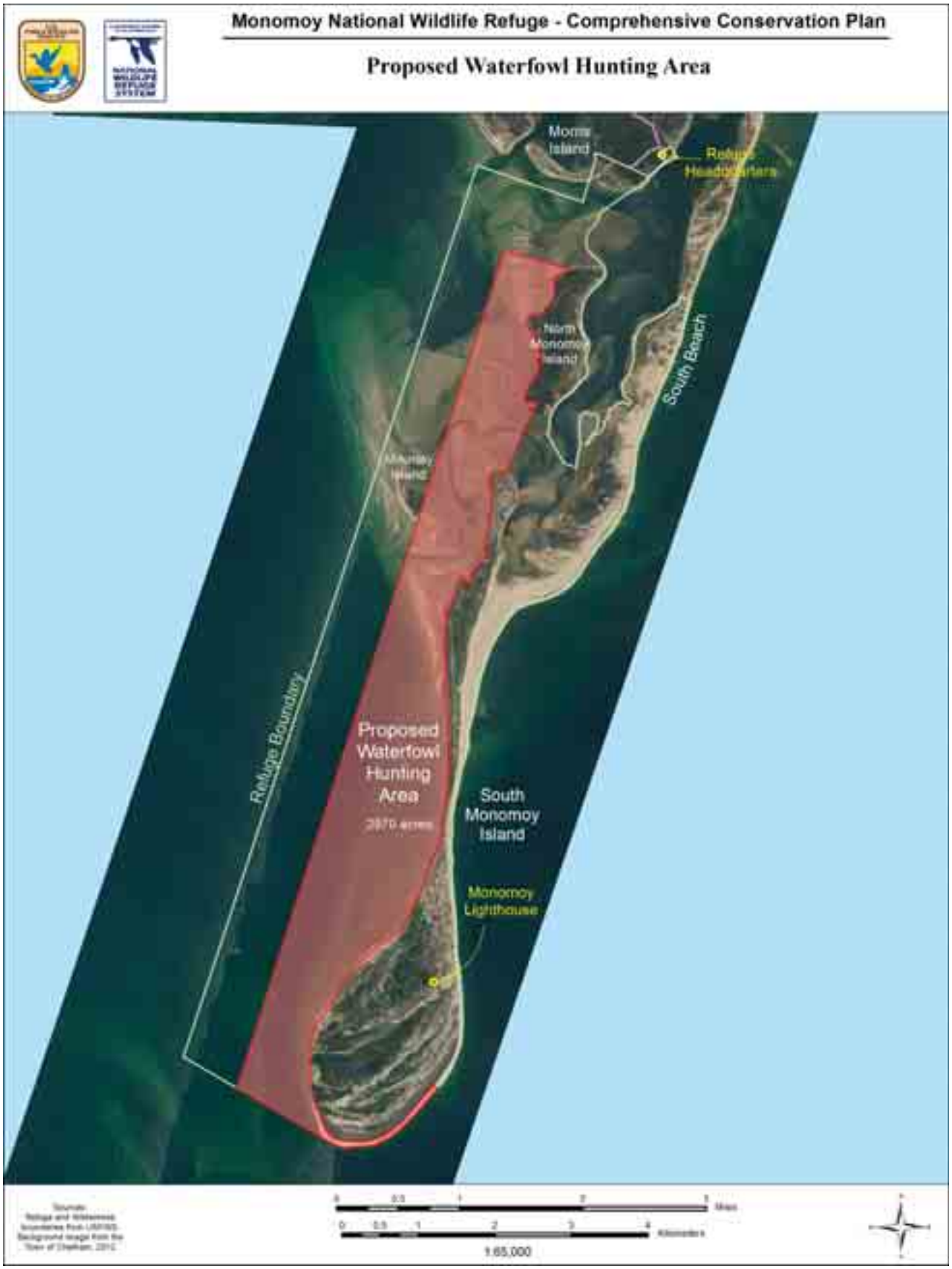
To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
Hunting is a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). This activity involves the taking of waterfowl including scaup (bluebill) and bufflehead, and sea duck species such as common eider, white-winged scoter, and black scoter.

(b) Where would the use be conducted?
Waterfowl hunting will only occur in designated areas within the Declaration of Taking open water boundary and certain portions of the western shoreline of north and south Monomoy, including Minimoy (map D.3). The hunting of any interior pond will not be permitted. Waterfowl hunting involves the use of calls and decoys to bring in waterfowl to a concealed hunter. Hunters may be on land facing out over the water or lying in a boat.

Map D.3. Monomoy National Wildlife Refuge Waterfowl Hunting Area



A boat is necessary when traveling to and from the hunting areas. No permanent blinds are allowed. Non-toxic shot is required.

(c) When would the use be conducted?
Waterfowl hunting activities will be conducted according to State regulations and restrictions. Commercial waterfowl guides are required to obtain a special use permit from the refuge prior to taking clients hunting on the refuge (50CFR 27.97)

(d) How would the use be conducted?
We would open no more than 40 percent of the refuge to waterfowl hunting, in accordance with the Migratory Bird Treaty Act (see map D.3). The hunt would also comply with refuge specific regulations outlined in 50CFR §32.40, and Massachusetts migratory bird regulations. Before opening the refuge to waterfowl hunting, we would need to complete other administrative procedures required for a new refuge hunt.

However, the refuge manager may, upon annual review of the hunting program, impose further restrictions on hunting or further liberalize hunting regulations up to the limits of Federal and State regulations. We will restrict hunting if it becomes inconsistent with other, higher priority refuge programs or endangers refuge resources or public safety.

Access to the Monomoy NWR hunting area will be by boat only. Boaters will travel approximately 2 nautical miles to reach the hunting area from the nearest public boat launch and up to 8.5 nautical miles to reach the furthest point. On the west-facing shoreline, waterfowl hunters will have the option to hunt from land along the shoreline. All land-based hunting along the shoreline falls within the refuge's wilderness boundary. Waterfowl hunting does not detract from the refuge's wilderness character, and all waterfowl hunting activity will be conducted in accordance with the Wilderness Act.

All persons engaged in waterfowl hunting on Monomoy NWR must also adhere to the following refuge-specific regulations:

- Hunters must only possess approved nontoxic shot while in the field.
- Hunters are not allowed to construct pit or permanent blinds on the refuge.
- All temporary blinds, boats, and decoys must be removed from the refuge following each day's hunt. All trash, including shot shell hulls, must be removed when leaving hunting areas.
- Anyone hired to assist or guide hunter(s) must obtain, possess, and carry a valid special use permit issued by the refuge manager.
- The cutting, pulling, marking, or removing of vegetation is prohibited.
- Hunting dogs must be under the immediate control of the hunter at all times.
- Target practice on the refuge or any non-hunting discharge of firearms is prohibited.
- The use of air-thrust and water-thrust boats on all waters within the refuge boundaries is prohibited.
- Individuals will be required to obtain a hunt permit from the refuge.

(e) Why is this use being proposed?
The 1997 Refuge Improvement Act states that priority, wildlife-dependent public uses should receive enhanced consideration in planning and be facilitated on refuges to the extent they are compatible. The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) identifies six legitimate and appropriate uses of wildlife refuges: hunting, environmental education, interpretation, fishing, wildlife observation and wildlife photography. These priority public uses depend on healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses in planning and management.

We are proposing waterfowl hunting for scaup (bluebill) and bufflehead, and sea duck species such as common eider, white-winged scoter, and black scoter to provide the public with recreational opportunities identified as priority, wildlife-dependent, public uses of the System. Hunting has been a traditional form of recreation along the Cape Cod coastline and in the Nantucket Sound for generations.

Under Service policy, hunting is an acceptable, traditional form of recreation, particularly in areas that historically supported hunting. Waterfowl hunting by individuals has been occurring in the area for centuries, and in more recent years the area has become famed for commercial waterfowl hunting excursions. In order to manage this use on the refuge, it will need to become an officially allowable activity. We may modify hunting opportunities on the refuge for various reasons: considering wildlife populations, maintaining habitat, maintaining a safe and high-quality hunting experience or, in rare instances, protecting a research population.

AVAILABILITY OF RESOURCES:

The cost involved in offering this wildlife dependent activity is minimal. Hunting on the refuge will be administered by issuing an annual permit; there will be no fee for non-commercial recreational waterfowl hunting on the refuge, however, a permit will still be required.The refuge will be collecting an annual fee for the issuance of a Special Use Permit (SUP); the fee for each permit will be determined on a case by case basis using Service policy and manager discretion. In addition to staff expenses, the refuge will incur the costs of posting signs, maintaining vehicles, printing leaflets, and providing miscellaneous supplies. We will request the assistance, as needed, of Service or other authorized law enforcement personnel from federal, state, county or local agencies during the hunt. The collection fees will help improve the quality of the hunting program.

Maintenance of parking areas	$500
Law enforcement	$1,000
Signs / pamphlets	$2,000 ($1,000 after first season)
Administration	$1,000
Total recurring annual costs	**$4,500**

ANTICIPATED IMPACTS ON REFUGE PURPOSE:

Migratory birds are managed on a flyway basis. Hunting regulations are established in each state based on flyway data. Current numbers of such birds would be reduced, within allowable limits, as determined by State and Federal agencies. Direct disturbance to non-target birds would likely occur from hunting, but would be short-term. For example, noise from shotguns would cause some birds to flush and go elsewhere. These impacts are of a temporary nature and would also be reduced by the presence of adjacent refuge habitat where hunting does not occur, and where birds can feed and rest relatively undisturbed.

Potential refuge impacts include disturbing endangered species, trampling vegetation, and creating unauthorized trails and subsequent erosion. Discarded shotgun shells and other litter can impact the visual experience of refuge visitors. Enforcement issues involving hunting may also impact the refuge, including illegal taking of migratory birds (unauthorized species, over limit); although significant, these occurrences are uncommon. Commercial hunting, even with a refuge permit, may not take place in a designated wilderness area.

Human disturbance to migrating birds and other wildlife using the open waters and marshes on the Monomoy refuge will occur as a result of hunting activity. Migratory waterfowl generally minimize time in flight and maximize foraging time because flight requires considerably more energy than any other activity except egg laying. Human disturbance associated with hunting includes loud noises, such as those produced by shotguns, and rapid movements. This disturbance, especially when repeated over a period of time, can cause waterfowl to change food habits, feed only at night, lose weight, or desert feeding areas. These impacts from disturbance can be reduced by the presence of adjacent sanctuary areas allowing birds to feed and rest relatively undisturbed. Sanctuaries or non-hunt areas have been identified as the most common strategy to reduce disturbance caused

by hunting. Prolonged and extensive disturbances may cause large numbers of waterfowl to temporarily or permanently leave disturbed areas (Madsen 1995, Paulus 1984). Sanctuary areas are therefore very important to minimize disturbance to waterfowl populations and ensure their continued use of the refuge. The temporary impacts of waterfowl hunting are mitigated by the presence of adjacent refuge habitat where hunting does not occur, where birds can feed and rest undisturbed. Refuge regulations ensure that areas of inviolate sanctuary remain free of disturbance throughout the season.

Boating activity associated with hunting during the fall and winter can alter distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). Boating and hunter activity will also cause some level of soil disturbance, erosion, and foot traffic in sensitive marsh habitats, among other physical effects. Specifying the use of nonmotorized boats, which leave virtually no wake, and limiting the number of hunters will serve to help reduce these impacts.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Law enforcement patrols of public use areas will minimize the above-mentioned types of violations. Staff will monitor hunting activities to determine any adverse impacts to refuge resources and adjust the hunt program as necessary.

Hunters must abide by all applicable refuge, State, and Federal regulations and have in possession all necessary refuge-issued permits. Commercial guides must follow the conditions outlined in the special use permit. These conditions would detail, for example, the primary boat to be used, and in what area of the refuge hunting would take place. Refuge staff will develop a hunt plan and amend the Code of Federal Regulations before permitting hunting on the refuge. No bait or electronic calls can be used for the taking of waterfowl. Cutting vegetation is prohibited. The use of unleashed dogs is permitted only while under the control of individuals actively engaged in hunting. At the end of each hunt, all decoys, blinds, and other equipment must be removed. All litter will be removed daily.

JUSTIFICATION:

The National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd et seq.) identifies six legitimate and appropriate uses of wildlife refuges: environmental education, interpretation, hunting, fishing, wildlife observation and wildlife photography. These priority public uses depend on healthy wildlife populations. Where these uses are determined to be compatible, they are to receive enhanced consideration over other uses in planning and management.

Waterfowl hunting helps us achieve refuge purposes and management goals and objectives, as outlined in refuge comprehensive conservation plans. In addition, waterfowl hunting in these areas is an historic, traditional and sustainable activity. Traditional consumptive uses such as hunting and fishing have a historical significance on Cape Cod, especially in the Chatham area, and there are still those in the area who make their living from the land. This culture of sustainability necessitates a strong connection to the environment. The refuge is vital to this culture and a significant part of the community. The refuge would like to provide the opportunity for waterfowl hunters to hunt on certain areas of the refuge. Hunting of waterfowl at Monomoy NWR is justified within refuge objectives by providing wildlife-oriented recreation and promoting appreciation of wildlife and the outdoors.

These activities will not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

LITERATURE CITED:

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COMPATIBILITY DETERMINATION

USE:

Wildlife Observation and Photography

REFUGE NAME:

Monomoy National Wildlife Refuge

DATE ESTABLISHED:

June 1, 1944

ESTABLISHING AND ACQUISITION AUTHORITY(IES):

Migratory Bird Conservation Act (16 U.S.C. § 715d) Public Law 91-504, 16 USC § 1132(c)

REFUGE PURPOSE(S):

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d).

"…wilderness areas…shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. (PL 88-577 § 2(a), Wilderness Act; as referenced in P.L. 91-504 § 1(g), An Act to Designate Certain Lands as Wilderness).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use? Is the use a priority public use?
The uses are wildlife observation and photography. Wildlife observation and photography are priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

(b) Where would the use be conducted?
Certain areas on Monomoy NWR are seasonally closed to public access from April 15 to September 15 to protect sensitive habitats or species of concern. Refuge staff prepare a closed areas map each April and make it available to the public on the refuge Web site, inside the refuge visitor contact station, and at the Morris Island Trail kiosk.

Wildlife observation and photography can be conducted on Monomoy NWR anywhere that is open for public use. On Morris Island, these uses will occur on the Morris Island Interpretive Trail, at overlooks, and along the beach, including the ¾ mile Morris Island Trail. The trail begins near the refuge headquarters/visitor contact station, goes along the top of the coastal bluff, and down a steep set of stairs to the beach, then through the sand dunes and along salt marshes and salt ponds. The public is asked to remain on this trail.

There are no official trails on North Monomoy Island, although there is a corridor crossing the island. On South Monomoy, there are no official trails, although there are paths that have been created over time by visitors or staff conducting management actions. Because these areas are part of the nationally designated wilderness area, these trails are not maintained, and except for seasonal closures, visitors are free to walk anywhere they wish to engage in wildlife observation or photography.

(c) When would the use be conducted?
Wildlife observation and photography would occur year-round, peaking during May 15 to October 15, during daylight hours when the refuge is otherwise open for public use, ½ hour before sunrise to ½ hour after sunset. Some activities may be allowed during non-daylight hours when the refuge is otherwise closed to public use under special use permit or in conjunction with refuge staff-led or volunteer-led programs.

(d) How would the use be conducted?
Visitors engaged in wildlife observation and photography tend to do so individually or in small groups, with the exception of outings by birding and photography clubs, which often have 20 or more participants in organized field trips to the refuge. Birders access both South Beach, which is owned by the Town of Chatham and managed as part of the Cape Cod National Seashore, as well as North Monomoy Island and South Monomoy. Due to the constant geomorphological changes that occur in this area, opportunities for excellent wildlife observation and photography can be found in both areas, with one area providing more opportunities than another at any given time. Most birders and photographers who depart from Morris Island will go to both South Beach and North and South Monomoy on their trip.

Access to refuge areas other than Morris Island will be by commercial ferry, motorized boat, or nonmotorized boat. Once on refuge lands, all access for wildlife observation and photography activities will be on foot. Motorized equipment is not allowed within the Monomoy Wilderness, which encompasses the more remote portions of Monomoy NWR and includes the majority of the refuge's lands. The Morris Island portion of Monomoy NWR is accessible by motor vehicles and bicycles and parking is provided. However, outside the refuge parking lot, no motorized vehicle or bicycle operation is permitted.

In general, wildlife observation and photography activities will be self-guided. Commercial photography requires a special use permit. Refuge staff do not maintain trails in the Monomoy Wilderness for public use. Staff will focus maintenance efforts on the Morris Island Interpretive Trail and existing and future structures on Morris Island. Currently, there is one observation and photography platform and a coastal bluff viewing area. There is also a short boardwalk at the beginning of the Morris Island Trail, which leads to an overlook and a tiered stairway. The stairway leads visitors to the shoreline and offers high-quality visibility of North Monomoy Island and South Monomoy and has a bench for resting. All these existing structures must be maintained annually. There is a new observation platform and photography blind proposed for some point along the Morris Island Interpretive Trail.

New permanent human-made structures are not permitted within wilderness, and in keeping with preserving and protecting wilderness values, none are planned, except for the Morris Island non-wilderness portion of Monomoy NWR. Portable, temporary blinds are allowed in open areas of the refuge provided they are not left standing when unattended or unoccupied.

(e) Why is this use being proposed?
The 1997 Refuge Improvement Act states that priority, wildlife-dependent, public uses should receive enhanced consideration in planning and be facilitated on refuges to the extent they are compatible.

The wildlife observation and photography programs promote refuge purposes and management objectives and increase public knowledge and understanding of wildlife and the importance of habitat protection and management. Refuge visitors who participate in wildlife observation and photography will gain an understanding of the missions of the Service, the National Wildlife Refuge System, and the contribution of the Monomoy NWR to this system.

AVAILABILITY OF RESOURCES:

Wildlife observation and photography currently occur with existing staff, but will be enhanced with the provision of new structures and staff. Monomoy NWR has long been one of the premier birding and photography sites in Massachusetts. Maintaining this reputation has more to do with the physical characteristics of Monomoy and South Beach and how the habitat changes with changes in geomorphology than it does with the existence of refuge staff and infrastructure. However, improvements in the quality of the programs will be realized with the construction of new facilities on Morris Island and two new staff positions, a portion of which will support the Monomoy NWR public use program.

New construction and renovation/estimated costs:			
Observation platform – install new, handicapped accessible platform			$15,000
Morris Island Trail photography blind—1 new			$5,000
Total new costs:			**$20,000**
Recurring annual costs:			
Regular maintenance of platforms, photo blinds, trails			$5,000
Equipment and supplies			$5,000
GS-11 Visitor Services Manager	1 staff	160 hours	$7,200
GS-9 Visitor Services Specialist	1 staff	120 hours	$4,500
WG-6 Maintenance Worker	1 staff	320 hours	$9,600
GS-11 Law Enforcement	1 staff	160 hours	$7,200
Total recurring annual costs:			**$38,500**

ANTICIPATED IMPACTS OF THE USE:

The majority of the impact from wildlife observation and photography will be disturbance to resting, feeding or nesting migratory birds and resting seals. There will be some trampling of vegetation. Incidences of littering, vegetation removal, and vandalism may increase as a result of the projected increase in visitation. On Morris Island, with use restricted to designated trails and other refuge structures, we predict the impacts will be confined to small areas and in areas already affected.

New structures will be located on the Morris Island Interpretive Trail outside the Monomoy Wilderness with consideration of the long-term consequences and cumulative impacts to wildlife and habitats. Most of the new structures proposed, e.g., kiosks, observation platforms, photography blinds, would each result in habitat losses of less than ¼ acre.

Visitors engaged in wildlife observation and photography have a vested interest in minimizing disturbance to the wildlife they wish to observe and photograph. However, birders and photographers are known to disturb wildlife in an attempt to get closer looks at the objects of their attention. On North Monomoy Island and South Monomoy in particular, pedestrians have the potential of impacting shorebird, waterfowl, and other migratory bird populations feeding and resting on beaches and tidal flats. Pedestrians can also impact seals resting on the beach if they get too close. Conflicts arise when migratory birds and humans are present in the same areas (Boyle and Samson 1985). Response of wildlife to human activities includes departure from site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschgen et al.1985, Henson and Grant 1991, Kahl 1991, Klein 1993), use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior (Burger 1981, Korschgen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990).

Numerous studies have documented that migratory birds are disturbed by human activity on beaches. Erwin (1989) documented disturbance of common terns and skimmers and recommended that human activity be restricted to a distance of 100 meters around nesting sites. Klein (1993) in studying waterbird response to human disturbance found that, as intensity of disturbance increased, avoidance response by the birds increased, and found that out-of-vehicle activity to be more disruptive than vehicular traffic. Pfister et al. (1992) found that the impact of disturbance was greater on species using the heavily disturbed front side of the beach, with the abundance of the impacted species being reduced by as much as 50 percent. In studying the effects of recreational use of shorelines on nesting birds, Roberton et al. (1980) discovered that disturbance negatively impacted species composition. Piping plovers, which intensively use the refuge, are also impacted negatively

by human activity. Pedestrians on beaches may crush eggs (Burger 1987, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Other studies have shown that if pedestrians cause incubating plovers to leave their nest, the eggs can overheat (Bergstrom 1991) or can cool to the point of embryo death (Welty 1982). Pedestrians have been found to displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993).

Several studies have examined the effects of recreation on birds using shallow water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1995, 1997, Burger and Gochfeld 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger 1981, 1986, Klein 1993, Burger et al. 1995, Klein et al. 1995, Rodgers and Smith 1997, Burger and Gochfeld 1998). The findings that were reported in these studies are summarized as follows in terms of visitor activity and avian response to disturbance.

Presence: Birds avoided places where people were present and when visitor activity was high (Burger 1981, Klein et al. 1995, Burger and Gochfeld 1998).

Distance: Disturbance increased with decreased distance between visitors and birds (Burger 1986), though exact measurements were not reported.

Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger and Gochfeld 1981, Burger et al. 1995, Knight and Cole 1995, Rodgers and Smith 1995, 1997).

Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger 1981, 1986, Burger et al. 1995, Knight and Cole 1995). Alternatively, birds may tolerate passing by with unabated speed, but may flush if the activity stops or slows (Burger et al. 1995).

Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger 1986, Klein 1993, Burger and Gochfeld 1998), though noise was not correlated with visitor group size (Burger and Gochfeld 1998).

The proposed use has the potential to intermittently interrupt the feeding habits of a variety of shorebirds, gulls, and terns, but encounters between pedestrians and migratory birds will be temporary. Refuge staff will manage wildlife observation and photographer access via seasonal closures to minimize disturbance to nesting, resting, and foraging waterbirds on the refuge.

Visitors accessing Monomoy NWR from Chatham town beaches could potentially impact the larval stage of the threatened northeastern beach tiger beetle. The recovery plan for this species describes that many of the species' habitats are threatened by human impacts such as habitat alteration and recreational activities (USFWS 1994). Larval burrows are especially susceptible to trampling, which results in excess energy expenditure and reduced time hunting for the inhabiting individual. We will continue to survey to determine the location and extent of larval beetle occurrence and habitat, and use closures and re-route trails to avoid larval habitats.

Visitor use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year round. A 150-foot buffer zone around all seals is required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Heavy beach use can dry out the sand and contribute to beach erosion. Trash left on the beach, particularly food or wrappers, can attract predators that prey on nesting and roosting shorebirds. Impacts of wildlife observation and photography are likely to be minimal if conducted in accordance with refuge regulations. We will manage refuge closures that restrict pedestrian access to minimize disturbance to priority avian species during critical times of the year. Closures can be expanded or contracted as needed, depending on bird activity and results of further disturbance studies. The refuge is a leave-no-trace, carry-in-carry-out facility. We

encourage all outfitters and guides to pack in and pack out all food containers, bottles, wrappers, trash, and other waste and refuse. Littering, dumping, and abandoning property are prohibited by Federal regulation at 50 C.F.R, 27.93.94.

All of North Monomoy Island and most of South Monomoy are designated wilderness and are part of the National Wilderness Preservation System. Wilderness, in contrast with those areas where humans and their works dominate the landscape, is an area where the Earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. Preserving wilderness character requires that we maintain both the visible and invisible aspects of wilderness. Aspects of wilderness character include maintaining the natural, scenic condition of the land; providing environments for native plants and animals, including those threatened or endangered; maintaining watersheds and airsheds in a healthy condition; maintaining natural night skies and soundscapes; retaining the primeval character of and influence on the land; serving as a benchmark for ecological studies; and providing opportunities for solitude, primitive and unconfined outdoor recreation, risk, adventure, education, personal growth experiences, a sense of connection with nature and values beyond one's self, a link to our American cultural heritage, and mental and spiritual restoration in the absence of urban pressures. We provide opportunities for appropriate and compatible use and enjoyment of wilderness areas in a manner that will preserve their wilderness character and "leave them unimpaired for future use and enjoyment as wilderness."

Wildlife observation and photography will not affect wilderness character. These activities do not alter the natural, scenic condition of the land and will not occur at a scale large enough to diminish the environment for native plants and animals.

Large groups have the potential to negatively infringe on the wilderness experience for those visitors who come to the refuge specifically to have a wilderness experience. This will generally be a short-term impact to wilderness visitors and will be regulated through the special use permit required for large groups.

PUBLIC REVIEW AND COMMENT:

As part of the comprehensive conservation planning (CCP) process for the Monomoy National Wildlife Refuge, this compatibility determination will undergo a 60-day public comment period concurrent with the release of our draft CCP/Environmental Impact Statement.

DETERMINATION (CHECK ONE BELOW):

____ Use is not compatible

__X__ Use is compatible, with the following stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

All wildlife observation and photography activities will avoid sensitive areas prone to disturbance (e.g., sensitive vegetation areas) or degradation (e.g., soil compaction), and will be designed to minimize impacts to nesting birds or other breeding, feeding, or resting wildlife. Areas that are open to this use will be evaluated on an annual, seasonal, and sometimes daily basis and will be influenced by beach geomorphology and wildlife use. Seasonal closures will vary year to year based on wildlife use and habitat conditions. Visitors will be expected to comply with closures. Updates on closures will be available at the Monomoy Headquarters and on the refuge Web site.

Access for wildlife observation and photography activities will be on foot, or by ferry, boat, and sea kayak. No motorized vehicles will be allowed on the refuge and in the wilderness areas.

Activities will be in public areas only (unless a special use permit is approved) where only minimal direct and short-term impacts are predicted, and adverse, long-term, cumulative impacts are not anticipated.

Periodic evaluations will be done to insure that visitors are not causing unacceptable adverse impacts. If we have evidence of unacceptable impacts occurring, we will modify or curtail access as deemed necessary by the refuge manager.

Occasional law enforcement patrol and regular staff presence should minimize potential violations. The refuge is open ½ hour before sunrise to ½ hour after sunset for wildlife observation and photography. These restrictions will be maintained. Refuge regulations will be posted and enforced.

All photographers must follow refuge regulations. On a case by case basis, photographers may be issued a special use permit to photograph inside closed areas. Permittees must follow the conditions outlined in the permit, which normally includes notification of refuge personnel each time any activity occurs in closed areas. Use of a closed area will be heavily restricted appropriately to reduce disturbance to wildlife.

JUSTIFICATION:

Wildlife observation and photography are priority, wildlife-dependent, public uses identified by the 1997 Refuge Improvement Act. By definition, these activities have been determined appropriate by law and, when compatible, are to be facilitated on refuges. These programs support the mission of the National Wildlife Refuge System by promoting an understanding and appreciation of natural and cultural resources and their management within a national system of refuges. Our programs will reach out to all segments of the public to expand support for the refuge system. Individual refuge programs will be consistent with, and fully support, the goals and objectives in the Monomoy NWR Comprehensive Conservation Plan.

We do not expect pedestrian access to materially interfere with or detract from the mission of the National Wildlife Refuge System, nor diminish the purpose for which the refuge was established. It will not pose significant adverse effects on refuge resources, interfere with public use of the refuge, or cause an undue administrative burden. These uses facilitate wildlife observation and photography, and will provide compatible recreational opportunities for visitors to observe and learn about wildlife and habitats firsthand.

SIGNATURE:

Refuge Manager: _____ _____
(Signature) (Date)

CONCURRENCE:

Regional Chief: _____ _____
(Signature) (Date)

MANDATORY 15 YEAR RE-EVALUATION DATE: _____

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Appendix E

Freshwater pond on refuge

Wilderness Review of Monomoy National Wildlife Refuge

- E.1 Wilderness Review of Monomoy National Wildlife Refuge
- E.2 Wilderness Stewardship Plan Outline
- E.3 Minimum Requirements Analyses Alternatives Matrix
- E.4 Minimum Requirements Decision Guide

Introduction

A wilderness review is the process the U.S. Fish and Wildlife Service (Service) uses to identify and recommend lands or waters in the National Wildlife Refuge System (Refuge System) for inclusion in the National Wilderness Preservation System (NWPS). Planning policy for the System (602 FW 3) mandates conducting wilderness reviews every 15 years through the Comprehensive Conservation Planning (CCP) process. Section 610 FW 4 of the Service's Wilderness Stewardship Policy provides guidance on the wilderness review process. We may also conduct a wilderness review prior to the next planning cycle, should significant new information become available, ecological or other conditions change, or we identify a need to do so.

The wilderness review process has three phases: inventory, study, and recommendation. After first identifying lands and waters that meet the minimum criteria for wilderness, the resulting wilderness study areas (WSA) are further evaluated to determine if they merit recommendation from the Service to the Secretary of the Interior to Congress for wilderness designation.

Areas recommended for designation are managed to maintain wilderness character in accordance with management goals, objectives, and strategies outlined in the final CCP until Congress legislatively designates an area or the CCP is amended to modify or remove the wilderness proposal. A brief discussion of wilderness inventory, study, and recommendation follows.

Wilderness Inventory

The wilderness inventory consists of identifying areas that minimally meet the requirements for wilderness as defined in the Wilderness Act of 1964 (Wilderness Act).

The definition of wilderness is in section 2(c) of the Wilderness Act: "A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. In this act, an area of wilderness is further defined to mean an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value."

Wilderness Study

During the study phase, lands and waters qualifying for wilderness as a result of the inventory are studied to analyze values (ecological, recreational, cultural, or symbolic), resources (e.g., wildlife, water, vegetation, minerals, or soils), public uses, and refuge management activities within the area. The analysis includes evaluation of whether the WSA can be effectively managed to preserve its wilderness character.

An "All Wilderness Alternative" and a "No Wilderness Alternative" is analyzed for each WSA to compare the benefits and impacts of managing the area as wilderness as opposed to managing the area under an alternate set of goals, objectives, and strategies that do not involve wilderness designation. The environmental analysis addresses benefits and impacts to wilderness values and other resources under each management alternative. The study evaluates how each alternative will:

- Achieve the purposes of the Wilderness Act and the NWPS.
- Affect achieving refuge or planning unit purpose(s).
- Affect that refuge's contribution toward achieving the Refuge System mission.
- Affect maintaining and, where appropriate, restoring biological integrity, diversity, and environmental health at various spatial or landscape scales.
- Meet other legal and policy mandates.

The findings of the study help determine whether to recommend the area for designation as wilderness. The information, analysis, and decisions in the CCP and associated National Environmental Policy Act (NEPA) document (in this case an Environmental Impact Statement) provide the rationale for wilderness suitability determinations and the basic source of information throughout the public, executive, and legislative review processes that follow.

Wilderness Recommendation

There is no requirement to recommend a WSA for congressional designation as wilderness. The Final CCP and Record of Decision document the Service's determination on a WSA's suitability (or unsuitability) for wilderness and decision to recommend (or not recommend) an area for designation.

For a WSA determined suitable and recommended for designation, additional steps are required including preparing a wilderness study report that presents the results of the wilderness review and a Legislative Environmental Impact Statement. Once prepared, these documents are transmitted along with the CCP, through the Secretary of Interior to the President of United States, and ultimately to the United States Congress for approval.

Wilderness Inventory of Monomoy National Wildlife Refuge

The wilderness inventory is a broad look at the CCP planning area to identify potential WSAs. WSAs are roadless areas within the refuge boundaries that meet the minimum criteria for wilderness identified in Sect. 2. (c) of the Wilderness Act. A WSA must meet the minimum size criteria (or be a roadless island), appear natural, and provide outstanding opportunities for solitude or primitive recreation. Other supplemental values are evaluated, but not required.

The wilderness inventory phase was conducted and reviewed by the CCP Planning Team. Members of the planning team are Service personnel from the Regional Office and the field, the district manager of the Massachusetts Division of Fish and Wildlife, and representatives from the Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head (Aquinnah). The inventory process and application of the wilderness criteria is described in the following sections and summarized in table E.1.

Evaluation of Size Criteria

The initial step to identify roadless areas and roadless islands in a planning area requires gathering land status maps, land use and road inventory data, satellite imagery, aerial photographs, and personal observations of areas within refuge boundaries. Lands and waters currently owned by the Service in fee title are evaluated. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.

An inventory unit meets the size criteria for a WSA if any one of the following standards applies (610 FW 4.8):

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Discussion

Monomoy National Wildlife Refuge (NWR) stretches for 8 miles off the elbow of Cape Cod. The 8,321-acre refuge includes the barrier islands of North Monomoy, South Monomoy and Minimoy, 40 acres on Morris Island

where the headquarters and visitor contact station are located, and waters out to the mean low water line around the Monomoy Islands. The refuge is one of eight refuges in the Eastern Massachusetts NWR Complex headquartered in Sudbury, MA.

All of the lands and waters within the refuge boundary are owned by the United States, and managed by the Service. The majority (86 percent) of the refuge's land and waters lying above Mean Low Water (MLW) were designated as wilderness in 1970. At that time, the wilderness designation was estimated to encompass 2,600 acres. With the exception of excluded areas, the Monomoy Wilderness boundary includes all lands extending to MLW within the original 1944 Declaration of Taking that established Monomoy NWR. Wilderness designation does not include subtidal or open water areas below MLW. The Monomoy Wilderness is currently the only nationally designated wilderness on the densely populated southern New England coastline.

The 1970 wilderness designation excluded four parcels: (1) the 40-acre property on Morris Island which contains the refuge headquarters and visitor contact station; (2) the approximately half-acre Stage Island lot; and (3) the Inward Point and (4) Powder Hole areas on South Monomoy. In the 1970 law, these latter areas are identified as 90 acres and 170 acres, respectively. However, the boundary description of these parcels conducted in 1971 and approved by the Regional Director identifies them as 73 acres and 137 acres, respectively.

In 2000, an updated survey of the refuge was completed by Service Regional Office surveyors who identified the refuge wilderness acreage to be 3,244 acres, the Inward Point exclusion as 432 acres and the Powder Hole exclusion as 163 acres. The sizes of the wilderness area and exclusions have both changed due to accretion, including 717 additional wilderness acres lying south of the February 2013 break in Nauset/South Beach. For the purposes of this review, we are using the numbers derived from the 2000 survey, which was approved in 2002 by the Service's Chief Surveyor plus the accreted acres south of the February 2013 break in South Beach.

The 432-acre Inward Point exclusion area includes the site of the former Monomoy Brant Club and seasonal camps described below. The 163-acre Powder Hole exclusion area includes the sites for the former Whitewash Village fishing community and U.S. Life Saving Service (and subsequently U.S. Coast Guard) Monomoy Point Lifesaving Station of which little evidence remains today. In addition, the Powder Hole exclusion area also includes the "cherry stem" access trail corridor and approximately 4-acre site of the existing Monomoy Point Light Station buildings, a National Historic Register designated site.

Although these two areas were excepted from the Wilderness designation, Congress intended the Secretary of the Interior to manage the entire area consistent with the concept of Wilderness (House of Representatives, Report No. 91-1441).

The wilderness inventory units which have been identified for this review are (1) the Morris Island/Stage Island unit; (2) the Inward Point unit; and (3) the Powder Hole unit, as shown on map E.1.

Conclusion

With the exception of the Morris Island portion, Monomoy NWR is once again surrounded by permanent waters and markedly distinguished from the surrounding lands by topographical or ecological features. It is also of sufficient size as to make practicable its preservation and use in an unimpaired condition. Additionally, the Inward Point unit and the Powder Hole units meet the size criteria as they are both contiguous to existing wilderness. The Morris Island/Stage Island unit is separated from the rest of the refuge by the Morris Island channel, and is therefore not contiguous with any designated wilderness.

Evaluation of the Naturalness Criteria

To qualify as a WSA, an area must meet the naturalness criteria (610 FW 4.9). Section 2 (c) of the Wilderness Act defines wilderness as an area that "…generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear "natural" to the average visitor rather than "pristine." The presence of ecologically intact, historic landscape conditions is not required.

An area may include some manmade features and human impacts provided they are substantially unnoticeable in the unit overall. In the inventory phase, the naturalness evaluation focuses on the *existing physical impacts*

of refuge management activities, refuge uses, or human-caused hazards, such as the presence of unexploded ordnance from military activity. At this stage, we do not disqualify an area from further study solely on the basis of established or proposed activities or uses that require the use of temporary roads, motor vehicles, motorized equipment, motorboats, mechanical transport, landing of aircraft, structures, and installations generally prohibited in designated wilderness. In addition, an area may not be considered unnatural in appearance solely on the basis of "sights and sounds" of human impacts and activities outside the boundary of the unit.

Discussion

Monomoy NWR and surrounding areas have a long history of human use. The vicinity of Chatham or "Manomoyick" was occupied by the Monomoyicks, a community of Native Americans of the federally recognized Wampanoag tribe. The Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head (Aquinnah) used the islands perhaps as early as 5,000 years ago and the area represented a local core of Native American settlement after A.D. 1500 (Steinitz and Loparto 1987). However, no Native American sites have been recorded on South Monomoy or North Monomoy. According to the archaeological site files on record with the Massachusetts Historical Commission, two Native American sites have been identified on the southern part of Morris Island, which is not in the current wilderness area. Native Americans likely visited the 8-mile peninsula from which the Monomoy barrier islands were later formed, but exposure to the elements and a lack of vegetation has meant that local landforms were subjected to extensive erosion and movement. As a result, Native American archaeological deposits may be deeply buried on the two islands, or may have been deflated by erosion, and no longer exist.

In the 1600s, European Americans settled in the communities of present day Cape Cod. In 1686, Captain James Forster purchased Morris Island, then known as "Quitnesset." The primary occupations were farming and maritime activities. The Town of Chatham was designated as the "constablewick of Monomoy" in 1696, during which time the Monomoy peninsula was being used as pasture for sheep and cattle.

By the early eighteenth century a small fishing community (later known as Whitewash Village) had been established on the peninsula. During the early 1800s, a deep natural harbor, known as Powder Hole, attracted a sizeable settlement at Whitewash Village. As many as 50 families maintained homes there and the village featured trading stores and a pair of shipyards. This community was largely abandoned after the deep harbor was filled with sediment following a hurricane in the latter half of the 19th century, and hindered the fishing that had sustained the local economy. At its peak, Whitewash Village housed about 200 residents and featured a public school and an inn, the Monomoit House. Little evidence of the historic Whitewash Village exists on the ground surface. Historical deposits and features have likely been subject to erosion, but no formal study has been conducted to map and inventory historic or archaeological resources at the refuge.

The first Monomoy Point Lighthouse was built in 1823. The U.S. Life-Saving Service was authorized to build several lifesaving stations on outer Cape Cod, including the Monomoy peninsula in 1872. A second lifesaving station (Monomoy) was built near Hospital Pond 2 years later, and a third at Monomoy Point in 1902 served as the southernmost component in a series of 13 stations between Chatham and Provincetown (Seufert-Barr 1995). The Morris Island and the Monomoy Point stations transferred to the U.S. Coast Guard in 1915 when the Coast Guard replaced the Life-Saving Service. The Morris Island Coast Guard facility became the current site for the Monomoy NWR administrative headquarters and visitor contact station. The Coast Guard transferred use and management of their remote and difficult to access Morris Island and Stage Island facilities to the U.S. Fish and Wildlife Service following refuge establishment in 1944.

By the early 1900s, the Monomoy peninsula became a popular holiday destination where families built summer camps and waterfowl hunters visited during the fall and winter. The elite Monomoy Brant Club brought sportsmen to the remote beach near Inward Point for waterfowl hunting from 1862 to 1932, at which time the U.S. Military took over the peninsula. Remains of the Brant Club structures persisted through the mid-1950s after which a series of coastal storms destroyed the buildings, leaving behind little evidence of their prior existence.

The refuge (and existing Monomoy Wilderness) includes an area previously known as the Monomoy Island Gunnery Range. The military used the island for aerial bombardment and gunnery range from 1944 through 1950 with evidence of the munitions used still found from time to time.

In the mid-1950s dredge spoil was placed across the cut separating Morris and Stage Islands from mainland Chatham after a storm deepened the cut but also began filling Stage Harbor with sand. This new "causeway" was paved in the late 1960s, affording all weather motor vehicle access, after which Morris and Stage Islands were "built out" for the residential land use that now surrounds and immediately adjoins existing Monomoy NWR facilities on these islands.

The Morris Island tract contains several buildings and parking areas, as well as a disjunct parcel comprised of salt marsh, small ponds, dunes and beach. The Morris Island Trail traverses this parcel; interpretative exhibits are found along the trail. The Stage Island lot is primarily a parking area and boat loading and unloading area.

The Inward Point area is now free of most permanent or manmade structures, as all the camps that were located in this area when the original wilderness was designated have now been removed. A building foundation and cistern and utility poles do remain. The Powder Hole area contains the historic Monomoy Point Light Station complex. These are the only buildings remaining on South Monomoy and include a lighthouse, a keeper's house, and former oil shed.

Conclusion

The residential land use and roads that surround or immediately adjoin Monomoy NWR lands on Morris and Stage Islands, and their close proximity to the high density development of mainland Chatham, detract from the natural characteristics and fail to satisfy the naturalness criteria for wilderness for this northernmost portion of Monomoy NWR.

Elsewhere, extant buildings and the remains of other structures such as concrete building foundations, water cisterns, and utility poles are signs of past human occupation and still serve as reminders that neither the Powder Hole nor the Inward Point non-wilderness areas have yet attained a primeval, undeveloped and natural condition.

Both the Inward Point and Powder Hole non-wilderness areas exhibit subtle but steadily diminishing evidence of the imprint of man and past habitation, since removal of the buildings on them. The overall impression is one of trending toward naturalness that may in time meet the criteria for naturalness. When on South Monomoy Island, one cannot visually tell when entering or leaving the Monomoy Wilderness surrounding the Inward Point non-wilderness area. When in the Powder Hole non-wilderness area, the historic Monomoy Point Light Station stands out as a clearly unnatural landscape feature, and other remains of past human occupation and motor vehicle use are commonly encountered. Stabilization and historic restoration of the light station buildings began in 2010, with exterior renovations substantially completed in 2012. These renovations were conducted because of the National Register status of the structures. Similar periodic in situ maintenance of the historic light station structures may require future periodic mechanized or motorized transport and equipment use and access to the worksite through the Monomoy Wilderness.

Evaluation of Outstanding Opportunities for Solitude or Primitive Recreation

In addition to meeting the size and naturalness criteria to qualify as a WSA, an area must provide outstanding opportunities for solitude or primitive recreation (610 FW 4.10). The area does not have to possess outstanding opportunities for both solitude and primitive recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be continuously open to public use and access to qualify under these criteria. Congress has designated a number of Refuge System wilderness areas that are closed to public access to protect ecological resource values.

Opportunity for solitude refers to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means nonmotorized, dispersed outdoor recreation activities that do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

These two opportunity "elements" are not explicitly defined by the Wilderness Act but in most cases can be expected to occur together. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

Discussion

The Morris Island/Stage Island area provides very limited opportunities to experience solitude or participate in primitive recreation. The Stage Island lot is closed to the public—it is a small lot surrounded by residential dwellings. The Morris Island parcel includes a public parking area, staff parking, a dormitory and maintenance shop, restrooms, and the refuge headquarters and visitor contact station. It is accessible by motor vehicles and receives over 30,000 visitors annually primarily from April to October. The Morris Island Interpretive Trail encompasses much of this parcel. It brings visitors to the beach, which can be heavily used by sunbathers, anglers, and dog walkers. Opportunity for solitude is largely confined to the colder months (November to March) when tourism is lower, but is still significant.

The Inward Point and the Powder Hole non-wilderness areas on South Monomoy are accessible only by boat. Although substantial motorized boating traffic is evident seasonally in the waters surrounding South Monomoy Island, boat traffic decreases progressing southward with increasing distance from mainland ports. The widening of the South Monomoy landmass around Monomoy Point along with the increased distance from mainland development and boating concentrations contribute to a greater opportunity for solitude and primitive recreation for wilderness users of interior reaches near South Monomoy's southern tip. The Monomoy light station, located within the Powder Hole area, does attract visitors, including occasional organized tours. There is a designated boat landing site at or near the northwestern edge of this non-wilderness area. Anglers and shell fishermen can be found in the intertidal areas of the Inward Point non-wilderness area. The part of South Beach which is now part of South Monomoy Island is a popular beach for town residents and visitors, especially in July and August.

Primitive recreation activity is currently confined to daylight hours (½ hour before sunrise to ½ hour after sunset), and is expected to remain so to protect disturbance-sensitive wildlife species. No overnight camping is allowed anywhere on the refuge. The only overnight activity permitted is saltwater angling from shore on the Morris Island portion of Monomoy NWR. There may be some seasonal closures to protect wildlife in the Inward Point and Powder Hole non-wilderness areas, but most of the refuge is open year round to visitors.

Conclusion

The Morris and Stage Island inventory unit does not provide meaningful or consistent opportunities for solitude or primitive recreation. Overall, both the Inward Point and (especially) Powder Hole non-wilderness areas meet the solitude and primitive and unconfined recreation criteria for wilderness. Both inventory units offer potential for outstanding opportunities for solitude or primitive forms of outdoor recreation.

Supplemental Values

The Wilderness Act defines supplemental values as "ecological, geological, or other features of scientific, educational, scenic, or historic value."

Discussion

Monomoy NWR is a vital and unique habitat for migratory birds along the Atlantic flyway and provides a diversity of habitat for passerines, raptors, waterfowl, and seabirds. Three federally listed endangered and threatened species (piping plover, roseate tern, and northeastern beach tiger beetle), plus one candidate species (red knot) are found on the refuge. Piping plovers are found in the Morris Island, Inward Point and Powder Hole non-wilderness areas; northeastern beach tiger beetles are also present in close proximity to the Inward Point inventory unit on its east side.

Monomoy NWR has been recognized as a Western Hemisphere Shorebird Reserve Network regional site and an Important Bird Area due to its importance to migratory shorebirds. The refuge also is a designated Marine Protected Area. Monomoy refuge's beaches provide valuable spawning habitat for horseshoe crabs, which can be found in the intertidal waters of all three inventory units. The refuge is the largest grey seal haulout site along the Atlantic seaboard, and seals can be commonly found hauled out on the east side of the Inward Point and Powder Hole inventory units. Much of the habitat in the three inventory units is maritime grassland with inclusions of maritime shrubland, which is considered rare in Massachusetts and is characterized by patches of dense shrubs with scattered more open areas of low growth or bare ground. The areas of maritime beach strand community and maritime dune community on the refuge are also considered rare in Massachusetts.

Scientific interest, such as research on coastal wildlife and fish, their habitats, and the geologic and hydrologic processes—especially in the face of global climate change and sea level rise—and potential offshore renewable energy development, is ongoing and expected to continue at Monomoy NWR in the foreseeable future.

Monomoy NWR is one of the few areas remaining where natural, dynamic, coastal barrier system geological processes still proceed largely unimpaired by man. Coastal engineering to retard erosion, such as rock armoring and beach nourishment, and dredging to maintain navigability of waterways, has already impacted Morris and Stage Islands.

Visitors are drawn to the Cape Cod region and Monomoy in particular for the scenic and historic values. Guided natural history tours with an educational focus by groups from Cape Cod Museum of Natural History, Massachusetts Audubon Society, university and school groups, and the Friends of Monomoy NWR have been, and are expected to remain, popular at Monomoy NWR.

Monomoy NWR also has significant cultural and historic supplemental values, including the Monomoy Point Light complex listed on the National Register of Historic Places.

Conclusion

All three inventory units provide supplemental wilderness values, with the Morris Island/Stage Island units providing less supplemental value than the Inward Point and Powder Hole inventory areas.

The Monomoy NWR (map E.1) was evaluated to determine suitability for designation, management, and preservation as wilderness (610 FW 4.13). Considerations in this evaluation included:

- Quality of wilderness values.
- Capability for management as wilderness (manageability) and minimum requirements/tool analysis.

This information provides a basis to compare the impacts of a range of management alternatives and determines the most appropriate management direction for each WSA.

Summary/Conclusion of Wilderness Inventory Phase

Table E.1 summarizes the quality of the three inventory units currently in a non-wilderness status for mandatory and supplemental wilderness characteristics. None of the three current non-wilderness portions of South Monomoy excluded from wilderness designation in 1970 yet meet the eligibility criteria for further detailed study as WSAs as defined by the Wilderness Act during the 15-year plan period.

The Morris Island/Stage Island inventory unit does not and is unlikely ever to meet the size criteria for wilderness. The residential land use and roads that surround or immediately adjoin refuge lands on Morris and Stage Islands and their close proximity to the high density development of mainland Chatham detract from the natural characteristics and fail to satisfy the naturalness criteria for wilderness for this northernmost portion of Monomoy NWR. The Morris and Stage Island inventory unit provides very limited opportunity to experience solitude or participate in primitive recreation due to accessibility by motor vehicles and proximity to concentrated human activity on the mainland shorelines, especially in light of the small acreage the Service manages.

Elsewhere, although the existing imprints of man are diminishing, evidence of past human occupation and use still exists, standing out as obvious detractors from the natural characteristics of the refuge. This especially pertains to the historic Monomoy Point Light complex structures located in the Powder Hole inventory unit. Remnants of old roadways and motor vehicles, building foundations or pilings, cisterns, and utility poles remain evident. On the whole, both the Inward Point and the Powder Hole inventory units do not yet appear to have been affected primarily by the forces of nature and do not yet meet the naturalness criteria for wilderness designation.

Table E.1. Wilderness Inventory Area Findings Summary for Monomoy NWR.

Refuge unit and acreage	(1) has at least 5,000 acres of land or is of sufficient size to make practicable its preservation and use in an unconfined condition, or is a roadless island;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude;	(3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(4) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	Parcel qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)
Morris and Stage Island	No	No	Seasonal only	No	Yes	No
Inward Point	Yes, the area is now a roadless island, although formerly roaded and accessible by motor vehicle.	No	Yes	Yes, for daytime recreation.	Yes, the diversity of waterbirds, shorebirds, rare maritime habitat, as well as barrier beach geology feature scientific, educational, scenic, and cultural and historic values.	No
Powder Hole	No. Evidence or former roads and motor vehicle use still apparent but diminishing.	No. Existing structures and access trails for the Monomoy Point. Lighthouse complex listed on the National Register of Historic Places.	Yes	Yes, for daytime recreation.	Yes, the diversity of waterbirds, shorebirds, rare maritime habitat, as well as barrier beach geology feature scientific, educational, scenic, and cultural and historic values.	No

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy National Wildlife Refuge
Morris Island
North Monomoy Island
South Beach
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Monomoy NWR Boundary
Easement
Fee
Wilderness Boundary
Maine
New Hampshire
Massachusetts
Map Location
Note: The refuge's eastern boundary extends to the mean low water line, which changes as a result of dynamic, coastal processes. The depiction here is an approximation based on this 2012 photography. The remainder of the refuge boundary is fixed. Other than in the exceptions, the Monomoy Wilderness extends to the mean low water line along its entire boundary.
1:70,000

Wilderness Study and CCP Alternatives for Monomoy NWR

Since the wilderness inventory phase determined that none of the three inventory units yet possess wilderness character sufficient for WSA designation, the wilderness study and recommendation phases of the Wilderness Review were not undertaken as part of this CCP cycle.

Another wilderness review in 15 years as part of the next planning cycle will reconsider WSA designation and the wilderness study and recommendation phases for the Inward Point and Powder Hole inventory units, but not the Morris Island/Stage Island inventory unit. All CCP alternatives must manage the existing Monomoy Wilderness to simultaneously secure both an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. We will also continue managing and the Inward Point and Powder Hole (currently non-wilderness) inventory units through the 15-year plan period to maintain their size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation, to the extent that it will not prevent us from fulfilling and carrying out refuge establishing purposes and the Refuge System mission, in accord with Service wilderness stewardship policy (610 FW). We may also conduct a wilderness review prior to the next planning cycle, should significant new information become available, ecological or other conditions change, or we identify a need to do so.

E.2 Wilderness Stewardship Plan Outline (See 610 FW 3, Exhibit 1)

I. **Introduction**

a. Wilderness establishment, including contents of pertinent laws, date(s) of establishment, boundary or other legal changes, pertinent committee report discussion, and special provisions.

b. Goals and objectives for the wilderness area and its relationship to the refuge's purposes and Refuge System mission and goals, including protection of the air-quality-related values of Class I wilderness areas.

II. **Description of the Wilderness Area**

a. Legal and narrative description of the area.

b. Map displaying Service refuge boundary, wilderness area boundary, and other relevant legal, administrative, and natural boundaries.

c. A description of the baseline wilderness resource condition existing at the time of designation as well as current wilderness resource conditions, including a description of the wilderness area, natural conditions, cultural resources and values, stewardship activities, existing facilities, and public use levels and activities.

III. **Interagency and Tribal Coordination and Public Involvement.** Description of coordination with States, other Federal agencies, and tribes. Description of public involvement activities and a summary and analysis of comments received and how the plan responds to them.

IV. **Stewardship**

a. Description of stewardship strategies (administrative, natural and cultural resources, public recreation, interpretation and education, and commercial services) required to adequately administer the area.

b. Minimum requirement analyses and documentation of NEPA compliance for all refuge management activities and commercial services necessary to administer the area.

c. Descriptions of how we will manage existing private rights, existing rights-of-way, activities associated with valid mineral rights, and congressionally authorized uses to protect wilderness values.

d. An explanation of how we will coordinate with adjoining wilderness units so that the wilderness character and natural and cultural resources and values are managed in a complementary manner that minimizes impediments to visitors traveling from one wilderness area to another.

V. **Research.** Description of any past and current research and identification of research needs. Includes necessary appropriateness and compatibility determinations, minimum requirements analysis, and relevant partnership, funding, and staffing requirements.

VI. **Funds and Personnel.** A discussion of staff and funds needed to administer the wilderness.

VII. **Monitoring.** To determine if we are meeting our wilderness stewardship objectives and other refuge management objectives in wilderness, identify: monitoring requirements; associated protocols; partnership, funding, and staffing needs; indicators of change in resource conditions; standards for measuring that change; and desired conditions or thresholds that will trigger management actions to reduce or prevent impacts on the wilderness.

VIII. **Implementation Schedule.** A schedule of implementation, prioritization of action items, staff assignments, and funding requirements to adequately administer the area.

IX. **Appropriateness and Compatibility Determination**

X. **Review and Approval**

XI. **Appendix**

a. A copy of the legislation establishing, modifying the boundary of, or making other changes to the wilderness.

b. Wilderness study report for the wilderness.

c. NEPA documentation

d. Public hearing record from the wilderness study and record of review of comments received from States, other Federal agencies, tribes, and the public.

e. Congressional hearing record.

f. Congressional committee report accompanying the authorizing legislation.

E.3 Minimum Requirements Analyses Alternatives Matrix

The matrix that follows identifies management activities, by CCP alternative, that may be expected to take place within the Monomoy Wilderness (with any recommended additions) based upon the strategies and monitoring elements listed in chapter 3. Management activity-alternative combinations marked with a "Y" in the matrix are those that minimum requirements analyses must address prior to, or during, development of the Wilderness Stewardship Plan.

Management Activity within Monomoy Wilderness	Alternative A	Alternative B	Alternative C
Temporary Field Camp	**Y**	**Y**	**N**
Boating/Paddling Landing/Anchoring Watercraft	**Y**	**Y**	**Y**
Artificial Wildlife Structures			
• Nest platforms	**Y**	**Y**	**N**
• Dredge material disposal/dredging/beach renourishment	**Y**	**Y**	**N**
• Decoys/broadcast ROST calls	**Y**	**Y**	**Y**
• Artificial eggs/incubation	**Y**	**Y**	**Y**
Wildlife/Resource Inventory & Monitoring			
• Nest census survey	**Y**	**Y**	**Y**
• Nest productivity	**Y**	**Y**	**N**
• Camera traps/motion sensors	**Y**	**Y**	**Y**
• Blinds	**Y**	**Y**	**N**
• Seals	**Y**	**Y**	**N**
• Shorebird banding – cannon nets	**Y**	**Y**	**Y**
• Horseshoe crab spawning survey and tagging	**N**	**N**	**N**
• Sharks	**N**	**N**	**N**
Predator Management			
• Lethal predator control	**Y**	**Y**	**Y**
• Blinds	**Y**	**Y**	**N**
• Predator exclosures at nests	**Y**	**Y**	**Y**
• Electric fence	**Y**	**Y**	**N**
• Chick shelters	**Y**	**Y**	**N**
• Blinds	**Y**	**Y**	**N**
• Camera traps/motion sensors	**Y**	**Y**	**Y**
Vegetation/Habitat Management			
• Tern colony – prescribed burn	**Y**	**Y**	**Y**
• Invasive (non-native) plants	**Y**	**Y**	**Y**
Signage/Navigational Aids			
• Area seasonal closures – symbolic fencing	**Y**	**Y**	**Y**
• Boat landings/wilderness entry points	**Y**	**Y**	**Y**
• Maritime navigational aids	**N**	**N**	**N**
• Wilderness boundary marking	**Y**	**Y**	**Y**
Cultural/Historic Resource Protection			
• Shipwrecks	**Y**	**Y**	**Y**
• Historic light station access for preservation or mitigation	**Y**	**Y**	**Y**
Coastal Change/SLR Monitoring	**Y**	**Y**	**Y**

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE

WORKSHEETS

Piping Plover Management in Monomoy Wilderness

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– the Wilderness Act, 1964

Step 1: Determine if any administrative action is necessary.

Description: Briefly describe the situation that may prompt action.

In 2011, 41 piping plover pairs (threatened) nested on South Monomoy within the refuge boundary, and 85 percent of those nested within the Monomoy Wilderness. Several different management actions are required to enhance plover productivity within the Monomoy Wilderness. Through seasonal closures and predator management actions, Monomoy NWR seeks to maintain at least 1.24 chicks fledged per pair annually, and a mean of at least 1.5 chicks fledged per pair over a 5-year period, consistent with Piping Plover Recovery Plan criteria. Monomoy NWR strives to support 10 percent of the State's annual nesting population, averaged over a 5-year period. Predation (both avian and mammalian) is an important factor limiting piping plover nest productivity. Gulls are opportunistic plover nest and chick predators, and thrived during the 1960s to 1990s coincidental with rapid human development and the unlimited food supply humans represented. Gulls reached and remained at unnaturally high regional population levels. In the early 1970s, the (larger) eastern coyote immigrated to Cape Cod and the Monomoy area, adapting readily to human-induced landscape changes and exploiting a void created when other large mammalian predators were extirpated. Piping plovers in the region have not yet fully developed effective defenses against this once foreign but now resident predator. Coyotes are able to negotiate the mainland to South Monomoy for nightly round trips via the 2006 land bridge. Piping plovers (threatened) require protection under the Endangered Species Act. All high quality piping plover nesting and nearby foraging habitat on Monomoy National Wildlife Refuge is protected from disturbance and degradation.

To determine if administrative action is necessary, answer the questions listed in A–F on the following pages.

A. Describe Options Outside of Wilderness

Is action necessary within wilderness?

Yes: ☒ **No:** ☐

Explain:
On Monomoy NWR, 85 percent of piping plover pairs nests within the Monomoy Wilderness. Piping plover recovery will not be achieved without seasonal closures, population monitoring, and predator management within the Monomoy Wilderness, given that such a large proportion of plover nesting occurs within wilderness.

The U.S. Fish and Wildlife Service is responsible for protecting and assisting in the recovery of federally listed threatened and endangered species, such as the piping plover, under the ESA. The Service is charged with the responsibility for managing (threatened) piping plovers in accordance with the species recovery plan, including those that nest within or adjacent to the Monomoy Wilderness.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? Cite law and section.

Yes: ☐ **No:** ☒ **Not Applicable:** ☐

Explain:
No special provisions are included in P.L 91-504, the 1970 Wilderness Act, establishing the Monomoy Wilderness and there are no remaining valid existing rights.

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
The refuge was established in 1944 pursuant to the Migratory Bird Conservation Act (16 U.S.C. § 715d) through a Declaration of Taking (United States vs. Commonwealth of Massachusetts, and Susie H. Kosak et al, Miscellaneous Civil No. 6340, District Court of Massachusetts) "… for use as an inviolate sanctuary, or for other management purpose, for migratory birds" and "…for the protection during the nesting season or while on their way to and from their breeding grounds…" with an emphasis on threatened, endangered, and migratory birds.

The Endangered Species Act of 1973 (16 U.S.C 1531-1544), as amended directs the Department of the Interior to identify those species of plants and animals listed as threatened, endangered, or candidates, and develop and implement plans and programs to ensure their continued survival into the future.

The piping plover is a migratory bird listed as threatened under the ESA. Piping plover *(Charadrius melodus)* nest productively and in high density along the South Monomoy beaches. Human disturbance during the critical nesting and brood rearing season can easily result in "take" under ESA provisions.

The National Wildlife Refuge System Improvement Act of 1966, as amended by the Wildlife Refuge System Improvement Act of 1997 (16 U.S.C 668dd-ee) directs the U.S. Fish and Wildlife Service "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future

generations of Americans." The Monomoy Wilderness lies entirely within the Monomoy National Wildlife Refuge, a unit of the National Wildlife Refuge System.

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other Federal agencies?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
The primary objective of the Atlantic Coast Piping Plover Recovery Plan (USFWS 1996) is to remove the piping plover (*Charadrius melodus*) population from the List of Endangered and Threatened Wildlife and Plants by (1) achieving well-distributed increases in numbers and productivity of breeding pairs, and (2) providing for long-term protection of breeding and wintering plovers and their habitat. The recovery plan strategies provide for the long-term viability of piping plover populations in the wild. The beach and dune edges provide vital breeding habitat for the piping plover, which nest in the beach berm and associated dune edge and washover areas, and forage on nearby intertidal flats. Monomoy NWR, including the Monomoy Wilderness, supports more than 40 nesting pairs of piping plovers.

Policy on Maintaining Biological Integrity, Diversity and Environmental Health (601 FW 3)—This policy provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and restore lost or severely degraded environmental components. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem. In recognition of Monomoy NWR's role as an avian diversity reservoir, the refuge was designated as a Western Hemisphere Shorebird Reserve Network (Regional) site under the auspices of the WHSRN Hemispheric Council, and an Important Bird Area (IBA) by the Audubon Society. The wetland complex and the non-wilderness beach berm, dune edges and washover areas extending northward from the Powder Hole into the Monomoy Wilderness contribute much toward local and regional biotic integrity, diversity, and environmental health.

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including: untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Undeveloped: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Natural: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Habitat and population management is necessary to maintain native species ecologically adapted to Monomoy NWR, including the Monomoy Wilderness, thus preserving and improving the naturalness of the Monomoy Wilderness.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Preserving and enhancing nesting piping plovers preserves outstanding opportunities to observe and photograph this native species in its natural habitat.

Other unique components that reflect the character of this wilderness:

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Piping plovers contribute to the biotic diversity and integrity of the Monomoy Wilderness and to the unique scientific and ecological values of the area.

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:
Action is not necessary to support the recreation public purpose because recreational opportunities will remain as they are.

Scenic: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scientific: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
As one of the few existing, relatively undisturbed, nesting piping plover populations, the Monomoy piping plovers provide an important scientific benchmark; further study of the Monomoy population could add to the scientific piping plover knowledge base. Improved scientific understanding about piping plovers and their management can improve nest productivity and rangewide population recovery.

Education: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Conservation: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
This action helps conserve a federally threatened species. Piping plover population management performed within the Monomoy Wilderness adds to the population, thereby improving prospects for species recovery and long-term population persistence.

Historical use: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Step 1 Decision: **Is any administrative action necessary in wilderness?**

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Actions providing nesting habitat, minimizing predation and human disturbance, and conducting monitoring to protect and restore piping plover on Monomoy NWR, including the Monomoy Wilderness, are necessary to achieve the migratory bird conservation purpose for which Monomoy Refuge was established in 1944; to satisfy requirements of other legislation, agency policy, and guidance; to preserve wilderness character; and to achieve the other public purposes for wilderness.

Action is necessary within the Monomoy Wilderness "…for the protection during the nesting season or while on their way to and from their breeding grounds…" of the migratory piping plover. Typically, 85 percent of Monomoy's piping plovers nest within the Monomoy Wilderness. The piping plover is also listed as threatened under the Endangered Species Act of 1973 (16 U.S.C 1531-1544). Piping plover recovery as defined in the Atlantic Coast Piping Plover Recovery Plan will not be achieved without seasonal closures, population monitoring, and predator management within the Monomoy Wilderness, given that such a large proportion of plover nesting occurs within wilderness. Piping plover (Charadrius melodus) nest productively and in high density along the South Monomoy beaches. Human disturbance during the critical nesting and brood rearing season can easily result in violating Endangered Species Act "take" provisions. Action is necessary within the Monomoy Wilderness to fulfill the National Wildlife Refuge System Improvement Act of 1966, as amended by the Wildlife Refuge System Improvement Act of 1997 (16 U.S.C 668dd-ee), directing the U.S. Fish and Wildlife Service "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Action is also necessary within the Monomoy Wilderness to fulfill Service Policy on Maintaining Biological Integrity, Diversity and Environmental Health (601 FW 3), including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems.

Action is necessary to preserve naturalness and outstanding opportunities for unconfined wildlife observation and photography within the Monomoy Wilderness by conserving piping plovers in their natural habitat. As one of the few relatively undisturbed nesting piping plover populations, the Monomoy piping plovers provide an important scientific benchmark, and further study of the Monomoy population could add to the scientific piping plover knowledge base. Improved scientific understanding about piping plovers and their management can improve nest productivity and prospects for regional and rangewide population recovery.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity.

Please refer to the accompanying Minimum Requirements Decision Guide *Instructions* **for an explanation of the effects criteria displayed below.**

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # A – Full Motor Access Option

Description:

Use motorized vehicles to access all areas of the island; install wire exclosures to protect nests; install symbolic fencing to minimize human disturbance to nesting.

Under this alternative, refuge staff travels to South Monomoy boat landings by motorboat daily from early April to Mid-August for daylight-hour fieldwork. Supplies and personnel are transported by motorboat to and from the island twice a week (weather permitting) to boat landings along or within the wilderness boundary. Prior to the nesting season, an all-terrain vehicle (ATV) is used to transport gear, supplies, and equipment through wilderness to a seasonal field base at the Monomoy Point light keeper's house, located outside wilderness. Staff also use the ATV within the Monomoy Wilderness to transport and install symbolic fencing to discourage people from entering potential nesting areas. ATV use remains within the intertidal zone (between the mean high and low tide lines) whenever possible, and fencing and predator exclosure supplies are transported on foot from the ATV in the intertidal zone to installation areas at and above the mean high tide line. During the nesting season, one staff member rides an ATV patrolling the entire length of the South Monomoy beach from the intertidal zone whenever possible, searching for plover nests and broods. The ATV patrol will monitor the nest status through mid-August. An assessment is made as to whether each nest found needs an exclosure against predators. It is expected that any nest requiring an exclosure will be fitted with one following existing plover nest exclosure protocols (typically 5 to 10 nests annually based on habitat). Staff (3 to 5) will carry the exclosure materials from the ATV to the nest location. At the end of the season, staff will remove all materials and equipment (including symbolic fencing and exclosure materials) from wilderness locations with transport by ATV and/or motorboat for storage in non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- Exclosing nests to prevent predators from preying on nests constrains the wildness of the Monomoy Wilderness predator-prey processes, and represents a trammeling.

"Undeveloped"
No Benefits
Adverse Effects

- Using motorized equipment such as ATVs and motorboats in wilderness may be perceived by some wilderness users as intruding on the primeval character of the Monomoy Wilderness. Of the options considered, this option includes the most frequent and longest duration use of motorized transport within the Monomoy Wilderness.

- Installing temporary symbolic fencing and exclosures will have a negative effect on the undeveloped quality of the wilderness identical to the other options considered.

"Natural"
Benefits

- Naturalness will improve by protecting and conserving a threatened wildlife species that is a part of the natural character of the wilderness.

Adverse Effects

- The active management to increase piping plover populations and protect their nests from predators will have a negative effect on the natural quality of the wilderness.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- Area closures and enforcement and nest predator exclosures would be visible and confine Monomoy Wilderness visitors during the piping plover breeding season to areas without plover nests. Refuge personnel, ATVs, and motorboats would be visually and audibly evident and may be perceived as intruding on solitude by some Monomoy Wilderness users more so than for the other options considered.

Other unique components that reflect the character of this wilderness—"ecological, geological, or other features of scientific, educational, scenic, or historic value."
Benefits

- The beach/dune nesting piping plover population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

No Adverse Effects

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits
Adverse Effects

- Use of motorized and/or mechanized transport (ATVs, motorboats, and/or wheeled carts) in the Monomoy Wilderness reduces the contrast between wilderness and non-wilderness and, of the options considered, least perpetuates the use of primitive/traditional skills.

Special Provisions

N/A

Special Provisions

N/A

Economic and Time Constraints

Benefits

- All plover nests can be checked daily by one observer using an ATV, providing higher quality and consistent nest/brood survival and loss data. This is preferable to the 2 to 4 monitors required to accomplish the same level of monitoring entirely on foot.

Adverse Effects

- Costs of ATV purchase and boat and ATV equipment operation and maintenance, personnel training, and personal protective equipment.

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

Benefits

- Locating injured/ill victims needing medical evacuation is easier if an ATV is an available tool. Medical emergency evacuations (allowed per Section 4(c) of the Wilderness Act) are potentially much faster with an ATV and motorboat available than emergency responders traveling overland on foot.

- Personnel riding ATVs are more mobile and therefore exposed and vulnerable to the weather and environmental hazards for shorter durations.

- To the greatest extent of the options considered, transporting all heavier or bulky supplies, equipment, and other gear over longer distances on an ATV or using a nonmotorized mechanized transport reduces physical exertion and risk for dehydration, heart attack, heat-related illnesses, or hypothermia for employees.

Adverse Effects

- Risks involved with ATV use can be partially mitigated by training, maintenance, and use of personal protective equipment (PPE), but the potential for personnel injury is increased.

Alternative # B – Partial Motor Option

Description:

Use motor boats to drop off and pick up personnel from camp; use nonmotorized mechanized transport (wheeled cart) if loads exceed 80lbs and/or exceed three trips per person on foot; install wire exclosures to protect nests; install symbolic fencing to decrease human disturbance.

Under this alternative, refuge staff travel to South Monomoy boat landings by motorboat daily from early April to Mid-August for daylight-hour fieldwork. Prior to the nesting season all gear, supplies, and equipment for the seasonal field base at the Monomoy Point light keeper's house (non-wilderness) are dropped off at a boat landing along the wilderness boundary by motorboat and then transported on foot through wilderness to the light keeper's house; If loads exceed 80 lbs per person and/or three trips each, a nonmotorized wheeled cart may be used for transport. For all plover work, supplies and personnel are transported to and from the island twice weekly (weather permitting) by motorboat to boat landings along or in the Monomoy Wilderness boundary. Staff (2 to 10) then carry, position, and set up symbolic fencing to discourage people from entering potential plover nesting areas. During the nesting season, 2 to 4 biological staff on foot will search the entire length of the South Monomoy beach to monitor nests and broods. An assessment is made as to whether each nest found needs an exclosure against predators. It is expected that any nest requiring an exclosure will be fitted with one following existing exclosure protocols (typically 5 to 10 nests annually). Staff (3 to 5), will carry nest exclosure materials to the installation site. At season's end, staff will remove all gear, materials, and equipment (including symbolic fencing and exclosures) from the Monomoy Wilderness on foot to wilderness boundary boat landings, and transport it via motorboat for overwinter storage in non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- Exclosing nests to prevent predators from preying on nests constrains the wildness of the Monomoy Wilderness predator-prey processes, representing a trammeling to the same extent as other options considered.

"Undeveloped"

No Benefits

Adverse Effects

- Using motorized and mechanized transport in the Monomoy Wilderness will intrude on the primeval character perceived by some wilderness users but to a lesser extent than alternative A, the Full Motor access option.

- Installing temporary symbolic fencing and predator exclosures will have a negative effect on the undeveloped quality of the Monomoy Wilderness from April to August each year to the same extent as other options considered.

"Natural"
Benefits

- Protecting and conserving an endemic, threatened, wildlife species population in its natural habitat helps restore a component of the natural character of the Monomoy Wilderness.

Adverse effects.

- Artificially exclosing predators from nests is intended to disrupt the natural predator-prey process during nesting season on Monomoy NWR, including the Monomoy Wilderness, in order to increase piping plover nest productivity and adult survival.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- Area closures and enforcement and nest predator exclosures present and visible during the piping plover breeding season confine the Monomoy Wilderness users' (primitive) recreation experience to areas devoid of plover nests to the same degree as other alternatives considered. Refuge personnel and motorboats will still be visually and audibly evident even without direct contact, and may be perceived as intruding on solitude by some Monomoy Wilderness users to a somewhat lesser extent than the Full Motor access option.

"Other unique components that reflect the character of this wilderness—ecological, geological, or other features of scientific, educational, scenic, or historic value."
Benefits

- The beach/dune nesting piping plover population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

No Adverse Effects

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits
No Adverse Effects

- Use of motorized and nonmotorized mechanized transport in wilderness does not enhance/accentuate the contrast between wilderness and non–wilderness backcountry or perpetuate the use of primitive/traditional skills to the extent that the non-motor alternative does.

Special Provisions

N/A

Economic and Time Constraints

Benefits

Adverse Effects

- Cost of boat operation and maintenance, personnel training, and personal protective equipment.
- More staff time is spent transporting/carrying supplies and materials on foot through wilderness to field base or installation locations and backhauling at the end of each nesting season than under the Full Motor access alternative.

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

Benefits

- Medical emergency evacuations (allowed per Section 4(c) of the Wilderness Act) are potentially much faster when a motorboat is available than emergency responders traveling overland exclusively on foot.
- Transporting heavier or bulky supplies, equipment, and other gear over longer distances using nonmotorized mechanized transport somewhat reduces physical exertion and refuge employee risk of dehydration, heart attack, heat-related illnesses, or hypothermia.

Adverse Effects

- People on foot are much less mobile and are therefore exposed and vulnerable to the weather and environmental hazards for longer durations.
- Carrying all but the heavier supplies, equipment, or other gear increases physical exertion and risk for dehydration, heart attack, heat related illnesses, or hypothermia. The higher level of physical fitness thus required can be only partially mitigated by training, personnel selection, and providing personal protective equipment and Go/No-Go criteria.

Alternative # C – No Motor Option

Description:

Use no motorized transport; nonmotorized mechanized transport (wheeled cart) will be used if loads exceed 80lbs and/or exceed three trips per person on foot; install wire exclosures to protect nests; install symbolic fencing to decrease human disturbance.

Under this alternative, refuge staff travel to South Monomoy by paddling (kayak) or by hiking along South Beach from the mainland (weather permitting) from early April to Mid-August for daylight-hour fieldwork. On reaching South Monomoy, refuge staff hike through the Monomoy Wilderness to reach a seasonal field base at the Monomoy Point light keeper's house (non-wilderness). Personnel return in the same manner at the end of their field base assignments (10-days on/4-days off schedule). Prior to the plover nesting season, symbolic fencing and nest predator exclosures are dropped off via motorboat over a one- to two-day period at boat landings along or within the Monomoy Wilderness boundary, and then transported on foot through wilderness to deployment

locations within wilderness. If loads exceed 80lbs per person and/or three trips each, a nonmotorized wheeled cart may be used for transport. All field base supplies are stored at the light keeper's house (nonwilderness) during the off-season. Motorboat operation will be timed to coincide with low tide in order to keep motorized equipment from entering wilderness and will be used only for potable water and necessary personnel health/safety supplies. Staff (2 to 10) will carry, position, and install symbolic fencing to discourage people from entering potential plover nesting areas. During the nesting season, 3 to 4 biological staff concurrently search the entire length of the South Monomoy beach on foot, performing nest monitoring duties through mid-August. Personnel carry binoculars, data sheets, and other gear (e.g., water, insect repellant, etc.). An assessment is made as to whether each nest found needs an exclosure against predators. It is expected that any nest requiring an exclosure will be fitted with one following existing exclosure protocols (typically 5 to 10 nests annually based on habitat). Staff (3 to 5), will carry and install the nest exclosure materials to the installation sites. A supply of exclosure material is kept at field base (nonwilderness). At the end of the season, staff will remove all symbolic fencing and exclosure materials from wilderness locations, backhauling them on foot or using a nonmotorized cart to the field base, or to the wilderness boundary boat landings for pick-up by motor boat and transport to overwinter storage in non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- Exclosing nests to prevent predators from preying on nests constrains the wildness of the Monomoy Wilderness predator-prey processes, representing a trammeling.

"Undeveloped"

Benefits

- This alternative uses no motorized equipment in wilderness and, of the alternatives considered, best retains the primeval character of the Monomoy Wilderness.

Adverse Effects

- Using even limited mechanized transport in the Monomoy Wilderness will intrude on the primeval character perceived by some wilderness users; this option is similar in impact to alternative B, the Partial Motor option.

- Installing temporary symbolic fencing and predator exclosures will have a negative effect on the undeveloped quality of the Monomoy Wilderness from April-August each year as in the other options considered.

Natural"

Benefits

- Protecting and conserving an endemic, threatened, wildlife species population in its natural habitat helps restore a component of the natural character of the Monomoy Wilderness.

Adverse Effects

- Artificially exclosing predators from nests is intended to disrupt the natural predator-prey process during nesting season on Monomoy NWR, including the Monomoy Wilderness, in order to increase piping plover nest productivity and adult survival to the same extent as the other options considered.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- Area closures and enforcement and nest predator exclosures present and visible during the piping plover breeding season confine Monomoy Wilderness users' (primitive) recreation experience to areas devoid of plover nests. With larger numbers of refuge personnel required concurrently for plover monitoring, their kayaks or motorboats would be more visually and audibly evident even without direct contact, and may be perceived as intruding on solitude by some Monomoy Wilderness users more than the other options considered.

Other unique components that reflect the character of this wilderness—ecological, geological, or other features of scientific, educational, scenic, or historic value."
Benefits

- The beach/dune nesting piping plover population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

No Adverse Effects

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

Benefits

- Minimizing non–motorized transport in the Monomoy Wilderness enhances and accentuates the contrast between wilderness and non–wilderness, and perpetuates the use of primitive traditional skills to a greater extent than the other options considered.

No Adverse Effects

- Even limited nonmotorized mechanical transport (wheeled cars) use within the Monomoy Wilderness somewhat reduces the contrast between wilderness and non-wilderness and reduces use of primitive traditional skills, but to a lesser degree than the other options considered.

Special Provisions

N/A

Economic and Time Constraints

No Benefits
Adverse Effects

- Cost to train personnel on kayak use.
- Cost to hire/acquire more staff.
- Cost to obtain more kayaks and safety equipment and otherwise equip refuge personal to safely and adequately perform their job duties.
- Substantially increased numbers of plover monitoring and management staff positions and time required to travel by kayak to and from field assignments. Fewer field days with weather and sea conditions suitable for kayaking across open water available.

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

No Benefits

- Transporting limited supplies, equipment, and other gear over longer distances using nonmotorized mechanized transport slightly reduces physical exertion and risk for dehydration, heart attack, heat-related illnesses, or hypothermia than the options considered, due to greater use of human-powered watercraft.

Adverse Effects

- People on foot or paddling are much less mobile and therefore exposed and vulnerable to the weather, adverse sea and tidal current conditions, and environmental hazards for longer durations.
- Carrying all but the heavier supplies, equipment, or other gear increases physical exertion and risk for dehydration, heart attack, heat-related illnesses, or hypothermia. The higher level of physical fitness thus required can only be partially mitigated by training, personnel selection, and providing personal protective equipment and Go/No-Go criteria.
- Risks of kayak use include exposure, capsizing, and drowing and can only be partially mitigated by training, communications, and personal protective equipment.
- Greatest reliance on maritime aerial medical evacuation is required. This is an already scarce emergency service resource (allowed under Section 4(c) of the Wilderness Act) in the area that is not always available when needed.

Alternative # D – No Action

The piping plover is a migratory, threatened species, and its protection and recovery is mandated under the Endangered Species Act. The migratory bird purpose for which Monomoy National Wildlife Refuge was established cannot be achieved under a No Action alternative. Therefore, the No Action alternative was not analyzed further.

Comparison of Alternatives

It may be useful to compare each alternative's positive and negative effects to each of the criteria in tabular form, keeping in mind the law's mandate to "preserve wilderness character."

	Alternative A	Alternative B	Alternative C
Untrammeled	-	-	-
Undeveloped	- - - -	- - -	- -
Natural	+/-	+/-	+/-
Solitude or primitive recreation	- -	-	- -
Unique components	+	+	+
WILDERNESS CHARACTER	++/--------	++/------	++/------

	Alternative A	Alternative B	Alternative C
Heritage & Cultural Resources	NA	NA	NA
Maintaining Traditional Skills	---	+/--	++/-
Special Provisions	NA	NA	NA
Economics & Time	++/-	--	- - -
Additional Wilderness Criteria	NA	NA	NA
OTHER CRITERIA SUMMARY	++/----	+/----	++/----

	Alternative A	Alternative B	Alternative C
SAFETY	++/-	+/-	+/---

	Alternative A	Alternative B	Alternative C
OVERALL	6+'s / 12 –'s	4 +'s/ 11 –'s	5 +'s / 13 –'s

Safety Criterion
Significant personnel safety concerns associated with kayak use in open waters intermixed with motorized boat traffic in the same waters surrounding the Monomoy Wilderness in alternative C's open-water kayak use can only partially be mitigated by training and provision of PPE. The unmitigated personnel safety concerns for alternative C override impacts to wilderness character or other criteria for alternative C. Job hazard analyses for watercraft operation and for working in remote areas summarize the hazards and mitigations that are common to all alternatives analyzed.

Documentation:

Step 2 Decision: **What is the Minimum Activity?**

Selected Alternative: Alternative B—Partial Motor Option

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):
The Partial Motor option adequately protects and conserves the piping plover while safely minimizing the negative impacts to the wilderness character of the Monomoy Wilderness. It does so by limiting the use of motor vehicles and nonmotorized mechanized transport to support restricted staff time used efficiently to monitor disturbance-sensitive piping plovers. The Partial Motor option best protects wilderness character and meets the requirements of the Endangered Species Act, as well as best satisfies the other comparison criteria.

The Full Motor option has the most negative impact on wilderness character from motorized vehicle (boats and ATV) and nonmechanized transport. The Partial Motor option has slightly greater negative impact than the No Motor option on the undeveloped character of the Monomoy Wilderness with greater motorboat use. Fewer human contacts are likely for wilderness users with the smaller plover monitoring workforce presence under the Partial Motor option than the No Motor option; the Partial Motor option therefore has less adverse impact on solitude. The Partial Motor option provides a greater level of safety hazard mitigation for refuge personnel engaged in piping plover monitoring and management by minimizing hazard exposure during open-water kayak transport to/from assigned work locations that is presented in the No Motor option.

Monitoring and reporting requirements:
Monitoring and reporting of the operations associated with the nesting and protection project will continue on a yearly basis. This information will be maintained in the Monomoy NWR headquarters and will be available for review by anyone interested.

The refuge manager for Monomoy NWR will document that a review and re-validation of this programmatic minimum requirements analysis has been completed prior to April 1 each year. If at any point the refuge manager determines this analysis is no longer valid, or within 10 years (whichever comes first), a new minimum requirements analysis will be prepared and approved.

Check any Wilderness Act Section 4(c) uses approved in this alternative:

- [x] mechanical transport
- [ ] motorized equipment
- [ ] motor vehicles
- [x] motorboats
- [ ] landing of aircraft
- [ ] temporary road
- [x] structure or installation

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

Approvals	Signature	Name	Position	Date
Prepared by:				
Recommended:				
Recommended:				
Approved:				

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE

WORKSHEETS

Monomoy Refuge Banding Station

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– the Wilderness Act, 1964

Step 1: Determine if it is necessary to take any action.

Description: Briefly describe the situation that may prompt action.

In support of the refuge's mission to conserve and protect migratory birds, the refuge is interested in studying how passerines utilize Monomoy NWR during fall migration.

The purpose of this study is to collect data on the use of the refuge as a stopover site for landbirds and to better manage the wildlife refuge for the benefit of those birds, in addition to seabirds and shorebirds that rely on the habitat. We are proposing to set up a banding station through partner cooperation at a site located on the refuge for the next few years to gather more data that will enable us to:

1. Determine species richness and composition of migrants traveling through the Monomoy NWR to identify critical resources.
2. Analyze the relationship between landbird use versus marine-oriented species use on the refuge
3. Provide the basis for long-term trend analysis of bird populations in the area.

To determine if administrative action is necessary, answer the questions listed in A–F on the following pages.

A. Describe Options Outside of Wilderness

Is action necessary within wilderness?

Yes: ☒ **No:** ☐

Explain:
Obtainable habitat for land bird migrants using stopover sites is only available within our wilderness. The goal of this project is to sample birds on Monomoy NWR to better understand the species richness and composition within our unique landscape and locale. In order for us to successfully sample these species, work must be done in the Monomoy Wilderness.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? Cite law and section.

Yes: ☐ **No:** ☒ **Not Applicable:** ☐

Explain:
There are no existing valid rights or special provisions found in any wilderness legislation to sample land birds during migration on the refuge.

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
The refuge was established in 1944 pursuant to the Migratory Bird Conservation Act (16 U.S.C. § 715d) "… for use as an inviolate sanctuary, or for other management purpose, for migratory birds"; through a Declaration of Taking (United States vs. Commonwealth of Massachusetts, and Susie H. Kosak et al, Miscellaneous Civil No. 6340, District Court of Massachusetts) "…for the protection during the nesting season or while on their way to and from their breeding grounds…", with an emphasis on threatened, endangered and migratory birds. The National Wildlife Refuge System Improvement Act of 1966, as amended by the Wildlife Refuge System Improvement Act of 1997 (16 U.S.C 668dd-ee), directs the U.S. Fish and Wildlife Service "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
The preferred alternative of the Draft Monomoy NWR Comprehensive Conservation Plan states in Alternative B, Objective 1.6 that the refuge is tasked with protecting existing native maritime shrubland and evaluating use by migrating land birds of conservation concern. If patches of maritime shrubland are found to be regionally important, the refuge must maintain native species composition (including bayberry, beach plum, etc.) with less than 5 percent invasive plants. To accomplish these objectives, the refuge must engage in monitoring of land bird species using the area surrounding the Monomoy keeper's house during migration.

Policy on Maintaining Biological Integrity, Diversity and Environmental Health (601 FW 3) This policy provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and to restore lost or severely degraded environmental components. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem. In recognition of Monomoy NWR's role as a reservoir for avian diversity, the refuge was designated as a Western Hemisphere Shorebird Reserve Network (Regional) site under the auspices of the WHSRN Hemispheric Council, and as an Important Bird Area (IBA) by the Audubon Society.

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including: untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Undeveloped: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Natural: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Habitat and population management is necessary to maintain a native species ecologically adapted to Monomoy NWR, including the Monomoy Wilderness, thus preserving and improving the naturalness of the Monomoy Wilderness.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

Yes: ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Other unique components that reflect the character of this wilderness:

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Migrating landbirds contribute to the biotic diversity and integrity of the Monomoy Wilderness and also to the unique scientific and ecological values of the area

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scenic: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scientific: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
This project will add to the scientific base of knowledge on how migrant species are using the refuge and what management could be done to improve the habitat for these species.

Education: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Conservation: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Understanding migrant land bird use on the refuge could help to better conservation and management for these species.

Historical use: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Step 1 Decision: **Is any administrative action necessary in wilderness?**

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Yes. Action is necessary to gain a base of scientific knowledge of how migrants are using the interior portions of the refuge as a stopover site so that appropriate actions can be taken to protect them and uphold the refuge's purpose.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # A – Full Motor Option

Description:

Use motorized vehicles to access all areas of the island (motorboats and ATVs); set up a daily banding station and erect temporary mist-nets to capture migrants; use a non-wilderness site to house staff when necessary (referred to as the Full Motor option).

Under this alternative, staff of the Monomoy Refuge Banding Station will travel to the south tip of South Monomoy daily by motorboat to perform data collection activities. Mist nets will be set up in various locations around the entire south tip interior of South Monomoy to sample all possible birds using the area. To expedite data processing, mist nets will be visited using an ATV, which will enable the data collection to be undertaken over a wide area of the refuge. The nets will be opened for 6 hours a day beginning ½ hour before sunrise. The netting period will start August 15th and end November 15th as weather and transportation allow. Following mist-netting, staff will conduct an hour-long survey each day by ATV using a set census path to count birds. At the beginning and end of the sampling period, supplies will be delivered to the south end via motorboat and transported to the Monomoy light keeper's house through wilderness to the area where the banding station will be based. ATVs will not be used on the beach or in wetland areas to avoid degradation of habitat and, instead, will be kept in areas already used as footpaths. Mist nets will also be utilized on North Monomoy Island to census various sparrow species during one week in October. ATVs will not be used on North Monomoy, but access to the island will be by motorboat. Staff of the Monomoy Refuge Banding Station will not live at the site and will travel back and forth each day for the entire sampling period.

Effects:

Wilderness Character

"Untrammeled"
No Benefits
Adverse Effects

- The action to capture migrant bird species prevents them for a temporary amount of time from moving around the refuge in a natural way.

"Undeveloped"
No Benefits
Adverse Effects

- Using motorized equipment and mechanized transportation in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.
- The temporary installation of mist nets will have a negative effect on the undeveloped quality of the wilderness.

"Natural"
Benefits

- Naturalness may improve if this research leads to future habitat protection for critical migrant species, thereby helping to maintain a component of the natural character of the Monomoy Wilderness.

No Adverse Effects

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- The operation of an ATV within the wilderness will disrupt the opportunities for solitude in the wilderness.

Other unique components that reflect the character of this wilderness

- The land bird population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits
Adverse Effects

- Use of motorized equipment and mechanized transportation in wilderness does not enhance the contrast between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions
N/A

Economic and Time Constraints
No Benefits
Adverse Effects
- Cost of ATV operation and maintenance.

Additional Wilderness-specific Comparison Criteria
N/A

Safety of Visitors, Personnel, and Contractors

No Benefits
Adverse Effects
- Risks associated with ATV use can be mitigated by training.

Alternative # B – Partial Motor Option A

Description:

Use motorboats to drop off personnel and supplies to island weekly; set up a daily banding station and erect temporary mist-nets to capture migrants; provide shelter at the Monomoy light keeper's house (referred to as Partial Motor Option A).

Under this alternative, staff of the Monomoy Refuge Banding Station will travel to the south tip of South Monomoy by motorboat to perform data collection activities. At the beginning and end of the sampling period, supplies will be delivered to the south end via motorboat and transported by foot to the Monomoy light keeper's house through wilderness to the area where the banding station will be based. The netting period will start August 15th and end November 15th as weather and transportation allow. A maximum of two boat trips per week will be conducted, if needed. Mist nets will be set up in various locations around the entire south tip interior of South Monomoy to sample all possible birds using the area. The nets will be opened for 6 hours a day, beginning ½ hour before sunrise. Following mist-netting, staff will conduct an hour-long survey each day by foot to count birds using a set census path. Mist nets will also be utilized on North Monomoy Island to census various sparrow species during one week in October; transportation will be through the use of a motorboat. Staff of the Monomoy Refuge Banding Station will live at the site in the Monomoy light keeper's house (non-wilderness) for the entire sampling period.

Effects:

Wilderness Character
"Untrammeled"
No Benefits
Adverse Effects
- The action to capture migrant bird species for study purposes prevents them from moving around the refuge in a natural way for a temporary amount of time.

"Undeveloped"
No Benefits
Adverse Effects

- Use, even limited use, of mechanized transportation in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.

- The temporary installation of mist nets will have a negative effect on the undeveloped quality of the wilderness.

"Natural"
Benefits

- Naturalness may improve if this research leads to future habitat protection for critical migrant species, thereby helping to maintain a component of the natural character of the Monomoy Wilderness.

No Adverse Effects

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits or Adverse Effects

Other unique components that reflect the character of this wilderness

- The land bird population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits
Adverse Effects

- Limited use of mechanized transportation in wilderness does not enhance the contrast between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions

N/A

Economic and Time Constraints

No Benefits or Adverse Effects

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

No Benefits or Adverse Effects

Alternative # C – Partial Motor Option B

Description:

Use motorboats to drop off personnel and supplies to the island weekly; conduct census of migrants in wilderness only (referred to as the Partial Motor Option B).

Under this alternative, staff of the Monomoy Refuge Banding Station will travel to the south tip of South Monomoy weekly by motorboat to perform data collection activities. The census period will start August 15th and end November 15th as weather and transportation allow. Each day, staff will conduct an hour-long survey by foot to count birds using a set census path. At the beginning and end of the sampling period, supplies will be delivered to the south end via motorboat and transported to the Monomoy light keeper's house through wilderness. A census will also be conducted on North Monomoy Island to survey various sparrow species during one week in October. Staff of the Monomoy Refuge Banding Station will live at the site and will have limited travel from the island during the entire census period.

Effects:

Wilderness Character

"Untrammeled"
No Benefits or Adverse Effects

"Undeveloped"
No Benefits
Adverse Effects

- Limited use of mechanized transportation in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.

"Natural"
Benefits

- Naturalness may improve if this research leads to future habitat protection for critical migrant species, thereby helping to maintain a component of the natural character of the Monomoy Wilderness.

No Adverse Effects

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits or Adverse Effects

Other unique components that reflect the character of this wilderness

- The land bird population is a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits

Adverse Effects

- Limited use of mechanized transportation in wilderness does not enhance the contrast between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions

N/A

Economic and Time Constraints

No Benefits

Adverse Effects

- More time will be spent to adequately identify land bird species by sight and sound, which may impact the overall results on how birds are using the wilderness area as a stopover site, which in turn could affect future management on Monomoy Refuge.

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

No Benefits or Adverse Effects

Comparison of Alternatives

It may be useful to compare each alternative's positive and negative effects to each of the criteria in tabular form, keeping in mind the law's mandate to "preserve wilderness character."

	Alternative A	Alternative B	Alternative C
Untrammeled	-	-	+
Undeveloped	---	--	-
Natural	+	+	+
Solitude or Primitive Recreation	-	+	+
Unique components	+	+	+
WILDERNESS CHARACTER	++/-----	+++/---	++++/-

	Alternative A	Alternative B	Alternative C
Heritage & Cultural Resources	N/A	N/A	N/A
Maintaining Traditional Skills	--	-	-
Special Provisions	N/A	N/A	N/A
Economics & Time	-	+	-
Additional Wilderness Criteria	N/A	N/A	N/A
OTHER CRITERIA SUMMARY	---	+/-	--

	Alternative A	Alternative B	Alternative C
SAFETY	Partially Mitigated	Mitigated	Mitigated

	Alternative A	Alternative B	Alternative C
OVERALL	2(+) / 8(-)	4(+) / 4(-)	4(+) / 3(-)

Safety Criterion
If safety issues override impacts to wilderness character or other criteria, provide documentation that the use of motorized equipment or other prohibited uses is necessary because to do otherwise would cause increased risks to workers or visitors that cannot be satisfactorily mitigated through training, use of personal protective equipment (PPE), or other requirements to alleviate the safety risk. (This documentation can take the form of agency accident-rate data tracking occurrences and severity; a project-specific job hazard analysis; research literature; or other specific agency guidelines.)

Documentation:

Step 2 Decision: **What is the Minimum Activity?**

Selected alternative: Alternative B – Partial Motor Option A

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):
Alternative B, Partial Motor Option A, adequately conserves land birds. At the same time, this option safely minimizes the negative impacts to the wilderness character of the Monomoy Wilderness by limiting the use of motor vehicles and using time efficiently to survey the species. Partial Motor Option A best protects the wilderness quality, meets the requirements of the Migratory Bird Conservation Act, and best satisfies the other comparison criteria.

Alternative A (Full Motor Option) has the most negative impact on wilderness character. Alternative B has slightly greater negative impact than Alternative C on the undeveloped character of the Monomoy Wilderness. However, Alternative B provides a decreased level of economic and time constraints than Alternative C by using time more efficiently to monitor and census land birds and potentially increase habitat protection.

Monitoring and reporting requirements:
Monitoring and reporting of the operations associated with the project will continue on a yearly basis. This information will be maintained in the Monomoy NWR headquarters and will be available for review by anyone interested.

The refuge manager for Monomoy NWR will document that a review and re-validation of this programmatic minimum requirements analysis has been completed prior to April 1 each year. If at any point the refuge manager determines this analysis is no longer valid, or within 10 years (whichever comes first), a new minimum requirements analysis will be prepared and approved.

Check any Wilderness Act Section 4(c) uses approved in this alternative:

- ☐ mechanical transport
- ☐ motorized equipment
- ☐ motor vehicles
- ☐ motorboats
- ☐ landing of aircraft
- ☐ temporary road
- ☐ structure or installation

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

Approvals	Signature	Name	Position	Date
Prepared by:				
Recommended:				
Recommended:				
Approved:				

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE

WORKSHEETS

Habitat Management and Predator Control for Nesting Roseate Terns and Common Terns on South Monomoy Wilderness Area

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– the Wilderness Act, 1964

Step 1: Determine if it is necessary to take any action.

Description: Briefly describe the situation that may prompt action.

Monomoy NWR's CCP recognizes the importance of resource management within the wilderness to insure the health of the wilderness, preserve the wilderness character and species richness, and improve nest productivity.

Since the reestablishment of a productive common tern colony on Monomoy in the late 1990s, this site has been one of the most important sites in the State, and in some years has provided nesting habitat for more than 50 percent of the State's total common tern population. The increase of nesting common terns in the first few years following the start of the reestablishment project was concomitant with a decline in the number of nesting common terns at Plymouth Beach (Massachusetts NHESP census data 1996). Birds nesting at Plymouth Beach had been subjected to predator pressures prior to abandoning that site and moving to Monomoy NWR, suggesting that Monomoy NWR was more appealing to prospecting terns at that time. Common terns were successfully nesting at Monomoy NWR and, as predator pressures remained unresolved at Plymouth Beach, many terns continued returning to Monomoy NWR to nest, attracting more common terns each year. For several years Monomoy NWR has also hosted an increasing number of roseate terns. However, the increasing nesting terns were generally nesting in a similar-sized area in successive years, although the shape of the nesting colony changed. Impacts of increased nesting density were not specifically studied, but anecdotal observations suggested increased neighbor aggression and disturbance among common terns. In addition, increased aggression was seen between common and roseate terns, which may have contributed to the decline in roseate tern numbers and

their eventual relocation to Minimoy Island, although predation may have also contributed to this shift. Storm overwash and erosion over the last several years has severely reduced available nesting space on Minimoy Island, and roseate terns have mostly abandoned this site as well.

During the last 10 years, we have experimented with various types of habitat management on a small scale, but have only recently applied management at a scale that exceeds the current nesting area, such as a prescribed burn of 30+ acres. Careful monitoring of different techniques now provides the foundation for moving forward with habitat management on a much larger scale. Providing more habitat may allow for more nesting common terns but, more importantly, would allow common terns to increase nearest neighbor distances while still maintaining the benefit of being colony members. We also expect prospecting roseate terns to find nesting space more readily within a common tern colony that is not at a saturated density. Roseate terns generally nest 7-10 days later than common terns, so prospecting roseate terns are often trying to establish a territory amid hundreds or thousands of already established common tern territories. Roseate terns are also generally a bit more skittish and less aggressive than common terns, which presents an additional challenge to prospecting roseate terns that are continually being chased by common terns. A larger habitat base would also allow terns to move around between microhabitats within the larger area, as we apply a rotational-based habitat management scheme. We plan to continue working mostly on the north end of South Monomoy, where terns have nested during the last 15 years.

We expect that by providing a larger habitat base, the number of nesting roseate terns would increase. The decline in the number of nesting roseate terns in the Northeast since 2000 is especially troubling because in most years very few sites host more than 100 pairs. In addition to providing more nesting habitat, we will actively attract prospecting roseate terns to this area. Sound systems that play recordings of roseate terns, combined with tern decoys, have been successful at luring terns to nesting sites on other islands (USFWS 2002, USFWS 2005). Placement of sound systems and playback protocols will be based initially on what has been successful at other sites, and will be modified annually to increase the effectiveness on Monomoy NWR.

To determine if administrative action is <u>necessary</u>, answer the questions listed in A - F on the following pages.

A. Describe Options Outside of Wilderness

Is action necessary within wilderness?

Yes: ☒ **No:** ☐

Explain:
The U.S. Fish and Wildlife Service is charged with the responsibility for successfully managing roseate terns nesting within or adjacent to the Monomoy Wilderness. On Monomoy NWR, 96% of our larger terns nest in wilderness (based on 2012 census data); however, this can vary from year to year. While some tern management performed outside of wilderness, like predator control or habitat management to improve other sites, can benefit terns in Massachusetts by creating other areas for them to nest, nesting terns benefit most when these management activities are done in close proximity to their chosen nesting areas, regardless of wilderness status. The non-wilderness areas on the refuge are either too far away from the colony or too small in size for management to benefit nesting terns. Other landowners of non-wilderness tern nesting areas are unable or unlikely to employ the full range of inter-dependent tern management activities to achieve refuge tern population and productivity objectives that we are able to conduct on the refuge.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? Cite law and section.

Yes: ☐ **No:** ☒ **Not Applicable:** ☐

Explain:
There are no existing valid rights or special provisions found in any wilderness legislation to recover threatened or endangered species inside this wilderness.

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
The Endangered Species Act of 1973 (16 U.S.C 1531-1544), as amended, directs the Department of the Interior to identify those species of plants and animals that are threatened and endangered, and develop and implement plans and programs to ensure their survival into the future.

The refuge was established in 1944 pursuant to the **Migratory Bird Conservation Act (16 U.S.C. § 715d)** "… for use as an inviolate sanctuary, or for other management purpose, for migratory birds"; through a Declaration of Taking (United States vs. Commonwealth of Massachusetts, and Susie H. Kosak et al, Miscellaneous Civil No. 6340, District Court of Massachusetts) "…for the protection during the nesting season or while on their way to and from their breeding grounds…", with an emphasis on threatened, endangered and migratory birds. **The National Wildlife Refuge System Improvement Act of 1966, as amended by the Wildlife Refuge System Improvement Act of 1997 (16 U.S.C 668dd-ee)**, directs the U.S. Fish and Wildlife Service "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Healthy habitat supports all CCP goals. The Roseate Tern Recovery Plan identifies specific habitat requirements for this species. This document addresses a critical preservation issue for current and future roseate tern populations. The plan lists six recovery strategies:

- Protection and stabilization of existing breeding colonies
- Determination of ecological characteristics and limiting factors
- Restoration/creation of breeding sites and enhancement of numbers
- Protection and management of terns in their winter quarters
- Administrative actions
- Public involvement

Policy on Maintaining Biological Integrity, Diversity and Environmental Health (601 FW 3)
This policy provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and to restore lost or severely degraded environmental components. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem. In recognition of Monomoy NWR's role as a reservoir for avian diversity, the refuge was also designated as a Western Hemisphere Shorebird Reserve Network (Regional) site under the auspices of the WHSRN Hemispheric Council, and as an Important Bird Area (IBA) by the Audubon Society.

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including: untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Undeveloped: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Natural: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Species management and predator control are necessary to improve the naturalness of this area and maintain native species on the island. This project contributes to the conservation of a native species that is ecologically adapted to the area.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
In order to preserve the outstanding character of wildlife observation, it is necessary to preserve roseate terns and a common tern colony. Doing so preserves the opportunity to see native species in their natural habitat.

Other unique components that reflect the character of this wilderness:

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Roseate and common terns contribute to the biotic diversity and integrity of the refuge and also provide scientific and ecological value, which are included in "other."

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scenic: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scientific: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
This project could add to the scientific base of knowledge on managing a highly productive common tern colony and increasing roseate tern productivity and population recovery.

Education: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Conservation: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
This action could help to conserve roseate tern, a federally endangered species, and could increase species success and population numbers overall.

Historical use: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Step 1 Decision: **Is any administrative action necessary in wilderness?**

Yes: ☐ **No:** ☐ **Not Applicable:** ☐

Explain:
Yes. Action is necessary to protect and conserve a federally listed endangered species, roseate tern, as well as a highly productive common tern colony. Roseate and common terns contribute to the biotic diversity and integrity of the refuge and its scientific and ecological value. Since the reestablishment of a productive common tern colony on Monomoy in the late 1990s, this site has been one of the most important sites in the State, and in some years has provided nesting habitat for more than 50 percent of the State's total population of the species.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity.

Please refer to the accompanying Minimum Requirements Decision Guide *Instructions* for an explanation of the effects criteria displayed below.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # A – Full Motor Option

Description:

Use motorized vehicles to access all areas of the island; build temporary structures and installations including field camp, blinds, symbolic fencing, nesting structures, chick shelters, sound system, decoys, productivity plots, and grid markers; conduct predator control (referred to as the Full Motor option).

Under this alternative, biological staff will travel to South Monomoy boat landing by motorboat every day from the beginning of April to mid-August and work all daylight hours. Prior to the nesting season, a motorboat would be used to carry materials to drop off all gear, supplies, and equipment to set up a temporary field camp within the wilderness boundary that would remain in place for the entire season and to establish the grid system. Staff would use an ATV to carry and set up symbolic fencing to keep people out of potential nesting areas. During this time temporary wooden nesting/chick structures (providing shade, cover, and artificial habitat), decoys, and sound system (two speakers, box containing cd player, battery, and sound equipment, and solar panel decoys) would be installed in the colony to attract nesting roseate terns during the start of the nesting season. The sound system will be operated during daylight use only and manually turned on and off by on-island staff personnel. Use of the ATV would remain below the mean high tide line where possible to reduce impacts on the upper beach, and fencing supplies would be carried from the ATV to the fencing areas on foot where possible. Motorboat operation would be used daily to transport and rotate biological staff and bring field supplies. Once reaching South Monomoy, personnel would complete tern management activities (install productivity plots and check daily) in the tern colony by foot. To minimize predator disturbance, non-lethal methods (including staffing camp 24 hours and using chick shelters within the nesting areas) and lethal methods (such as shooting) of predator control will be conducted in the colony with the use of six plywood blinds. Field camp will include four large wall tents and two small tents that provide facilities for sleeping, cooking, privacy sanitation, and storage of supplies for up to eight individuals. At the end of the season, all materials and equipment (including symbolic fencing, field camp, blinds, nesting/chick shelters, flagging and pvc from grid system) would be removed and stored in both wilderness and non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- The action to use nesting/chick shelters and prevent natural predators from preying on the nests or chicks represents a trammeling of the wilderness
- The action to use nesting shelters as artificial habitat represents a trammeling of the wilderness.
- The action of removing natural predators for the habitat represents a trammeling of the wilderness.

"Undeveloped"

No Benefits

Adverse Effects

- Using mechanized transportation in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.
- The temporary installation of symbolic fencing, nesting boxes, chick shelters, field camp, blinds, and sound system will have a negative effect on the undeveloped quality of the wilderness.

"Natural"
Benefits

- Naturalness be will improved by protecting and conserving an endangered wildlife species – a part of the natural character of the wilderness.
- Manipulating the habitat through use of nesting/chick shelters will preserve native species.

No Adverse Effects

- The active management to increase roseate tern populations and protect roseate and common terns from predators will have a negative effect on the natural quality of the wilderness.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- Area closures and enforcement and temporary structures would be present and visible during the roseate tern and common tern breeding season and may be perceived by some wilderness users as "confining" the wilderness experience. Refuge personnel, ATVs, and motorboats would be visually and audibly evident and may be perceived by some Monomoy Wilderness users as intruding on solitude.

Other unique components that reflect the character of this wilderness
Benefits

- The beach/dune nesting roseate and common tern populations are unique ecological featurea with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

No Benefits
Adverse Effects

- Using mechanized transportation in wilderness does not enhance the contracts between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions

N/A

Economic and Time Constraints

Benefits

- Roseate and common tern management would be conducted in a time-saving, efficient manner.

Adverse Effects

- Added costs of ATV purchase, boat and ATV equipment operation and maintenance, personnel training, and personal protective equipment.
- Cost of training personnel on lethal predator control use

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

Benefits

- Locating injured or ill persons needing medical evacuation is easier if an ATV is available. Medical emergency evacuations are potentially much faster when an ATV and motorboat are available (Section 4-C of Wilderness Policy).

Adverse Effects

- Risks associated with ATV use can be partially mitigated by training, maintenance, and personal protective equipment (PPE), but personnel injury could potentially increase.
- People on foot are much less mobile and are therefore exposed and vulnerable to the weather, environmental hazards, and dehydration for longer durations.
- Risks associated with predator control can be mitigated by training.

Alternative # B – Partial Motor Option A

Description:

Use motorboats to access all areas of the island; build temporary structures and installations, including field camp, blinds, symbolic fencing, nesting structures, chick shelters, sound system and decoys, productivity plots, and grid markers; conduct predator control (referred to as Partial Motor Option A).

Under this alternative, biological staff will travel to the South Monomoy boat landing by motorboat every other day from the beginning of April to mid-August, work all daylight hours, and rotate staff. Prior to the nesting season, a motorboat would be used to carry materials to drop off all gear, supplies, and equipment to set up a temporary field camp within the wilderness boundary that would remain in place for the entire season and to establish the grid system. Staff would carry and set up symbolic fencing to keep people out of potential nesting areas. During this time temporary wooden nesting/chick structures (providing shade, cover and artificial habitat), decoys, and sound system (two speakers, box containing cd player, battery and sound equipment, solar panel decoys) would be installed in the colony to attract nesting roseate terns during the start of the nesting season. The sound system will be operated during daylight use only and manually turned on and off by on-island personnel. Once reaching South Monomoy, personnel would complete tern management activities (install productivity plots and check 50 percent of plots on alternating days) in the tern colony by foot. To minimize predator disturbance, non-lethal methods (including staffing camp 24 hours and using chick shelters within the nesting areas) and lethal methods (such as shooting) of predator control will be conducted in the colony with the use of four plywood blinds. Field camp will include two large wall tents and one small tent that provide facilities for sleeping, cooking, privacy sanitation, and storage of supplies for up to six individuals. At the end of the season, all materials and equipment (including symbolic fencing, field camp, blinds, nesting/chick shelters, flagging and pvc from grid system) would be removed and stored in both wilderness and non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- The action to use nesting/chick shelters and prevent natural predators from preying on the nests or chicks represents a trammeling of the wilderness.
- The action to use nesting shelters as artificial habitat represents a trammeling of the wilderness.
- The action of removing natural predators for the habitat represents a trammeling of the wilderness.

"Undeveloped"

No Benefits

Adverse Effects

- Using motorboats in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.
- The temporary installation of symbolic fencing, nesting boxes, chick shelters, field camp, blinds, and sound system will have a negative effect on the undeveloped quality of the wilderness.

"Natural"

Benefits

- Naturalness will be improved by protecting and conserving an endangered wildlife species – a part of the natural character of the wilderness.
- Manipulating the habitat through use of nesting/chick shelters will preserve native species.

No Adverse Effects

- The active management to increase roseate tern populations and protect roseate and common terns from predators will have a negative effect on the natural quality of the wilderness.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"

No Benefits

Adverse Effects

- Area closures and enforcement and temporary structures would be present and visible during the roseate tern and common tern breeding season and may be perceived by some wilderness users as "confining" the wilderness experience. Refuge personnel and motorboats would be visually and audibly evident and may be perceived by some Monomoy Wilderness users as intruding on solitude.

Other unique components that reflect the character of this wilderness

Benefits

- The beach/dune nesting roseate and common tern populations are unique ecological features with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources
N/A

Maintaining Traditional Skills
Benefits
- Use of motorboats helps to maintain traditional skills throughout the wilderness.

Adverse Effects
- Use of motorboats in wilderness does not enhance the contracts between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions
N/A

Economic and Time Constraints
Benefits
- Roseate and common tern management would be conducted in a time-saving, efficient manner.

Adverse Effects
- Costs of boat operation and maintenance and personnel training.
- Cost to train personnel on lethal predator control.

Additional Wilderness-specific Comparison Criteria
N/A

Safety of Visitors, Personnel, and Contractors
No Benefits
Adverse Effects
- People on foot are much less mobile and are therefore exposed and vulnerable to the weather, environmental hazards, and dehydration for longer durations.
- Risks associated with predator control can be mitigated by training.

Alternative # C – Partial Motor Option B

Description:

Use motorboats to access all areas of the island; build temporary structures and installations including spike camp, blinds, symbolic fencing, nesting structures, chick shelters, sound system and decoys, productivity plots, and grid markers; conduct predator control (referred to as the Partial Motor Option B).

Under this alternative, biological staff will travel to South Monomoy boat landing by motorboat every other day from the beginning of April to mid-August and work all daylight hours. Prior to the nesting season, a motorboat

would be used to carry materials to drop off all gear, supplies, and equipment to set up a temporary field camp (non-wilderness) and a spike camp within the wilderness boundary that would remain in place for the entire season and to establish the grid system. Staff would carry and set up symbolic fencing to keep people out of potential nesting areas. During this time temporary wooden nesting/chick structures (provide shade, cover and artificial habitat), decoys, and sound system (two speakers, box containing cd player, battery and sound equipment, solar panel decoys) would be installed in the colony to attract nesting roseate terns during the start of the nesting season. The sound system will be operated during daylight use only and manually turned on and off by on-island personnel. Once reaching South Monomoy, personnel would complete tern management activities (install productivity plots and check half of the plots on alternating days) in the tern colony by foot. To minimize predator disturbance, non-lethal methods (including staffing camp 24 hours and using chick shelters within the nesting areas) and lethal methods (such as shooting) of predator control will be conducted in the colony with the use of four plywood blinds. Field camp would have unlimited staff and the spike camp will include one small tent to provide a 24 hour presence near the tern colony. At the end of the season, all materials and equipment (including symbolic fencing, field camp, "spike" camp, blinds, nest/chick shelters, flagging and pvc from grid system) would be removed and stored in both wilderness and non – wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- The action to use nesting/chick shelters and prevent natural predators from preying on the nests and chicks represents a trammeling of the wilderness.
- The action to use nest shelters as artificial habitat represents a trammeling of the wilderness.
- The action of removing natural predators for the habitat represents a trammeling of the wilderness.

"Undeveloped"

No Benefits

Adverse Effects

- Using motorboats in wilderness is inconsistent with the requirement to retain the primeval character of wilderness.
- The temporary installation of symbolic fencing, nesting boxes, chick shelters, spike camp, blinds, and sound system will have a negative effect on the undeveloped quality of the wilderness.

"Natural"

Benefits

- Naturalness will be improved by protecting and conserving an endangered wildlife species – a part of the natural character of the wilderness.
- Manipulating the habitat through use of nesting/chick shelters will preserve native species.

No Adverse Effects

- The active management to increase roseate tern populations and protect roseate and common terns from predators will have a negative effect on the natural quality of the wilderness.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
No Benefits
Adverse Effects

- Area closures and enforcement and temporary structures would be present and visible during the roseate tern and common tern breeding season and may be perceived by some wilderness users as "confining" the wilderness experience. Refuge personnel and motorboats would be visually and audibly evident and may be perceived by some Monomoy Wilderness users as intruding on solitude.

Other unique components that reflect the character of this wilderness
Benefits

- The beach/dune-nesting roseate and common tern populations are a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources
N/A

Maintaining Traditional Skills
Benefits

- Use of motorboats helps to maintain traditional skills throughout the wilderness

Adverse Effects

- Use of motorboats in wilderness does not enhance the contracts between wilderness and non-wilderness or perpetuate the use of primitive traditional skills.

Special Provisions
N/A

Economic and Time Constraints
Benefits

- Roseate and Common Tern management would be conducted in a time-saving, efficient manner.

Adverse Effects

- Cost of boat operation and maintenance, and personnel training.
- Cost to train personnel on lethal predator control use.

Additional Wilderness-specific Comparison Criteria
N/A

Safety of Visitors, Personnel, and Contractors

No Benefits

Adverse Effects

- People on foot are much less mobile and therefore exposed and vulnerable to the weather, environmental hazards and dehydration for longer durations.
- Risks associated with predator control can be mitigated by training.

Alternative # D – No Motor Option

Description:

Use no motor vehicles; mechanized equipment will be used if loads exceed 80lbs and/or exceed three trips per person on foot; build temporary structures and installations including field camp, blinds, symbolic fencing, nesting structures, chick shelters, sound system and decoys, productivity plots, and grid markers; conduct predator control; install symbolic fencing to decrease human disturbance; manipulate habitat; conduct predator control (referred to as the No *Motor* Option).

Under this alternative, biological staff will travel to South Monomoy by paddling kayaks from the mainland, weather permitting, from early April to mid-August and work all daylight hours. Personnel return in the same manner at the end of their field base assignment (10 days on/4-days off schedule). Prior to the nesting season, a motorboat would be used to carry materials to drop off in non-wilderness all gear, supplies, and equipment to set up a temporary field camp within the wilderness boundary that would remain in place for the entire season and to establish the grid system. If any load exceeds 80lbs and/or three trips per person on foot, a wheeled cart will be used. Staff would carry and set up symbolic fencing to keep people out of potential nesting areas. During this time temporary wooden nesting/chick structures (provide shade, cover and artificial habitat), decoys, and sound system (two speakers, box containing cd player, battery, and sound equipment, solar panel decoys) would be installed in the colony to attract nesting roseate terns during the start of the nesting season. The sound system will be operated during daylight use only and manually turned on and off by on island staff personnel. Once reaching the colony on South Monomoy, personnel would complete tern management activities (every other year install productivity plots and check daily) in the tern colony by foot. To minimize predator disturbance non-lethal methods (including staffing camp 24 hours and using chick shelters within the nesting areas) and lethal methods (such as shooting) of predator control will be conducted in the colony with the use of four pop-up blinds that are removed when not in use. Field camp will include four individual pup tents and a sanitation tent; cooking would be conducted outdoors, and use more wilderness-friendly backpacking gear. If camp is closed during the season for any reason, all gear (personal and safety) will be removed from the camp area. At the end of the season, all materials and equipment (including symbolic fencing, blinds, nesting/chick shelters, flagging, and pvc from grid system) would be removed and stored in both wilderness and non-wilderness locations.

Effects:

Wilderness Character

"Untrammeled"

No Benefits

Adverse Effects

- The action to use nesting/chick shelters and prevent natural predators from preying on the nests and chicks represents a trammeling of the wilderness.
- The action to use nest shelters as artificial habitat represents a trammeling of the wilderness.
- The action of removing natural predators for the habitat represents a trammeling of the wilderness.

"Undeveloped"

No Benefits

Adverse Effects

- The temporary installation of symbolic fencing, nesting boxes, chick shelters, field camp, and blinds will have a negative effect on the undeveloped quality of the wilderness.

"Natural"

Benefits

- Naturalness will improve by protecting and conserving an endangered wildlife species – a part of the natural character of the wilderness.
- Manipulating the habitat through use of nesting/chick shelters will preserve native species.

No Adverse Effects.

- Use of nonmotorized transportation would extend the time needed to conduct management activities in wilderness and, therefore, could negatively affect productivity and habitat improvement.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"

No Benefits

Adverse Effects

- Area closures and enforcement and temporary structures would be present and visible during the roseate tern and common tern breeding season and may be perceived by some wilderness users as "confining" the wilderness experience.
- Refuge personnel and motorboats would be visually and audibly evident and may be perceived by some Monomoy Wilderness users as intruding on solitude.

Other unique components that reflect the character of this wilderness

Benefits

- The beach/dune-nesting roseate and common tern populations are a unique ecological feature with scientific, educational, and scenic value to current and future generations of Americans.

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

Benefits

- Use of nonmechanized modes of transportation in wilderness enhances the contrast between wilderness and non-wilderness and perpetuates the use of primitive traditional skills.

No Adverse Effects

Special Provisions

N/A

Economic and Time Constraints

No Benefits

Adverse Effects

- Cost to train personnel on kayak use.
- Cost to hire/acquire more staff.
- Cost to obtain more kayaks, safety equipment, and other personal equipment to support adequate job duty performance.
- Time required to travel by kayak to island.
- Cost to train personnel on lethal predator control use.

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

No Benefits

Adverse Effects

- People on foot or paddling are much less mobile and therefore exposed and vulnerable to the weather, adverse sea and tidal current conditions, and environmental hazards for longer durations.
- Carrying all gear and paddling increases one's risk for heart attack and dehydration.
- Risk associated with kayak use can be partially mitigated by training.
- A higher level of physical fitness is required. Risks can be partially mitigated by conditioning, personnel selection, and providing personal protective equipment and Go/No-Go criteria.
- Medical emergency evacuations are potentially much faster when a motorboat is available than individuals traveling on foot or paddling. Greater reliance on maritime aerial medical evacuation is required, an already scarce emergency service resource in the area that is not always available when needed (See section 4-C of Wilderness policy).

Alternative # E- No Action

The roseate tern is a listed endangered species and its protection is mandated under the Endangered Species Act. In order to successful manage for roseate terns, a common tern colony must be managed. A "no action" alternative cannot be selected in a Minimum Requirements Analysis. Therefore, this alternative was not analyzed.

Comparison of Alternatives
It may be useful to compare each alternative's positive and negative effects to each of the criteria in tabular form, keeping in mind the law's mandate to "preserve wilderness character."

	Alternative A	Alternative B	Alternative C	Alternative D
Untrammeled	- -	- -	--	- -
Undeveloped	- - - -	- - -	---	-
Natural	+/-	+/-	+/-	+/-
Solitude or primitive recreation	-	-	-	-
Unique components	+	+	+	+
WILDERNESS CHARACTER	++/--------	++/-------	++/-------	++/-----

	Alternative A	Alternative B	Alternative C	Alternative D
Heritage & Cultural Resources	NA	NA	NA	NA
Maintaining Traditional Skills	- -	+/ -	+/-	+
Special Provisions	NA	NA	NA	NA
Economics & Time	+/- -	+/- -	+/---	- - -
Additional Wilderness Criteria	NA	NA	NA	NA
OTHER CRITERIA SUMMARY	+/----	++/---	++/----	+/---

	Alternative A	Alternative B	Alternative C	Alternative D
SAFETY	Partially Mitigated	Mitigated	Mitigated	Partially Mitigated

Safety Criterion
If safety issues override impacts to wilderness character or other criteria, provide documentation that the use of motorized equipment or other prohibited uses is necessary because to do otherwise would cause increased risks to workers or visitors that cannot be satisfactorily mitigated through training, use of personal protective equipment (PPE), or other requirements to alleviate the safety risk. (This documentation can take the form of agency accident-rate data tracking occurrences and severity; a project-specific job hazard analysis; research literature; or other specific agency guidelines.)

Documentation:

Step 2 Decision: What is the Minimum Activity?

Please refer to the accompanying Minimum Requirements Decision Guide *Instructions* **before describing the selected alternative and describing the rationale for selection.**

Selected alternative: Alternative B - Partial Motor Option A

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):
Alternative B, Partial Motor Option A, adequately protects and conserves roseate terns and common terns while minimizing the negative impacts to the wilderness character of the Monomoy Wilderness. The alternative does so by limiting the use of motor vehicles and using time and economics efficiently to monitor roseate and common terns. The Partial Motor Option A alternative best protects the wilderness quality and meets the requirements of the Endangered Species Act, as well as best satisfies the other comparison criteria.

	Alternative A	Alternative B	Alternative C	Alternative D
Untrammeled	- -	- -	--	- -
Undeveloped	- - - -	- - -	---	-
Natural	+/-	+/-	+/-	+/-
Solitude or Primitive Recreation	-	-	-	-
Unique components	+	+	+	+
WILDERNESS CHARACTER	++/--------	++/-------	++/-------	++/-----

	Alternative A	Alternative B	Alternative C	Alternative D
Heritage & Cultural Resources	NA	NA	NA	NA
Maintaining Traditional Skills	- -	+/ -	+/-	+
Special Provisions	NA	NA	NA	NA
Economics & Time	+/- -	+/- -	+/---	- - -
Additional Wilderness Criteria	NA	NA	NA	NA
OTHER CRITERIA SUMMARY	+/----	++/---	++/----	+/---

	Alternative A	Alternative B	Alternative C	Alternative D
SAFETY	Partially Mitigated	Mitigated	Mitigated	Partially Mitigated

Monitoring and reporting requirements:
Monitoring and reporting of the operations associated with the nesting and protection project will continue on a yearly basis. This information will be maintained in the Monomoy NWR headquarters and will be available for review by anyone interested.

Check any Wilderness Act Section 4(c) uses approved in this alternative:

- [x] mechanical transport
- [ ] motorized equipment
- [ ] motor vehicles
- [x] motorboats
- [ ] landing of aircraft
- [ ] temporary road
- [ ] structure or installation

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

Approvals	Signature	Name	Position	Date
Prepared by:				
Recommended:				
Recommended:				
Approved:				

Appendix F

Kate Iaquinto

Prescribed burning to improve habitat

Fire Management Program Guidance

- Introduction
- The Role of Fire
- Wildland Fire and Management Policy and Guidance
- Fire Management Planning
- Fire Management Program at Monomoy National Wildlife Refuge

Introduction

The U.S. Fish and Wildlife Service's (Service) Northeast Regional Fire Program (Fire Program) helps support the mission of the National Wildlife Refuge System (refer to chapter 1 of the draft CCP/EIS) by creating and managing important wildlife habitat with prescribed fire, and protecting human safety by reducing the risk of wildfire through fire suppression. This appendix outlines guidance for fire management, explains the fire management planning process, and describes the fire management program at Monomoy National Wildlife Refuge.

There are six wildfires (unplanned, human-caused ignitions) in wildland fuels documented for Monomoy NWR during the 60-year period from 1951 to 2011, ranging in size from less than 0.1 to 6 acres. No natural (lightning) ignitions are documented during that same 60-year period. Wildfire causes included two from signal flares from boaters in distress, one unattended campfire, one arson, one grass fire during cabin disposal, and one undetermined cause.

There are at least eight planned ignitions (prescribed fires) in wildland fuels documented for Monomoy NWR during the 60-year period from 1951 to 2011, up to 43 acres in size. Refuge personnel experimented with prescribed fire to provide green forage for fall and spring migrating waterfowl during the early 1950s. Burning for wildlife habitat was discontinued after the 1954 burns on a belief that the risk from erosion outweighed the forage benefits to migrating waterfowl and the logistical difficulties of applying fire in such remote, inaccessible areas during the few suitable weather windows available each year. The refuge resumed using fire as a tool for disposing of camps during the late 1960s, and continued this use through the early 1980s. Fire was absent as a habitat management tool at Monomoy until 2002, when two small vegetation management study plots were burned within the tern colony. During the period 2002 to 2009 there were three prescribed burns executed within the tern colony on South Monomoy, with the largest on October 15, 2009, when 36 acres of primarily beach grass was prescribed burned.

The Role of Fire

Historically, natural fire and ignitions by Native American people played an important disturbance role in many ecosystems by:

- Removing fuel accumulations.
- Decreasing the impacts of insects and diseases.
- Stimulating regeneration of vegetation.
- Cycling nutrients.
- Providing a diversity of habitats for plants and wildlife.

In the heavily developed areas of the northeastern U.S., that role has been modified significantly. However, when fire is used properly it can

- Reduce hazardous fuels build-up in both wildland-urban interface[1] and other areas.
- Improve wildlife habitats by reducing the density of vegetation, or changing plant species composition.
- Sustain and increase biodiversity.
- Improve woodlands and shrublands by reducing plant density.
- Reduce the susceptibility of plants to insect and disease outbreaks.
- Assist in the control of invasive and noxious species.

[1] The wildland-urban interface is the line, area, or zone where human development and structures meet with undeveloped wildland or vegetative fuels.

Wildland Fire and Management Policy and Guidance

In 2001 the Secretaries of the Interior and Agriculture approved an update to the 1995 Federal Fire Policy. The 2001 Federal Wildland Fire Management Policy directs Federal agencies to (*http://www.nwcg.gov/branches/ppm/fpc/archives/fire_policy/index.htm*) achieve a balance between using fire suppression to protect life, property, and resources, and using wildland fire to regulate fuels and maintain healthy ecosystems. It also directs agencies to provide a management response to all wildfires that is commensurate with the values at risk, human safety, and the costs for suppression. This policy provides nine guiding principles that are fundamental to the success of the fire management program. These guiding principles are as follows:

1. Firefighter and public safety is the first priority in every fire management activity.
2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into all land management planning processes.
3. Fire management plans, programs, and activities support land and resource management plans and their implementation.
4. Sound risk management is a foundation for all fire management activities.
5. Fire management programs and activities are economically viable, based on values to be protected, costs, and land and resource management objectives.
6. Fire management plans and activities are based on the best available science.
7. Fire management plans and activities incorporate public health and environmental quality considerations.
8. Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.
9. Standardization of policies and procedures among Federal agencies is an ongoing objective.

The following provide further direction on fire management decisions:

- Every fire requires a response and decision on how to respond to it.
- The Service's initial reaction to human-caused fires will be to suppress the fire while providing for firefighter and public safety, limiting damage and loss, and minimizing costs of the fire.
- The interagency nature of fire management work requires the involvement and participation of cooperators, including both State and local agencies, in planning for, and potentially responding to, wildland fire.

The Fish and Wildlife Service Fire Management Handbook provides standards for operational fire management activities, procedures, and practices based upon the above referenced current interagency, departmental, and Service policies (*http://www.fws.gov/fire/handbook/index.shtml*). The FWS Fire Management Handbook is updated annually to coincide with the Interagency Standards for Fire and Fire Aviation Operations Handbook and is incorporated by reference into the Service Manual (621 FW 1).

Fire Management Planning

The Fire Management Plan (FMP) for the Eastern Massachusetts National Wildlife Refuge Complex defines the fire management direction for Monomoy refuge and other refuges in the complex based on the objectives outlined in the comprehensive conservation plans (CCP) and habitat management plans (HMP). The FMP follows the most recent Interagency Fire Management Plan Template and applies the most recent Service-specific guidance on use of that interagency template. It provides a detailed description of how the refuge will

- Respond to wildland fires.
- Manage fuels to reduce the risk of wildland fires.
- Use prescribed burning to meet management objectives, if applicable.

In order for a refuge to use wildland fire, prescribed burning, and other hazardous fuel reduction techniques, these methods must be specified and pre-approved as appropriate management responses in the refuge's FMP.

If none of these methods are described in the FMP, the refuge's only allowable response to wildland fire is aggressive suppression. An appropriate response must be determined for any unplanned ignition. The FMP must address a full range of potential responses to wildfires and outline the potential range of strategies and limitations and constraints on tactical operations, local approvals needed, etc.

An annual review process requires the refuge/unit line officer and servicing fire management officer to review the FMP using the annual review checklist, discuss and update FMP sections as needed, and complete an amendment containing any updates.

All prescribed fires must meet all Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide requirements.

Fire Management Program at Monomoy National Wildlife Refuge

Fire Management Goals

The goals and strategies of the National Wildlife Refuge System Wildland Fire Management Program Strategic Plan are consistent with Department of Interior (DOI), National Fire Plan direction, the President's Healthy Forest Initiative, the 10-year Comprehensive Strategy and Implementation Plan, National Wildfire Coordinating Group (NWCG) guidelines, initiatives of the Wildland Fire Leadership Council, and Interagency Standards for Fire and Aviation operations.

The current fire management goals for the refuge are to use prescribed fire to meet the habitat goals and objectives identified in this CCP.

Fire Management Objectives

The purpose of the fire management program is to use prescribed fire, chemical, and manual and mechanical treatment to:

- Ensure public and firefighter safety while protecting property and natural resource values from wildfire.
- Reduce the wildfire impacts to all resource management activities. Reduce the threats associated with accumulations of hazardous fuel loads in marsh, coastal dune, and maritime woodland habitats.
- Provide and enhance and protect habitats for State and Federal endangered and threatened species and species of special concern.
- Provide, maintain, enhance, and protect nesting, brood, feeding, and resting habitat that meet the requirements of migratory birds and resident wildlife.
- Maintain health and vigor of marsh and coastal dune vegetation.
- Facilitate the control of invasive and exotic species.
- Increase habitat diversity in refuge upland habitats.
- Demonstrate and educate the public about the role and benefits of wildland fire protection and prescribed fire use in natural resource management.
- Maintain current ecosystem diversity within the landscape context.
- Comply with the State Air Quality Implementation Plan to protect public respiratory health and the environment.

Fire Management Strategies

The refuge will use fire management strategies and tactics that consider public and firefighter safety, as well as resource values at risk. The FMP will provide a more detailed description of the wildfire suppression, prescribed fire, chemical, manual, and mechanical treatment methods the refuge plans to use. The FMP will also explain the timing and monitoring of the refuge's fire management strategies. The refuge will

develop prescribed fire burn plans for specific sites, following the interagency Prescribed Fire Planning and Implementation Procedures Reference Guide (2009) template.

Some fire management strategies techniques, such as prescribed burning, may impact air quality. Prescribed fire temporarily reduces air quality by diminishing visibility and releasing particulates and pollutants through combustion. However, the refuge will meet the Clean Air Act emission standards by adhering to the Massachusetts Air Quality requirements during all prescribed fire activities.

Fire Management Organization, Contracts, and Cooperation

The Service's Northeast Regional Fire Program is divided into four fire management zones, which provide technical fire management oversight to refuges. Monomoy NWR is currently within the New England fire management zone, which includes all the national wildlife refuges in Massachusetts. The primary fire management staffing and support equipment are located at the Eastern Massachusetts National Wildlife Refuge Complex, and are shared among all units. All fire management activities are conducted in a coordinated and collaborative manner with the refuge and other Federal and non-Federal partners. The New England fire management zone has also developed a close working relationship with the Massachusetts Department of Fish and Game and The Nature Conservancy.

Upon approval of this CCP, a new FMP will be developed for the refuge. The FMP may cover only Monomoy NWR, or may cover all the refuges within the Eastern Massachusetts National Wildlife Refuge Complex.

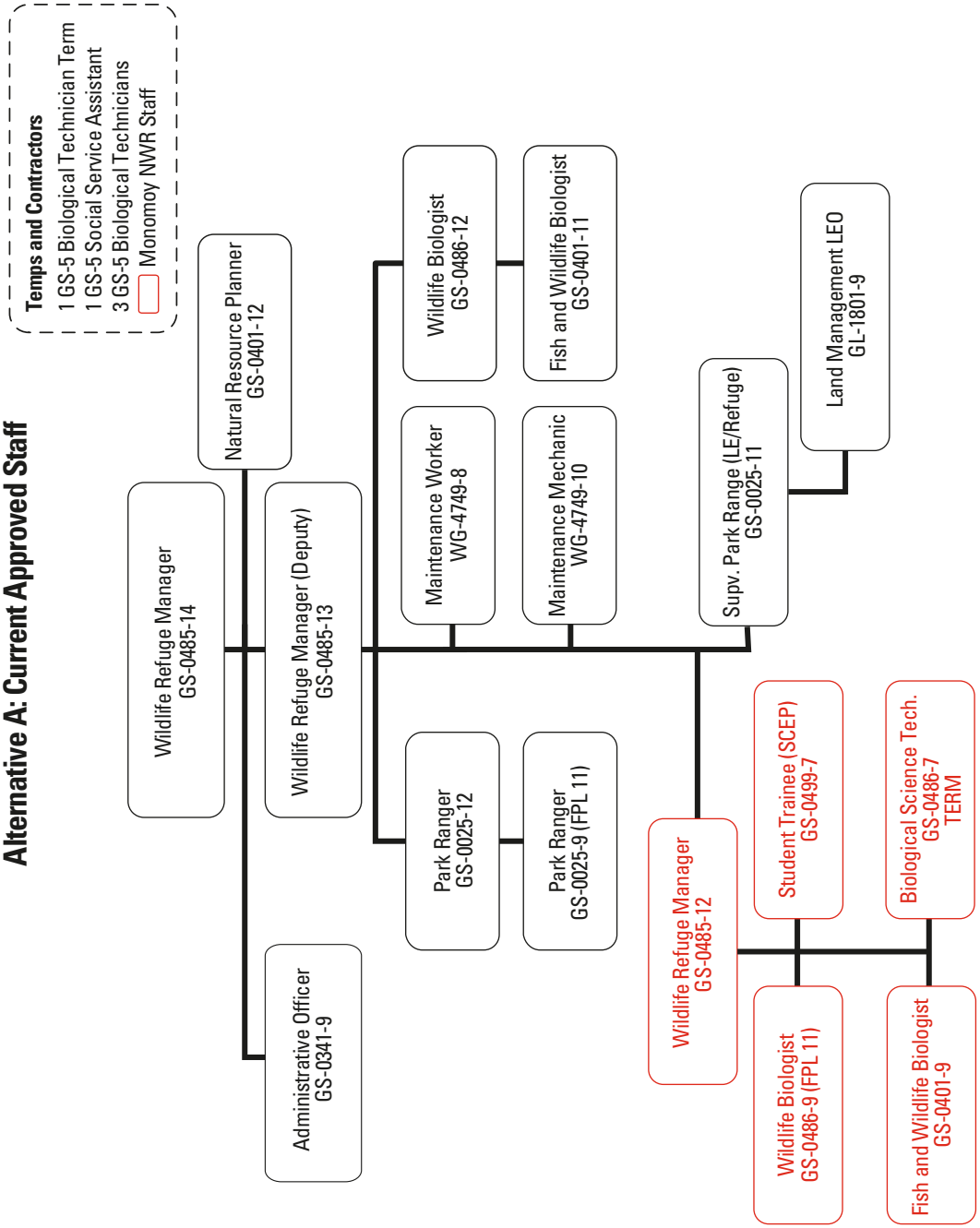
Appendix G

USFWS

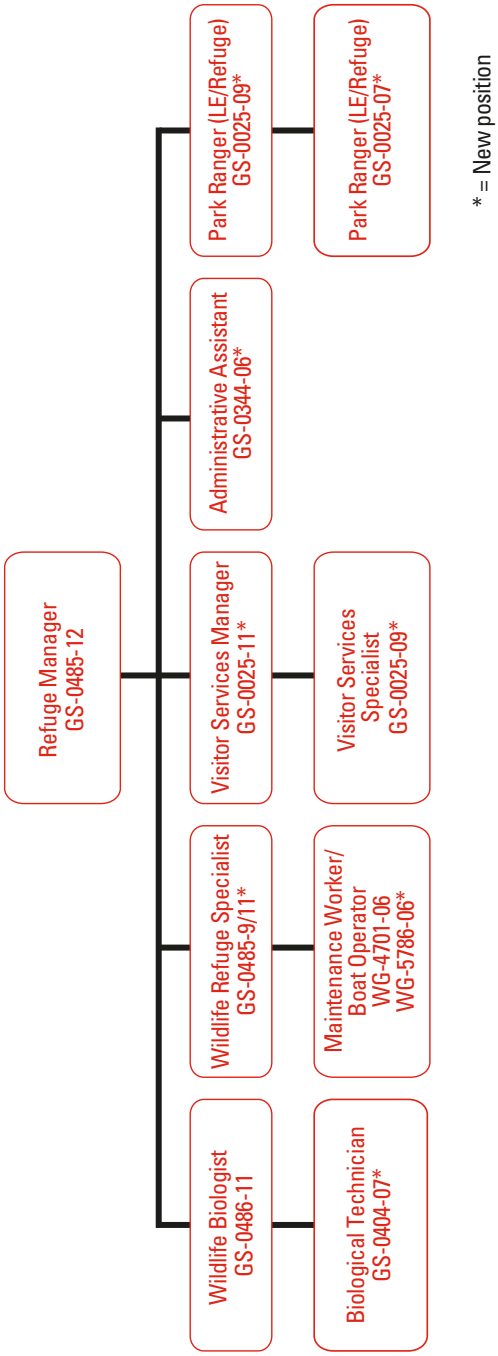
View of refuge

Refuge Staffing Charts

U.S. Fish and Wildlife Service
Northeast Region
Eastern Massachusetts National Wildlife Refuge Complex and Monomoy National Wildlife Refuge
Alternative A: Current Approved Staff

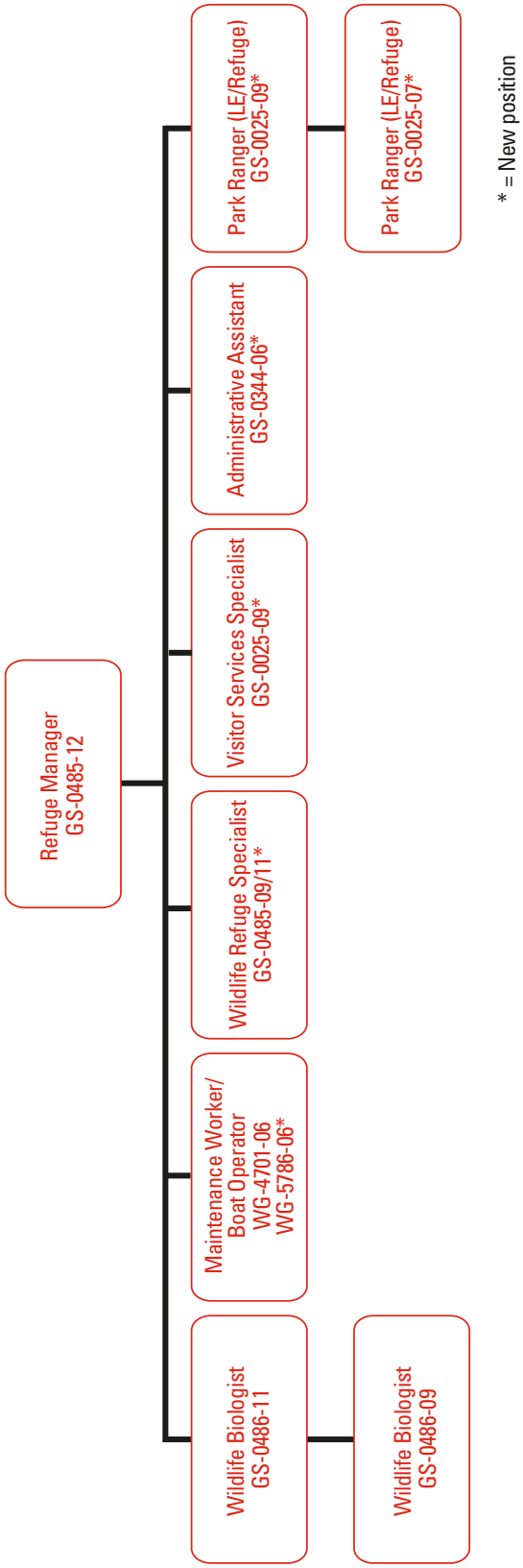


U.S. Fish and Wildlife Service
Monomoy National Wildlife Refuge
Alternative B: Proposed Staff



* = New position

U.S. Fish and Wildlife Service
Monomoy National Wildlife Refuge
Alternative C: Proposed Staff



* = New position

Appendix H

USFWS

Horseshoe crabs

Refuge Operations Needs System (RONS) and Service Asset Maintenance Management System (SAMMS)

Table H.1. Proposed RONS Projects for Monomoy National Wildlife Refuge (FY08).

Project Title	Costs ($1,000)	Refuge Rank	FTE* (personnel)
Projects			
Provide Visitor, Resource, and Facility Protection (Law Enforcement GS-09)	150	1	1
Support Biological, Visitor Services, and Law Enforcement Programs (Small Craft Operator/Maintenance Worker GS-XX)	77.65	3	1
Implementation of Law Enforcement Program		2	
Improve Communications, Interpretation, and Education (Visitor Services Manager GS-11)	128.99	5	1
Protect Endangered, Threatened, and Rare Coastal Nesting Birds from Predation (Wildlife Biologist GS-09)		4	
Native Upland Habitat Restoration and Invasive Species Control		11	
Protect Habitats and Food Resources for Migrating Shorebirds (Temp)		11	.5
Census Nesting, Staging, Wintering, and Resident Wildlife	87.16	9	1
Manage Refuge Resources and Restore Beach Habitats	106.61	6	1
Habitat and Native Vegetation Restoration	87.16	7	1
Greet Visitors and Support Refuge Operations (Office Assistant GS-06)	78.43	12	1
Provide Visitor, Resource, and Facility Protection (Law Enforcement GS-XX)	150	13	1
Provide and Enhance Visitor Opportunities	48.42	10	1
Total	**9,543.26**		

Table H.2. SAMMS Projects for Monomoy National Wildlife Refuge.

Project Title	Costs ($1,000)	Refuge Rank
Existing Facilities		
Rehabilitate Cultural Heritage Improvement at Monomoy Lighthouse	1,399.79	9
Replace Interpretive Signs	38	8
Replace Monomoy Morris Island Entrance Signs	42	4
Rehabilitate Morris Island Erosion	522	2
Rehabilitate Historic Monomoy Lighthouse	726	6
Rehabilitate Historic Oil House/Generator Building	113	7
Rehabilitate 504 ADA Beach Trail	41	5
Rehabilitate Historic Lighthouse Quarters	647	3
Replace Stairs Public Beach Access	139.48	1

Appendix I

USFWS

View of refuge

A Geomorphological Analysis of the Monomoy Barrier System

Provincetown
Center for Coastal Studies

A Geomorphological Analysis of the Monomoy Barrier System

by

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1. PREFACE

This report is submitted at the request of the Eastern Massachusetts National Wildlife Refuge Complex for geomorphological research and report preparation in support of a comprehensive conservation plan for Monomoy National Wildlife Refuge. Areas of interest specified include a summary of the present understanding of outer Cape Cod coastal processes; a chronology of southeastern Chatham coastal forms using aerial photographs to illustrate changes at Monomoy; a general overview of climate change and associated sea level rise with respect to the study area; discussion of the potential benefits and problems associated with dredging around Monomoy; and discussion of potential future research to benefit Refuge management.

2. INTRODUCTION

"Monomoy" as seen on regional maps appears as an appendage to the bended arm of Cape Cod, extending southward some 15 km. from the Cape's sharp elbow at Morris Island in Chatham (e.g., Fig. 1). Depending on the map's date, Monomoy may have the form of a continuous peninsula – a barrier spit consisting of dunes, marshes and beaches with a bulbous terminus at Monomoy Point, or it may appear as a series of isolated and small barrier islands and shoals in the north leading southward to a larger island, "South Monomoy Island". However, the marine setting is similar at all dates: Monomoy is bordered on the southeast by a northeast-southwest trending channel, "Pollock Rip Channel"; on the southwest by a string on shoals known collectively as "Handkerchief Shoal" parts of which are sometimes exposed at extreme low water; and on the west by a broad shallow triangular platform, "Monomoy Flats" (Fig. 1).

3. METHODOLOGY

Cartography. Studies of the Monomoy Barrier Beach System using comparative cartographic sources began in earnest in 1871 with the work of Henry Mitchell. Mitchell, a prominent scientist and accomplished topographer with the Coast Survey, relied on the accurate field work and charts of the Coast Survey to document the movement and growth of the Monomoy

Spit and its offshore shoals and to investigate the potential effect of this movement on maritime commerce (Mitchell, 1871; Mitchell, 1873; Mitchell, 1874; Mitchell, 1886; and Mitchell, 1887). This present study, employing a similar methodology of chronological cartographic and aerial photograph comparisons, continues work undertaken for the Chatham Conservation Commission more than 30 years ago on the Nauset Beach System (Giese, 1978, Giese et al., 1989).

A major goal of the present study was to develop and document a chronology of the changing form of the Monomoy barrier beach system. To help achieve this goal, methodology from the Massachusetts Office of Coastal Zone Management (CZM) Historical Shoreline Mapping Project (Mapping Project) was adapted to meet the specific requirements of the current work. The Mapping Project, completed in 2007, evaluated historical cartographic documents from the 17th century through the present to establish presumptive lines of state tidelands jurisdiction for the entire coast of Massachusetts (Mague & Foster, 2008) and the methodology used to assess and apply historical cartographic documents in a contemporary mapping context is well-documented (BSC, 2007).

The methodology of this current study is based on a six-step approach: (1) research of cartographic and archival information depicting onshore and offshore historical configurations of the Monomoy barrier beach system; (2) qualitative assessment of historical information, including maps, charts, plans and narratives, to identify documents for further consideration; (3) registration of cartographic information to the North American Datum of 1983 (NAD83); (4) analysis and assessment of registered maps and charts with verifiable spatial accuracies; (5) digitization of topographic and bathymetric barrier beach features representing the location of salt marsh, mean high water (MHW) lines, mean low water (MLW) lines, and 1-, 2-, and 3-fathom lines for the following time frames: 1853-54, 1873-74, 1886-89, 1902, 1931, 1979, and 1996; and (6) compilation of figures depicting the location of these barrier beach features for each period to facilitate a comparative analysis.

As a recognized authority for the location of historical coastal features (Shalowitz, 1964), the work of the U.S. Coast Survey and in particular the information recorded on its topographic (T-sheets) and hydrographic (H-sheets) field sheets form the basis of the chronological series of figures and cartographic comparisons considered in this study.[1] Period-specific nautical charts, where necessary, were used to clarify cartographic symbology on T- and H-sheets and to fill in gaps in spatial coverage.

The horizontal accuracies of T- and H-sheets are well documented and quantifiable, making them well-suited for historical studies (Mague, 2009). When T-sheets and H-sheets are registered using archived coordinate values for Coast Survey triangulation stations (Coast Survey, 1851; Coast and Geodetic Survey, 1894) or sheet graticules translated to the project datum in accordance with accepted procedures (BSC, 2007), they have been shown to meet or exceed National Map Accuracy Standards at their respective compilation scales (BSC, 2007; Daniels & Huxford, 2001; Crowell et al, 1991). Estimates of H-sheet accuracies, with horizontal and vertical components, are more difficult to quantify. Referenced to local MLW datums frequently defined relatively short series of tidal measurements, H-sheet sounding accuracies have been estimated to range from 3 to 4± feet for 1800s to early 1900s surveys, 2 to 3± feet for mid-1900s surveys, and 0.5 to 1.0± feet for modern surveys (Byrnes, 2002; Johnston, 2003; and U.S. Coast Survey, 1878). For shallow depths (± 15 feet), small tidal ranges, and regular bottoms with minimal relief, such as much of the area surrounding Monomoy, these estimates would appear to be conservative. Future work that includes refining these uncertainties is necessary for a detailed assessment of the sediment transport systems, nearshore and offshore processes, and the calculation of sediment budgets and volumes that contribute to the formation of the extensive shoals surrounding Monomoy, particularly the triangular area extending approximately 2 miles to the west, characterized by flat relief, a tidal range of 3 ± feet, and a significant shoal area defined by the 1-, 2-, and 3-fathom lines. (Note: 1 fathom = 6 feet).

[1] The official name of the U.S. Coast Survey has evolved over time. Reference to the Coast Survey throughout this report is meant to include the U.S. Coast Survey and its successor agencies the U.S. Coast & Geodetic Survey and the current Office of Coast Survey.

Copies of the historical plans of the U.S. Coast Survey were obtained from the digital database of the Mapping Project, which contains in excess of 2,600 historical plans, maps, and charts of the Massachusetts coast (BSC, 2007). Historical charts were obtained from the Historical Map & Chart Project website of the National Oceanic & Atmospheric Administration (NOAA) Office of Coast Survey. Contemporary charts of the area were obtained from the NOAA Office of Coast Survey Nautical Charts website. A list of all historical and contemporary cartographic information considered for this study is contained in Section 11.

Information from historical and contemporary maps, charts, sketches, and orthophotos were incorporated into a project Geographic Information System (GIS), created in ArcGIS 9.3 with MassGIS, 1:5,000 scale, 2005 orthophotos as the base map, to develop figures depicting the shape and orientation of Monomoy Spit and its nearshore bathymetry out to a depth of three fathoms (18 feet), local MLW datum. Historical cartographic manuscripts were registered to the North American Datum of 1983 (NAD83) using the ESRI, ArcGIS 9.3 georeferencing extension, set for a First Order Polynomial (Affine) Transformation. Registration points consisted of Coast Survey triangulation stations or map graticules with a minimum of six points retained for each registration with the goal of minimizing the root mean square (rms) of the error associated with the registration or control points. To the extent possible, registration points were distributed equally across each manuscript to account for potential unequal distortion of the source document.

Finally, similar to the approach of Mitchell, figures depicting the historical positions and spatial orientation of Monomoy and its offshore shoals were compiled at the same scale to facilitate qualitative comparisons of geomorphic changes over the past 160 years. These figures are presented in Section 5.

Photography. A review of historic aerial photographs was completed at the Cape Cod National Seashore (CCNS) collection, and the Barnstable Service Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA/NRCS) office. Printed photos that

cover Monomoy from 1938 and 1960 were located at the CCNS. The 1938 set does not extend northward to the southeastern shore of Chatham. A set of 1978 aerial photos ends in Chatham; it does not extend southward to include Monomoy. A set of 1947 photos also stopped in Chatham for the printed copies of the CCNS collection, however, additional photos in this series are available and could be incorporated in to future analyses.

Black and white aerial photos available from USDA/NRCS are 1938, 1951, 1971 and 1980. A set of color infrared photos are available for 1984. Orthorectified aerial photographs were available in digital format for 2009 from the Town of Chatham. A 2002 orthophoto was provided by the Town of Chatham, which was acquired by the National Fish and Wildlife Service. Additional orthorectified aerial photos were available for 1994, 2001 and 2005 from the Massachusetts state office of Geographic Information Systems (MassGIS).

Year	Description	Source Location	Comments
1938	B & W	NPS and NRCS/USDA	scanned and mosaiced, used for interpretation
1947	B & W	NPS/Aerial Viewpoint	available for purchase, may be useful for future study
1951	B & W	NRCS/USDA	reviewed, may be useful for future study
1960	B & W	NPS Highland Lab	scanned and mosaiced, used for interpretation
1971	B & W	NRCS/USDA	reviewed, may be useful for future study
1980	B & W	NRCS/USDA	reviewed, very small scale probably not useful
1984	CIR	NRCS/USDA	reviewed, may be useful for future study
1991	B & W paper	Town of Chatham	scanned and mosaiced
1994	Orthophoto	MassGIS	digital files used for interpretation
1997	B & W paper	Town of Chatham	scanned and mosaiced
2001	Orthophoto	MassGIS	digital files used for interpretation
2002	Orthophoto	DFW/Town of Chatham	digital files used for interpretation
2005	Orthophoto	MassGIS - Coastal	digital files used for interpretation
2009	Orthophoto	Town of Chatham	digital files used for interpretation

Table 1 Summary of Aerial Photo Review

Blue text denotes aerial photos used in this report. Aerial photos in green text were acquired but not utilized for this study. Black text denotes other photos that are available for the study area.

The scanned aerial photos for 1938, 1960, 1991 and 1997 were cropped and compiled in Adobe Photoshop, because there were not enough common features through time to georeference each photo frame given the dynamic nature of Monomoy. Once the photos were compiled into a montage for each year they were aligned generally in ArcView 9.3 using the georeferencing toolbar resizing and adjustment tools. There were not enough common points evenly

distributed throughout the different time series to rectify the photos with common tie points. However, the general adjustment did allow for a basic alignment of the photos for comparison and scaling purposes.

4. REVIEW OF GEOMORPHOLOGICAL HISTORY

The genesis of Monomoy as the southern extremity of a 34 km deposition feature beginning at Coast Guard Beach in Eastham, the "Nauset-Monomoy Barrier System", has been treated in detail by Goldsmith (1972). In brief, the system is a complex of barrier beaches, barrier spits, barrier islands and associated tidal inlets consisting of sediment initially supplied by the erosion of glacial deposits exposed along the 32 km-long line of east-facing cliffs and nearshore sea bed that extends northward from Eastham to North Truro.

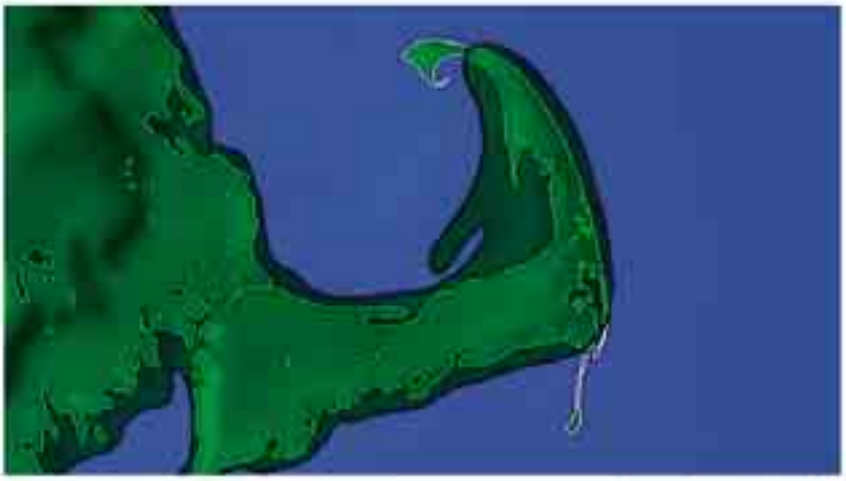
FIGURE 1

Early Holocene. As discussed in Section 5, historical geomorphic changes at Monomoy occur in step with those of Nauset Beach, however, before examining these processes in detail, let us review the broader scale development of the Cape Cod landmass during the Holocene Period – the approximately 12,000 year period following the most recent ("Wisconsin" stage) glaciation. At that time, sea level was some 55 m below its present level and most of the area comprising present-day Cape Cod Bay, Cape Cod, Nantucket Sound and Nantucket, and Vineyard Sound and Martha's Vineyard was part of the terrestrial borderland of the continental margin (Fig. 2).

Adapted from Uchupi, et al. 1996

FIGURE 2

The early Holocene was a period of rapid sea level rise. By 6,000 years B.P. (before present), sea level had risen some 45 m and was approximately 10 m below its present level. As a result of this submergence, the Cape and Islands, with their bays and sounds, became fully differentiated (Fig. 3), however, the major depositional features of outer Cape Cod, Provincetown Hook, Nauset Beach and Monomoy had not yet formed.



Adapted from Uchupi, et al. 1996

FIGURE 3

Late Holocene. Wave-driven sediment transport became the major process controlling shoreline evolution during the past 6,000 years. At the beginning of this period, George's Bank - until that time a gradually shrinking landmass between Cape Cod and the open Atlantic basin – became fully submerged. As a result, higher energy, open ocean waves - previously highly damped by the time they reached the coast – were capable of transporting increased amounts of sediment. According to Uchupi et al. (1996), glacial sediments eroded from the sea cliffs and nearshore bottom between North Truro and Eastham during this time period were responsible for the construction of Provincetown Hook to the north and the Nauset-Monomoy barrier system and Handkerchief Shoals to the south.

Notably, the rate of shoreline retreat accompanying these changes increased southward. Between about 6,000 and 1,000 years ago, the eroding bluff section retreated at an average rate of approximately 0.3 m/year at the northern end and 0.6 m/year in the south (Uchupi et al., 1996). A recent study (Giese and Adams, 2007) reports that contemporary century-scale bluff retreat rates continue to increase north-to-south by a factor of two, but the contemporary rates (ranging from 0.5 m/year to 1.0 m/year) are greater in magnitude, perhaps a response to

acceleration in the rate of sea level rise. Presently on-going research indicates that the southward increase in coastal retreat continues southward, past the end of the bluff section and along the length of Nauset Beach at least as far south as North Chatham. There, the century-scale average retreat exceeds 1.5 m/year, 3 times the retreat rate of the north end of the bluff section (Vaux, in press). Many local anecdotal reports confirm continual westward migration of Nauset Beach during the historical period (e.g., Nickerson, 1988).

If we assume, based on these rates of coastal retreat, that Nauset Beach lay 1 to 2 km offshore of its present location a thousand years ago, it seems unlikely that the origin of Monomoy predates that time. Geological maps of Cape Cod (e.g., Oldale and Barlow, 1986) indicate "ice contact" glacial deposits west of the northern section of Nauset Beach, and Uchupi et al. (1997) propose that the original eastern boundary of glacial Cape Cod lay just eastward of the present upland coasts of Nauset Harbor, Pleasant Bay, and Chatham Harbor. In that case, a long marine embayment lay inside Nauset Beach at 1,000 years BP, extending from the Eastham upland southward to the vicinity of Chatham.

Presently restricted basins such as Pleasant Bay, Little Pleasant Bay, and Nauset Harbor would have had free access to the embayment, while the embayment would have had a relatively unrestricted connection with the sea. Given this configuration, southward moving littoral sediment would not have reached the upland coast of south Chatham as it does today.

Recent history. By the time that accurate maps of the coast became available (e.g., Des Barres, 1764), Nauset Beach had migrated far enough westward to severely restrict tidal flow in the narrowing embayment. Even earlier (17th Century) sketches and notes by Champlain (1607) (Fig. 4) suggest that Nauset Harbor was already largely tidally-separated from the Pleasant Bay system to the south. The restriction of tidal flow between the Pleasant Bay basins and the open sea produced by changes in Nauset Beach have produced a quasi-cyclic pattern of tidal inlet/barrier island formation and barrier spit development (e.g., Mitchell, 1873; Goldsmith, 1972; Giese, 1978). In brief, this pattern consists of the following steps: 1) a breach in Nauset

Beach, 2) southwest migration of the southern barrier island (i.e., detached south end of Nauset Beach), 3) Nauset Beach elongation to the south, followed by, 4) a new breach.

Champlain, 1607

FIGURE 4

It is the second step of this pattern that concerns us here because an analysis of historical shoreline changes in the Monomoy region indicates that the detached end of Nauset Beach is the major sediment source for landforms in that region. As can be seen in Figure 5, adopted from a recent report by (Giese et al., 2009), following initiation of a new inlet referred to as "North Inlet" (Fig. 5b,) the former inlet ("South Inlet") closes (Fig. 5c) enabling littoral transport of sediment southward from the barrier island ("South Beach") to Monomoy.

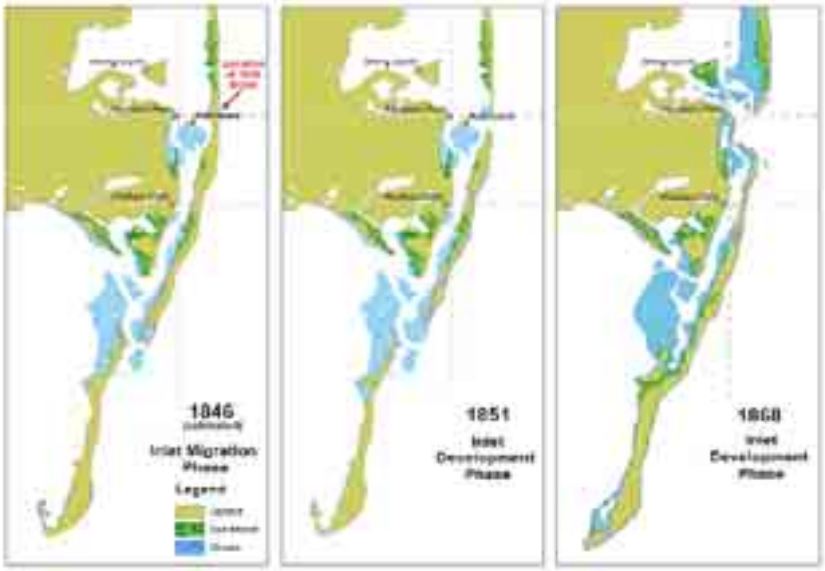


FIGURE 5 (a, b, c)

As the result of southward and westward sediment transport over the following decades (Figs. 6 and 7), Monomoy shifts westward, widens, attaches to Morris Island, and grows southward. After about a century, southward-growing Nauset Beach overlaps North Monomoy, which is deprived of incoming sediment, and begins to break-up into a group of islets and shoals. Finally, when Nauset Beach breaches again, and a new "South Beach" attaches to South Monomoy Island, a renewed sediment supply is available to nourish South Monomoy (Fig. 8c).

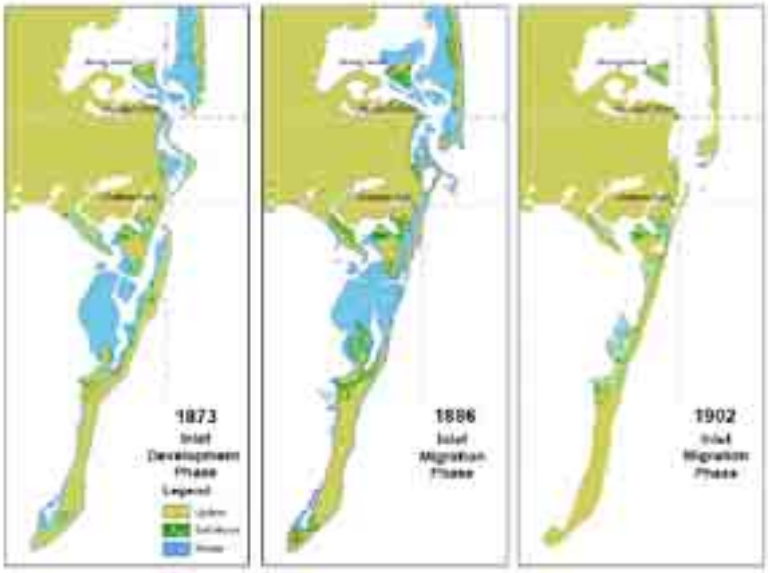


FIGURE 6 (a, b, c)

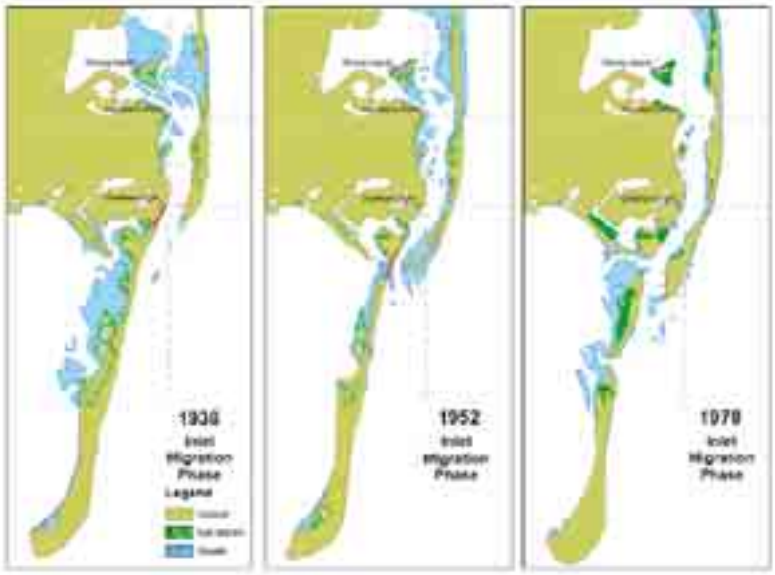


FIGURE 7 (a, b, c)

12

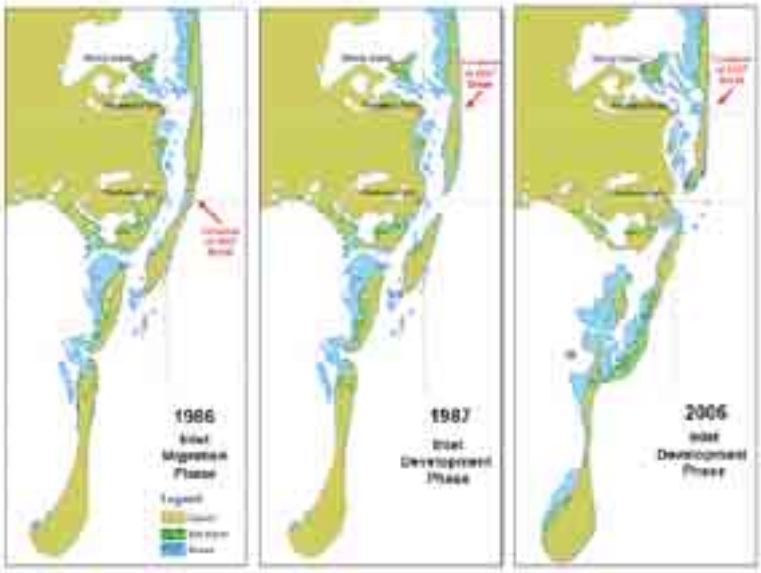


FIGURE 8 (a, b, c)

5. TIME SERIES OF MONOMOY CHANGES

The first two of the following three sub-sections present the results of cartographic and photographic research described in Section 3. The figures in *U.S Coost Survey Mapping* illustrate the general shape and position of the dominant landforms within the context of the surrounding shallow water features shown to a depth of 18 feet (3 fathoms) below mean low water. In contrast, the figures in *Aerial Photography* provide details of the changing landforms but little bathymetric information. In the third sub-section, *Discussion*, we call attention to the relationship between the landform changes and those of the surrounding bathymetry, as well as the distinction between the northern and southern sections of Monomoy.

U.S. Coast Survey Mapping.

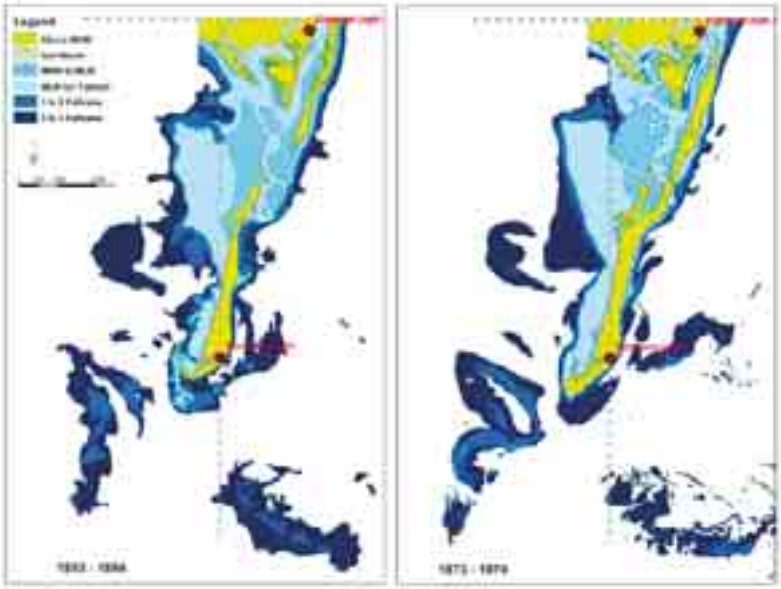


FIGURE 9 (a, b)

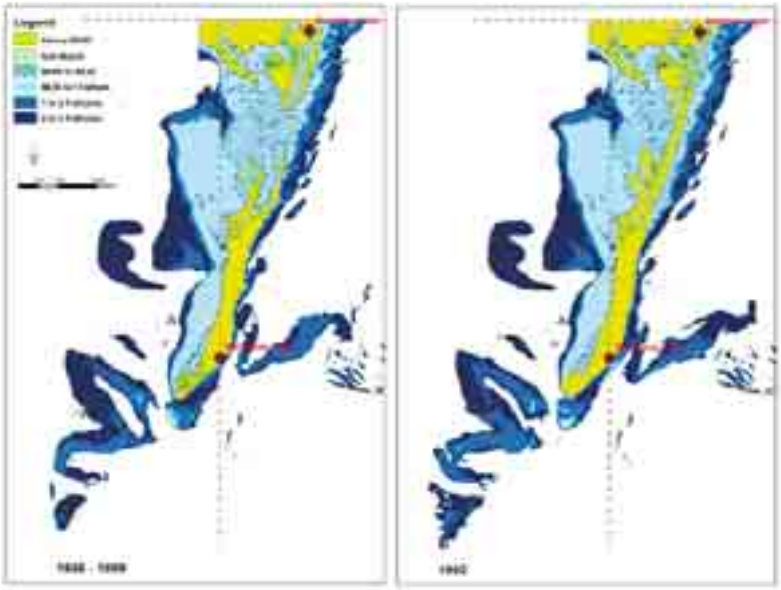


FIGURE 10 (a, b)

14

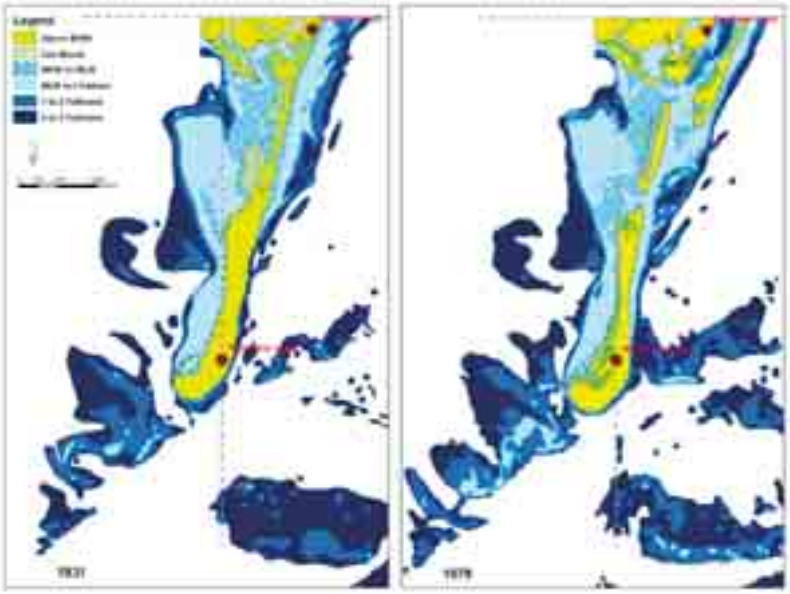


FIGURE 11 (a, b)

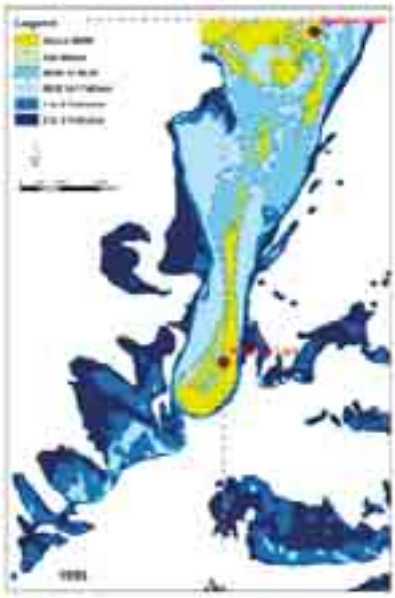


FIGURE 12

Aerial Photography.

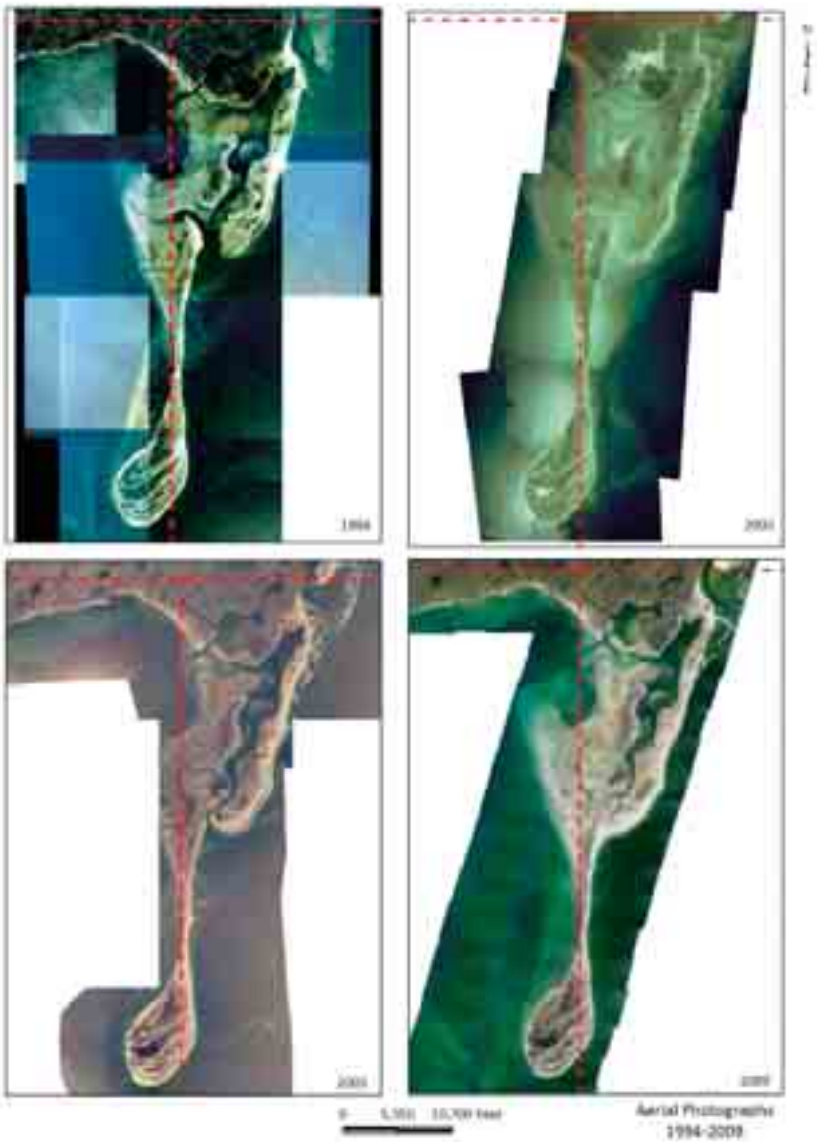


FIGURE 13

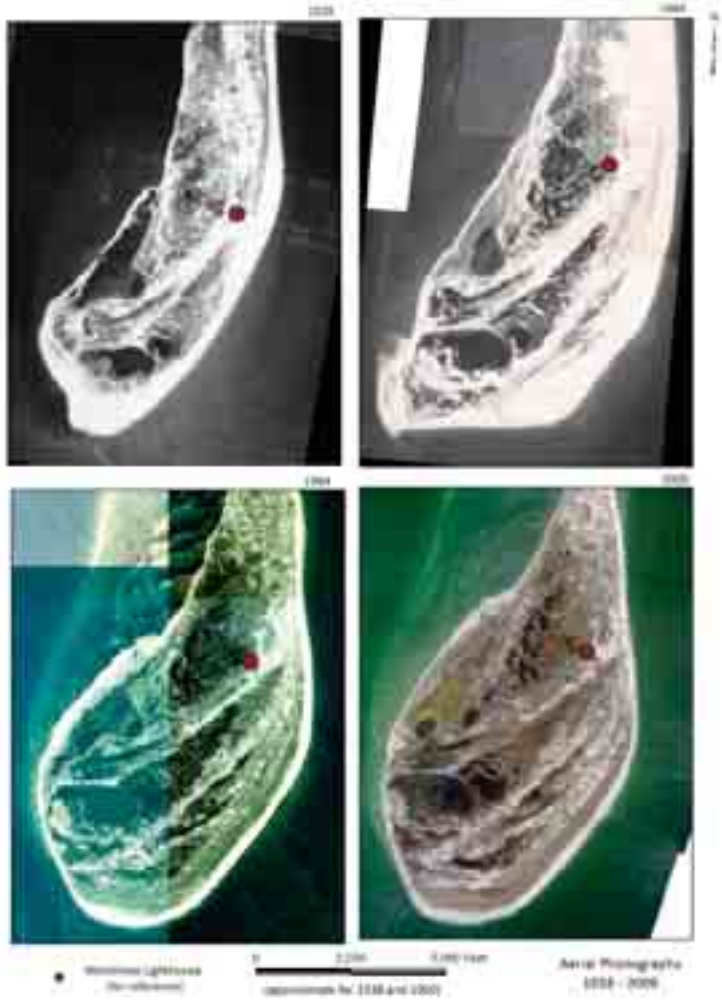


FIGURE 14

North Monomoy. Figures 9-12 reveal that Monomoy is comprised of two very distinct features. "North Monomoy" is a triangular shaped, mostly sub-tidal platform which widens northward. Subaerial landforms, when and where present, typically shift in position, size and shape. The margins of the North Monomoy Platform - well defined by the 6-foot (1 fathom) contour – appear remarkably similar in Figures 9-12 with the exception of Figure 9a, the earliest (1853-

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1854). It is likely that the somewhat irregular form of this figure's depth contours results from less accurate navigational techniques than those employed for the later surveys. The stability of the North Monomoy Platform is illustrated in Figure 15, which compares the location of the 6-foot contour in 1873-74 with its location in 1996. Both are superimposed on a 2009 photograph. The only apparent trend is on the western (Nantucket Sound) side, with a small retreat along the southwest-facing margin, and a small advance along the north-facing margin.

FIGURE 15

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Also apparent on Figures 9-12 is the mode of sediment transport from the eroding coast lying north of Monomoy (see Section 4), across North Monomoy Platform, to South Monomoy. A comparison of Figure 9 and Figure 5 illustrates the development of a second, more northerly tidal inlet in North Chatham that resulted in (1) closure of the inlet shown in Figure 9a, and (2) southward extension of the barrier spit to its north, leading to its welding onto South Monomoy (Figure 9b). Westward migration of the barrier across the platform is apparent in Figures 10a and b, leading to its eventual attachment to Morris Island (Figure 11a). At this stage, Monomoy was an unbroken peninsula connecting Monomoy Point to glacial upland in south Chatham.

This lasted only until southward extending Nauset Beach (Figures 6 and 7) reached the vicinity of Morris Island (Figure 11b) inhibiting wave-driven sediment transport along the Morris Island/North Monomoy coast. Deprived of a sediment supply, the peninsula broke down, first through a breach just south of Morris Island (1950's), then through a second breach (1978) (Figure 11b) separating North Monomoy from South Monomoy – each becoming a separate island. Tidal flow through the 1978 inlet produced a flood-tidal shoal near the western margin of the platform, which under the influence of the prevailing southwesterly wind waves, gave rise to the islet known as "Minimoy".

South Monomoy. "South Monomoy" is primarily a well-established and growing subaerial landform, consisting of dune, heathland, pond and marsh environments. It is a rare example of an actively accreting coastal landform along the exposed outer shore of Cape Cod, a distinction it shares only with the region near Race Point at the opposite extremity of the outer shore. Century-scale increase in area of the feature can be seen in the eastward and southward growth of the 6-foot (1 fathom) contour in Figure 15, and the southward extension of Monomoy Point since the mid-19th Century is clearly evident in Figures 9-12. Twentieth century change is shown in Figure 16 documenting a pattern of successive beach ridge development.

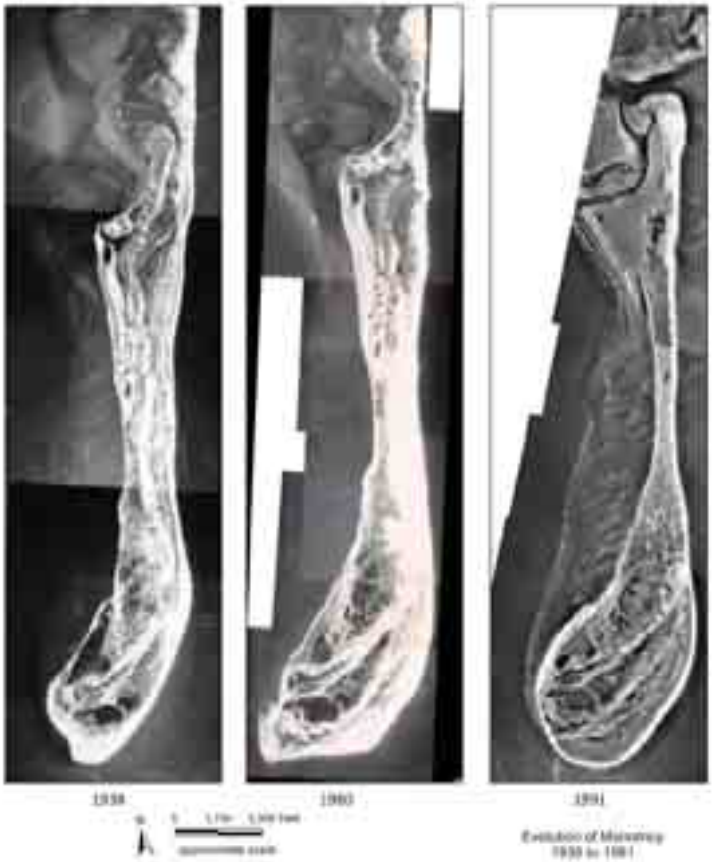

FIGURE 16

Change in location of the southern-most extremity of Monomoy Point is shown by the red vectors in Figure 17. The blue vectors in Figure 17 illustrate the change in location of the southern-most extremity of Handkerchief Shoal over the same time period. Evidently the evolution of South Monomoy is interdependent with that of Pollock Rip Channel and Handkerchief Shoal, which forms the channel's western boundary south of Butler Hole. Figure 18 shows historical locations of Monomoy Point for the years 1853, 1931, 1967, 1952 1979, and 1996, as defined by former ridge lines visible on the 2009 orthophoto.

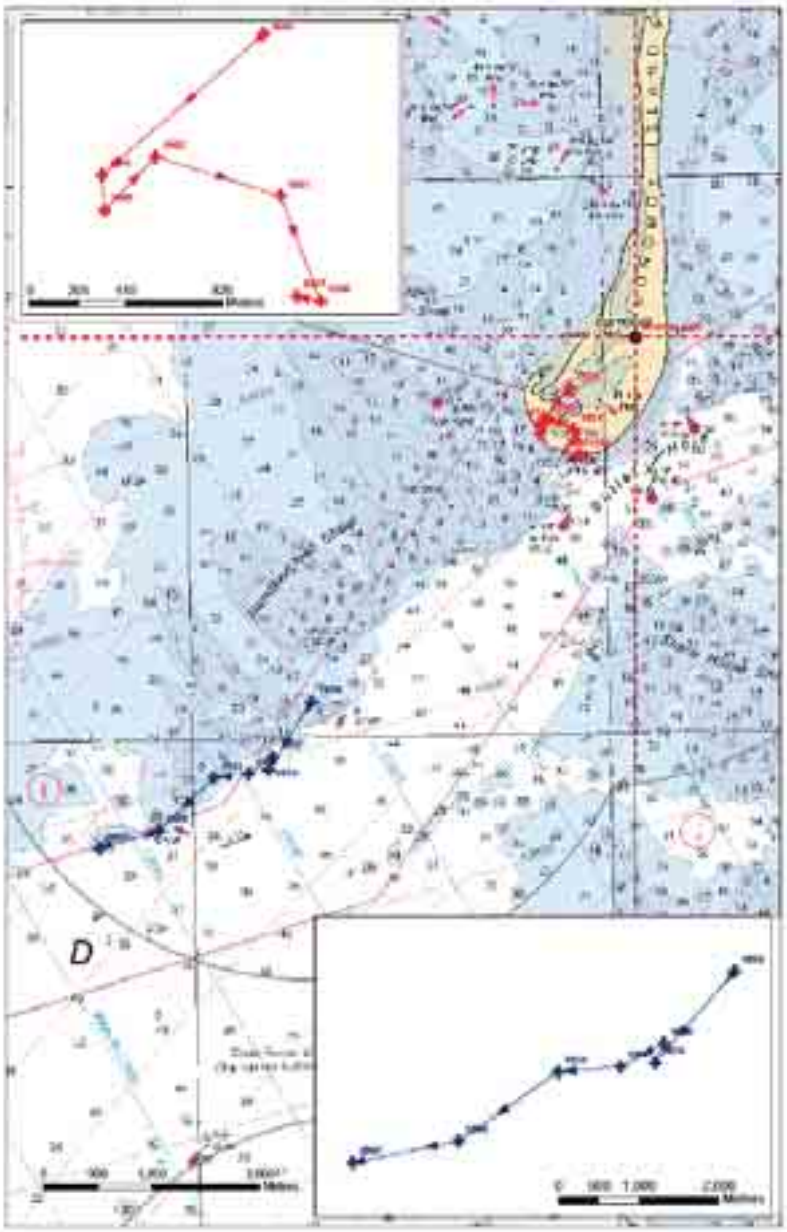

FIGURE 17

FIGURE 18

It is interesting to note in Figures 9-12 that Monomoy Point appears to have grown southward directly onto an adjacent portion of Handkerchief Shoal, and that at present, for the first time,– it directly abuts on the margin of Butler Hole. However, the figures also indicate that

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Handkerchief Shoal has developed considerably over the same time period. Together these observations suggest that future growth of Monomoy Point may follow a more southwesterly trajectory.

Figures 9 -12 also illustrate that some of the Nauset Beach-derived sediment that nourishes the growth of the eastern and southern South Monomoy continues around the point and forms the northward-trending spits that characterize the western shore of South Monomoy. The manner in which such spits develop into recurved spits that can eventually enclose ponds has been described by Zeigler, et al. (1965), who refer to Mitchell's (1886) account of the development of Powder Hole on South Monomoy:

> In my boyhood the Powder Hole was considered to be a very valuable harbor of refuge, but when I ran into it ... in 1856, forty fishing vessels ... packed it nearly full. Three fathoms at low water could be carried into this snug little place when our chart of 1854 was issued, but Mr. Chapin found but two feet at the time of his recent visit.

Wind waves from the southwest dominate sediment transport along the western coast of South Monomoy because of the extensive distance of fetch across Nantucket Sound. Winter prevailing northwesterly winds, in contrast, have a very limited fetch and, as a result, net sediment transport is directed to northward.

6. CLIMATE, SEA LEVEL AND 21st CENTURY MONOMOY

Small islands are particularly vulnerable to sea level rise (IPCC, 2007). However, this report shows that at the current rate of sea level rise, sediment supply from Nauset Beach to Monomoy is not only capable of maintaining the barrier complex, but of supporting ongoing accretion along the southern portion of South Monomoy Island.

Recent changes in global, or eustatic, sea level rise are largely driven by two phenomena: the thermal expansion of seawater as a result of increasing sea surface temperatures and the

melting of glacial ice (Williams and Gutierrez, 2009). The most recent report of the Intergovernmental Panel on Climate Change (IPCC) predicted future rises in sea level of 0.18 – 0.59 m by the year 2100 (Fig. 19; IPCC, 2007). However, some more recent studies include higher contributions from melting ice and suggest a global sea level rise by 2100 of 1 m or more (Rahmstorf, 2007; Rahmstorf, et al., 2007; Vermeer and Rahmstorf, 2009).

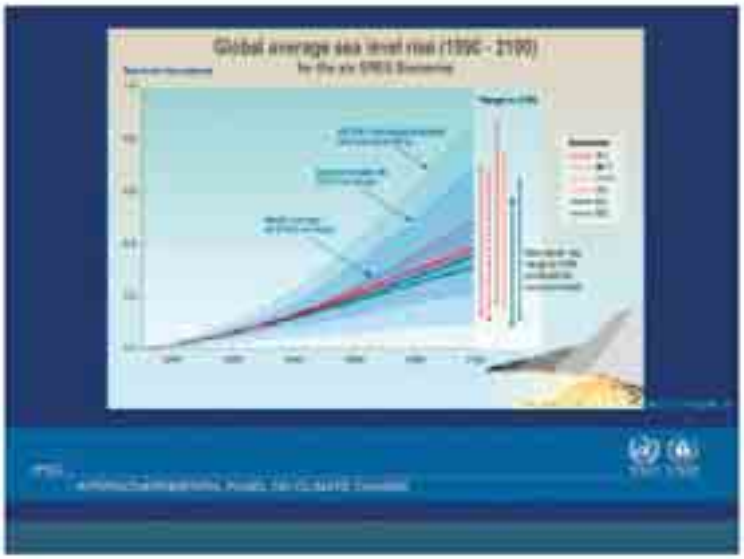

FIGURE 19

"Relative" sea level includes the augmentation or diminution by local phenomena on global sea level. Some of these phenomena include subsidence, post-glacial rebound, tectonic processes and oceanographic currents. For instance, in much of Scandinavia relative sea level is falling due to the rapid uplift of the land resulting from deglaciation since the Late Pleistocene.

Along the eastern seaboard of the U.S. researchers have identified a sea level trough maintained by the Gulf Stream and the North Atlantic Current that has kept the sea level anomalously low (Gregory, 2005; Meehl et al., 2007). Sea level in this area is 0.6 m lower than the global average and it has been shown that climate change will weaken those currents

resulting in a relative sea level change in parts of the North Atlantic. Investigators modeled several scenarios for the eastern seaboard of the United States and demonstrated that if these currents are weakened relative sea level rise could increase between 0.15 – 0.21 m along the eastern seaboard, which would be superimposed upon the global sea level rise (Yin, et al., 2009).

During the 20th Century, relative sea level in southern New England rose at a long-term rate of about 2.6 – 3 mm/year (e.g., Fig. 20) or approximately 0.3 m (one foot) , and this represented an almost three-fold acceleration of the rate that the region had experienced for many centuries (Donnelly, 2004; Fig. 21).

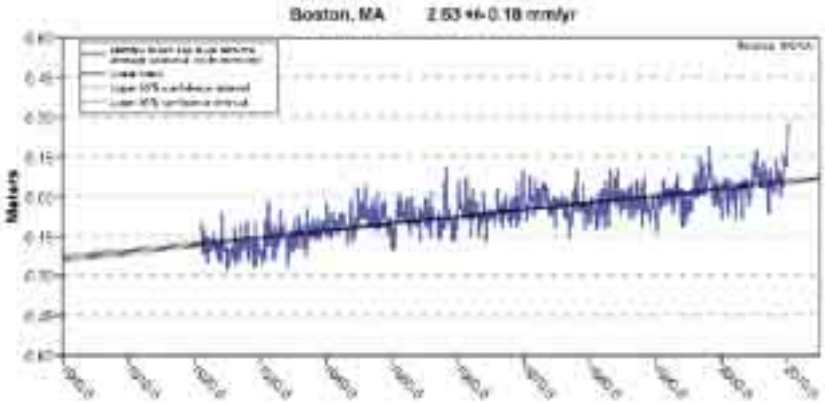

FIGURE 20

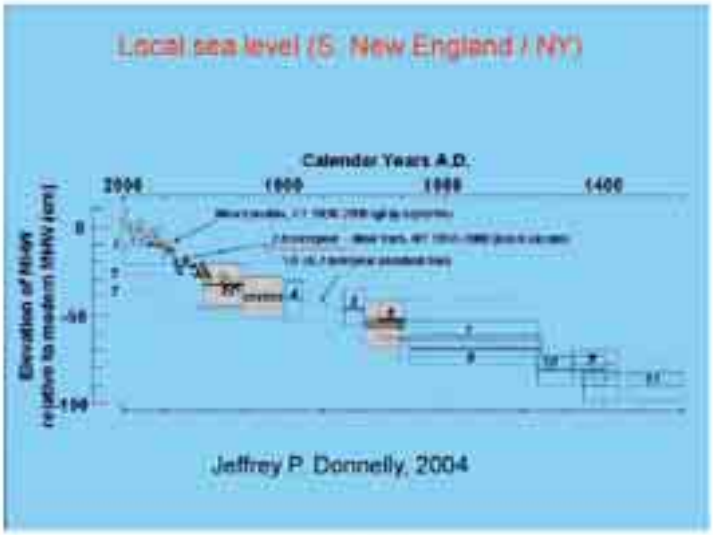

FIGURE 21

The global component of the southern New England 20th Century relative sea level rise of 0.3 m is close to the 0.18 m "low" IPCC estimate (IPCC, 2007) for the 21st Century. Therefore, under this scenario, we would expect 21st Century changes at Monomoy to follow the general patterns observed over the past century as follows:

During the 2nd and 3rd decades (2010-2030), South Beach overwashes more frequently producing washover fans on its inner (western) side; South Beach sediment moves southward along the South Monomoy outer shore; Monomoy Point grows southward/southwestward. In the 4th and 5th decades (2030-2050), South Beach overwashes thoughout its length; washover shoals reach Morris Island ending Outermost Harbor navigation; a re-curved spit, or hook, develops on southwestern side of Monomoy Point, sweeping northward. In the 3rd quarter-century (2050-2075), shoals from former South Beach end all "inside" navigation and finally connect Morris Island to South Monomoy; the Monomoy Point hook almost joins the western shore of South Monomoy. During the final quarter-century (2075-2100), Monomoy exists as peninsula for most of period, but thins south of Morris Island by close of century; Monomoy

Point extends southwestward onto nearby section of Handkerchief Shoal; and an enclosed pond forms on western shore of South Monomoy inside former re-curved spit.

This scenario for the 21st Century assumes that the major forcing factors for the period will be similar to those of the recent past, but this assumption would not be valid if global sea levels rise a half-meter or meter or more by century-end. The magnitude of relative sea level rise in that eventuality would significantly modify a number of factors affecting the evolution Monomoy, such as regional wave climate, Nantucket Sound tides, and the elevation of the ground water table.

In such a case, the resulting increase in water depths over inner- and outer continental shelf shoals, including George's Bank, could increase ocean wave energy reaching Nauset Beach and Monomoy sufficiently to markedly increase southward net sediment transport – perhaps to the extent that Chatham upland south of Minister's Point becomes directly exposed to wave action (Giese, et al., 2009). In such a case, the large amount of sediment made available between the coast and upper shoreface (c. 10 m depth) could be sufficient to maintain a permanent barrier connection between Morris Island and South Monomoy.

A marked increase in Nantucket Sound water depths could increase tidal range and currents in the eastern sound, increasing the scour of Pollock Rip Channel – an erosional trough (Uchupi, et al., 1996) – thereby adding to the bulk of Handkerchief Shoal. This, in turn, coupled with an increased supply of sediment from the north, could enhance the southwestern growth of Monomoy Point.

A large and rapid relative sea level rise would be accompanied by a similar rise in the South Momonoy water table, flooding low-lying areas and enlarging existing ponds and wetlands. Prevailing southwesterly wind waves coupled with higher sea levels could markedly increase erosion of sound-side Monomoy, narrowing the peninsula. At the same time, higher sea levels and reduced sediment supply could be expected to deepen Monomoy Flats.

In summary, while the IPCC "low" global sea level rise projection might be expected to produce patterns of change over the 21st Century that are basically similar to those of the recent past, patterns accompanying the much higher sea level rise projections would be strikingly different. As stated above, there is a general consensus in the earth science community that global sea level rise rates are increasing and will continue to increase during the 21st Century, but there is much uncertainty regarding the magnitude of that increase within the ranges discussed. Accordingly, it seems reasonable to assume that the patterns of coastal change at Monomoy during the 21st Century will follow the general trends of those experienced over the recent past, but at an accelerated pace.

7. DREDGING

Bottom sediment dredging in the vicinity of Monomoy raises question with respect to the potential negative and positive impacts of this activity on the Sanctuary. Dredging in the region is not uncommon. The entrance channel to Stage Harbor, which lies north and west of Morris Island, is a federally maintained waterway and regularly dredged. In addition, the Town of Chatham dredges to maintain safe navigation of its waters for both commercial (especially fishing) and private vessels. Past history has shown these operations to be benign with respect to local environmental impacts on water quality (e.g., turbidity, nutrients, toxins), but the need for suitable sites for dredge spoil deposition has been recognized, and the possibility of depositing such sediment within the Sanctuary has been discussed.

Such biological questions as effects of dredging activities on benthic infauna are beyond the scope of this report, but potential impacts on the physical environment can be addressed within the context of its findings. Given the history of high-energy sediment transport at North Monomoy and Monomoy Flats, the addition of suitably-sized sediment there would not appear to present difficulties. Since the potential sediment volumes involved would be small in comparison to those contributed annually by natural processes, the major impact would be to slightly increase the rate of growth of the barrier complex.

However, the suggestion of using Stage Harbor dredge spoil to create an islet, similar to "Minimoy", that would provide a suitable environment for beach nesting birds raises several concerns. First, although a northerly location on Monomoy Flats would be preferred for economic reasons, it could have negative impacts on nearby navigation channels. Second, there is the question of the lifespan of such an islet. Unlike Minimoy, which developed slowly as a flood tidal shoal over an extended period under natural conditions, a single, quickly-deposited islet would soon be reworked by waves and tides, and lacking a extended source of additional sediment, could be transformed to an inter-tidal shoal sooner than expected.

A possible alternative plan could locate a Stage Harbor dredge spoil deposition site immediately adjacent to the western shore of North Monomoy. While not providing the advantages of a separate islet, such a deposit would increase the bird nesting area and could be could be designed to be compatible in form with the existing wave-dominated shoreline.

8. FUTURE RESEARCH

Coastal Change Monitoring. Historical data discussed in this report confirm earlier suggestions that evolution of the Monomoy barrier system is closely linked to that of the Nauset Beach barrier system. Since the formation in 1987 of a new tidal inlet (now known as "South Inlet") opposite Chatham Light, the Town of Chatham has been recording annual changes in Nauset Beach using high-resolution vertical aerial photography. It would be prudent for the Sanctuary to partner with Chatham in this effort, thereby by extending the annual coverage to include all of Monomoy. Interpretation of the resulting time series of photographic images would provide invaluable guidance for Sanctuary management decision-making.

Bathymetric Analysis. The historical bathymetric data depicted on the H-sheets of the U.S. Coast Survey and its successor agencies can be an important source of information for assessing large-scale and long term coastal change in response to natural processes and human activity. When used appropriately, comparisons of H-sheets prepared at different points in time can yield important insights into changes in regional sediment transport systems, estimates of

sediment transport, and determinations of sediment budgets, which can in turn be used to study and predict geomorphic changes (Byrnes, 2002).

In order to achieve meaningful results from a comparative analysis, historical data must be translated accurately to a common, contemporary horizontal datum. Further, detailed analyses of the accuracies and uncertainties associated with the vertical data (soundings) must be conducted in order to assess the reliability of the comparative analysis for the calculation of sediment volumes. With uncertainties accounted for, these calculations may be used to quantify the net movement of sediment into and out of a study area and associated long-term net transport rates, to assess changes to sediment volumes, and to evaluate changes in nearshore bathymetry.

Recognizing the importance of the Monomoy Barrier Beach system to the local community and its significance as a coastal resource and habitat, further study of the system (beyond the scope of the current study) that incorporates a detailed and quantified assessment of historical bathymetric data depicted on the H-sheets would be an important contribution to contemporary coastal zone management decisions that will affect the long-term sustainability of areas such as the Monomoy Barrier Beach system.

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Appendix J

Malcolm Grant 2011/USFWS

Fencing exclosure to protect shorebirds from predators

Predator and Competitor Management Plan for Monomoy National Wildlife Refuge

Background and Introduction

Throughout North America, the presence of a single mammalian predator (e.g., coyote, skunk, and raccoon) or avian predator (e.g., great horned owl, black-crowned night-heron) at a nesting site can result in adult bird mortality, decrease or prevent reproductive success of nesting birds, or cause birds to abandon a nesting site entirely (Butchko and Small 1992, Kress and Hall 2004, Hall and Kress 2008, Nisbet and Welton 1984, USDA 2011). Depredation events and competition with other species for nesting space in one year can also limit the distribution and abundance of breeding birds in following years (USDA 2011, Nisbet 1975). Predator and competitor management on Monomoy refuge is essential to promoting and protecting rare and endangered beach nesting birds at this site, and has been incorporated into annual management plans for several decades. In 2000, the Service extended the *Monomoy National Wildlife Refuge Nesting Season Operating Procedure, Monitoring Protocols, and Competitor/Predator Management Plan, 1998-2000*, which was expiring, with the intent to revise and update the plan as part of the CCP process. This appendix fulfills that intent.

As presented in chapter 3, all proposed alternatives include an active and adaptive predator and competitor management program, but our preferred alternative is most inclusive and will provide the greatest level of protection and benefit for all species of conservation concern. The option to discontinue the management program was considered but eliminated due to the affirmative responsibility the Service has to protect federally listed threatened and endangered species and migratory birds. The rationale sections in alternative A, objectives 1.1 to 1.4, include information about the importance of predator management to promote nesting tern species (including federally listed roseate terns), piping plovers, and American oystercatchers. Discontinuing the predator management program would prevent us from meeting our productivity objectives for these and other high priority bird species.

Regardless of the alternative chosen, monitoring programs accompany all predator and competitor management actions; monitoring helps us evaluate the success of the management actions in meeting our objectives. The lessons we learn annually, and daily, are continually used to help us refine our future management efforts. We strive to use non-lethal methods of predator and competitor management whenever it is feasible and effective. Non-lethal methods at Monomoy refuge include, but are not limited to, predator exclosures (to protect piping plover nests from avian and mammalian predators), electric fences (to protect piping plover, least tern, and American oystercatcher nests from mammalian predators), human disturbance (to prevent gulls from nesting in tern habitat), and prescribed burning and herbicide application to improve habitat conditions for terns and deter competing laughing gulls. Often, non-lethal methods alone are not sufficient to reduce predation and competition, and lethal methods are necessary.

Although predation and competition can have a tremendous effect on beach-nesting birds, we recognize that changes in bird abundance, distribution, and reproductive success are often influenced by several other variables, including daily weather patterns, food resources, seasonal storm events, and human disturbance. We strive to manage the variables that are within our control (predator and competitor species, human disturbance) to help offset negative impacts of variables that are outside our control (weather, food resources). Monitoring programs are important, but even with careful monitoring it is sometimes difficult to make cause-effect connections between predator and competitor management efforts, and the birds' response. The collective effect of several influential variables, in addition to a lag effect of some variables, e.g., predation pressure this year can affect bird distribution in the following year, can prevent us from identifying the effect of any one variable in a given year.

However, there is a general inverse correlation on Monomoy refuge between the number of predators removed in a given year and the productivity of beach-nesting birds in that year. For example, in both 2007 and 2009, higher numbers of black-crowned night-herons, gulls, and coyote were lethally removed from the island, indicating these years were characterized by extreme predator pressure. In both years, piping plover and common tern productivity were below the threshold needed to maintain these populations and meet our biological objectives. Based on our experience and knowledge of the refuge and wildlife interactions, we believe piping plover and common tern productivity would have been lower had these predators not been removed.

The predator and competitor species discussed in this plan include all species that were addressed in the original plan, additional species that have since become prevalent on Monomoy refuge, and species that may become prevalent in the future. However, we recognize that additional species that we have not considered here may

be influential predator or competitor species in the future and may result in additional analysis to determine if management is warranted. In this appendix, we provide information about each predator and competitor species, including a summary of their population status, impacts to birds of conservation concern, proposed management techniques (lethal and non-lethal) for our most inclusive alternative presented in chapter 3 (proposed alternative), and impacts of management to targeted species. We encourage the reader to read the rationale sections in chapter 3, which additionally provide information about the role that predator and competitor species have played in limiting beach-nesting birds of conservation concern. A thorough analysis on the impacts of predator management to all avian and mammalian target predators included in this appendix has been previously discussed in an environmental assessment prepared by U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS), Wildlife Services, in March 2011. The environmental assessment was completed in cooperation with the U.S. Fish and Wildlife Service. We encourage the reader to review this document for more detailed information, and have noted throughout this appendix relevant page numbers in that document.

Species-specific Predator and Competitor Management

1. Eastern Coyote

Population Status:
Eastern coyotes were first documented in New England in the 1930s (Richens and Hugie 1974) and in western Massachusetts in the late 1950s (Pringle 1960). They are thought to have expanded to Cape Cod by the late 1970s (Way 2002).

Eastern coyotes are now well established throughout most of Massachusetts (except Nantucket and Martha's Vineyard) and the State's population has likely been stable at about 10,000 animals since the mid-2000s. When individuals die or are lethally removed, territories are quickly filled with new generations of coyotes. The territories can be taken over by transients, i.e., individuals that do not currently maintain a territory, or by a member of the family group. Eastern coyotes are classified as a furbearer species in Massachusetts with an established hunting season. The total number of eastern coyotes harvested Statewide, and from within the southeast district (which includes Cape Cod and the islands) is in table J.1. Beginning with the 2007/2008 hunting season, the Massachusetts Division of Fisheries and Wildlife expanded the eastern coyote hunting season by 5 weeks, and the number of eastern coyotes harvested more than doubled from the 2006/2007 season. The increase in harvest numbers reported in this year may also be attributed to the increase in check stations throughout the State in 2007/2008. The number of check stations has remained stable since the initial increase in 2007/2008. Harvest has been stable between 400 to 500 coyotes (with the exception of 09/10) for the last 5 seasons. Since the 2006/2007 season, the number of eastern coyotes harvested annually from the southeast district (which includes Cape Cod and the islands) has numbered more than 100, and it is likely that the number of eastern coyotes on Cape Cod has also stabilized since the mid-2000s (Hajduk-Conlee 2013 personal communication).

Table J.1. Eastern Coyote Harvests in Massachusetts 2002 to 2013.

Hunting Season	Total # Eastern Coyotes Harvested State-wide	# Eastern Coyotes Harvested in Southeast District (% of Total)
2002 / 2003	85	19 (22%)
2003 / 2004	176	57 (32%)
2004 / 2005	190	60 (32%)
2005 / 2006	188	79 (42%)
2006 / 2007	242	103 (42%)
2007 / 2008	532	203 (38%)
2008 / 2009	513	167 (33%)
2009 / 2010	599	164 (27%)
2010 / 2011	489	174 (36%)
2011 / 2012	449	117 (26%)
2012 / 2013	470	115 (24%)

Eastern coyote tracks were first observed on Monomoy refuge on South Monomoy Island in 1996. In 1997, 3 sets of tracks were documented together, suggesting the presence of more than one individual. One dead eastern coyote was found on the west shore of South Monomoy Island in July in 1997, and in 1998 eastern coyotes were confirmed to be denning on South Monomoy Island. Since that time, eastern coyotes have denned on the refuge nearly every year. Eastern coyote presence on the island increased in the mid-2000s and has remained high since then. One reason for the increased number of eastern coyotes on the refuge, beginning in 2005, was the proximity of neighboring South Beach. Due to cyclic movement of sand in the area, the tip of South Beach extended closer to the north end of South Monomoy in 2005. At that time, the crossing was only several hundred yards wide and easy for eastern coyotes to navigate. An eastern coyote was observed exiting the channel from South Beach to South Monomoy Island in 2005 by refuge staff, and on several occasions eastern coyote tracks were seen leading to the water's edge on both South Beach (Jedrey 2013 personal communication) and South Monomoy Island, indicating regular movement across this channel. As the flats surrounding the Monomoy Islands continued to expand, crossings also become possible at several additional locations during low tide. Eastern coyotes were seen crossing from North Monomoy Island to the north tip of South Monomoy Island on several occasions, and tracks seen throughout the season indicated that crossings occurred regularly between the two islands in 2005. Eastern coyotes were also likely crossing from Morris Island to North Monomoy Island at that time. By the fall of 2006, the channel between the tip of South Beach and South Monomoy Island filled in and formed a land bridge connecting South Monomoy to the mainland, providing easy access for eastern coyotes. This land bridge formation is still intact, but in February 2013 a blizzard caused a new break in South Beach approximately 3 miles north of the land bridge, effectively separating South Monomoy from the mainland once again. During the 2013 nesting season, we observed less coyote activity on South Monomoy as a result of this break. The sediment in and around this new channel is continually shifting and the break is not likely to be permanent. Although the width of the channel can be ¼ mile wide at high tide, one storm could cause the break to abruptly fill in and reconnect South Monomoy to the mainland, or it could gradually fill back in and cause a reconnection.

Impacts to Birds of Conservation Concern:
Coyotes have been widely documented as predators on least terns (Butchko and Small 1992, Krogh and Schweitzer 1999, Adrean and Jedrey 2007), piping plovers (Adrean and Jedrey 2007), common terns (USDA 2011, Kress and Hall 2004), and American oystercatchers (Schulte et al. 2010). Management has been implemented at many sites (USDA 2011, Butchko and Small 1992, Bent and Taygan 2010). On Monomoy refuge, eastern coyotes have been documented preying on all ground-nesting birds, including least and common terns, piping plovers, American oystercatchers, gulls, and waterfowl, as well as seals and other non-focal species such as Canada goose and voles. Eastern coyote presence on Cape Cod and southeastern Massachusetts nesting sites is frequent and has increased in the last 10 to 15 years (Adrean and Jedrey 2007, USDA 2011, Monomoy field season reports, Bent and Taygan 2010).

Coyotes are problematic to nesting birds for several reasons. They are nocturnal and easily move from nest to nest in dense nesting colonies, preying on eggs, chicks, and incubating adults. In addition to direct predation, eastern coyote presence in the colony at night elicits defense-attack responses by adult terns, leaving chicks vulnerable to other opportunistic predators and inclement weather (particularly cold and rain). When eastern coyotes successfully den, adults are motivated to hunt more to provide food for their pups. When pups are old enough to travel from the denning site, adults may take pups into nesting colonies to teach them how to hunt and kill. Therefore, in years when eastern coyotes successfully raise pups, there is likely to be greater loss at nearby nesting sites.

Eastern coyotes have been the most prevalent mammalian predator on the refuge during the last 12 years, and in most years refuge staff document them depredating on terns, piping plovers, and American oystercatchers. The extent of depredation varies from year to year, however, the result in some years is significant nest loss and lowered productivity. For example, in 2002 and 2009, consistent eastern coyote depredation resulted in extensive nest loss and lowered reproductive success to nesting common terns (USFWS 2003, USFWS 2012). In most years since 1998, eastern coyotes also attempted to den on the refuge (USFWS annual field season activities reports from 1998 to present) and adult eastern coyotes have taken mobile pups hunting in the tern colony (Koch 2012 personal observation). Similarly, although not quantitatively monitored, eastern coyotes frequently prey on least tern eggs and chicks, and in some years, eastern coyote tracks are regularly seen traversing least tern nesting areas (USFWS 2012a). Eastern coyotes have been effective predators on piping plovers as well, and

were responsible for predating four plover nests (of nine lost nests for which cause of loss could be identified) in 2009 (USFWS 2012) and at least nine plover nests (the most common known cause of nest loss) in 2011 (USFWS unpublished data). Quantifying the total loss of productivity from eastern coyotes can be difficult because often no evidence of take is left behind; therefore, the observed loss is generally an underestimate of the actual loss. Coyote stomach dissection gives a general sense, however, of how catastrophic eastern coyotes can be to productivity on Monomoy refuge. For example, an eastern coyote stomach collected in 2006 contained 69 common tern chicks, likely representing one night of feeding (USFWS unpublished data.). In 2009, two coyote stomachs collectively contained 75 common tern chicks (USFWS 2012). Similarly, stomach dissection of an eastern coyote removed from another nesting site in Massachusetts in June 2010 revealed 3.4 pounds of tern chicks, which equates to 50 to 100 chicks taken in one night of hunting (USDA 2011). Eastern coyotes can frequent the tern colony dozens of nights in a season, and the number of chicks lost can quickly add up (USFWS field season reports 2001 to current).

In general, productivity of piping plovers and common terns has decreased over time, as more eastern coyotes have been observed in and around the nesting areas (USFWS field season reports). In most years, the number of eastern coyotes lethally removed from the refuge is generally positively correlated with the degree of predator pressure (table J.2); the higher the predator pressure, the lower the productivity. Therefore, it is likely if eastern coyotes were not removed from the refuge in these years, productivity would have been further suppressed.

In addition to the impact coyotes have on nesting piping plovers, American oystercatchers, and terns, they may be responsible for the precipitous decline in nesting herring and great black-backed gulls on South Monomoy in recent years. Chapter 2 contains details of nest counts of herring and great black-backed gulls through the 1900s. In recent years, complete counts of nesting gulls have been conducted on North Monomoy Island in 2000 and 2007. South Monomoy was surveyed using aerial photography in 2000, and was surveyed using a stratified random-sample transect method in 2007. In 2000, 1,609 herring gull nests and 1,018 great black-backedgull nests were counted on North Monomoy Island, but the aerial photography for South Monomoy was never full analyzed (Koch 2013 personal communication). In 2007, 1,245 herring gull nests and 683 great black-backed gull nests were counted on North Monomoy Island (USFWS 2009b), and 1,088 herring gull nests and 2,490 great black-backed gull nests were estimated on South Monomoy (Koch 2013 personal communication), for a total refugewide count of 2,333 herring gull nests and 3,173 great black-backed gull nests. In 2013, a gull census was conducted on both North Monomoy Island and South Monomoy, using the same methodology as in 2007. Data compilation is still ongoing but preliminary numbers for North Monomoy Island are 1,180 herring gull nests and 995 great black-backed gull nests. On South Monomoy, no herring gull nests were observed on transects, and the total number of great black-backed gull nests islandwide likely numbered less than 100 (Iaquinto 2013 personal communication). This sharp decline in nesting gulls on South Monomoy did not occur on North Monomoy Island, suggesting the cause was specific to South Monomoy. It also coincides with the connection of South Monomoy to South Beach, and increased presence of coyotes on South Monomoy. Evidence of coyotes preying on herring and great black-backed gulls on Monomoy refuge has been frequently observed, but not systematically documented (Koch and Iaquinto 2013 personal communication).

Current and Future Management Techniques:
The refuge employs a variety of non-lethal and lethal techniques to minimize eastern coyote depredation. Non-lethal techniques are only effective in some circumstances, and include the use of electric fencing (to protect least tern, American oystercatcher, and piping plover eggs) and individual nest exclosures (to protect piping plover eggs). These methods can also be effective in deterring other predators, and are explained in more detail in the Non-lethal Methods Common to Many Predators section of this plan.

Beginning in 1998, focused lethal eastern coyote management has been conducted annually to prevent establishment on the refuge and minimize depredation on nesting birds. We have adopted a zero tolerance policy for eastern coyotes on South Monomoy and North Monomoy Islands during the nesting season because of the impact they can have on nesting birds. Service staff or contractors shoot eastern coyotes that are present on South Monomoy or North Monomoy Island from April through August. They are not managed in other months of the year because they don't present a threat to refuge resources outside the bird nesting season. Eastern coyotes may be shot while opportunistically observed traversing the refuge, or located with the use of dogs trained

specifically to hunt coyotes. Efforts to remove eastern coyotes are especially important in the early spring to increase the chances that adults do not raise young successfully on the refuge. Any young that are found during the bird nesting season are also shot.

A total of 189 eastern coyotes (adults and pups) have been lethally removed (mostly from South Monomoy, except pups in 2009) between 1998 and 2012 as part of the predator management program (table J.2).

Table J.2. Annual Eastern Coyote Management and Bird Productivity on Monomoy NWR (1998 to 2012).

Year	# Adult Eastern Coyotes Removed	# Pups Removed	Total Piping Plover Nests Lost (% of Total Lost to Known Causes) to Eastern Coyotes	Total American Oystercatcher Nests Lost (% of Total Lost to Known Causes) to Eastern Coyotes	Common Tern Productivity
1996	0	0	0	0	1.50
1997	0	0	0	0	1.70
1998	1 female	0*	2 (15%)	No data	1.83
1999	1 female	0*	0	No data	1.61
2000	2 males	8	0	No data	1.85
2001	1 unknown	12	0	No data	1.20
2002	0	10	3 (12%)	1 (25%)	0.70
2003	4 females, 2 males	0	5 (19%)	9 (26%)	1.26
2004	11 females, 6 males	3	7 (41%)	7 (30%)	1.59
2005	1 female, 4 males	0	0	7 (18%)	1.41
2006	2 females, 6 males, 1 unknown	0	3 (33%)	2 (20%)	0.96
2007	5 females, 10 males	4	4 (44%)	5 (45%)	0.70
2008	7 females, 12 males	0	4 (18%)	4 (24%)	1.12
2009	9 females, 16 males, 1 unknown	4	4 (44%)	4 (44%)	0.35
2010	5 females, 6 males, 1 unknown	7	0 (0%)	5 (50%)	1.25
2011	3 females, 7 males, 1 unknown	2	10 (71%)	5 (36%)	1.28
2012	2 females, 5 males	7	8 (33%)	2 (12%)	1.38
Total	132	57			

**Although no pups were removed in these years, coyotes were confirmed to have pups on South Monomoy Island.*

In most years, even with an adaptive management approach, we are not able to remove all coyotes. Our level of success at removing coyotes varies depending on weather, funding, and availability of experienced personnel.

Impacts of Management to Eastern Coyote Population:
Given the Statewide estimated population of 10,000 eastern coyotes and the likely population stabilization since the mid-2000s (Hajduk-Conlee 2013 personal communication), it is not likely that the removal of 189 adults from Monomoy refuge in the last 15 years is impacting the local population any more than the annual hunting pressures. Between 2002 and 2012, 3,463 eastern coyotes have been harvested in Massachusetts through the regulated harvest seasons. During this timeframe, 164 eastern coyotes were lethally removed from Monomoy refuge, representing less than 5 percent of the total State harvest. Additionally, the maximum removed in any one year was 30 coyotes (2009); this represents 0.3 percent of the total eastern coyote population. Therefore, lethal removal on Monomoy refuge is not impacting the overall State population.

It is possible that more eastern coyotes will be removed from Monomoy refuge annually in future years. Even if 50 eastern coyotes are removed in a given year, it is still less than 1 percent of the State's population. The fact that the State has not set a limit on the number of eastern coyotes that may be taken during the State-regulated harvest seasons additionally suggests that the species is not at risk for overharvesting (USDA 2011).

2. Other Mammalian Predators Including Gray Fox, Red Fox, Virginia Opossum, Raccoon, Red Fox, Striped Skunk, Long-tailed Weasel, Short-tailed Weasel, River Otter, Mink, and Fisher

Population Status:
There are no population estimates for furbearer species (other than coyotes) in Massachusetts, but all populations are considered to be stable. The Massachusetts Division of Fisheries and Game establishes harvest seasons for red fox, gray fox, opossum, raccoon, striped skunk, weasels, mink, and river otter. Harvested gray fox, red fox, mink, and river otter are required to be reported to a check station so the State has harvest information for all animals that were taken by permit or salvage (road kill). Total harvests for the last 3 seasons are listed in table J.3 below.

Table J.3. Harvest Information for Furbearer Species in Massachusetts from 2010 to 2013.

	Gray Fox	Red Fox	Virginia Opossum	Raccoon	Striped Skunk	Weasels	River Otter	Mink
2010/2011	49	55	74	237	12	6	79	35
2011/2012	38	42	43	287	15	9	88	38
2012/2013	57	47	not yet compiled	not yet compiled	not yet compiled	not yet compiled	156	50

Impacts to Birds of Conservation Concern:
Small mammals can be a risk to beach nesting adult birds as well as their chicks and eggs (USDA 2011, Kress and Hall 2004, USFWS 1988, USFWS 1996). All the refuge focal bird species are potentially at risk from small mammal predation. Many small mammals, including opossum, are opportunistic feeders, and eggs are considered a basic part of their omnivorous diet (Burt 1976). Mammals are also often active during the night when they are less visible to incubating adults. Given their powerful sense of smell, small mammals can find nests in the dark and often take out a series of nests in one night.

It is possible that as South Monomoy grows due to sand deposition, mammalian predator populations on the island may also increase. Access to the island had become easier for land- based mammalian predators since the connection to South Beach in November 2006 and an increase had been seen in mammal activity on South Monomoy. However, the recent separation of South Beach from the mainland (refer to the Eastern Coyote section) may help reduce mammalian predation pressures on Monomoy refuge.

When the island first became isolated from the mainland, the Service removed red fox. Mammal sightings were rare through the 1980s (long-tailed weasel in 1983, Norway rats in 1985, raccoon in 1986). Red fox, Virginia opossum, raccoon, striped skunk, and river otter have all been periodically noted on the refuge since 2000. A red fox washed up on the north tip of South Monomoy in 2007, but evidence of live red fox on the island has not been documented in recent years. Virginia opossums were seen or confirmed as present most years between 2007 and 2012, though predation on beach-nesting birds was only confirmed in 2008 and 2009. In 2008, nine adult Virginia opossums were lethally removed, including four females with young. The stomachs of two of the opossums removed contained eggshells (USFWS 2009c). In 2009, one Virginia opossum was lethally removed from the tern colony. Its stomach contained eggshells and yolk. Three additional animals were found dead during this year (USFWS 2012). Raccoons were first seen on the island in recent years in 2005 when a dead animal washed up. A second animal was lethally removed this year (USFWS 2009a). From 2007 to 2009, four more animals washed up dead on the refuge but evidence of live animals (tracks) weren't documented again until 2010 and 2011 (USFWS 2009b, USFWS 2009c, USWFS 2012, USFWS unpublished data). Tracks and a raccoon carcass were observed on South Beach near the South Monomoy connection in 2012 (Iaquinto 2013 personal communication). Striped skunks were first seen on the refuge in 2000, and one animal was lethally removed. In 2001, a striped skunk was

shot and removed from the refuge. In 2011 skunk tracks were seen near the lighthouse, but no predation was observed (USFWS unpublished data). Evidence of river otter (mostly tracks) has been documented in 2005, 2007, 2009, 2011 and 2012, (USFWS 2009a, USFWS 2009b, USFWS 2012, USFWS unpublished data) and although they are a suspected predator, this has not been confirmed. Lastly, in 2009 three predated common terns were examined by the National Wildlife Health Center. Puncture wounds on all three terns indicated a canine bite, and the spacing suggested the predator was mink, fisher, or river otter (Organ 2011 personal communication). Gray fox and long- and short-tailed weasels have not been documented on the refuge in recent years of monitoring.

Current and Future Management Techniques:
Since small mammals have not been prevalent predators on the refuge in most years, efforts to remove them have been infrequent and focused. Personnel are prepared to shoot small mammals when observed during night stints in the same manner as described for coyotes and black-crowned night-herons. Signs of depredation and presence in the tern colony and around beach nesting bird areas are recorded when observed.

Several non-lethal techniques are also effective at reducing small mammal depredation on eggs, including the use of electric fencing (to protect least tern, American oystercatcher, and piping plover eggs) and individual nest exclosures (to protect piping plover eggs). These methods can be effective at deterring several predators under some circumstances, and are explained in more detail in the non-lethal section of this plan.

Preparedness for managing mammalian predators will continue and mammalian predators will be removed when appropriate. We will also continue to document impacts from mammalian predators.

Impacts of Management to Target Mammalian Predators:
Although there are no current State population estimates for any furbearer species (other than coyotes) in Massachusetts, all are considered stable, and most do not have harvest limits during the harvest seasons, suggesting they are not at risk for overharvesting (USDA 2011). Since 2000, only two striped skunk, one raccoon, and ten adult Virginia opossums have been lethally removed from the refuge and this certainly has had no impact on the State's populations.

The environmental assessment prepared by USDA APHIS in 2011 includes an effects analysis of their management actions for all small mammal predators, including Virginia opossum (pages 50 and 51), red fox (pages 54 to 56), gray fox (pages 56 to 58), raccoons (pages 58 to 60), fisher (pages 60 and 61), short-tailed weasel (pages 61 and 62), long-tailed weasel (pages 62 and 63), mink (pages 63 and 64), and striped skunk (pages 64 to 66). Because population estimates are not available for these species, APHIS estimated conservative populations based on typical species densities and amount of available habitat. They calculated the maximum of each species that they would lethally take as part of their annual management actions, and calculated the percentage of the total population that maximum take represents. For fisher and mink, maximum lethal take was compared to recent harvest numbers, instead of an estimated statewide population. This is presented in table J.4.

Table J.4. Estimates of Predator Populations and Harvest (APHIS 2011).

	Virginia Opossum	Red Fox	Gray Fox	Raccoon	Fisher	Short-tailed Weasel	Long-tailed Weasel	Mink	Striped Skunk
Most Conservative Population Estimate*	5,100 to 79,200	10,200	12,200	7,900	1,707	20,580	17,640	149	32,500
Maximum Annual Take	50	50	50	50	50	50	50	15	50
Percent of Total Population**	0.1 to 1	0.5	0.4	0.6	11.7	0.3	0.3	10	0.2

** Total harvest from 2006 to 2009 for fisher and mink*
*** Percent of total harvest from 2006 to 2009 for fisher and mink*

Mammalian predator pressure may increase in future years, resulting in higher lethal take of mammals from the refuge. While we can't predict how many predators we are likely to remove, annual take will almost certainly be below the maximum annual take in the table above, and well below 1 percent of the total population.

3. Black-crowned Night-Heron

Population Status:
Throughout the Commonwealth of Massachusetts, colonies of nesting black-crowned night-herons have generally been declining and becoming more widely dispersed, although increases have been observed in some years. Black-crowned night-herons declined from an estimated 3,300 to 3,600 pairs in 1955 through the early 1970s. Although they increased to nearly 2,000 pairs in 1977 (Erwin 1978, Erwin and Korschgen 1979), only 973 pairs were counted during a coastwide survey in 1984 (Andrews 1990). Coastwide surveys were repeated from 1994 to 1995 and 2006 to 2008, and a 45 percent decline was documented between these two surveys, with only 781 pairs counted at 14 sites most recently (Melvin 2010a). Statewide surveys of black-crowned night-herons were conducted in 2013, but survey results have not yet been compiled.

The number of nesting black-crowned night-herons on Monomoy NWR increased from 12 pairs in 1980 to 200 pairs in 1987. In most years since 1996, when annual surveys were initiated, between 150 and 250 black-crowned night-herons have nested on Monomoy refuge (see table J.5). Monomoy NWR is an important nesting site in Massachusetts and was one of only 14 nesting sites in 2008, with about 20 percent of the State's nesting total (Melvin 2010a).

Impacts to Birds of Conservation Concern:
Black-crowned night-herons are also nocturnal predators and will prey on eggs and chicks, especially beginning in late June when tern chicks are hatching and many young chicks are present. Black-crowned night-herons may also teach their young to hunt in tern colonies and we often observe juvenile black-crowned night-herons feeding in the tern colony at Monomoy refuge (USFWS 2003a, 2009d, 2007a, 2007b). Night-heron predation has been documented at other tern nesting sites as well (Collins 1970, Hunter and Morris 1976, Kress and Hall 2004), and because individual night-herons are likely specialist predators, removing these specialized individuals can significantly improve tern productivity (Hall and Kress 2008).

Black-crowned night-herons were significant predators of tern eggs in 1982, 1984 (Fitch and Folger 1983, Fitch 1985), and 1985 to 1987 (Humphrey personal communication as in USFWS 1988). For several years in the late 1970s and early 1980s, Massachusetts Audubon Society tern biologists and Service employees held State and Federal permits to shoot individual night-herons identified as tern predators.

In 1997, removal of predatory black-crowned night-herons resumed (table J.5) due to the impact they were having on the newly established tern colony. The extent of black-crowned night-heron presence in the tern colony has varied among years, but was most extensive in 2002, 2003, and 2004. During these years, black-crowned night-herons were present in the tern colony more than 20 nights each year (table J.5). This is probably an underestimate, as visibility was often limited by weather, failed night vision equipment, dense vegetation, and the overall size and expanse of the colony. Often more than one black-crowned night-heron was in the colony on one night (USFWS 2003, USFWS 2007a, USFWS 2007b). In 2002, four black-crowned night-herons were removed on one night (USFWS 2003). Extensive egg and chick loss was documented in 2002 to 2004 (table J.5); however, the numbers of eggs and chicks taken likely represents a minimum because terns may clear their nesting area of depredated egg shells before they are checked by staff, and chicks, especially the very young, are often eaten whole. Black-crowned night-herons were dissected after removal and tern chicks were often found in the digestive tracts, with a maximum of seven chicks found in one black-crowned night-heron (2004).

Table J.5. Black-crowned Night-Heron Predation and Removal in Monomoy NWR Tern Colony (1996 to 2012).

Year	Nights in the Tern Colony	Minimum Total Eggs and Chicks Depredated	Adults Removed	Juveniles Removed	Total Nesting Black-crowned Night-herons	% of Total Adult Birds Removed
1996	0	0	0	0	460	0
1997	9	0	4	0	450	0.9
1998	0	0	0	0	364	0
1999	11	9	0	0	386	0
2000	0	0	0	0	382	0
2001	0	0	0	0	414	0
2002	36	210	7	3	498	1.4
2003	30	254	3	1	482	0.6
2004	22	404	8	1	400	2.0
2005	11	10	2	0	334	0.6
2006	4	45	0	0	316	0
2007	9	169	1	1	278	0.4
2008	6	29	0	0	300	0
2009	10	117	3	0	216	1.4
2010	1	8	0	0	296	0
2011	3	12	0	0	no data	0
2012	1	21	0	0	326	0

In addition to predation on common tern chicks and eggs, black-crowned night-herons have been documented on Monomoy refuge depredating eggs of laughing gulls, black skimmers, and American oystercatchers (USFWS 2007b), as well as an American oystercatcher chick (USFWS 2009b).

Current and Future Management Techniques:
Black-crowned night-herons observed predating in the tern colony or on other beach nesting species of conservation concern will be shot. Black-crowned night-herons observed flying over the tern colony or walking near the tern colony and not disturbing terns are not considered predatory and are not targeted (Megyesi 1997). Black-crowned night-heron removal generally occurs from dusk to dawn. Total number of black-crowned night-herons removed annually is in table J.5. No management actions will be taken to discourage nesting black-crowned night-herons, with the exception of removal of woody vegetation that is on the perimeter or within the tern nesting colony.

Impacts of Management to Black-crowned Night-Heron Population:
We recognize the importance of maintaining nesting habitat and protecting black-crowned night-herons on Monomoy NWR, given the relative importance of this site and especially the likely future loss of additional sites due to sea level rise, shoreline erosion, and increasing pressure for development and human recreation. Table J.5 includes a tally of the black-crowned night-herons removed from the tern colony annually, the total number of nesting birds (pairs x 2), and the percentage of adult birds that were lethally removed. Even during the years of the most intense predator pressure and lethal removal, no more than 2 percent of the total of nesting adults was removed in any one given year, and this is unlikely to impact the local nesting population or the Statewide population. The decline in nesting black-crowned night-herons beginning in 2005 may be attributed to eastern coyote predation on South Monomoy; wading birds have shifted from nesting primarily on South Monomoy Island to nesting almost solely on North Monomoy Island. Eastern coyotes are frequently seen resting in the woody vegetation that had been used as nesting habitat by black-crowned night-herons (Iaquinto personal communication).

4. Laughing Gull

Population Status:
The laughing gull is primarily a southern nesting species, though sporadic colonies have existed in the Northeast (Nisbet 1971). Laughing gulls are abundant throughout their breeding range with 202,646 breeding pairs (MANEM 2006). Similar to terns and other colonial nesting waterbird species, northern laughing gull populations were almost completely extirpated in the late 1800s by the millenary trade before coming under the protection of the Migratory Bird Treaty Act of 1918 (USFWS 2008, Veit and Petersen 1993). Nesting numbers in Massachusetts immediately began to increase following the passage of the Act reaching a peak in the 1940s (Nisbet 1971), especially on Muskeget Island where approximately 20,000 pairs nested. After reaching this peak, the laughing gull population slowly declined due to the direct competition with larger gulls that were also seeing population increases (Nisbet 1971). Laughing gulls on Muskeget Island were completely wiped out in June 1972 by Hurricane Agnes (Nisbet 1976). Laughing gulls, perhaps displaced from Muskeget, first colonized Monomoy refuge in 1971 and succeeded in establishing a colony adjacent to and within the tern colony at the northern-most tip of the refuge.

Laughing gull numbers rose steadily on the refuge during the 1970s to a peak of 1,000 pairs in 1981 (USFWS 1988), but then declined and eventually stopped nesting by the mid-1990s (USFWS 1996b). This was most likely the result of continued expansion of the herring and great black-backed gull populations, which encroached on tern and laughing gull nesting areas (USFWS 1996b, USFWS unpublished reports 1985 to 1994). As the decline on Monomoy began laughing gulls were reported to be nesting with terns (Melvin 2010) on New Island in Eastham by Hecker (956 pairs in 1990) (Veit and Petersen 1993). This colony collapsed in 2001 and 2002 as the natural westward migration of Nauset Spit created a landbridge that allowed mammalian predators easier access at low tide to the nesting area (Melvin 2010). This incident at New Island was similar to what was documented after the attachment of South Beach to South Monomoy Island in 2006 (see section 1.). With the collapse of the New Island colony, increased nest destruction to prevent large gulls from nesting on Monomoy, and the beginning of lethal removal of adult herring and great black-backed gulls that began in 1996 on the refuge, the Monomoy population of laughing gulls again increased and by 2002 had reached 1,106 pairs (USFWS 2003a). The numbers of pairs on the refuge continued to increase to a high of 1,498 pairs in 2007 (figure J.1) (USFWS 2009e). Between 2002 and 2007, Monomoy refuge was the only nesting site for laughing gulls in Massachusetts. Laughing gulls began nesting on Plymouth Beach in Plymouth in 2007, two years after nest destruction began on Monomoy, and have continued to nest there since (Mostello 2009 to 2012 personal communication, Kerin McCall 2013 personal communication). No management to prevent nesting of laughing gulls has been implemented on Plymouth Beach (McCall 2013 personal communication).

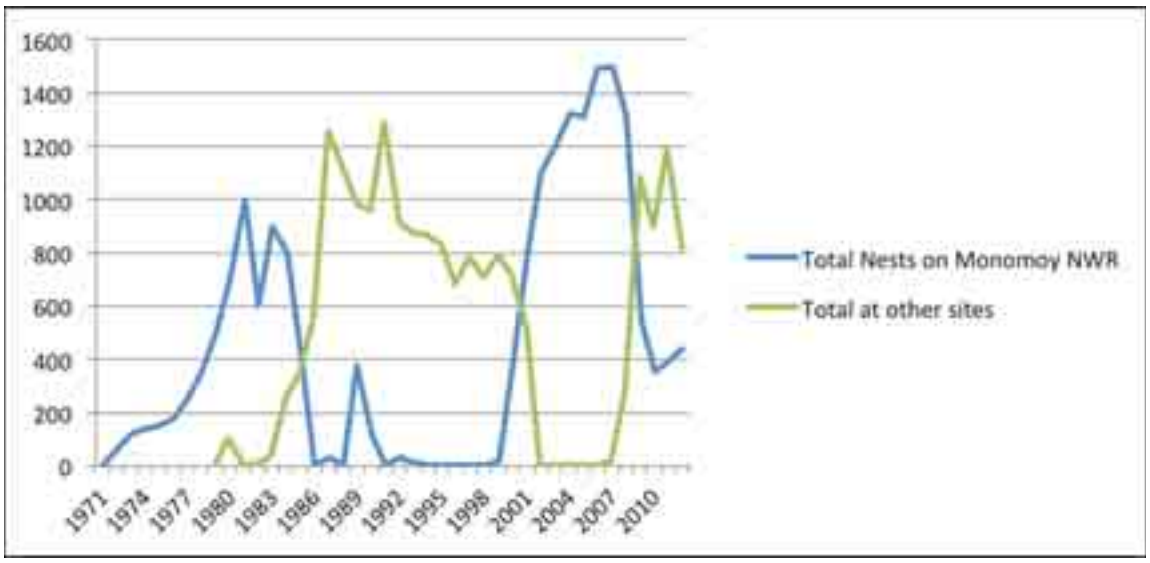

Figure J.1. Number of Nesting Laughing Gulls Counted on Monomoy National Wildlife Refuge vs. State of Massachusetts

The most recent compilation of the species as a whole in Birds of North America (Burger 1996) suggests that laughing gulls have steadily increased rangewide between 1966 and 1994.

Impacts to Birds of Conservation Concern:
The rapid increase in nesting laughing gulls on Monomoy refuge in the early 2000s resulted in direct competition with common and roseate terns for available nesting habitat, and increased rates of kleptoparasitism were documented. High densities of nesting laughing gulls within or on the immediate edge of the common tern colony increase the chances for interspecific interactions during the nesting season (harassment or direct predation). In addition, individual nesting laughing gulls that are pioneering nesting sites within the common tern colony are of concern because these pioneers may attract other prospecting laughing gulls to these areas (USFWS 2012). Laughing gulls have been documented preying on common tern chicks and eggs most years they have been present within the nesting colony on Monomoy. Eastern Egg Rock, Petit Manan Island, and Matinicus Rock in the Gulf of Maine have all reported that laughing gull predation on common, Arctic, and roseate tern eggs and chicks has directly reduced productivity rates in the terns (USFWS 2008). Documentation of this predation is likely underestimated since the events happen quickly and can be difficult to see within the dense vegetation in which laughing gulls nest.

In addition to displacing nesting terns by occupying their habitat and directly preying on tern eggs and chicks, laughing gulls frequently steal fish from terns returning to the colony from feeding; this is referred to as kleptoparasitism. Kleptoparasitism of tern by laughing gulls has been documented on the refuge extensively. Systematic recording of kleptoparasitism began in 2001, when this behavior was increasingly seen within the tern colony. Efforts increased from 68 hours in 2005 to more than 100 hours in 2008 to achieve a more accurate snapshot of laughing gull and common tern interactions. Between 2001 and 2012, a total of 859 hours has been spent documenting 15,022 attempts of laughing gulls to steal fish from terns. During each kleptoparasitism event, the maximum number of laughing gulls involved in a pursuit, victor, time, and location were recorded. Overall in the surveys conducted on Monomoy since 2001, laughing gulls were successful in stealing the fish from the tern between 32 and 57 percent of the time (USFWS unpublished and annual reports 2002 to 2013, and Johnson 2003). A study to monitor the effects of laughing gull kleptoparasitism rates on the seabird colony conducted on Matinicus Rock (Bishop unpublished data 1996 as in USFWS 2008) found that laughing gulls were successful in 38.5 percent of their attempts to steal fish from terns. A similar study conducted on Eastern Egg Rock by the National Audubon Society (NAS) found that groups of gulls were successful 44 percent of the time in their attempts to steal food from terns (NAS unpublished data 2006 as in USFWS 2008). Kleptoparasitism decreases food deliveries from tern adults to chicks, therefore decreasing the growth rate of tern chicks and overall increasing energetic demands on adults; this has the potential to reduce overall productivity in the tern colony (USFWS 2008).

Current and Future Management Techniques:
Each year on Monomoy refuge, laughing gulls are censused in conjunction with the annual tern census. Due to the increasing population of laughing gulls within the tern colony on South Monomoy Island, in 2004 we conducted a prescribed burn in the nesting area. A combination of prescribed fire and herbicide was used to create more suitable habitat for terns and discourage laughing gull nesting. The laughing gull population continued to rise. In 2004, there had only been a few instances of documented common tern chick depredation by laughing gulls, however, as the number of gulls increased annually, the instances of depredation increased as well as instances of kleptoparasitism. The refuge proposed and gained permission from the State to destroy laughing gull nests to keep the population managed at about 1,000 to 1,100 pairs beginning in the 2005 field season. Laughing gull nests and eggs (not chicks) were destroyed in late June and early July in areas where they were encroaching on tern nesting habitat within the nesting area on South Monomoy. Nonlethal management of laughing gulls was initiated for the first time in 2005 (USFWS 2009a) and was continued annually through 2009. Laughing gull nesting numbers were immediately reduced due to the nest destruction activities. When numbers were at a low of 355 pairs in 2010 (USFWS unpublished data), nest destruction was discontinued mid-season since the population was well below 1,100 pairs. Although nest destruction has not been conducted in recent years, if the laughing gull pair numbers increase beyond 1,000, it will be resumed to maintain a low population. See Figure J.2 for a comparison of nesting numbers to the number of nests destroyed between 2004 and 2012. In 2009 and 2012, subsequent burns were performed to continue to manage the colony habitat to promote a mosaic of sand and grass that is more favorable to terns and less favorable to laughing gulls. Vegetation within the tern colony and numbers of nesting laughing gulls will be monitored in the future to determine the management actions that are most successful at creating habitat for nesting terns.

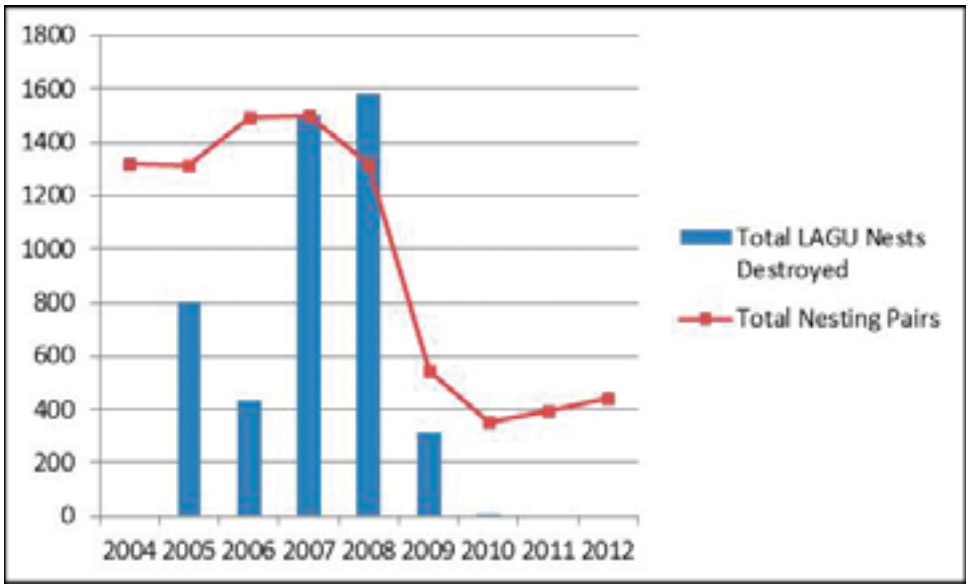

Figure J.2. Laughing Gull Nests Destroyed Between 2006 and 2012. (No nests were destroyed in 2004, 2011, or 2012.)

Impacts of Management to Laughing Gull Population:
Though laughing gull nest destruction on Monomoy has directly impacted the number of gulls nesting within our colony, the number of nesting laughing gulls in Massachusetts has steadily increased since the early 1990s. Plymouth Beach has seen increasing numbers of laughing gulls nesting in recent years, while Monomoy numbers have been low though we have not implemented any predator management to discourage nesting (Kerin McCall 2013). In areas where there is control of larger gulls like great black-backed gulls and herring gulls, it is likely that laughing gulls would out-compete terns for habitat and continue to increase as they did in the early 2000s before control was initiated on the refuge.

5. Great Black-backed and Herring Gull (Large Gulls)

Population Status:
Great black-backed and herring gulls are East Coast species, with herring gull being year-round residents of these areas. Historically both great black-backed and herring gulls have been expanding their range southward since the 1960s, at the expense of laughing gull populations (Pierotti and Good 1994, Good 1998). Both species are abundant throughout their breeding range with breeding pairs at 37,372 and 90,734 respectively (MANEM 2006).

In May and June of 2006 through 2008, a coastwide survey of nesting colonial waterbirds was completed in Massachusetts; 9,725 pairs of herring gulls were counted at 55 colonies and 9,054 pairs of great black-backed gulls were counted at 49 colonies (Melvin 2010). For both species of large gulls, North Monomoy Island and South Monomoy were listed as being two of the largest three colonies Statewide, with Muskeget Island being the second-largest nesting site for great black-backed gulls and Penikese Island being the third-largest nesting site for herring gulls. Herring gulls declined by 42.2 percent, from 15,812 to 9,143 pairs, between 1994 and 1995 and 2006 to 2008 surveys, based on comparable counts at 54 of 73 (74 percent) sites surveyed (Melvin 2010). Great black-backed gulls declined by 40.0 percent between 1994 and 1995 and 2006 to 2008, from 14,616 to 8,774 pairs, based on counts at 56 of 71 (79 percent) sites that were surveyed using comparable methods (Melvin 2010). This survey was replicated in 2013 and preliminary numbers suggest that the populations of herring and great black-backed gulls in the State have continued to decline (Melvin 2013 personal communication).

Herring gulls were first seen nesting on Monomoy Island in 1924 (Forbush 1925). The recent history of herring gull nesting on Monomoy NWR started with five pairs in 1963 (Kadlec and Drury 1968). The colony growth in successive years was spectacular, with 75 pairs in 1964, 420 pairs in 1965, 1,000 pairs in 1966, 8,000 pairs in 1969, and more than 15,000 pairs in 1980; but in 1995 only 5,200 pairs of herring gulls were found on the refuge. This drop in herring gull numbers may be correlated to the closing of landfills and poor census methods used during

the census in 1995. Great black-backed gulls moved onto Monomoy soon after the herring gulls did; there were 75 to 80 pairs in 1965 and 1966 and about 175 pairs in 1972. By 1980, the great black-backed population had reached 3,300 pairs and in 1995 had reached a total of 7,350 pairs, for a combined count of more than 13,000 pairs of the two large gull species (USFWS 1996b).

These counts (through the mid-1990s) are estimates however, and uncertainty and inconsistency in methodology among years reduces their reliability. In recent years, complete counts of nesting gulls have been conducted on North Monomoy Island in 2000 and 2007 (refer to table J.6) In 2000, South Monomoy was surveyed using aerial photography, and in 2007 it was surveyed using a stratified random-sample transect method. In 2000, 1,018 great black-backed gull nests and 1,609 herring gull nests were counted on North Monomoy Island, but the aerial photography for South Monomoy was never fully analyzed. In 2007, 1,245 herring gull nests and 683 great black-backed gull nests were counted on North Monomoy Island. An additional 1,088 herring gull nests and 2,490 great black-backed gull nests were estimated on South Monomoy, for a total refugewide count of 2,333 herring gull nests and 3,173 great black-backed gull nests.

Table J.6. Great Black-backed Gull and Herring Gull Nests Counted in Areas A and B During May Gull Censuses in 1996 to 2007* on South Monomoy.

Year	Great Black-backed Gull		Herring Gull		Empty		Total		
	Area A	Area B	Area A	Area B	Area A	Area B	Area A	Area B	Total
1996	307	652	544	178	859	322	1710	1152	2862
1997	78	356	26	51	262	147	366	554	920
1998	7	259	0	10	6	99	13	368	381
1999	2	195	0	35	1	98	3	328	331
2000	0	139	0	33	0	86	0	258	258
2001	3	115	0	28	3	55	6	198*	204*
2002	3	114	0	56	0	47	3	217	220
2003	1	79	0	32	0	47	1	158	159
2004	4	59	0	14	0	104	4	177	181
2005	0	39	0	18	0	61	0	118	118
2006	0	12	0	3	0	43	0	58	58
2007	0	13	0	5	0	17	0	35	35

**No gull census took place in 2008 through 2012.*

Gull census was again performed in 2013, concurrent with a regionwide effort to count all colonial nesting waterbird colonies. As stated in section 1, data compilation is still ongoing, but preliminary numbers for North Monomoy Island are 1,180 herring gull nests and 995 great black-backed gull nests. On South Monomoy, no herring gull nests were observed on transects, and great black-backed gull nests likely numbered fewer than 10 (Iaquinto personal communication). This sharp decline in nesting gulls on South Monomoy did not occur on North Monomoy Island, suggesting the cause was specific to South Monomoy.

Impacts to Birds of Conservation Concern:
The overall increases in the northeastern populations of herring and great black-backed gulls have led to declines in tern populations (Cavanagh and Griffin 1993) through competition for nest sites and predation on chicks and

eggs (Burger 1979, Morris and Hunter 1976). Herring and great black-backed gulls (large gulls) have been documented taking eggs, chicks, or fledglings from terns (Hatch 1970, Donehower et al 2009, Kress and Hall 2004), oystercatchers (Schulte et al. 2010), and plovers (USFWS 1996) on Monomoy refuge (USFWS unpublished reports 1996 to 2013) and other locations in the Gulf of Maine where these species are present.

On Monomoy NWR, increases in nesting gulls were matched with precipitous declines in nesting terns. Common terns declined from a high of 4,000 pairs in 1970 to only hundreds of pairs by 1985. Roseate terns on Monomoy NWR declined from a high of 900 pairs in 1966 to fewer than 100 pairs in 1981 (USFWS 1996b). During most years from the early 1980s through 2000, no roseate terns nested. Further, predators (Nisbet and Welton 1984, Nisbet and Forster 1980), storm tides, and loss of habitat resulted in virtually zero productivity between 1980 and 1994 (Fitch 1985, USFWS unpublished reports 1985 to 1994).

Great black-backed gulls are both nocturnal (Nocera and Kress 1996) and diurnal predators in tern colonies. At Monomoy refuge we have observed them preying on eggs and chicks at night and during the day, as well as preying on fledged chicks and adults during the day as terns preen and stage on the sand flats. McNicholl (1973) suggested frequent tern mobbings of herring gulls may decrease common tern productivity by reducing time spent incubating, brooding, and guarding eggs and chicks. Herring gulls and northern harriers are generally only seen preying in the tern colony during the day. Herring gulls will prey on eggs and chicks, including large chicks, and northern harriers generally prey on fledged chicks or adults (USFWS unpublished reports 1996 to present).

Predator visits are monitored opportunistically throughout the season, and it is documented when large gulls enter and disturb the colony. Gull tracks in plover and oystercatcher nesting areas are documented as well. Gulls are considered predators when they are actively depredating nests or disturbing and being chased by terns or other birds. The following table reflects the interactions gulls have had in the colony since 1998 when data collection started, numbers of plover and oystercatcher nests taken by gulls, and the total number of herring and great black-backed gulls taken each year.

Table J.7. Large Gulls selectively removed from the Tern Colony on South Monomoy and Depredation by Gulls in these years 1998-2012

Year	# Great Black-backed Gulls Removed	# Herring Gulls Removed	Total Piping Plover Nests Lost (% of Total Lost to Known Causes) to Eastern Coyotes	Total American Oystercatcher Nests Lost (% of Total Lost to Known Causes)
1998	0	1	2 (15%)	nd
1999	0	0	2 (17%)	nd
2000	0	0	0	nd
2001	nd	nd	0	nd
2002	7	1	2 (8%)	0
2003	1	0	3 (12%)	6 (18%)
2004	3	0	2 (12%)	6 (26%)
2005	19	4	1 (6%)	7 (18%)
2006	12	0	0	0
2007	19	5	2 (22%)	0
2008	37	7	2 (9%)	3 (18%)
2009	0	0	1 (11%)	2 (22%)
2010	12	3	4 (57%)	4 (40%)
2011	0	0	0	1 (7%)
2012	0	0	3 (13%)	1 (6%)
Total	110	21	24 (11%)	30 (16%)

Though gulls directly impact nesting species on the refuge by consuming their chicks and eggs, a major factor for terns has been large gulls using habitat that would be preferred by terns. Once gulls were removed from nesting areas on South Monomoy during the initiation of the avian diversity project in 1996, habitat was available for terns to nest and they began nesting in this habitat in the same year. Gulls have predated plover and oystercatcher nests in most years, though they have caused only about 11 percent on average of the total nest loss. For piping plovers, 2010 was an outlier year, with exceptionally high productivity, so the percentage of nests taken by gulls is very high since very few nests were lost throughout the season (USFWS unpublished reports 1996 to present).

Current and Future Management Techniques:
In 1979, the Service made a preliminary effort to protect a large tern colony on North Monomoy Island (the only colony remaining on the refuge at that time) from encroaching herring and great black-backed gulls. Active gull nests were sprayed with an oil-formaldehyde mixture, which inhibits egg hatching, and at least 45 adult herring gulls were shot in a buffer zone adjacent to the nesting terns (USFWS 1988). In 1980, a more comprehensive program was initiated. In addition to targeting nesting gulls from a buffer zone around the terns, the plan called for the creation of a 130-acre alternate tern nesting area at a former colony site on South Monomoy using avicide DRC 1339 to lethally remove gulls from the area. The first of two planned annual avicide applications was administered in June 1980, and reduction in the number of nesting herring and great black-backed gulls was achieved. However, the avicide program was suspended after the first treatment due to the negative public reaction (USFWS 1988).

Subsequently, control efforts from 1980 to 1984 were focused on reducing the number of nesting gulls on North Monomoy Island only, using shooting, hazing devices, scarecrows, and nest destruction methods. While this program did prevent gulls from expanding their colony, it was unsuccessful in reducing gull populations (Lortie et al. 1985).

Maintenance of existing gull-free habitat between 1988 and 1992 was attempted through the destruction of gull nests and eggs. In 1993 and 1994, Migratory Bird Treaty Act permits were issued for the taking of herring and great black-backed gulls (using selective shooting) within a 210-acre area, with the objective of removing up to 5,000 birds (combined species total). Due to the fact that these gulls quickly adapt to stay beyond shooting range, this method resulted in an effective take of less than 1,500 birds in 1993 and less than 200 birds in 1994. Observations of large numbers of herring and great black-backed gulls nesting and loafing in the vicinity of less abundant nesting species prompted reconsideration of management alternatives following the 1994 field season (USFWS 1996b).

In accordance with tasks outlined in the Piping Plover Recovery Plan, Roseate Tern Recovery Plan, Endangered Species Act of 1973 and the goals of the National Wildlife Refuge System, which direct national wildlife refuge units to "preserve, restore, and enhance in their natural ecosystem (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered," the Service proposed to strengthen ongoing efforts to manage habitat for nesting species on Monomoy NWR. The avian diversity project began in 1996, and a contiguous 169.5-acre area (67.7 ha) was chosen on the north end of South Monomoy (designated Areas A and B) to provide gull-free nesting habitat. An additional 175 acres immediately to the south of Area B was delineated as a control area, Area C (map 2.5) (USFWS 1996b).

The Service baited approximately 2,850 well-formed herring and great black-backed gull nests (both those with and without eggs) twice in this area in May 1996 using the avicide DRC 1339 (see USFWS 1996 for details). The avicide applications resulted in an almost 80 percent reduction in the number of territorial birds in Area A and a 50 percent reduction in Area B. The use of DRC 1339 on Monomoy NWR was later suspended after a public outcry when more than 600 of the birds died at freshwater roosting sites on the mainland rather than on South Monomoy. A total of 448 adult herring and great black-backed gulls were shot in the treatment area (map 2.5: Areas A and B; Megyesi 1996).

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Gull Management Areas
Area A
Minimoy Island
Refuge Boundary
Area B
Area C
South Monomoy Island
1:24,000

In 1997, nonlethal harassment, which involves discouraging territorial gulls from establishing territories and destroying any nests that are found, was used. Selective shooting took place in Area A when territorial gulls were discovered attending nests with eggs (refer to Megyesi 1997 for a complete description). Nonlethal harassment was performed in 1998, 1999, and 2000 in Areas A and B. Decline in nesting gulls has been documented in both of these areas. Area A experienced a decrease from 1,710 in 1996 to zero in 2000; Area B had 1,152 nesting gulls in 1996 and 258 in 2000 (USFWS 1996 and USFWS unpublished data).

Area A has been successfully maintained as a gull-free zone, while Area B has had minimal nesting. From 2001 to 2007, nest destruction and non-lethal harassment efforts were implemented each season to maintain low populations of herring and great black-backed gulls and prevent them from encroaching on the common and roseate tern colony. In 2008, these actions were deemed unnecessary due to the low numbers of gulls censused in Area B during the 2007 census, and non-lethal harassment only has been conducted sporadically since then to maintain Areas A as gull-free.

The start of the avian diversity project in 1996, when thousands of nesting great black-backed and herring gulls were removed from potential tern nesting areas, marked the beginning of nesting tern population increases that have been largely sustained for the last 15 years on Monomoy NWR. Nesting common terns increased from just a few hundred pairs in 1995 to more than 2,000 pairs in 1998 and more than 10,000 pairs by 2003. Maintaining gull-free areas for terns has also proven to be effective in restoring large numbers of nesting terns in Maine (Kress 1983, USFWS 2005b) and other Massachusetts sites (Blodget and Henze 1992).

Since the recent peak nesting years (2003 to 2006), numbers have fluctuated in response to habitat changes, predator pressures, and nesting habitat quality at other nearby sites. Monomoy NWR remains one of the most important common tern nesting sites in the State, and one of just a few sites that support roseate terns. However, the long term continued success of this project depends on a flexible adaptive management approach that incorporates annual management actions focused on habitat manipulations and management of predator and competitor species. We also carefully monitor habitat and birds' responses to the management actions, which leads to informed adaptations of strategies for the following year.

In recent years since regular gull harassments have been discontinued, the refuge has continued to closely monitor nesting gulls on the refuge and destroy nests that are placed in close proximity to nesting plovers, terns, and oystercatchers as soon as they are found. We have also continued to shoot predatory great black-backed and herring gulls that are actively preying on plover or oystercatcher eggs, chicks, or adults in the nesting area or actively preying on fledged chicks and adults on the adjacent staging flats (USFWS unpublished reports 1996 to present).

Impacts of Management to Great Black-backed and Herring Gull Population:
It is unlikely that management at Monomoy refuge has had a significant effect on the East Coast population of gulls, despite their recent decline locally. Massachusetts gulls have been declining in recent years for a variety of reasons; nest destruction and gull removal on the refuge has been very small compared to the size of the overall decline. As stated in section 1, evidence of coyotes preying on herring and great black-backed gulls on Monomoy refuge has been frequently observed, but not systematically documented (Koch and Iaquinto personal communiction). This sharp decline in nesting gulls on South Monomoy did not occur on North Monomoy Island, suggesting the cause was specific to South Monomoy. It also coincides with the connection of South Monomoy to South Beach, and increased presence of coyotes on South Monomoy. It is likely that the most powerful force in the declining gull population on Monomoy in recent years may be eastern coyote depredation.

6. Great Horned Owl

Population Status:

Breeding Bird Atlas [1] (BBA) data for Massaschusetts shows great horned horned owls are likely increasing in the State as they take advantage of increasing surburban habitats and maturing forest (*http://www.massaudubon.org/StateoftheBirds/species_account.php?spc=GHOW*, MassAudubon 2011, Joan Walsh personal communication July 2013). Great horned owls were detected[2] in 27 percent of the blocks (263 blocks) during Atlas 1(Petersen and Meservey 2003) and 42 percent of the blocks (435 blocks) during Atlas 2. After correcting for differences in block survey effort[3], it appears great horned owl presence has increased by about 40 percent (Walsh July 2013 personal communication). At the time of the first BBA, great horned owls were considered widespread but uncommon, and although they were common in the southern coastal regions, they were absent from the islands (Petersen and Meservey 2003). They are now considered to be fairly widespread (Walsh July 2013 personal communication), and are present on some of the islands (*http://www.pwrc.usgs.gov/bba/index.cfm?fa=explore.ResultsBySpecies*).

Great horned owls were first confirmed nesting on Monomoy NWR when a nest with owlets was found in 2000. Since that time, a pair has probably nested in some years on South Monomoy (adults are frequently seen on the south end of the island in the spring) but no census or nest searching has been conducted (Iaquinto 2011 personal communication). Great horned owls also nest on Morris Island (Iaquinto personal communication).

Impacts to Birds of Conservation Concern:
Great horned owl has been the most sporadic of all the avian predators at Monomoy refuge in recent years, and most years there is very little evidence of their presence. However, in years when great horned owls are present at Monomoy refuge as well as at other tern colonies, complete abandonment of the tern colony until the following morning is often observed, leaving eggs and chicks exposed to inclement weather and other predators (Holt 1994, Fisk 1974, Nisbet and Welton 1984, Morris and Wiggins 1986). Additional consequences of nocturnal abandonment include prolonged incubation periods for chicks and sometimes inattentiveness to eggs during the day, which can leave them vulnerable to diurnal predators (Mostello 2007). The adult terns' decision to either abandon their nest and young or stay and attack a predator is likely based on the perceived risk of the predator to the adult itself. Owls are skilled at catching and preying on adult terns and large chicks, but have also been reported preying on small chicks (Nisbet and Welton 1984). Many other avian predators, however, are most likely to target eggs and smaller chicks (Collins 1970, Nisbet and Welton 1984, Shealer and Kress 1991, USFWS annual field season activities reports from 1996 to present). At Monomoy refuge we often observe nocturnal abandonment in conjunction with great horned owl presence, but we have also occasionally observed groups of terns attacking an owl that is present in the colony (Koch 2012 personal communication).

Great horned owls have been an influential predator on Monomoy refuge since the 1970s. A 1979 study of common tern nesting on Monomoy (Nisbet and Welton 1984) suggested that great horned owls were a major factor in tern nesting failure in the 1970s. The owls were responsible not only for direct predation on tern chicks but, more importantly, caused night desertion of the colony by adult terns, thereby exposing eggs and chicks to attacks by ants, predation by black-crowned night-herons, and chilling. Great horned owl visits ceased after 1983.

In more recent years and since active management for terns began in 1996, great horned owls were first observed preying in the tern colony on the north end of South Monomoy in 1999. In that year, they were documented in the colony on 17 nights, took a minimum of 15 to 20 common tern adults, and caused nocturnal abandonment

[1] The first Massachusetts BBA was conducted from 1974 to 1979 and the second was conducted from 2007 to 2011. The entire state was divided into 1,134 blocks; 969 blocks were surveyed in Atlas 1 and 1,037 blocks were surveyed in Atlas 2 (Walsh July 2013 personal communication). Detailed information on the methodology and analyses can be found at *http://www.massaudubon.org/birdatlas/bbaportal/index.php*

[2] Detected birds include those classified as confirmed, probable, or possible breeders

[3] Some blocks were removed from analysis when calculating % change in block detection between survey windows because of differences in survey effort (Walsh personal communication July 2013)

every night until the end of June (USFWS 2000). In 2000, great horned owls were documented in the tern colony early in the nesting season. As a result, the tern colony was abandoned every night from May 11 to June 14, at which point common tern chicks started nesting; for a total of 3 weeks there was full abandonment, and for 1 to 2 weeks there was partial abandonment. The decline in nesting roseate tern numbers observed in 2000 from 1999 is likely attributed to great horned owl presence in the colony during tern nest establishment (Koch personal communication). In 2001, great horned owl was again present in the colony early in the season and nocturnal abandonment occurred throughout May and then again at the end of June, which resulted in the death of many small chicks. Great horned owl presence in the tern colony has been documented in most years since 2001, but in many years the impact was likely insignificant (USFWS annual field season activities reports from 2001to present). However, great horned owl caused repeated nocturnal abandonment in 2003 (USFWS 2007a) and 2009 (USFWS 2012). Direct loss of adults and chicks from great horned owls is not easy to quantify because carcasses are not always found, and it is often difficult to identify a kill resulting from great horned owls from that of other avian predators.

Current and Future Management Techniques:
Great horned owls have been frequently removed from other tern colonies in Maine where they are posing a threat (Kress and Hall 2004). In addition, "owl predation is unpredictable; an individual may return to the colony on successive nights, but may also be absent for two or more weeks before returning (Kress and Hall 2004). Several techniques were used in 1999 to 2001 on Monomoy refuge to try to capture great horned owls in the tern colony, but none were successful.

Personnel have been prepared annually to shoot great horned owls that are actively preying in the tern colony (though this also hasn't been successful in recent years) at night, and will continue to be prepared. In 2002, the refuge began using triangular shaped "area closed" signs, instead of square or rectangular shaped signs, around the perimeter of the tern colony in an effort to reduce perching opportunities for hunting owls. We will continue to use these signs.

Impacts of Management to Great Horned Owl Population:
To date, no great horned owls have been removed from Monomoy refuge, so there has been no negative impact from our management actions to the great horned owl population. It is unlikely that more than three great horned owls would ever be removed in one year, so the anticipated impact of our management actions on the great horned owl population in the State is inconsequential.

7. Short-eared Owl

Population Status:
Short-eared owls are a State-endangered species and BBA data shows a strong decline between the two survey periods in Massachusetts. Short-eared owls were detected in 1 percdent of the blocks (13 blocks) during Atlas 1(Petersen and Meservey 2003) and less than 0.5 percent of the blocks (3 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears short-eared owl presence has decreased by about 85 percent (Walsh July 2013 personal communication). At the time of the first BBA, short-eared owls were only documented breeding on Monomoy refuge, Martha's Vineyard, and Nantucket, Tuckernuck, and Muskeget Islands (Petersen and Meservey 2003). In 1985, 20 to 25 pairs of short-eared owls were estimated breeding at these sites and Pochet Marsh, Orleans (Veit and Petersen 1993). They did not nest at all in 2011 on Tuckernuck Island, which is the last known nesting site (*http://www.massaudubon.org/StateoftheBirds/species_account.php?spc=SEOW*) and have essentially been extirpated from the State (Walsh July 2013 personal communication). Short-eared owls only breed in three other states in the Northeast (New York, Pennsylvania, and Vermont), and incidences of short-eared owls there are even less than in Massachusetts (*http://www.mass.gov/eea/docs/dfg/nhesp/species-and-conservation/nhfacts/asio-flammeus.pdf*).

On Monomoy refuge, five pairs of short-eared owls nested in 1986 and two nesting pairs were confirmed in 1987. During this time, Monomoy's short-eared owls represented about one-quarter of the State's population. Holt and Melvin (1986) suspected that habitat loss and human disturbance have been the primary factors contributing to the decline of short-eared owl in Massachusetts. Short-eared owls are ground-nesters, and small mammals are their major prey. Lortie et al. (1985) speculated that failure of short-eared owls to breed successfully on North

Monomoy in 1983 and 1984 may be partially attributable to early season gull harassment efforts coinciding with owl nest site selection and courtship activities. Fitch (1985) reported that a late short-eared owl nesting attempt on North Monomoy Island in 1984 was abandoned, possibly due to its proximity to an access trail frequented by the public.

Impacts to Birds of Conservation Concern:
Short-eared owls can cause similar nocturnal disturbances in tern colonies as great horned owls. On Monomoy refuge, short-eared owls have been documented killing common tern adults and chicks and causing nocturnal abandonment, which led to prolonged incubation periods and chick mortality. "Night desertion allowed other predators and inclement weather to kill eggs, nestlings, and dispersed chicks incapable of flight." (Holt 1994). Short-eared owls have not been identified as a predator in recent years on Monomoy refuge.

Current and Future Management Techniques:
Because of the State-listed status of short-eared owls and likely extirpation from the State, we do not implement management of this species, nor do we actively discourage them from hunting in the common tern colony. Signs of depredation and presence in the colony are recorded when observed.

Impacts of Management to Short-eared Owl Population:
Short-eared owls are not actively managed on Monomoy refuge so there is no impact to their population.

8. Northern Harrier

Population Status:
BBA data for Massachusetts shows northern harriers are strongly increasing (Joan Walsh, personal communication, July 2013). Northern harriers were detected in 4 percent of the blocks (36 blocks) during Atlas 1(Petersen and Meservey 2003) and 10 percent of the blocks (72 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears northern harrier presence has increased by about 97 percent, or nearly doubled (Walsh July 2013 personal communication). However, northern harriers are a State-threatened species, and while BBA data shows a strong increase, their population is still at risk as open habitats are lost (*http://www.massaudubon.org/StateoftheBirds/species_account.php?spc=NOHA*).

Northern harriers have been nesting on Monomoy refuge since at least the mid 1980s when three nests were confirmed in 1985 and one nest confirmed in 1986 (USFWS 1988). In recent years, northern harriers have been observed nesting on the refuge: at least four nests in 1997, three nests in 1998, one nest in 1999, and three nests in 2000. The refuge has never been systematically searched for nesting northern harriers, but frequent observations of adults in most years suggest they are still nesting on the refuge (Iaquinto personal communication).

Impacts to Birds of Conservation Concern:
Northern harriers have been active predators of piping plovers on Monomoy refuge and adjacent South Beach. In 2002, a northern harrier was most likely to blame for the death of an adult female plover in an exclosure (placed on piping plover nests to prevent nest predation) on the northeast tip of South Monomoy (USFWS 2003). In 2004, an adult female plover was found dead inside an exclosure with injuries consistent with those inflicted by a northern harrier in the same area (USFWS 2007b). Refuge staff removed exclosures on the northeast tip of South Monomoy following this event. Three adult piping plover mortalities due to avian predators were reported on South Beach during 2004 as well, although it was suspected that a peregrine falcon was the cause of at least one of these mortalities (Jedrey 2004 personal communication). None of the South Beach mortalities during 2004 were associated with exclosures. In addition, during 2001-2003, northern harriers were thought responsible for most of the 15 known plover fatalities at exclosed nests on South Beach (Melvin and Mostello 2002, 2003, Jedrey 2004 personal communication).

Northern harriers have also been active predators in the tern colony on Monomoy refuge and other sites (Burger and Gochfeld 1991). They likely nest within 1 mile of the Monomoy tern colony, and in most years, make frequent visits into the tern colony to hunt (Koch personal communication, USFWS annual field season reports 1998 to present, and unpublished data). It is difficult to quantify the total number of chicks and adults taken by northern harriers, but a minimum tally of loss is in table J.8 below.

Table J.8. Northern Harrier on Monomoy NWR Tern Colony.

Year	# Times Seen Hunting in the Colony (# Days)	# Tern Chicks Taken	# Adult Terns Taken
1998	15 (13)	>3	nd
1999	92 (33)	5	6
2000	nd	nd	nd
2001	nd	nd	nd
2002	87 (32)	27	4
2003	37 (24)	6	13
2004	40 (29)	11	9
2005	24 (nd)	1	3
2006	13 (nd)	13	2
2007	5 (5)	1	7
2008	21 (17)	3	1
2009	nd (5)	nd	nd
2010	nd (4)	nd	nd
2011	nd	0	0
2012	nd	0	0
Total		67	45

Current and Future Management Techniques:
Because of the State-listed status of northern harriers and concern for population stability in Massachusetts, we do not implement management of this species, nor do we actively discourage northern harriers from hunting in the common tern colony. Signs of depredation and presence in the colony are recorded when observed.

Impacts of Management to Northern Harrier Population:
Northern harriers are not actively managed on Monomoy refuge so there is no impact to their population.

9. American Kestrel, Merlin, and Peregrine Falcon

Population Status:
BBA data for Massachusetts shows American kestrels are strongly declining (Joan Walsh, pers. comm., July 2013). American kestrels were detected in 51 percent of the blocks (498 blocks) during Atlas 1 (Petersen and Meservey 2003) and 21 percent of the blocks (215 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears American kestrel presence has decreased by about 62 percent (Walsh July 2013 personal communication).

BBA data for Massachusetts shows merlins are strongly declining (Joan Walsh, pers. comm., July 2013). Merlins were not detected during Atlas 1(Petersen and Meservey 2003) and were detected in 1 percent of the blocks (10 blocks) during Atlas 2. Merlins were detected in too few blocks to assign trend information (Walsh July 2013 personal communication).

Peregrine falcons are a State-endangered species and BBA data for Massachusetts shows their population is strongly increasing (Joan Walsh, pers. comm., July 2013). Peregrine falcons were not detected during Atlas 1 (Petersen and Meservey 2003) and were detected in 2 percent of the blocks (25 blocks) during Atlas 2 (Walsh July 2013 personal communication).

Impacts to Birds of Conservation Concern:
"Terns usually mob hawks such as buteos, accipiters and ospreys, driving them far from nesting islands. They are less likely to effectively defend against falcons. Peregrines, merlins, American kestrels, and an occasional

gyrfalcon sometimes frequent tern colonies. Falcons can arrive at any time during the nesting season, but usually move on after a few days. While present, they can be extremely disruptive. For example, a single American kestrel killed more than 200 least terns over a 10-day period (J. Atwood personal communication)" (Kress and Hall 2004). A peregrine falcon was also responsible for killing at least 36 roseate terns and 18 common terns on Bird Island in Massachusetts when it took up residence early in the nesting season (Nisbet 1992).

Current and Future Management Techniques:
Because of the State-listed status of peregrine falcon (State-listed endangered) and concern for population stability of American kestrel and merlin, we do not implement management of these species, nor do we actively discourage them from hunting in the common tern colony. Signs of depredation and presence in the colony are recorded when observed.

Impacts of Management to American Kestrel, Merlin, and Peregrine Falcon Populations:
American kestrels, merlins, and peregrine falcons are not actively managed on Monomoy refuge so there is no impact to their population.

10. American Crow, Fish Crow, and Common Grackle

Population Status:
In the U.S., American crow and fish crow have been protected by the Migratory Bird Treaty Act since 1971, but hunting is allowed in some locations. Individual states set hunting seasons (not to exceed 124 days) that exclude the nesting season (Clapp and Banks 1993). Crows are hunted on specific days in Massachusetts except during April 11 to June 30 (*www.mass.gov* 2013).

Massachusetts Audubon Society Breeding Bird Atlas (BBA2) data shows American crows are stable in Massachusetts (Walsh July 2013 personal communication). American crows were detected in 89 percent of the blocks (870 blocks) during Atlas 1(Petersen and Meservey 2003) and 95 percent of the blocks (990 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears American crow presence has increased by about 4 percent, or stayed relatively the same. Additionally, American crows are nearly ubiquitous in Massachusetts (Walsh July 2013 personal communication).

BBA2 data for Massachusetts shows fish crows are strongly increasing in Massachusetts (Walsh July 2013 personal communication). Fish crows were detected in 3 percent of the blocks (27 blocks) during Atlas 1(Petersen and Meservey 2003) and 18 percent of the blocks (183 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears fish crow presence has increased by about 530 percent (Walsh July 2013 personal communication).

BBA2 data for Massachusetts shows common grackles are stable in Massachusetts (Walsh July 2013 personal communication). Common grackles were detected in 92 percent of the blocks (896 blocks) during Atlas 1(Petersen and Meservey 2003) and 95 percent of the blocks (984 blocks) during Atlas 2. After correcting for differences in block survey effort, it appears common grackle presence has increased by about 2 percent, or stayed relatively the same. Additionally, common grackles are nearly ubiquitous in Massachusetts (Walsh July 2013 personal communication).

A brood of crows was banded by June A. Chamberlain-Auger in 1992 on North Monomoy Island. In recent years, American crows were first recorded as being seen on South Monomoy Island in April 2003. American crows were seen early in the season in 2011, though little impact was documented and crows were not seen on the island through the season. 2012 was the first nesting season in which crows and grackles were documented taking piping plover nests. Fish crows have been heard on the refuge though no documentation of their presence exists and no predation is directly attributed to them. Common grackles have been common on the refuge for many years, as they nest in the freshwater wetlands surrounding the Monomoy Light, though there is no data to quantify this presence since surveys have not been done and predator visits have not been recorded for this species (Iaquinto personal communication). Common grackles had been commonly seen feeding on dead seal carcasses on the refuge beaches, especially on the southern end of South Monomoy (Iaquinto, personal communication). In 2013, a pair of American crows nested and hatched chicks just outside the main tern nesting area before being detected.

Three additional crows were seen flying, perching, and walking around the island and many piping plover nests were lost to them.

Impacts to Birds of Conservation Concern:
Corvids are generally egg and nest predators; however, there are some examples of crows taking least tern chicks (Burger and Gochfeld 1991, Kress and Hall 2004). Corvids are intelligent predators that can learn to associate fencing or exclosures with nests of terns and plovers and are therefore attracted to nesting areas because they know there are potential meals there (Blodget and Melvin 1996). These species (American and fish crow) have earned a reputation for eating other birds' eggs and nestlings, and common grackles occasionally kill and consume adult birds (Verbeek and Caffrey 2002, Mcgowan 2001). Some sites, including Crane Beach and the Cape Cod National Seashore (CACO) have had issues with American crows learning to target piping plover nests that are in exclosures. Predators, especially crows and coyotes, have a significant impact on the reproductive success of piping plovers, least terns, and other shorebirds nesting at the national seashore (CACO fact sheet).

On Monomoy refuge, three lost piping plover nests were attributed to grackle depredation and one lost nest was attributed to crow depredation during the 2012 nesting season. None of these nests were exclosed. As of 26 July 2013, crow and grackle predation increased dramatically and became a serious problem. A total of 28 nests were either determined to be lost to or suspected to have been lost to American crow and common grackle on South Monomoy this year (12 nests determined predated by American crow, 4 nests determined predated by common grackle, 10 nests possibly predated by American crow, 2 nests possibly predated by common grackle). It was often difficult to determine the exact cause of the nest loss, but tracks were measured carefully. As with all predation on the refuge, unless it is witnessed, it is often difficult to tell what predator actually depredated the nest. A document compiled by refuge staff outlines how the cause of nest loss was identified. Tracks were often more difficult to distinguish based on length alone, as tracks made in sand appear enlarged after time and after rain and weather events. In general, most common grackle tracks measured 2 ¼ to 2 ½ inches long, while almost all American crow tracks measured above 2 ¾ inches in length. American crow tracks had very noticeable bulges at the toes.

In 2013, nests determined to be depredated by American crow occasionally had broken eggs or large egg fragments near or at the nest. Nests found depredated by common grackle did not exhibit this. In all cases of known or suspected American crow and common grackle predation, nests had significant amounts of yolk pieces in or near nest bowl. Yolk pieces were usually found dried and in clumps. In many cases of depredation, plover tracks were found surrounding the nest, replacing any sign of American crow or common grackle tracks within about 2 feet of nest. Because exclosures have been targeted at other sites by crows and grackles, the refuge staff was hesitant to use them this year to deal with this predation. Loss of adult plovers or making nests a target would be much worse than losing nests as crows and grackles found them opportunistically. Two false exclosures with fake wooden eggs in the center were erected in areas where grackles had been seen (lighthouse boat landing and plover beach). In both cases, grackle tracks were documented entering the exclosure and approaching the nest within. In one case, a fake egg was removed from the exclosure and later found on the beach approximately 40 feet from the exclosure. No evidence of grackles or crows were found surrounding the exclosures with actual plover nests, though these were not located in areas with lots of evidence of crow or grackles predation. More nests were not exclosed for a variety of reasons, including poor weather conditions that did not allow for exclosures to be erected and nests being located in areas that would be deemed as inappropriate for exclosure use. Data for the 2013 season is still in draft and should be considered preliminary.

Current and Future Management Techniques:
A common depredation order stands for the removal of any species of crows, grackles, and blackbirds when they are in direct competition with federally endangered species (50 CFR 21 Migratory Bird Permits § 21.43). In 2013, 4 adult American crows and 4 chicks were removed from South Monomoy Island. One pair of crows was found to be nesting in a shrub close to the common tern nesting area. The refuge plans to remove the small trees and shrubs from this area before nesting season 2014 to discourage any future nesting in this area.

Crane Beach initiated a crow removal program in 2008 using toxicants to target individual crows foraging in piping plover nesting areas. False, open-topped exclosures were constructed in nesting areas and pre-baited with hard-boiled chicken eggs. Once the crows ate the eggs, USDA APHIS contractors baited the exclosures once more with hard-boiled chicken eggs laced with the DRC-1339. This is the same toxicant used for gull removal on Monomoy in the 1990s. Crow activity was monitored using point counts, and the program had an immediate and lasting effect on crow abundance and activity within the nesting areas (Crane Beach 2008 and 2009 annual report). While only three carcasses were recovered in 2008, it is estimated that the program removed at most 30 crows. The program is credited with significantly increasing piping plover nest success and chick survival at Crane Beach in 2008 and 2009 (Crane Beach 2008 and 2009 annual report).

If crow and grackle predation continues to be a problem for nesting piping plovers, terns, or oystercatchers, we will consider using toxicants and shooting to remove predatory American crows and grackles. If fish crows were deemed a predator on the refuge, they would be treated in the same way as American crows.

Impacts of Management to Crow Population:
Given the widespread distribution of American crows and common grackles in Massachusetts, and their stable population status, lethal removal of a small number of predatory individuals at Monomoy refuge would not have an impact on the overall population.

Non-lethal Methods Common to Many Predators

At Monomoy NWR, we have been utilizing a variety of non-lethal management techniques to reduce impacts of predator and competitor species during different times of the breeding season. A description of these techniques follows; we propose continuing to use all these methods under our preferred alternative.

1. Maintaining a Staffed Field Camp

"This is the primary technique for displacing small gull colonies (up to 300 pairs) that occupy islands of 2 ha (7 acres) or less. The technique is also useful for preventing gulls from reclaiming former breeding grounds up to 20 ha (49 acres), where lethal control has previously lowered gull numbers. The technique requires a team of resident stewards camping in a conspicuous location adjacent to tern habitat. For new restoration projects at well-established gull colonies, set up the field camp before egg laying begins (in Maine and New Hampshire, during the third week of April). After several years, the season may be pushed back to mid-May, but more breaking of gull eggs may be necessary. Daily visits by mainland-based stewards to large, well-established colonies (e.g., Bird and Ram Islands in Buzzards Bay) are sufficient to deter gull nesting, with occasional breaking of gull eggs. However, depending on proximity to the mainland, landing conditions and other logistic constraints can make daily visits more difficult than staffing resident camps." (Kress and Hall 2004).

Since 1998, refuge staff have maintained a field camp on South Monomoy adjacent to the tern colony for at least June and July, and sometimes from May to August. Maintaining a human presence on the island most of the time has successfully prevented nesting herring and great black-backed gulls from reestablishing territories in close proximity to tern nesting habitat. It has also greatly facilitated our ability to manage other predators and collect data about predator visits and impacts.

2. Using Rectangular Signs to Reduce Perching

Refuge staff noticed that great horned owls were perching on square and rectangular "Area Closed" and "Beach Closed" signs that were around the perimeter of the tern colony. In 2002 refuge staff began using triangular signs around the perimeter of the tern colony in an effort to eliminate perches for great horned owls. This technique has been successful, but great horned owls will also hunt from the ground, so this is not a complete solution. However, using these signs might reduce perching by other avian predators as well.

3. Habitat Management

Habitat management can be an effective method for controlling competitor species and minimizing risk of predators. For example, prescribed burning has been used at Monomoy refuge to reduce habitat suitability for nesting laughing gulls (a competitor species of terns), increase habitat for nesting terns, and reduce shrubby vegetation that provides shelter for mammalian predators.

4. Chick Shelters

Wooden tern chick shelters are placed throughout the tern colony, especially in areas devoid of natural vegetation, to provide additional shelter from weather and predators. Shelters are designed to minimize the chances that black-crowned night-herons can reach chicks, but their effectiveness at minimizing coyote depredation is uncertain.

5. Electric Fencing

Electric fencing has been successful on the refuge in flat, sparsely vegetated areas that are free of the risk of overwash. If the fence is placed in areas where it may be overwashed by salt water, electrical shorts may occur and destroy the fence for future electrified use. Erecting the fence in thick vegetation is very difficult and the vegetation needs to be trimmed, causing potential habitat damage, increased staff labor, and drawing more attention to the fenced area. Currently the energizers used at the refuge can only support fences of up to 12 panels or a circumference of 1,800 feet. When the fencing is used in areas with a varying elevation, predators can more easily breach the fence by jumping in from a higher area. This was observed on the refuge in both 2008 and 2009. For these reasons, enclosing the entire common and roseate tern colony is not practical. Nesting least terns and piping plovers have benefited from areas protected by electric fence on the refuge. However, electric fencing does not reduce avian predation.

6. Non-electric Fence

Funding provided by the National Fish and Wildlife Foundation in 2009 allowed us to test the effectiveness of 6-foot-tall non-electrified wire fencing on the refuge to protect American oystercatcher eggs and chicks from mammalian predators. The tall wire fencing was deemed impractical to set up in the field without causing considerable disturbance to the target nesting American oystercatchers and was discontinued.

7. Predator Exclosures on Piping Plover Nests

Studies have shown that predator exclosures can help minimize predation or reduce nest abandonment (Rimmer and Deblinger 1990, Vaske et al. 1994, Mabee and Estelle 2000), and they are actively being utilized on the refuge. Though exclosures are a useful tool, they may be inappropriate under certain conditions, including habitat that is too steep, highly vegetated, or susceptible to predators that may use exclosures to target nesting birds (refer to Blodget and Melvin 1996 for more information about appropriateness of use). All exclosures placed on the refuge are monitored frequently to ensure they are safely protecting the nests and birds within them and not putting the adults at risk. In some years, raptors have targeted adults on exclosed nests (see the Northern Harrier section), but exclosures are still an effective management tool when monitored carefully. However, exclosures only protect eggs, and do not provide protection for piping plover chicks, which leave the nest bowl soon after hatching.

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