U.S. Fish & Wildlife Service - Chesapeake Bay Field Office

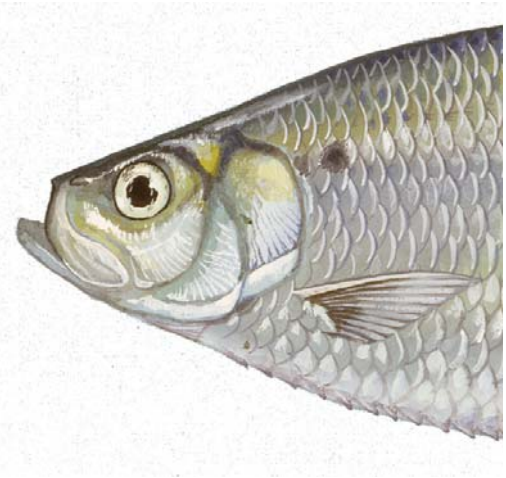
Priority Species Action Plans

Fiscal Years 2011 – 2016

CBFO

3/4/2011

Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*) Yellow Perch (*Perca flavescens*) Species Action Plan



Focus Areas: Blackbird Millington, Lower Potomac Patuxent, Lower Western Shore Rivers

Other Species Benefitting: alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), hickory shad (*Alosa mediocris*), striped bass (*Morone saxatilis*), white perch (*Morine americana*)

Biological Planning

Species Information: Along the east coast of North America, yellow perch range from South Carolina to Nova Scotia. The range extends to the west as far as Saskatchewan an to the northern half of the Mississippi drainage (Piavis 1991). The yellow perch is a treasured resource in the Chesapeake Bay. A semi-anadromous species, it lives in fresh to brackish waters of many Chesapeake Bay tributaries, and migrates upstream to fresher water habitats to spawn. According to Piavis (1991), adults remain in their natal tributaries. The primary movements are the upstream spawning migration of adults and the downstream dispersal of juveniles. Yellow perch is sought by recreational fishermen both for its excellent taste and as a harbinger of spring, since its spawning run in February and March is the earliest of the season. Historically, yellow perch have been a major commercial and recreational fishery in the Chesapeake Bay but populations in many tributaries have declined (see Threat and threat assessment). Yellow perch are eaten by top predators such as striped bass, largemouth bass (Micropterus salmoides), and piscivorous birds.

The habitat for yellow perch eggs and larvae overlaps with that for anadromous species such as alewife and blueback herring (Klauda et al. 1991). Juvenile and adult habitats also overlap with those for shad and striped bass. Thus, the approach and conclusions derived for yellow perch are applicable for the protection of these species. We consider yellow perch a better indicator of the effects of ecological stressors because of its more compressed spawning period.

Justification for Species Selection: On May 12, 2009, the President issued Executive Order 13508, recognizing the Chesapeake Bay as a national treasure and calling on the federal government to lead a renewed effort to restore and protect the nation's largest estuary and its watershed. Section 601 calls for the Departments of Commerce and Interior to conduct research

to evaluate the effects of climate change on the Chesapeake Bay. The areas to be assessed include 1) evaluating the effects of changing rainfall levels and rainfall intensity on water quality and aquatic life; 2) the impacts of increasing temperature, acidity, and salinity levels; and 3) potential impacts of climate change on fish, wildlife and their habitats. Through long-term monitoring and modeling conducted by Maryland Department of Natural Resources, it is clear that reproduction in the Severn River and other western shore rivers is poor while that in the Choptank and Nanticoke is much more successful. Thus, the river specific yellow perch populations can serve as indicators to evaluate habitat quality for anadromous fish with regard to land use changes (i.e., increasing impervious surface due to urbanization) and sediment/ contaminant loading.

Within CBFO's geographic region, yellow perch is a focal species for the Lower Western Shore and Lower Potomac areas. These areas include the most stressed populations, South and Severn Rivers (Uphoff et al. 2005, 2006, 2010) as well as an area threatened by development, Mattawoman Creek (American Rivers 2009).

Threats and Assessment

Maryland's commercial fishery for yellow perch declined from over one million pounds per year around 1900 to 66,000 pounds in 1990 (Piavis 1991). Population declines resulted in commercial (Choptank, Magothy, Miles, Nanticoke, Patapsco, Severn, South, West, Wye rivers) and recreational (Magothy, Nanticoke, Patapsco, Severn, South, West rivers) closures in 1989. New regulations for the 2009 season reopened the Patapsco, Magothy, Severn, South, and Nanticoke rivers to recreational fishing. Portions of the Magothy and Severn rivers remain closed to recreational fishing to protect spawning habitat (http://www.dnr.state.md.us/fisheries/management/yperch/ypmngindex.html).
Threats to yellow perch include:
Nutrient loading leading to hypoxia
Sediment loading - sediments carry toxic chemicals such as metals, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), nutrients, and pesticides (USGS 2005; U.S. EPA Chesapeake Bay Program 2009)sediment loading.
Poor reproduction although it is not known whether this is due to an increased prevalence of abnormal gametes, possibly due to endocrine disrupting chemicals, hypoxia, or from the effects of stressors on early life stages
Climate change - recent (2007-2009) collections of ripe (pre-spawning) adults indicates that spawning occurs over an approximately 3-5 day period, triggered by water temperatures reaching about 8-10 °C (S. Minkkinen, USFWS, personal communication). Climate change could result in an even more compressed spawning season due to a more rapid rise in

temperature (S. Minkkinen, personal communication). Heavy rainfall can threaten hatching success by: dislodging egg chains, which are usually suspended from woody debris, and wash them downstream or destroy their integrity; increasing the concentrations of suspended sediment which will decrease yellow perch larval survival; and increasing loadings of contaminants off the impervious surfaces during winter storms.

Research/Actions Needed

Examine effects of hypoxia on the reproductive function of adult yellow perch. Hypoxia is a pervasive condition in the Severn River and is projected to increase as a result of climate change.
Examine the effects of sediment and contaminant loading on survival of early life stages of yellow perch.
Evaluate how urbanization and increased impervious coverage are associated with yellow perch population trends.

Potential Funding: Beginning in 2007, Chesapeake Bay Field Office and Maryland Fisheries Resource Office launched two yellow perch contaminant studies with two groups from U.S. Geological Survey, the National Fish Health Research Laboratory and the National Wetlands Research Center funded by the Mirant Power Company. The objective is to compare the reproductive status of yellow perch in five Chesapeake Bay tributaries – two of which (South and Severn rivers) have experienced serious population declines. The study utilizes histopathology, hormone analyses, and sperm quality analyses as endpoints. A final report is expected in early 2011.

The current project, started in 2010, is a collaboration with Towson University and the University of Maryland Wye Research and Education Center to analyze the impacts of salinity (as altered by the addition of road salts) and exposure to suspended sediments on the survival of yellow perch eggs and larvae. Funding was received from the U.S. Fish Wildlife Service's Division of Environmental Quality as an Off-Refuge Proposal.

For both studies, Dr. Jim Uphoff, Maryland Department of Natural Resources, has served as an advisor and collaborator.

Population Goal: To increase the strength of the western shore populations as measured by the Maryland Department of Natural Resource's modeling effort. Before that can be achieved, studies are needed to identify stressors that adversely affect the populations.

Conservation Design

Assemble multi-disciplinary teams on a project-specific basis to unraveling the effects of multiple stressors on yellow perch

populations in the Chesapeake Bay. The teams are linked by collaborating on the proposal writing, working together on the projects, and co-authoring the reports. Financial arrangements are made through reimbursable agreements and Interagency Agreements.
Assess the impacts of these stressors, including climate change, and advise on adaptations A constant presence has been the long-term knowledge and advice provided by Dr. Jim Uphoff of Maryland Department of Natural Resources.

Conservation Delivery

Future actions may include total maximum daily limits (TMDLs) to limit sediment and nutrient inputs.
Engage in early project planning (e.g. rerouting highway expansions away from spawning areas).
Increase/restore riparian buffers to benefit the habitats that are utilized by anadromous fish.

Outreach

CBFO will develop an outreach strategy to communicate the threats to yellow perch habitat and transmit the results of the studies to the public. This will take the form of fact sheets, information on the CBFO web site, and presentations to watershed groups.

Monitoring

Population monitoring is continuing as funding permits by the Maryland Department of Natural Resources. These efforts could be supplemented by the Service so that long-term data sets are maintained. Some limited (and semi-quantitative) egg mass monitoring is currently conducted by the Maryland Coastal Conservation Association using volunteers. With funding, the Service could develop a more rigorous program. Future studies will revisit specific tributaries as part of the multiple stressor assessments. One study we suggest is an analysis of the effects of hypoxia in the Severn River on yellow perch populations.

Partners

Maryland Department of Natural Resources
Mirant Power Company
Towson University, Chemistry Department
University of Maryland Wye Research and Education Center
U.S. Fish and Wildlife Service, Division of Environmental Quality
U.S. Fish and Wildlife Service, Maryland Fisheries Resource Office
U.S. Geological Survey, the National Fish Health Research Laboratory
U.S. Geological Survey, National Wetlands Research Center

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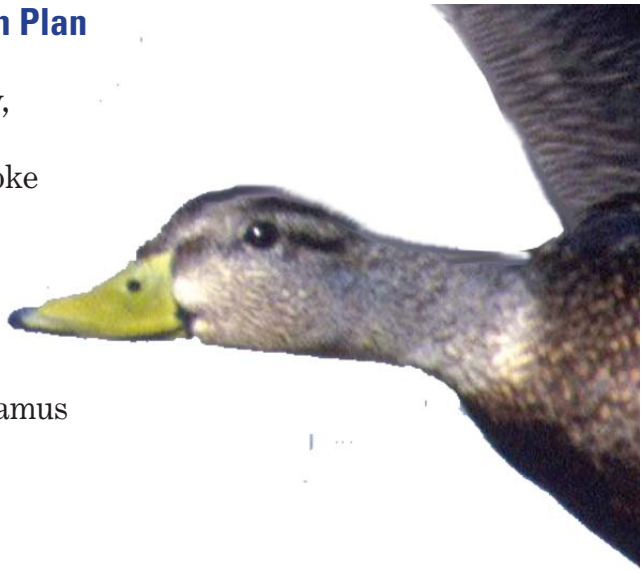
American Black Duck (*Anas rubripes*) Species Action Plan



Focus Areas: Chesapeake Bay Islands, Chincoteague Bay, Delaware Bay Shoreline, Lower Chester River, Lower Potomac Patuxent, Lower Rappahannock River, Nanticoke Choptank, Pocomoke River Cypress Swamp, Western Highlands

Other Species Benefitting
Black rail (*Laterallus jamaicensis*), saltmarsh sparrow (*Ammodramus caudacutus*), seaside sparrow (Ammodramus maritimus)

Biological Planning

Species Information
The American black duck (hereafter black duck) is a large dabbling duck that breeds in North American wetlands, including freshwater wetlands created by beaver; brooks lined by speckled alder; lakes, ponds, and bogs throughout mixed hardwood and boreal forests; and in salt marshes. Post molting males, females, and fledged young assemble near breeding areas in early September. Southward migration begins in September to early October with individuals reaching wintering sites in coastal marshes from Nova Scotia to the mid-Atlantic states.

Nesting begins in February in southern parts of its range, but often not until late May in northern areas. Nests are usually well concealed and on the ground, often in uplands. Only females incubate the eggs. Once the ducklings hatch females lead broods to rearing areas where food and cover can be found.

Black ducks are omnivorous. Ducklings feed almost exclusively on insects until 18 days post-hatch when ducklings begin feeding on plants including seeds and leafy material. (Longcore et al. 2000b). Migrants eat seeds, foliage, and tubers of aquatic plants and seeds and fruits of terrestrial species, a variety of invertebrates, agricultural grains, and occasionally fish and amphibians. Animal foods, including saltmarsh snail (Melampus bidentatus), blue mussels (Mytilus edulis) and small crustaceans are important fall and winter food items along the Atlantic coast.

Justification for Species Selection: The black duck population remains below the North American Waterfowl Management Plan (NAWMP) continental population goal and has been identified as a "Species of Greatest Conservation Need" by 23 states in the Mississippi and Atlantic Flyways. One measure of success for sustaining healthy populations of fish and wildlife

contained within President Obama's Executive Order 13508 on Chesapeake Bay Protection and Restoration is the restoration of a three-year average wintering black duck population in the Chesapeake Bay watershed of 100,000 birds by 2025.

State Contribution to Overall Species Population

Black ducks occur in both the Mississippi and Atlantic Flyways but the majority of birds winter on the Atlantic coast The Mid-winter Waterfowl Survey conducted each January in most Atlantic Flyway states reported that for the years 2001 to 2005 Maryland, Delaware, and Virginia wintered about 25 percent of the Atlantic Flyway total count and the Chesapeake Bay watershed accounted for about 12 % of the Flyway's black ducks. In 2010 Maryland, Delaware, and Virginia wintered about 30 percent of the Atlantic Flyway total count and the Chesapeake Bay Watershed accounted for about 15 % of the Flyway's black ducks

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There are two populations of black ducks that inhabit the mid-Atlantic Region, resident breeding birds and a wintering population that migrates from Quebec, Ontario, and the maritime provinces.

In the Chesapeake Bay marshes, black ducks were once an abundant breeder throughout tidal marshes with the largest numbers nesting along the eastern shore from the Chester River to the Saxis marshes in VA, including all of the islands. The breeding population has steadily declined since the 1960's due to the loss of submerged aquatic vegetation, competition with millions of farm-raised mallards released at Regulated Shooting Areas (RSAs), competition and interbreeding with mallards (Anas platyrhynchos), development of shorelines, disturbance, predators, loss of coastal islands and brackish marshes, overharvest at RSAs and poaching. All of the factors have contributed to their demise to where there are probably less than 1000 breeding pairs remaining in the Chesapeake Bay.

The migratory population faces many of the same problems including overharvest, competition and hybridization with mallards, decrease in quality and quantity of wintering and breeding habitat, and environmental contaminants (Conroy et al. 1989, Rusch et al. 1989, Longcore et al. 2000 a,b, Merendino et al. 1993, Nudds et al. 1996, Conroy et al. 2002, McAuley et al. 2004, Zimpfer and Conroy 2006).

Threats and Assessment:
Causes of black duck mortality and habitat loss are numerous and complex and include:

- Over harvest and poaching
- Predators including black-backed gulls, herring gulls, crows, bald eagle, raccoons, exotic red fox, and skunks
- Loss of high salt marsh breeding habitat due to sea level rise, damage caused by nutria, human intrusion, and development
- Encroachment of non-native invasive plants such as common reed (Phragmites australis)
- Competition and interbreeding with mallards

Conservation Goal
To conserve and protect American black duck population, ensuring its long term sustainability in the wild.

Research/Actions Needed

- Recent research suggests that black duck food sources may be limited in coastal salt marshes. Research should expand to determine if this is an issue of low or reduced productivity or competition with other animals.
- Support research for a biological control of common reed by federal, state and non-governmental programs.
- Research the impact of native and nonnative predators on various life stages of black ducks, and seek methods to reduce predation if it is substantial.
- Estimate the take of black ducks in legal hunting, poaching and incidental take at Regulated Shooting Areas (RSA).
- Study the effectiveness of mosquito control especially spraying of larva ides and insecticides in marshes and its reduction of black duck foods. Do cost/benefit analysis of damage to marsh and birds to need for mosquito control.
- Evaluate bycatch in legal and illegal fishing gear such as fyke nets, pound nets, and gillnets.

Conservation Design

- Permanently protect salt marsh habitats from development and pollution through fee simple purchases, conservation easements, and private donations
- Restore wetlands from prior –converted crop fields and farmed wetland pastures
- Continue restoring Poplar Island and other Chesapeake Bay islands to provide nesting habitat for black duck
- Control invasion of common reed (Phragmites australis) to prevent encroachment into black duck high salt marsh habitats
- Reduce mute swan population to in order to reduce its detrimental effect on submerged aquatic vegetation, an important black duck food source
- Continue nutria eradications efforts and reconstruct wetlands

at Blackwater National Wildlife Refuge and adjacent habitats on private lands
- Restore natural ponds degraded by mosquito control actions
- Control predators especially the exotic red fox, but attempt to reduce predations of other invasive species through control or habitat manipulations
- Increase law enforcement to reduce illegal take of birds

Conservation Delivery

- Through the National Coastal Wetlands Conservation grant program properties within the breeding range of the black duck can be protected under conservation easements to allow for potential marsh migration
- Work with the state of Maryland's Rural Legacy Program to protect large, contiguous tracts of black duck breeding and wintering habitat through cooperative efforts among state and local governments and land trusts.
- Utilize the North American Wetlands Conservation Act (NAWCA to provide funding for Black duck habitat conservation or restoration in conjunction with partner organizations like National Audubon, Maryland-DC.

Outreach

Outreach is extensive through the Flyways, and the Black Duck Joint Venture. We will partner with other federal agencies in outreach connected with the black duck restoration in the Chesapeake Bay.

Monitoring

Current monitoring by U.S. Fish and Wildlife Service Division of Migratory Bird Management and the states are sufficient to determine the status of black ducks in the watershed.

Monitoring of common reed stands adjacent to black duck nesting habitat is important to ensure that the extensive grassy high marsh habitats required by the black duck aren't lost to invasion by this non-native plant species.

Partners

Appalachian Mountain Joint Venture (AMJV)
Atlantic Coast Joint Venture (ACJV)
Central Hardwoods Joint Venture (CHJV)
Delaware and Maryland Coastal Bays Program
Ducks Unlimited
Eastern Habitat Joint Venture (EHJV)
Environment Canada's Canadian Wildlife Service (CWS),
Maryland Department of Natural Resources
state and provincial conservation agencies of the Atlantic and Mississippi Flyways
Upper Mississippi River and Great Lakes Joint Venture (UMRGLJV)
U.S. Fish and Wildlife Service, Division of Migratory Bird
U. S. Fish and Wildlife Service, National Wildlife Refuge System (Regions 5, 3,4)
U. S. Fish and Wildlife Service, Regional Migratory Bird Programs (Regions 5, 3,4)

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American Eel (Anguilla rostrata) Species Action Plan

Focal Areas
Anacostia Watershed, Blackbird Millington, Lower Chester River, Lower Rappahannock River, Lower Susquehanna Aberdeen, Nanticoke Choptank, Western Highlands

Other Species Benefitting
Freshwater mussel (Elliptio complanata)

Biological Planning

Species Information
American eel occupy a significant and unique niche in coastal rivers and tributaries. Historically, American eel were very abundant in the Chesapeake Bay rivers, comprising more than 25 percent of the total fish biomass. The abundance of this species has declined from the historic high levels and now remains relatively stable at historic low levels. Resource managers and scientists are warning that future declines in abundance may come from greater harvest and other impacts. In an effort to address the decline in abundance, a working group was established by the Atlantic States Marine Fisheries Commission to develop a Fishery Management Plan (FMP) for the American eel in order to protect and restore the species. The document outlines the conservation measures to take for the species. The U.S. Fish and Wildlife Service is in full support of the measures to attain the goals of the FMP.

Justification for Species Selection: Proposed as a Federally-listed threatened species, the American eel has a unique life history and uses a variety of aquatic habitats. The American eel was selected as a priority species because it is an indicator of good water quality in aquatic habitats that range from the coastal estuary to the highland streams. Eels are highly adaptive to various food sources and undergo long migrations upstream and downstream in the watershed. This occurs even in rivers with small dams. The successful migration of American eels is essential to the full restoration of a river ecosystem due to the fact that eel typically provide for freshwater mussel distribution upstream in a watershed. This relationship between the eel and mussel is short lived, but it is essential for mussel distribution and survival in a watershed.

On May 12, 2009, the President issued Executive Order 13508, recognizing the Chesapeake Bay as a national treasure and calling on the federal government to lead a renewed effort to restore and protect the nation's largest estuary and its watershed. Among one of the goals set forth by the Executive order is to restore historical fish migratory routes by opening

1,000 additional stream miles by 2025, with restoration success indicated by the presence of American eel, American shad and river herring.

State Contribution to Overall Species Population

American eel are found in all Chesapeake Bay rivers and streams that are free of blockages.

Threats and Assessment

American eel assessments are conducted annually in Maryland with some fishery dependent and independent methods. Eel abundance may be adversely impacted by:

- Habitat loss
- Water quality impairment
- Commercial fishing
- Recreational bait fishing
- Hydroelectric turbines
- Drinking water intakes

Conservation Goals

The goal is to conserve and protect the American eel ensuring its continued role in the ecosystems, while providing the opportunity for its commercial, recreational, scientific, and educational use.

Specifically

Protect and enhance the abundance of American eel in the watershed and contribute to the viability of the American eel spawning population

- Provide for sustainable commercial and recreational eel fisheries by preventing overharvest of any life stage.

Research/Actions Needed

The American eel needs considerably more research conducted on migration, biology, habitat use and aquaculture (see attachment).

Concservation Design

- Lead the Potomac River Dams 4 and 5 eelway projects
- Develop eel passage monitoring on the Potomac River
- Develop and support eel passage and monitoring on the Shenandoah River
- Plan to open Potomac and Shenandoah Rivers to eel passage, with a vision to open the entire Potomac Watershed
- Improve knowledge of eel utilization at all life stages through mandatory reporting of harvest and effort by commercial fishers and dealers, and enhanced recreational fisheries monitoring.
- Increase understanding of factors affecting eel population dynamics and life history through increased research and monitoring.

- Protect and enhance American eel abundance in all subwatersheds where eel now occur.
- Where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for and adequate escapement to the ocean for pre-spawning adult eel.
- Investigate the abundance level of eel at the various life stages, necessary to provide adequate forage for natural predators and support ecosystem health and food chain structure.

Conservation Delivery

- Open access on the Potomac River at dams 4 and 5
- Open upstream and downstream eel passage on the Shenandoah River
- Reduce downstream passage mortality at hydroelectric stations with nighttime shutdowns on the Shenandoah and Potomac Rivers
- Coordinate and support dam removals and other eel passage projects in the Chesapeake Bay watershed

Outreach

- All completed dam removal and eelway projects include a media and environmental education day
- Volunteer and education opportunities exist for children and adults during eelway monitoring
- The Potomac River Dams 4 and 5 eelway projects will have environmental education kiosks or signage
- The National Park Service will assist with education and outreach on the Potomac River watershed projects

Monitoring

The Chesapeake Bay Field Office is the lead for American eel restoration and protection in the Shenandoah River since 1986 and through the process of regulatory actions of the hydroelectric relicensing. A partnership with the Allegheny Energy Supply Company , University of West Virginia, Fish and Wildlife Cooperative Unit, the Service's Maryland Fisheries Resource Office and other federal and state resource agencies to monitor upstream and downstream eel passage including:

- Downstream out-migration of silver eels within the Shenandoah River relative to Luray, Warren, and Millville hydroelectric dams
- Downstream outmigration of silver eels at a larger geographic scale from Luray to the mouth of the Potomac River
- Effectiveness of the eel laddersat Millville, Warren, and Luray Dams for upstream migration of yellow eels
- Timing, periodicity, and environmental correlates of upstream movements of yellow eels between the dams and age-length relationships of yellow eels to assess relative growth rates
- Infection rates of swimbladder nematodes in eels of the lower Shenandoah River.

Management actions (such as periods of shut down or methods to assist eel passage) could be refined with additional understanding of seasonal variation in downstream migration, environmental fluctuations on downstream migration, the timing and daily periodicity of downstream migration, and the locations (spillway vs. turbines) of where eels pass the dam.

Partners

Allegheny Energy Supply
Interstate Commission on the Potomac River Basin
Maryland Department of Natural Resources
National Park Service
The Nature Conservancy
U. S. Army Corps of Engineers, Baltimore District
U.S. Fish and Wildlife Service, Maryland Fisheries Assistance Office
West Virginia Department of Natural Resources
West Virginia University Cooperative Fish and Wildlife Unit, U.S. Geological Survey

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Attachments

- American eel research needs recommended in the Atlantic States Marine Fisheries Commission FMP.
- Assessment and determination of fishing mortality rates (F) to develop sustainable harvest rates
- Economic studies are necessary to determine the value of the fishery and the impact of regulatory management.
- Investigate: mechanism of sex determination; growth rates for males and females throughout their range; habitat preferences of males and females; predator-prey relationships; behavior and movement of American eel during their freshwater residency; oceanic behavior, movement and spawning location of mature adult American eel; and all information on the leptocephalus stage of the American eel.
- Evaluate contaminant effects on American eel and the effects of bioaccumulation with respect to impacts by age on survival and growth and effect on maturation and reproductive success.
- Study the nutrition of American eel leptocephali larvae in the ocean.
- Determine growth rates of male and female American eel in different habitats.
- Determine if geographic sub-populations exist, which may have implications for management.
- Investigate larval and juvenile survival and mortality to assist in the assessment of annual recruitment
- Determine food habits of glass eel while at sea
- Investigate location and triggering mechanism for metamorphosis from leptocephalus to glass eel
- Investigate mechanisms of exit from the Sargasso Sea and of transport across the continental shelf
- Evaluate the impact, both upstream and downstream, of barriers on American eel with respect to population and distribution affects. Determine areas of extirpation and historical distribution
- Investigate, develop, and improve technologies for American eel passage upstream and downstream
- Evaluate the ecosystem importance of American eels as prey, predators, and mechanisms of transporting freshwater biomass to marine systems
- Determine fecundity-length and fecundity-weight relations for female American eel from various parts of its geographic range
- Determine mortality rates at different life history stages (leptocephalus, glass eel, yellow eel, and silver eel) and mortality rates with size within the yellow eel stage
- Investigate mechanism of sex determination in American eel
- Determine age at entry of glass eel into estuaries and fresh waters

- Investigate migratory routes and guidance mechanisms for silver eel in the ocean
- Investigate mechanisms of recognition of the spawning area by silver eel
- Investigate mate location in the Sargasso Sea
- Conduct studies on spawning behavior
- Determine gonadal development in maturation
- Conduct workshop on aging techniques
- Sustainable fishing mortality rates (F) for American eel have not been examined.
- Researchers and fishery managers have not determined the best means to ensure the stability
- of the American eel populations
- Identification and understanding of American eel habitat needs for all life stages
- Model the effect of increased habitat availability and reductions in mortality at various freshwater life stages on escapement
- Research the impacts of elver fishing on the abundance and distribution of later life stages within a watershed and what, if any, impacts there are on sexual determination and upstream migration.
- Research techniques (physical and behavioral) for providing upstream and downstream passage around dams
- Research the feasibility and ecological/genetic impacts of trap and truck programs for elvers
- Quantify and assess male eel habitat and male eel abundance
- Quantify and estimate the impact of the bait fishery for juvenile/bootstrap eels.

Bald Eagle (*Haliaeetus leucocephalus*) Species Action Plan

Focus Areas
Anacostia Watershed, Lower Potomac Patuxent, Lower Rappahannock River, Lower Susquehanna Aberdeen

Other Species Benefitting
Delmarva fox squirrel (Sciurus niger cinereus)

Biological Planning
Species Information: Bald eagles are large birds of prey (raptors) of North America, weighing between 10 -14 pounds and have an average wingspan of 6 feet. Bald eagles live near rivers, lakes, marshes and estuaries where they forage for fish, their predominant year round food source. Bald eagles will also feed on waterfowl, turtles, rabbits, snakes, and other small animals including carrion, especially during the winter months. The Chesapeake Bay has the distinction of hosting a large breeding population and an equally important non-breeding and migrant population. In winter, bald eagles congregate in forested areas near open water for foraging, loafing, sheltering and overnight roosting.

The regulated nesting season begins December 15 and ends June 15 of each year. Bald eagles in the Chesapeake Bay region prefer nesting in mature loblolly pines, tulip poplars and oaks near undisturbed shorelines. Nest heights average 90 feet above the ground. The massive nests are often used year after year, growing to 6-8 feet in width and averaging 4 feet deep. By late January to early February, bald eagles will lay one to three eggs which hatch after 35 days of incubation. The young fledge between 11 and 12 weeks of age.

Historical records show that in the early 1900s several thousand pairs of eagles nested around the Chesapeake Bay each year. However, just prior to the 1940s, bald eagles began to decline due to the direct killing, loss of habitat and the introduction of the pesticide DDT. The near demise of the population prompted the federal government to list the species in 1967 for regulatory protection. In 1978, the species was listed as endangered under the Endangered Species Act throughout the lower 48 states.

During the past 25 years of recovery, eagles have made a significant rebound. Bald eagles have responded to the absence of DDT in the environment in addition to landowner compliance of the Endangered Species Act. The species was removed from the ESA in 2007 but remains protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (MBTA). The Service also developed the National Bald Eagle Management Guidelines in 2007, to inform the public of measures to avoid disturbance to bald eagles.

Justification for Species Selection: The Chesapeake Bay encompasses one of the largest concentrations of bald eagles in the lower 48 states. In addition to the breeding population, the Chesapeake Bay supports winter migrants from as far north as Canada and northern states and summer migrants from Florida and the Carolinas. State and federal monitoring programs have documented only a limited number of communal and concentration areas throughout the Chesapeake Bay and its tributaries in Maryland and Virginia. These areas are deemed significant not only to protect recruitment levels for the Chesapeake Bay nesting population but also winter and summer eagles from the northern and southern bald eagle populations. The level of importance the Chesapeake Bay has on the migrant population has yet to be determined.

In 2009, the Service promulgated new permit regulations under the Bald and Golden Eagle Protection Act, including a regulatory definition of disturb. Two new take permits under CFR 50, 22.26 (disturbance) and CFR 50 22.27 (nest removal) were established for development projects which comply with the permit issuance criteria for take.

State Contribution to Overall Species Population

Maryland and Virginia support approximately 1,600 nesting pairs to the overall national nesting population of 10,000 (+) breeding pairs. The Chesapeake Bay area supports no less than 10 recognized concentration areas which collectively sustain several thousand non-breeding aged adult, sub-adult and juvenile individuals during the summer and winter months. Known locations in Maryland include areas of the Conowingo Dam on the lower Susquehanna River, Aberdeen Proving Ground in northern Chesapeake Bay, lower Potomac River (Maryland and Virginia shoreline) and Blackwater National Wildlife Refuge. In Virginia, sites include a significant portion of the James and Rappahannock Rivers.

Threats and Assessment

Cumulative impacts (direct effects) from habitat loss due to shoreline development projects including new construction of private and community boat ramps and marinas. Recreational water activities (indirect effects) will have increased negative impacts to communal and concentration areas over time which may substantially fragment or completely eliminate these important areas.

- Mortality (line strike collision with electrical utilities and wind turbines, environmental contaminants such as ingested lead; mercury)
- Noise disturbance (human activity)

Management Actions Needed

The National Bald Eagle Management Guidelines provides criteria to avoid and minimize disturbance to nests, foraging and roost areas. In addition, new federal regulatory documents have been developed which provide the framework for authorizing eagle take through a permit process. The majority of permits will likely involve disturbance of nests. The number of permits issued will not exceed the Regional Take Allocation per given year. The Endangered Species Act established a requirement for monitoring a species once removed from Threatened and Endangered Species List. Post-Delisting Monitoring for nest occupancy was initiated in 2009 and will continue every 5 years for a 20 year period. The state of Maryland recently removed their designation of threatened status and therefore no longer allocate funding or resources to protect the species. All inquires are directed to the Service due to the federal status designation. A serious problem persists however, for potential take/ disturbance of eagles at concentration areas. The Service has an incomplete inventory of communal and concentration areas, especially in Maryland, and currently lack necessary funds for conducting shoreline roost surveys. These data gaps will result in the Services inability to address potential take which may result in projects moving forward without receiving mitigation or compensation for the species.

Potential Funding

Funding priorities do not include bald eagle communal roost and concentration surveys at this time. The Service must recognize this need in order to be able to assess the local population dynamics which would then enable field offices (Eagle Coordinators) and the Regional Endangered Species and Migratory Bird Programs to set annual take thresholds for eagles that may be disturbed within these areas. The Service's Eagle Management Team has a strategy to initiate a National Eagle Compensation Fund as a mitigation component within the permit framework for disturbance, which could possibly be used to fund actions such as communal roost surveys.

Research/Monitoring Actions Needed

As cited earlier, current monitoring is an extension of the Endangered Species Act which requires implementation of a Post-Delisting Monitoring Plan. Aerial nesting surveys are conducted for a sub-set of the population once every 5 years for 20 years to ascertain any declines in the population level that may dip below the baseline threshold. In April/May 2009, the Service conducted the first of five aerial monitoring for nest occupancy.

Population Goals

The national breeding population (and Chesapeake Bay Eagle Region) has been stable or steadily increasing since delisting in 2007. Chesapeake Bay Bald Eagle Recovery Plan objectives of 300-400 nesting pairs, productivity of 1.1 young and long term, adequately protected habitat continue to be met or exceeded.

Results of the first Post-Delisting Monitoring indicated an increasing eagle population, above the baseline threshold (20 % population decline). Thus far, the Regional permit allocation number has not been exceeded (based on limitation of 5% of the annual nest productivity). However, the population goal is based on the number of nesting pairs and productivity. There is no accounting for eagles within the concentration areas which must be addressed.

Conservation Design

The Bald Eagle Coordinator at Chesapeake Bay Field Office, in coordination with the Service's Eagle Management Team and Region 5 Endangered Species and Migratory Bird Permit Office and Virginia Field Office, will develop a strategy to quantify the parameters necessary to sustain long term protection for bald eagles at communal roost/concentration areas. Take threshold levels will be addressed which may be inclusive of the entire local Chesapeake Bay communal roosting areas or determined individually, based on watershed or tributary unit.

Conservation Delivery

- Continue to actively provide technical assistance to Aberdeen Proving Grounds and other Department of Defense facilities

Outreach

Continue to work with the Service's Eagle Management Team and sub-teams and provide updates for posting on at Chesapeake Bay Field Office and Region 5 Endangered Species and Migratory Bird Permit Office web sites as new information becomes available.

Monitoring

Other than an Endangered Species Act requirement to implement post-delisting monitoring ever 5 years, annual monitoring for nesting territories is no longer conducted by the state of Maryland. Efforts have begun internally with the Service to address these needs but with an added emphasis to monitor eagle concentration areas.

Partners

Maryland Department of Natural Resources
College of William and Mary-Center for Conservation Biology

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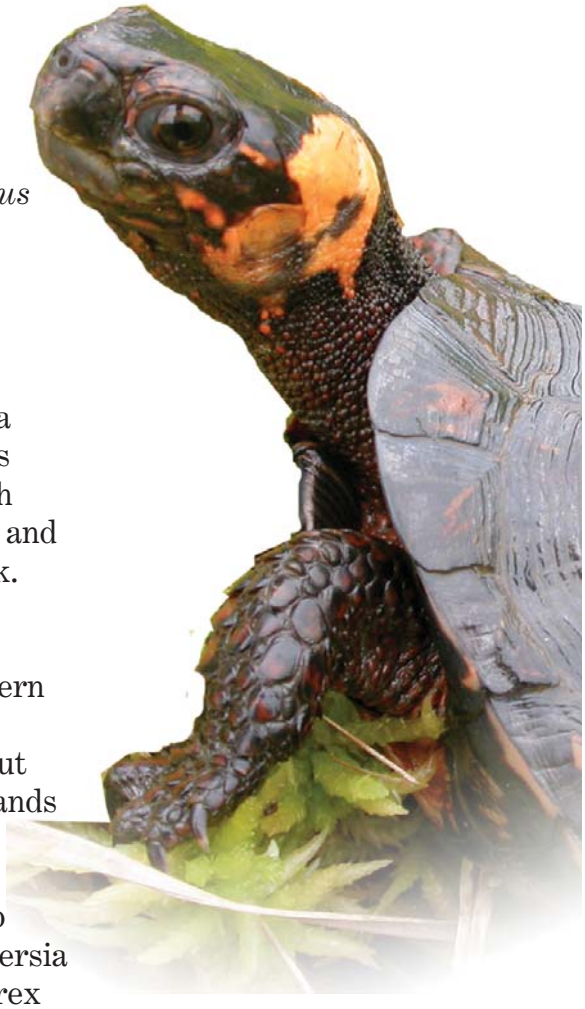
Bog Turtle (*Clemmys muhlenbergii*) Species Action Plan



Focus Area
Gunpowder River Deer Creek

Other Species Benefitting
American woodcock (*Scolopax minor*), brook trout (*Salvelinus fontinalis*), Indiana bat (*Myotis sodalis*)

Biological Planning

Species Information
The bog turtle is one of the smallest turtles in North America with a carapace between 7.5 – 11.4 centimeters in length. It is distinguished by a bright orange, yellow or red blotch on each side of the head and neck. The shell is a light brown to ebony and is weakly keeled. The limbs and head are dark brown to black. The plastron is yellow with black patches.

The northern population of the bog turtle extends from western Massachusetts to northern Maryland and Delaware. The geographic distribution of the bog turtle is fairly extensive but its habitat requirements limit it to spring fed emergent wetlands with thick mucky organic soils (Smith 2000). These wetland types are very rare in its distribution range. These wetlands are dominated by low grasses and sedges with a mix of shrub species.Common emergent species include rice cut-grass (Leersia oryzoides), tearthumbs (Polygonum spp.), tussock sedge (Carex stricta), skunk cabbage (Symplocarpus foetidus), soft rush (Juncus effuses), sensitive fern (Onoclea sensibilis), jewelweed (Impatiens spp.), arrowheads (Saggittaria spp.), and a variety of other sedges (Carex spp.). Common scrub species include alder (Alnus spp.), viburnum (Viburnum spp.) and poison sumac (Toxicodendron vernix) (Lee and Norden 1996).

Research is needed on the affects of predation on bog turtle populations and reproduction. Wildlife cameras will be deployed at several sites to observe the species of predators, duration of visits, and numbers of each species moving through these wetlands. Depending on the results, a stomach analysis study may be recommended on the most common predators frequenting the sites.

Confer with institutions breeding bog turtles and other endangered turtles to determine the practicality of developing captive breeding programs at two or three zoos. Presently, there are several isolated bog turtle wetlands in Maryland with populations of fewer than 10 individuals. These turtles will never generate self-sustaining populations and should be bred in zoos. Young turtles could be kept in the zoo for a year or two or until they reach a size that makes them less vulnerable to predation

and then released in Population Analysis Sites (PAS) with more than one wetland to reestablish populations in these priority sub-watersheds.

Justification for Species Selection

The bog turtle was listed as threatened under the Endangered Species Act in 1997 because it was being excessively collected for the pet trade and was limited to wetland habitat types that are rare throughout its northern range. The collection of turtles for the pet trade has been diminished because of its listing. Its low population numbers also makes the turtle very hard to find. However, the loss of bog turtle wetlands and Population Analysis Sites (PAS) is continuing because of land development and habitat succession. The Chesapeake Bay Field Office has the responsibility of developing recovery plans for bog turtles located in Baltimore, Carroll, Cecil, and Harford counties in Maryland; New Castle County in Delaware; and Adams, Cumberland, Franklin, and York counties in Pennsylvania. These counties encompass portions of two major watersheds that are separated into two bog turtle recovery units. The recovery units are listed as the Delaware and Susquehanna/Potomac Recovery Units and include the Delaware Bay, Susquehanna River, and Potomac River watershed regions that are occupied by the bog turtle.

State Contribution to Overall Species Population

The Maryland Department of Natural Resources (MDNR) conducted three bog turtle surveys between 1976 and 2004 and provided detailed data on 177 wetlands and 91 bog turtle populations (U.S. Fish and Wildlife Service 2005).

Threats and Assessment

Habitat loss and segmentation of Population Analysis Sites (PAS)

- Habitat succession and nutrient inputs
- Low reproduction, low population numbers and unknown predation impacts
- Barriers to migration

Management Actions Needed

Habitat Loss and Segmentation of Population Analysis Sites
In 2001, there were approximately 350 Population Analysis Sites (PAS) throughout the northern population of the bog turtle (U.S. Fish and Wildlife Service 2001). A PAS consists of one or more emergent wetlands that are close enough to each other and support or could potentially support bog turtles. These wetlands are located in small sub-watersheds consisting of first and second order streams and are not blocked from each other by roads, or by residential, office, or industrial development. Turtles should be able to travel easily between each wetland for it to be considered

a habitat unit in the same PAS. Ongoing road construction and land development continually threaten bog turtle wetlands and PAS's.

The situation of wetland and PAS destruction can be illustrated by two bog turtle surveys conducted by the Maryland Department of Natural Resources (MDNR) in 1976 -1978 and 1992-1993 (Smith 1994). In 1976, the MDNR found 177 wetlands comprising 94 PAS's inhabited by bog turtles. By 1993, only 91 sites of the 159 sites surveyed contained bog turtles and only 56 PAS's remained. Bog turtles were missing from 68 sites and 38 PAS's that contained bog turtles in the late 1970's. This represents a 43% reduction in wetlands and a 40% in PAS's in 16 years. Protecting bog turtle wetlands and preventing fragmentation of Population Analysis Sites (PAS) is critical to the recovery of this species.

Habitat Succession and Nutrient Inputs

Another problem affecting bog turtles concerns invasive native and exotic plant species overwhelming the emergent and shrub species needed for viable bog turtle habitat. Bog turtles need wetlands dominated by a diverse community of emergent vegetation. Over 50% of the remaining bog turtle wetlands are being overrun by red maple (Acer rubrum), multiflora rose (Rosa multiflora), cattail (Typha latifolia), and reed canary grass (Phalaris arundinacea) which engulf and shade out the emergent vegetation utilized by bog turtles. To prevent succession of bog turtle wetlands into forested wetlands and reduce nutrients from croplands we recommend:

- Control invasive woody and herbaceous vegetation with glyphosate and imazapyr. The glyphosate will be applied to the cut stump of red maple, willow, and alder and to the leaves of reed canary grass, cattails, and multiflora rose. Imazapyr will be injected in the trunks of red maple and willow.
- Fence bog turtle wetlands and allow goats, sheep, or cattle to graze on the invasive wetland vegetation.
- Identify potential nutrient sources and place the wetland and a 300-foot wide upland buffer into a conservation easement. The vegetation in the buffer incorporates the nutrients into plant tissue.

Low reproduction, low population numbers, and unknown predation impacts

We recommend that a captive breeding program be initiated in three to four zoos in the Northeast. These bog turtles can be removed from small populations that are in isolated PAS's with only one or two wetlands. Since there is little variation in the genetics of bog turtles (Rosenbaum et al. 2006), all the turtles collected can be interchanged between the zoos involved with this program. A captive breeding program can no longer be dismissed as too problematic due to the high rate of loss.

Increased predation may be having a significant effect on bog turtle populations and reproductive success. To determine the predator species and determine the frequency of predator travel through the bog turtle wetlands, wildlife cameras should be placed in some of these wetlands.

Barriers to migration
Where subdivision of the land base is imminent, continue to work NRCS and landowners to promote the purchase of conservation easements. Buffer if part of the conservation easement, would also minimize the impacts of new developments on wetland hydrology. Because of past land uses many of the streams adjacent to bog turtle wetlands have steep banks which prevent bog turtles from accessing adjacent wetlands. Stream restoration should be implemented on the highest priority PAS's.

Research Actions Needed:
Deploy wildlife cameras at several sites to observe predation on bog turtle populations and identify the species of predators, duration of visits, and numbers of each species moving through these wetlands. Depending on the results, a stomach analysis study may be recommended on the most common predators frequenting the sites.

Confer with institutions breeding bog turtles and other endangered turtles to determine the practicality of developing captive breeding programs at two or three zoos. Young turtles could be kept in the zoo until they reach a size that makes them less vulnerable to predation and then released in PAS's to reestablish populations in these priority sub-watersheds.

Conservation Design

- Prioritize Maryland bog turtle wetlands according to reproduction/no reproduction, population size, and number of wetlands in each PAS.
- Place each Maryland wetland on an aerial photo to determine the spatial relationship between wetlands rated as to value.
- Place traps in newly discovered bog turtle wetlands to estimate turtle population sizes.
- Conduct bog turtle walk through surveys in Maryland.
- Hire crews to fence bog turtle wetlands that will utilize goats, sheep, or cattle to control invasive vegetation.
- Hire crews to spray vegetation that needs to be controlled in bog turtle wetlands.
- Assist the Natural Resources Conservation Service in identifying properties with bog turtle wetlands.
- Conduct stream and riparian restoration to increase floodplain connectivity, and restore wetland hydrology.
- Work with the Corps of Engineers to ensure no permits are

issued for alterations to bog turtle wetlands.
- Visit facilities that are breeding endangered and threatened turtles. If captive breeding seems feasible, meet with zoo officials to try to initiate two or three breeding programs.

Conservation Delivery

- Develop location maps for the top 110 priority wetlands in the state of Maryland
- Control invasive woody and herbaceous vegetation with glyphosate and imazapyr. The glyphosate will be applied to the cut stump of red maple, willow, and alder and to the leaves of reed canary grass, cattails, and multiflora rose. Imazapyr will be injected in the trunks of red maple and willow.
- Control invasive plant species in 10 to 15 bog turtle wetland each year. Spray ten to twenty bog turtle sites each year.
- Conduct 10 bog turtle surveys in Maryland per year.
- Fence bog turtle wetlands and allow goats, sheep, or cattle to graze on the invasive wetland vegetation. Fence four bog turtle sites each year.
- Work with identified landowners to encourage them to place their wetlands in a conservation easement that allows the Service to restore or enhance the wetland for bog turtles.
- Work with the U.S. Army Corps of Engineers to ensure that property owners are not given permits to fill or alter the hydrology of known jurisdictional bog turtle wetlands.
- Work with the U.S. Army Corps of Engineers and the regulatory branches in Chesapeake Bay Field Office and Pennsylvania Field Office on permit applications that may impact bog turtle wetlands.
- If feasible, establish two bog turtle captive breeding programs by 2015.

Outreach

- Work with Natural Resources Conservation Service to organize meetings to discuss the various funding opportunities to promote wetland and buffer easements, fencing, and construction of stream crossings.
- Provide this information through brochures, websites and social networks to landowners.
- Contact a minimum of 50% of the landowners at least once a year to ask how we can assist them in the maintenance of their wetlands.

Partners

Landowners
Maryland Department of Natural Resources
Natural Resources Conservation Service
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service, Pennsylvania Field Office

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Brook Trout (*Salvelinus fontinalis*) Species Action Plan

Focus Areas
Gunpowder River Deer Creek, Shenandoah Upper Rappahannock, Western Highlands

Other Species Benefitting
American eel (*Anguilla rostrada*), freshwater mussels

Biological Planning

Species Information
Brook trout range from Maine to Georgia in the eastern portion of the United States. Although self sustaining populations are found in lakes and ponds in Maine, New York, and Vermont (Hudy et al., 2005), they are typically found in silt-free, spring-fed headwater streams with mixed gravels, cobble and sand substrate (Maryland Department of Natural Resources, 2006). Spawning occurs from mid-October to late November or early December when the trout migrate upstream to gravel-bottomed areas in cold, spring-fed tributaries. Aquatic insect larvae and other terrestrial invertebrates make up much of their diet. Due to their feeding habits, brook trout can be negatively impacted by persistent water turbidity (Maryland Department of Natural Resources, 2006).

Traditionally, the value of brook trout has been linked to recreational and economic benefits. In addition to this, however, brook trout are very significant biologically. They require pristine, stable habitat and high water quality conditions to survive, and are indicators of high biological integrity in streams. These requirements make this species a very good candidate when planning biological and conservations actions for the entire ecosystem they live in.

Justification for Species Selection
Brook trout populations are declining throughout the native range. Currently 388 of 1,294 sub-watersheds in the Chesapeake Bay are classified as "reduced" for brook trout. May 12, 2009, President Barak Obama signed the Chesapeake Bay Protection and Restoration Executive Order (EO) 13508 requiring a renewed commitment from Federal Agencies to protect and restore the Chesapeake Bay. A brook trout outcome was included in the "Sustain Fish and Wildlife" goal under this EO. Brook trout are listed as a "Species of Greatest Need of Conservation" in the Maryland Department of Natural Resources Wildlife Diversity Conservation Plan (Maryland Department of Natural Resources, 2005). The recognition of the significance and uniqueness of brook trout habitat, and the widespread detrimental effects of its decline, has also resulted in the creation of various alliances, such

as the multi-state Eastern Brook Trout Joint Venture and the Maryland Brook Trout Alliance.

State Contribution to Overall Species Population: Hudy, et al. (2005) show that brook trout are extirpated from 26% of their native subwatersheds in Maryland, West Virginia and Virginia. In Maryland specifically, brook trout have been extirpated from 62% of their native habitat and 82% of the remaining populations are classified as "greatly reduced" (Hudy et al. 2005).

Threats and Assessment

Climate change, increases in water temperature - Research indicates that water temperature is the single most important factor limiting the geographic distribution of brook trout (Maryland Department of Natural Resources, 2006).

- Habitat degradation and alteration - Brook trout populations become extirpated and its habitat declines when human land use in a subwatershed is greater than 18% (Hudy et al. 2005).

Hudy et al. (2005) indentified urbanization as a high or medium impact in 100 of 145 subwatersheds in Maryland. Urbanization typically effects brook trout through loss of riparian buffer, loss of stream shading, change in surface and sub-surface hydrological regimes, increased sedimentation, reduced flow, increased high flow events, changes in channel morphology, changes in the physical makeup of streambeds, and increased impervious surface (Maryland Department of Natural Resources, 2006).

Hudy et al. (2005) identified agriculture as the most widely distributed factor in the decline of brook trout across its eastern range. The impacts to brook trout populations are similar as in urbanization (i.e. increased water temperature, increased sedimentation, hydrological changes, loss of riparian vegetation etc.). Additionally, livestock in agricultural areas can increase problems by damaging stream banks and contributing nutrients.

- Mining activities impact brook trout populations through acid mine drainage (AMD), hydrological changes and physical habitat degradation.
- Non-native fish species, such as brown trout, have negative impacts on brook trout populations due to competition for resources.
- Population fragmentation due to physical and chemical barriers - Hilderbrand and Morgan (2009) indicate that isolation of populations due to connectivity loss will decrease genetic diversity, and therefore increase the risk of extirpation.

Rangewide Recovery Goals
Conserve, enhance or restore naturally reproducing brook trout populations.

Rangewide Recovery Objectives
Improve 58 sub-watersheds from "reduced" classification to "healthy."

Research/Actions Needed
Maryland Department of Natural Resources (2006) indentified the need to:

- Determine brook trout life history parameters
- Investigate brook trout movement patterns
- Investigate the impact of non-native trout and other exotic species
- Determine the extent of streams impacted by acid rain and acid mine drainage

Hudy et al. (2005) identified the need for:

- Increased quantitative population monitoring where there are data gaps.
- Continued quantitative population monitoring to document trends.

The U.S. Fish and Wildlife Service, Chesapeake Bay Field Office and Maryland Fisheries Resource Office identified the need for continued inventory of fish passage barriers, particularly in the western portion of Maryland.

Potential Funding Sources
National Fish Habitat Action Plan, Mid-Atlantic Highlands Action Plan, Wildlife Habitat Initiative Program (WHIP), Conservation Reserve Enhancement Program (CREP), Eastern Brook Trout Joint Venture

Conservation Design
Existing Strategies

- The Eastern Brook Trout Joint Venture 2008 Action Strategies
- The 2006 Maryland Brook Trout Fisheries Management Plan
- The Chesapeake Bay Summit 2010 outcomes from the Wetland Restoration and Enhancement and Stream Restoration Maryland Action Teams.

Other Strategies for Addressing Threats

- Conduct stream restoration using a natural channel design methodology (NCD). NCD uses the rivers natural tendencies to design a channel that will maintain its dimension, pattern, and profile overtime. Projects will range in scope from bank stabilization using native materials to full channel

reconfiguration with the installation of bank stabilization and in-stream structures, while increasing floodplain connectivity. The Service will use native grasses, trees, and shrubs for bank stabilization and riparian plantings. Construction of in-stream structures will utilize logs and rocks, with preference given to log structures when their use is possible.

- Design and implement fish passage using a natural channel design methodology (NCD). NCD uses the rivers natural tendencies to design a channel that will maintain its dimension, pattern, and profile overtime. Projects will range in scope from removing the blockage with a small amount of bank stabilization using native materials to full channel reconfiguration with the installation of bank stabilization and in-stream structures, while increasing floodplain connectivity. The Service will use native grasses, trees, and shrubs for bank stabilization and riparian plantings. Construction of in-stream structures will utilize logs and rocks, with preference given to log structures when their use is possible.
- Conserve or enhance existing riparian habitat
- Conduct riparian plantings and livestock fencing
- Develop a Brook Trout Project Prioritization matrix to assist in the strategic identification of high priority brook trout stream restoration and dam removal projects

Conservation Delivery

To address climate change, increases in water temperature, habitat degradation and alteration, and mining, the following actions are recommended:

- Assess and design 3 miles of stream for brook trout
- Restore 1 mile of stream for brook trout
- Enhance, restore, or conserve 2 miles of riparian habitat
- Work with federal, state, local, and non-governmental organization partners to develop a database and framework to identify and prioritize brook trout restoration and conservation projects.

To address population fragmentation due to physical and chemical barriers, the following actions are recommended:

- Assess and design 2 fish passage projects
- Implement 1 fish passage project
- Identify data gaps and collect data on additional blockages

Outreach

- Develop informational and educational resources describing recovery actions. Examples include signage at restoration sites and fact sheets.
- Produce a GIS based information source describing potential and successful projects.

Monitoring

- Work with Maryland Department of Natural Resources, and the U.S. Fish and Wildlife Service, Maryland Fisheries Resource Office to monitor brook trout populations after restoration is complete. Monitoring activities will include electroshocking the restored site to determine if brook trout are successfully using the site.
- Conduct stream stability assessments to determine the lateral and vertical stability of a restoration site.
- Conduct as-built surveys as needed to document success of any structures installed during restoration.

Partners

American Rivers
Eastern Brook Trout Joint Venture
Environmental Protection Agency
Maryland Department of Natural Resources
Maryland Brook Trout Alliance
Mid-Atlantic Highlands Action Plan
Natural Resources Conservation Service
Soil Conservation Districts
Trout Unlimited
U.S. Fish and Wildlife Service, Maryland Fisheries Resource Office
Virginia Department of Game and Inland Fisheries

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Common Tern (*Sterna hirundo*) Species Action Plan

Focus Areas
Chesapeake Bay Islands

Other Species Benefitting: least tern (Sterna antillarum), American oystercatcher (Haematopus palliates), black skimmer (Rynchops niger), gull-billed tern (Sterna nilotica), Forster's tern (Sterna forsteri)

Biological Planning

Species Information
The common tern is the most widespread and recognizable tern in North America. Its breeding range is from central to eastern Canada at inland lakes and along the Atlantic Coast from the Canadian Maritimes south to South Carolina where it typically nests on islands or barrier beaches. They prefer nesting areas with sand, gravel, or shell with sparse vegetation, but along the Atlantic are often found using small marsh islands where they nest on wrack or on small shell ridges (rakes). Along barrier islands, colony sites are often at overwash sites with little or no vegetation; here they may associate with gull-billed terns, black skimmers, American oystercatchers and/or piping plovers (Charadrius melodus). Two to three eggs per nest is common with hatching taking place between 21-23 days without predator interference. Most common avian predators are great horned owls (*Bubo virginianus*) herring gulls (*Larus argentatus*) and greater black-backed gulls (*Larus marinus*); terrestrial predators include red fox (*Vulpes vulpes*) and raccoons (P*rocyon lotor)*. Feeding usually occurs near (several km) the breeding site on the Atlantic Coast where they are take small fish (up to 150 mm long). Occasionally they feed on small crustaceans and insects (Erwin 1977, Nisbet 2002).

Justification for Species Selection
Common tern populations within the Chesapeake Bay region are undergoing significant declines. From 1977-2003, common tern populations in the Chesapeake Bay region declined by approximately 39 percent; however more striking is the 60 percent decline they experienced from 1993-2003 (Brinker et al. 2007). At present, the Paul S. Sarbanes Environmental Restoration Project at Poplar Island supports the only nesting colony of common terns in the Maryland portion of the Chesapeake Bay (Brinker et al. 2007; Erwin 2010).

State Contribution to Overall Species Population
Maryland is one of the Atlantic Coast states with nesting populations of common terns. A recent population survey

(2003) conducted in the Chesapeake Bay region indicated that 3,236 nesting pairs were present and were distributed among 45 colonies (Brinker et al. 2007). Most colonies exist in Virginia and along the coast of Maryland and Virginia.

Threats and Assessment

Human development, building, and recreation

- Erosion of island habitat and sea level rise
- Avian and mammalian predators reduce the number of suitable nesting and roosting sites
- Displacement from nesting sites by herring and greater black-backed gulls
- Continued use of pesticides in the Caribbean, Central America and South America (winter range) as well as sporadic trapping for food in some countries there

Rangewide Recovery Goal

To establish long-term sustainability of the species in the wild.

Rangewide Recovery Objective

Interim - improve nesting success of common terns on Poplar Island; increase number of potential nesting sites along coastal bays and in Chesapeake; reduce gull predation at key colony sites (e.g. Hampton Roads Bridge Tunnel). Long term - increase the number of predator-free nesting sites in Maryland and Virginia.

Conservation Goal for Maryland

Same as rangewide goals.

Research/Actions Needed

Erwin (personal communication) of the U.S. Geological Survey/ Patuxent Wildlife Research Center identified these additional research needs:

- Document movement patterns by nesting individuals within colonies on a local and regional scale
- Gain greater understanding of mortality types (i.e. percent of mortality due to predation, weather, and disturbance)

Conservation Design

- Coordinate with Maryland Department of Natural Resources, U.S. Army Corps of Engineers, and Virginia Department of Game and Inland Fisheries to develop island restoration plans for both bay and oceanside
- Develop land management plans which incorporate conservation measures into the local planning processes
- Initiate measures to protect, maintain, and improve all species habitats and populations through coordinated efforts with various programs within state, federal and non- governmental organizations.
- Utilize coastal zone management programs

- Conduct an inventory of islands with habitat capable of supporting nesting colonies and determine current use
- Conduct quantitative surveys identifying all populations, habitats, and critical resources, followed by long-term research on population trends and assessments of mortality factors

Conservation Delivery

- Use more aggressive enforcement of area restrictions (with additional sign postings) at sites used by nesting or roosting terns. Increase fines imposed by law enforcement where violations occur.
- Stabilize island shorelines and use dredge material and/or other materials to replenish eroding islands.
- Look for signs of mammalian predators and remove if necessary
- Establish avian and mammalian predator control on the islands where common terns nest
- Monitor avian species such as great horned owls and herring and black-backed gulls and remove if necessary..
- Trap and remove gulls in cases where they are usurping common tern prime nesting habitat.
- Oil gull nests to decrease the number of hatchlings and slow population growth.

Outreach

- Produce a fact sheet to be distributed by the Chesapeake Bay Field Office.
- Develop a video that shows the habitat and life cycle of a common tern to be posted on Chesapeake Bay Field Office website as well as social media sites.

Monitoring

- Monitoring common tern populations at restored or habitat enhanced island sites within the Chesapeake Bay would be conducted using similar protocols used by Maryland Department of Natural Resources and U.S Geological Survey biologists that currently conduct colonial waterbird surveys within the Chesapeake Bay (Erwin 2010). In Maryland and Virginia, coordinated surveys are conducted on a five-year basis.
- Establish coordinated habitat and population monitoring programs on a regional level using standardized surveying techniques designed to have minimal impacts on populations
- Continue nesting monitoring and reproduction success at Poplar Island

Partners
U.S. Geological Survey/Patuxent Wildlife Research Center
Maryland Department of Natural Resources
Virginia Department of Game and Inland Fisheries
U.S Department of Agriculture APHIS
U.S. Army Corps of Engineers – Baltimore and Norfolk Districts

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Delmarva Fox Squirrel (*Sciurus niger cinereus*) Species Action Plan

Focus Areas
Blackbird Millington, Lower Chester River, Nanticoke Choptank

Other Species Benefitting
Kentucky warbler (Oporonis formosus), pileated woodpecker (Dryocopus pileatus)

Biological Planning

Species Information
The Delmarva fox squirrel (DFS) is a subspecies of the eastern fox squirrel and is only found on the Delmarva Peninsula. It inhabits mature, mixed pine/hardwood forests that have a closed canopy and relatively open understory. Habitat models for this species indicate that variables associated with forest maturity (e.g. percent of trees over 12" dbh, percent of canopy closure, and height of trees) are the most significant variables (Dueser 2000, Morris 2006). DFS inhabit forests that range from 100% hardwoods to 100% pine, but a mix of both conifers and hardwoods with a diversity of species is probably preferred. Mature forest provides large trees for den sites and leaf nests. Larger trees also produce more food for DFS such as hard mast (e.g. acorns and walnuts) and soft mast (maple flowers and samaras, pine cones). This species has been expanding into new forest blocks on the Eastern Shore and often uses riparian forests as well as the forest/agricultural edges of these riparian forests. These forests are likely providing corridors for DFS movement and expansion.

Justification for Species Selection
Since forest habitat maturity is strongly correlated to the presence of Delmarva fox squirrels, the species functions as a great indicator of this habitat type. Restoring and maintaining large mature forest blocks connected to each other has been identified as one of the most important conservation actions for the Delmarva Peninsula. In addition, this subspecies was listed as federally endangered by the U.S. Fish and Wildlife Service in 1968 because its range had diminished to only 10% of the Delmarva Peninsula. Since that time, translocations have been conducted to expand its range, and additional sightings have occurred in new areas. A 2007 Status Review for this species summarized that the larger range, and its persistence within the range, indicated this species was close to recovery and concluded that the appropriate status for this animal was threatened until new information could help evaluate the possible threat from timber harvest (USFWS 2007).

State Contribution to Overall Species Population
Approximately 97% of the DFS distribution is in Maryland (USFWS 2007) and 2% and 1% are in Delaware and Virginia respectively. Even historically, the DFS distribution was limited in Delaware and its historic occurrence in Virginia was certainly limited as is was never documented to occur there but assumed to occur because of its presence in Maryland counties on the Virginia border. Thus most of the DFS occurrence is in eight Maryland counties of the Delmarva Peninsula.

Threats and Assessment

Loss of habitat from short-term pine management, development, and over-hunting were the original threats to this species. While these threats are no longer considered to threaten this species with extinction, additional protections of habitat that are expected to occur in the future, will also benefit this species. In addition, development pressure (commercial, urban and infrastructure), forest fragmentation, and habitat loss due to sea level rise are emerging challenges that could affect the conservation of this species.

Conservation Goal

The current goal is primarily insuring persistence and continued growth of the population within its existing range, especially in the northern counties where DFS are not as abundant. The 2007 Status Review estimated the total DFS population to be a little less than 20,000. This is over 150 times the estimated minimum viable population (Hilderbrand et al. 2007).

Research/Monitoring Actions Needed

The species is doing relatively well and expanding, and its most important needs are conserving mature forests tracks and the connectivity between them. Monitoring needs will continue into post-delisting for this species and the Service has obligations for a post-delisting monitoring plan. Monitoring will include the use of camera surveys in some areas, but reports of DFS sightings are still the best source of information on the range. Widening the network of individuals who report DFS sightings will be important. Post-delisting may also improve the monitoring as reluctance of individuals to report endangered species can be problematic for documenting presence in some areas.

Management Actions Needed

Maintaining a network of relatively connected forests in the northern portion of the Delmarva Peninsula (Lower Chester River Focus Area) would also be helpful and there may be some areas where riparian forest protection from logging or development would be beneficial. The northern counties have less forested area than the southern counties, and, in the north, riparian forests form the best network that connect many forest tracks. For example, DFS have been using the Tuckahoe River corridor and other corridors in Queen Anne's County to expand. Actions that protect riparian forests from logging, prevent losses from development, or enhance areas where riparian forests are very limited could be beneficial to the DFS. Forest connectivity is also important to the south (Nanticoke Choptank Focus Area). It is important to maintain large forested corridors intact.

Potential Funding

Maryland Department of Natural Resources, Natural Resources Conservation Service

Conservation Design

- Conduct a GIS analysis of riparian forest areas in the Lower Chester River Focus Area to identify riparian forests that have mature forest habitat; the proportion that is currently protected from development; the logging frequency of these riparian forests; and stream areas that currently do not have riparian forests.
- The GIS analysis will be used to prioritize areas where riparian forests can be improved for the DFS and other species, specifically the dwarf wedge mussel, another endangered species in the area. Conservation delivery will range from protecting sites with easements, or working with local foresters to minimize impacts from logging.

Conservation Delivery

- Focus upland and forested wetland habitat protection efforts to conserve forest corridors and expand the size of forest blocks.
- Work with the Natural Resources Conservation Service and other partners on restoring connectivity of forest tracts by restoring riparian corridors.

Outreach

- Develop awareness of DFS through more information on the Chesapeake Bay Field Office website and Maryland Delaware websites. Postings should include: photographs of DFS from remote cameras; photographs distinguishing DFS from gray squirrels; instructions for reporting sightings of DFS (possible Google Earth platform)
- Develop a hunter survey form for reporting DFS sightings

Monitoring

A DFS Monitoring Plan has been drafted and currently involves a combination of camera surveys at some sites, and use of the network of volunteer observers to report sightings of DFS in individual woodlots. This network of volunteers are the most cost-effective way to document the range, but these volunteers have to be kept informed and interested to keep this monitoring going. These sightings can be reported at the scale of Atlas blocks, however, since we currently have DFS presence/absence at the level of woodlots for much of the range, we will try and continue monitoring DFS occurrence at this scale. Initial work towards an Atlas or mapping approach has found that we need to access the hunting community more thoroughly as hunters, sitting still in hunting stands, have the best opportunity for seeing DFS. Accessing private lands is difficult. We will be work with the state of Maryland in identifying ways to better access the hunting community. Hunting clubs lease Maryland Department of Natural Resources. There are 58,000 acres of these lands scattered throughout the lower Eastern Shore. DFS sighting cards on these properties would provide additional information about a large area. Sighting cards provided to other hunt-clubs could help in other areas (Queen Anne's County)

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Partners
Maryland Department of Natural Resources
Maryland Environmental Trust
Eastern Shore Land Conservancy
Natural Resource Conservation Service
Queen Anne's County.

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Dwarf Wedge Mussel (*Alasmidonta heterodon*) Species Action Plan

Focus Areas
Lower Chester River, Lower Potomac Patuxent

Other Species Benefitting
American black duck (*Anas rubripes*), Acadian flycatcher (*Empidonax virescens*), cerulean warbler (*Dendroica cerulean*), common elliptio mussel (*Elliptio complanata)*, Eastern narrow-mouthed toad (*Gastrophryne carolinensis*), flier (*Centrarchus macropterus*), Kentucky warbler (*Oporornis formosus*), Louisiana waterthrush (*Seiurus motacilla*), mallard (*Anas platyrhynchos*) Northern pintail (*Anas acuta*) redbreast sunfish (*Lepomis auritis*), wood duck (*Aix sponsa*), wood thrush (*Hylocichla mustelina*), yellow-throated vireo (*Vireo flavifrons*)

Biological Planning

Species Information
The dwarf wedge mussel is a small (~ 145 mm long) mussel that lives on muddy sand, sand, and gravel bottoms, in creeks and rivers of varying sizes, in areas of slow to moderate current, good water quality, and little silt deposition.

Little is known about the reproductive biology of the dwarf wedge mussel; however, the reproductive biology of freshwater mussels appears to be similar among nearly all mussel species. During the spawning period, males discharge sperm into the water column, and the sperm are taken in by females during siphoning. Eggs are fertilized in the gills, which also serve as a place for larval development. Clarke (1981b) indicates that the dwarf wedge mussel is a long-term brooder. Fertilization typically occurs in mid-summer and fall, and larvae are released the following spring and summer. Larvae release for some long-term brooders also has been observed during fall and winter (Zale 1980). Upon release into the water column, mature larvae of the genus Alasmidonta attach to the fins and soft tissue of the mouth of host fishes to encyst and eventually metamorphose to the juvenile mussel stage. When metamorphosis is complete, they drop to the streambed as juvenile mussels.

Justification for Species Selection
The dwarf wedge mussel was listed as endangered under the Endangered Species Act on March 14, 1990. The species' dramatic decline, as well as the small size and extent of most of its remaining populations, indicate that individual populations remain highly vulnerable to extirpation.

Historically, the dwarf wedge mussel was widely but discontinuously distributed in Atlantic drainages from the Petitcodiac River in New Brunswick, Canada, south to the Neuse River in North Carolina. The species was known from at least 74 locations in 11 states and one Canadian province. Master (1986) reported that an extensive status survey of historical and potential sites turned up only eight extant populations. Since then, 12 additional extant populations have been

found in Maryland, North Carolina, Virginia, and New York. Although a few additional populations may still be discovered, a clear pattern has emerged -- relatively small, scattered relict populations remain from a once extensive distribution.

State Contribution to Overall Species Population

The following are locations of three (3) extant populations of the dwarf wedge mussel in the Potomac River drainage in Maryland and Virginia: McIntosh Run in St. Mary's County, Maryland, Nanjemoy Creek in Charles County, Maryland and Aquia Creek in Stafford County, Virginia. In addition, the species occurs in two tributaries, the Corsica River and Southeast Creek, within the lower Chester River drainage in Maryland.

Threats and Assessments

- The damming and channelization of rivers has resulted in the elimination of formerly occupied habitat. Discharge rate modifications from dams can also affect the dwarf wedge mussel.
- Siltation generated by road construction, agriculture, forestry activities, and removal of streambank vegetation is considered to be an important factor in the decline of many freshwater mussel species, including the dwarf wedge mussel.
- Sedimentation from forestry operations and agriculture
- The continuing decline and ultimate loss of the dwarf wedge mussel from most of its historical sites can best be explained by agricultural, domestic, and industrial pollution of its aquatic habitat.
- Residential, highway, or industrial development
- Removal of streambank vegetation affects both the physical and biological processes of the waterways. Tree removal alters the amount of organic material and light reaching the stream, impacting both temperature and dissolved oxygen, which are critical factors for both fish and mussels. The floodplain biomass can also help buffer the stream from pollutants.
- The invasion of the Asian clam (Corbicula fluminea) and the zebra mussel (Dreissena polymorpha) may be a significant threat to the dwarf wedge mussel.
- Mussel die-offs, the cause of which remains unknown, may be a threat to the dwarf wedge mussel.
- Most of the dwarf wedge mussel populations are small, and all are geographically isolated from each other. This isolation restricts the natural interchange of genetic material between populations. The small population size also reduces the reservoir of genetic variability within populations.

Research/Actions Needed

- Conduct life history research on the species to include reproduction, food habits, age and growth, and mortality factors. Characterize the species' habitat requirements (physical, biological, and chemical components) for all life history stages.

Potential Funding

Section 6 Recovery Land Acquisition Grants, National Coastal Wetland Grants, Farm Bill Wetland Reserve Program, National Park Service, Chesapeake Gateways Initiative.

Conservation Design

- Conduct additional population and habitat surveys for dwarf wedge to identify essential habitat and key areas in need of protection.
- Identify and determine significance of specific threats faced by the species such as pesticide contamination, siltation, acidification, and municipal and industrial effluents.
- Use data from GIS layers to determine if properties that contain dwarf wedge mussels can be purchased or have easements placed on the banks of the waterways to improve water quality for the dwarf wedge mussel.

Conservation Delivery

- Protect populations of the dwarf wedge mussel (Corsica River, Southeast Creek tributaries, McIntosh Run and Nanjemoy Creek in Maryland and Aquia Creek in Virginia) from impacts upstream and along the stream banks.
- Protect the hydrology and ground water quality and quantity in the vicinity of river reaches known to be occupied by dwarf wedge mussels
- Protect riparian buffers along and upstream of occupied reaches of the Corsica River and Southeast Creek tributaries in the Lower Choptank focus area, and Nanjemoy Creek and McIntosh Run in the Lower Potomac/Patuxent focus area.
- Develop a successful technique for re-establishing and augmenting populations. Where appropriate, reintroduce the species within its historical range and evaluate success.

Outreach

- Develop and distribute informational and educational materials, such as power point presentations and brochures to school children, civic groups, and the general public.
- Develop and distribute informational and educational materials in the priority watersheds identified above.
- Continue to facilitate the initiation of River Watch Programs in dwarf wedge mussel rivers.
- Continue to provide information through updating dwarf wedge mussel website

Monitoring

- Develop a program to monitor the three existing populations of the dwarf wedge mussel (McIntosh Run and Nanjemoy Creek in Maryland and Aquia Creek in Virginia).
- Monitor population levels and habitat conditions of presently established and introduced populations

Partners

Charles County, MD
Maryland Department of Natural Resources
North American Land Trust and other non-governmental organizations
Stafford County in Virginia
St. Mary's County MD
U.S. Geological Survey
Virginia Department of Game and Inland Fisheries

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Eastern Oyster (*Crassostrea virginica*) Species Action Plan

Focus Areas
Chesapeake Bay Islands, Chesapeake Oyster Reef, Lower Chester River, Lower Rappahannock River. Nanticoke Choptank

Other Species Benefitting
Long-tailed duck *(Clangula hyemalis*), scoters (*Melanitta sp.*) striped bass (*Morone saxatilis*), sturgeon (*Acipenser sp.*)

Biological Planning

Species Information
The oyster is a keystone species for the Chesapeake Bay because of its unique ability to continuously build extensive three-dimensional reef habitat that supports a diverse and productive community of fish, wintering waterfowl, as well as, crabs, mussels and other invertebrates. Many Service Trust fish species, such as striped bass and Atlantic sturgeon use oyster reefs as vital habitat for feeding and refuge (Chesapeake Bay Program, 2007). Migratory waterfowl, such as scoters and long tailed ducks directly benefit from oyster reefs. For example, black, surf and white-winged scoters directly benefit from oyster reefs with 50%, 22%, and 28% respectively of their winter diet of hooked mussels (Ischadium recurvum), a species closely associated with oyster reefs in the Chesapeake Bay (Perry et al. 2007). Rodney and Paynter (2006) found that the restored oyster reefs are colonized by large densities of hooked mussels and many other species.

In addition to the direct benefits to Service Trust species, there are many indirect benefits associated with restoring oyster reef habitat including improved water quality, shoreline stabilization, and carbon sequestration. Oysters filter water improving its quality around the oyster reef. The high densities of mussels colonizing these reefs are additional biofilters. This water quality improvement can have a direct positive effect on submerged aquatic vegetation (SAV) beds (NRC 2004). The SAV beds in turn serve as refuge and nursery habitat for many other fish species and feeding grounds for migratory waterfowl. Oyster reefs can also play a vital role in helping to mitigate the effects of climate change in the Chesapeake Bay by stabilizing shorelines and mitigating some of the impacts of sea level rise.

Justification for Species Selection
On May 12, 2009, the President issued Executive Order 13508, recognizing the Chesapeake Bay as a national treasure and calling on the federal government to lead a renewed effort to restore and protect the nation's largest estuary and its

watershed. The strategy developed to carry out the Executive Order calls on Federal agencies to coordinate with the states in a multijurisdictional effort to restore oyster reefs and establish self sustaining oyster reef sanctuaries. As part of our support of this Executive Order, the Service will implement native oyster reef restoration in the Chesapeake Bay.

State Contribution to Overall Species Population

The oyster is a keystone species for the Maryland and Virginia portion of the Chesapeake Bay watershed. While the Eastern oyster's natural range is from the Gulf of Mexico to Nova Scotia Canada, historically the densest and most productive reefs occurred in the Chesapeake Bay (NRC 2004).

Threats and Assessment

Decades of overharvest, habitat destruction, disease, and poor water quality have reduced the population of oysters in the Chesapeake Bay to less than 1 percent of its historic levels (NRC 2004). The "Final Programmatic Environmental Impact Statement for Oyster Restoration in the Chesapeake Bay" (U.S. ACOE 2009) estimates that as much as 70 percent of the 450,000 acres of historic oyster bar habitat in the Chesapeake Bay has been lost to siltation during the last 100 years and less than 1% is classified as clean. Although degraded and in need of conservation and restoration, oyster reefs remain critical wintering feeding grounds for long-tailed duck and scoters. They also provide important feeding and/or nursery grounds for striped bass and sturgeon.

Research/Actions Needed

- Develop bay-wide restoration goals (success/performance metrics) for sustainable oyster populations that include specific, compatible and quantitative goals for ecological function and ecosystem services from restored oyster populations.
- Develop and identify support for a bay-wide complementary survey, monitoring and assessment program of oyster abundance and other key physical, chemical, and ecological parameters that will allow consistent evaluation of progress toward the oyster restoration goals.
- Gather and evaluate available data sets of Chesapeake Bay benthic habitats and sea duck wintering distributions.
- Map these distributions using GIS software for a visual and empirical correlation between the benthic habitats and wintering sea duck distributions.
- Create trophic model that quantifies the ecological linkages between oyster reefs and wintering sea duck utilization.
- Evaluate model integrity, determine if any data gaps exist, and create a plan to ground truth these gaps to better inform the trophic model.

Potential Funding

There are many key players involved in a comprehensive Bay-wide strategy to restore native oysters to the Bay. It is our intention to strongly support those efforts focusing on sites and oyster reef habitat restoration projects that will maximize benefits to fish and wildlife resources.

Population Goals

Restoring oyster reef habitat is essential to restoring ecosystem function. Oysters tend to recruit best on living oyster shell. Unfortunately, oyster shell availability for habitat restoration is extremely limited. Restoration using artificial materials like reef balls or granite has shown promise in recent years. Diverse communities established on artificial materials can serve as reasonable and functional surrogate for traditional oyster restoration.

Conservation Design

There are many key players involved in a comprehensive Bay-wide strategy to restore native oysters to the Bay. Achieving this goal, requires a new strategy anchored by substantial collaboration among oyster restoration partners bay wide, guided by the best available science, and targeted in areas most likely to succeed. The Maryland Oyster Restoration and Aquaculture Development Plan and the U.S. Army Corps of Engineers Native Oyster Restoration Master Plan are integral components to this effort. The Sustainable Fisheries Goal Implementation Team (Fisheries GIT) has agreed to serve as the coordinating body to provide guidance and oversight in aligning oyster restoration efforts and ensure bay-wide scientific and technical capabilities are leveraged to address challenges. It is our intention to strongly support those efforts focusing on sites and oyster reef habitat restoration projects that will maximize benefits to fish and wildlife resources.

Conservation Delivery

The conservation objective is to enhance and restore the function of oyster reef communities to benefit several of the Service's Trust resources. Our approach will be to work with partners to restore and conserve reef habitats that are used by long-tailed ducks and scoters. We also expect to achieve a substantial improvement in the foraging habitat available for shortnose sturgeon, Atlantic sturgeon and other anadromous fish.

Outreach

- Develop an outreach strategy to engage the public in the importance of reef ecology and reef habitat restoration in the Chesapeake Bay.

Monitoring

- Develop bay-wide restoration goals (success/performance metrics) for sustainable oyster populations that include specific, compatible and quantitative goals for ecological function and ecosystem services from restored oyster populations.
- Develop and identify support for a bay-wide complementary survey and monitoring and assessment program of oyster abundance and other key physical, chemical, and ecological parameters that will allow consistent evaluation of progress toward the oyster restoration goals.

Partners

Army Corps of Engineers
Maryland Department of Natural Resources
National Oceanic and Atmospheric Administration
Potomac River Fisheries Commission
Smithsonian Environmental Research Center
The Nature Conservancy
University of Maryland
Virginia Institute of Marine Science
Virginia Marine Resources Commission

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Kentucky Warbler (*Oporornis formosus*) Species Action Plan

Focus Areas
Anacostia Watershed, Blackbird Millington, Lower Chester River, Lower Potomac Patuxent, Lower Rappahannock River, Lower Western Shore Rivers, Nanticoke Choptank

Other Species Benefitting
hooded warbler (*Wilsonia citrine*), Louisiana waterthrush (*Seiurus motacilla*), red-shouldered hawk (*Buteo lineatus*), wood thrush (*Hylocichla mustelina*)

Biological Planning

Species Information
The Kentucky warbler is a familiar sound of rich, moist, deciduous forests in the southeastern United States. This forest interior dweller is a skulking, ground-nesting bird that is more often heard than seen.

Nesting habitat includes bottomland hardwoods and riparian forests, often at low elevations. A well-developed ground cover and a thick understory are essential for successful nesting. Studies of forest fragmentation in Missouri indicate that blocks of suitable habitat of at least 500 ha are necessary for successful breeding.

Justification for Species Selection
The Kentucky warbler is listed on all three Bird Conservation Regions within Maryland/Delaware as a Bird of Conservation Concern and as a Bird of Conservation Concern in the Northeast region. Analysis of total Breeding Bird Survey data set found significant declines in continent wide population, both over long term (1966–1988: change of –1.26%/yr) and over short term (1978–1988: change of –1.95%/yr). However, local increases and expansion of range northward have been observed in BBS data.

Threats and Assessment
- Forest fragmentation on breeding grounds
- Rapid deforestation on wintering grounds. Kentucky warblers are territorial even in the non-breeding season, so only small numbers of individuals can coexist even in the most suitable habitat.
- Recent Supreme Court decisions have removed federal protection from isolated forested wetlands. Delaware does not have a wetland protection law.
- Collisions with TV and cell towers, and with large glass windows
- Over abundant deer can denude forest understory and impact nesting habitat
- Nest predation and parasitism (brown-headed cowbird)

Research/Actions Needed

The most important research needs are those related to the monitoring and management of the species. Continuing annual surveys of suitable habitat and known populations using point counts and spot-mapping techniques are probably the most efficient ways to monitor this species. Unpublished data, however, suggest that even conscientious, season-long application of these techniques misses some breeding birds, and may also lead to erroneous conclusions about the suitability of the surveyed area to birds actually reproducing (Gibbs and Faaborg 1990, Gibbs and Wenny 1993).

Management research priorities on the breeding grounds should be the assessment of minimum area requirements, and quantification of specific habitat requirements, especially of nest sites, as related to breeding success. In addition, research is needed to determine minimum viable population sizes and the impacts of forest fragmentation (including its effect on predation and cowbird parasitism). On the wintering grounds, all aspects of life need investigation, especially quantification of specific habitat requirements and minimum area requirements. Habitat requirements for post fledglings and migrating individuals should also be addressed.

Potential Funding

Wetland Reserve Program, Coastal Wetlands Grant, North America Wetlands Conservation Act

Population Goal for Maryland/Delaware

Maintain current population

Conservation Design

- Develop a ranking system of habitat which could include a matrix of variables and multiple species
- Rank habitats for their importance to migrating and nesting Kentucky warblers
- Using GIS, identify the most important site-specific areas to be protected and/or restore
- Work with Natural Resources Conservation Service to utilize this ranking to prioritize restoration and protection of forested wetlands meeting the needs of the Kentucky warbler.

Conservation Delivery

- Forest Fragmentation
- Restore hydrology to forested wetlands
- Permanently protect large blocks of forested wetland habitat.
- Restore, protect or manage riparian forests to provide migration corridors.
- Restore forested wetlands in open fields especially those

adjacent to existing large blocks of forested wetland to increase suitable nesting habitat
- Provide agency comments on proposed federal actions that are likely to impact forest interior habitat
- Provide agency comments on wind power and other projects that could impact migrating birds

Forest Management Practices

Forest management practices that encourage a dense understory and well-developed ground cover should enhance forest stands for this species (Bushman and Therres 1988). Because Kentucky warblers are tolerant of openings in canopy, harvesting techniques such as group selection, small or narrow clear-cuts, thinning of "overmature" trees, and selection-cutting are acceptable practices (Crawford et al. 1981). Light timber stand improvement should also be acceptable to Kentucky warblers. Although species was thought to benefit from selective logging (Whitcomb et al. 1977), numbers actually declined after such practices in Indiana (Adams and Barrett 1976). Clear-cutting temporarily removes habitat for Kentucky warbler, but regenerating forest may be reoccupied after 6 to 7 years in Virginia (Conner and Adkisson 1975).

Outreach

Continue to contact and work with landowners on enrollment in land conservation programs, especially Natural Resources Conservation Service's' Wetland Reserve Program. Promote deer management to ensure understory vegetation is not denuded by high deer populations.

Monitoring

The North American Breeding Bird Survey, managed by U.S. Geological Survey, is a long term monitoring program that dates back to 1966. This is the most comprehensive long term monitoring for North American Birds and provides that basis for the trends of the Kentucky warbler. In addition, the Maryland Breeding Bird Atlas occurs every 10 years and provides more detailed distribution for breeding birds in Maryland. The second Atlas (2002-2006) was published in November 2010.

Partners

Natural Resource Conservation Service
Maryland Department of Natural Resources
Local land trusts

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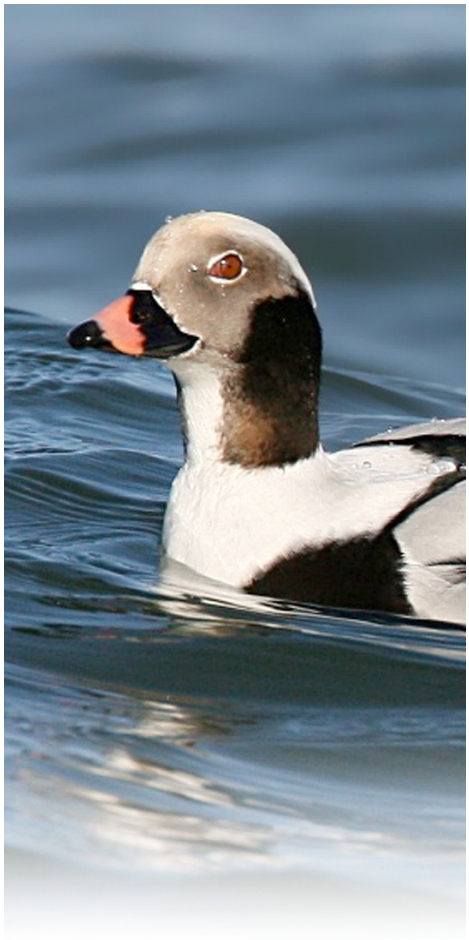
Long-tailed Duck (*Clangula hyemalis*) and Scoter (*Melanitta sp.*) Species Action Plan



Focus Areas
Chesapeake Bay Islands, Chesapeake Oyster Reef, Chincoteague Bay, Delaware Bay Shoreline, Lower Chester River, Lower Rappahannock River

Other Species Benefitting
Black scoter (*Melanitta americana*), surf scoter (*Melanitta perspicillata)*, white-winged scoter (*Melanitta fusca*)

Biological Planning

Species Information
Long-tailed ducks breed in arctic and subarctic wetlands from the west coast of Alaska across most of northern Canada to the east coast of Labrador. The ducks migrate relatively late in fall and early in spring. Actual migration routes to the Chesapeake Bay are overland from the Great Lakes, and some moving down the coast from New England and the Canadian Maritimes. Southern Virginia is the maximum extent of most birds southern migration and the declining numbers in the Chesapeake Bay are probably the effect of warmer winters and that the Great Lakes and freshwater ponds are not freezing and no longer pushing the birds as far south.

Their winter diet is varied but chiefly animal matter, including bottom-dwelling crustaceans, clams, mussels, small fish, and snails. Most feeding is in water <9 m (30 ft) deep, but the long-tailed duck has been documented to dive to more than 60 m (200 ft), deeper than any other duck.

Long-tailed ducks have a very narrow bill as compared to scoters allowing them to extract small animals such as crustaceans in small crevices in three dimensional habitats such as oyster reefs. Both scoters and long-tailed ducks eat a large variety of bivalves and crustaceans. In Chesapeake Bay long-tailed ducks tend to eat a high percentage of gema clams and mussels while scoters tend to eat more mussels and surf clams (Perry et al. 2007).

Justification for Species Selection
The Breeding Population and Habitat Survey, conducted by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service, shows that breeding populations of long-tailed ducks have declined about 80% since the survey started in 1957. Unfortunately, that survey covers only a small portion of Alaska and northwestern Canada, a tiny part of their overall breeding

range. Causes for declines are unknown. Despite indications of long term declines, the long-tailed duck is the most abundant Arctic sea duck and, as such, is not considered a threatened or endangered species. Furthermore, the population seems to have stabilized since the early 1990's. All four seaducks are listed as birds of management concern by the U.S. Fish and Wildlife Service and all three species of scoters are believed to be declining.

State Contribution to Overall Species Population

The Service estimates that at least 105,000 long-tailed ducks were present in Chesapeake Bay during the winter of 1992-93, making it the second most abundant duck in Chesapeake Bay after the surf scoter with an estimated population of 135,000 birds. While we do not have valid population estimates of sea ducks on the East Coast, a conservative estimate would be that Delaware Bay, Chesapeake Bay, and coastal areas of Delaware and Maryland winters about one third of the scoters on the East Coast and possibly 25 percent of long-tailed ducks.

Threats and Assessment

The magnitude of harvest and the role of hunting in regulating populations of long-tailed ducks is largely unknown. Long-tailed ducks are a small component of the sport harvest of waterfowl. They are generally considered poor table fare because of their strong taste. However, they are a major species in the subsistence harvest in some northern communities, and co-management of migratory birds with First Nation and Alaska Native groups should help ensure a sustainable use of long-tailed ducks.

Long-tailed ducks and scoters are vulnerable to oil spills, pollution, and disturbance by shipping vessels. Large numbers of these ducks are sometimes caught and killed in gillnets in both fresh and marine waters. Other potential threats include extensive habitat alterations, increased industrialization and development of traditional wintering grounds, including aquaculture, sand mining, over-fishing, clam dredging, and wind power development. Shellfish aquaculture in small amounts apparently does not affect scoter food availability, but an unknown amount of illegal take of seaducks occurs at aquaculture facilities. Contaminants such as lead, mercury, cadmium, and organochlorines (from pesticides) have been found at high levels in long-tailed ducks in both eastern Canada and Alaska.

Aquaculture that covers sandy and hard bottom reef substrates and excludes diving birds with nets can result in a loss of habitat for the birds. Dredging or filling of sandy substrates and hard bottom reef areas eliminates foraging habitat. Over harvest of bivalves, (clams, oysters, and mussels) removes or degrades

important food resources. Dredging clams and other bivalves also destroys three dimensional habitats, silts in reefs, disturbs bottom substrate.

Research/Actions Needed

Reliable techniques for monitoring population size and trends of long-tailed ducks and scoters need to be developed and implemented. Satellite telemetry studies are currently underway that will help identify where birds from a particular breeding area spend the winter (and vice versa) as well as their migratory behavior and pathways.

Long-tailed ducks, scoters, and diving ducks are drowned in both legal and illegal gillnets in most coastal and freshwater areas. All fisheries should be assessed for their impact on waterbirds and mitigation techniques developed where possible. Illegal nets should be the center of active law enforcement effort and prosecutions and equipment confiscations should pursued.

Conservation Design

- Per the Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, Federal agencies taking actions in coastal areas that reduce or impact bird habitat should mitigate their for their actions and enhance habitats.
- Long-tailed ducks, scoters, and diving ducks are drowned in both legal and illegal gillnets in most coastal and freshwater areas. Mitigation of fisheries impacts should be implemented where possible and could be funded by NRDA funds or mitigation from wind power development.
- Increase law enforcement of illegal gillnetting in Chesapeake Bay and coastal waters where long-taileds are drowned along with scoters, diving ducks, and loons. Illegal nets should be the center of active law enforcement effort including prosecutions and equipment confiscations.

Conservation Delivery

- Conduct offshore surveys to determine distribution and abundance and to define current habitat preferences.
- Restore reef habitat with hard, three dimensional habitat that provides mobile invertebrates such as amphipods, worms, and isopods, plus bivalves such as mussels and clams.

Outreach

Engage the public, local bird clubs, and other non-profit organizations to join in the effort to report observations of illegal fishing activities through the state of Maryland's report a poacher program.

Monitoring

The only surveys that adequately assess long-tailed duck and scoter numbers in coastal waters are low level surveys that crisscross the Chesapeake Bay from shore to shore. The problem is they are very expensive and adequate sample size requires tens of thousands of dollars.

Because long-tailed ducks breed over a vast range and at low densities, there have been no comprehensive surveys of their abundance. Because they, like other sea ducks, inhabit offshore areas more than other waterfowl during winter, long-tailed ducks are also poorly monitored by mid-winter surveys for waterfowl. A crude estimate of the North American population is at least one million birds.

Partners

Chesapeake Bay Program
Delaware Department of Natural Resources and Environmental Control
Maryland Coastal Bays Program
Maryland Department of Natural Resources
Sea Duck Joint Venture
U.S. Fish and Wildlife Service, National Wildlife Refuges Program
U.S. Geological Survey, Patuxent Wildlife Research Center

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Prairie Warbler (*Dendroica discolor*) Species Action Plan

Focus Areas
Lower Potomac Patuxent, Lower Rappahannock River, Lower Western Shore Rivers, Pocomoke River Cypress Creek, Shenandoah Upper Rappahannock, Western Highlands

Other Species Benefitting
Brown thrasher (*Toxostoma rufum)*, Eastern towhee (*Pipilo erythrophthalmus*), field sparrow (*Spizella pusilla*), yellow-breasted chat (*Icteria virens*)

Biological Planning

Species Information
The prairie warbler breeds in shrubby old fields, early-stage regenerating forests, dunes, mangroves, pine barrens, and other early successional habitats. It spends the winter in the Bahamas, on Caribbean islands, and in southern Florida. Before European settlement, the species was rare or absent in much of its present breeding range; following deforestation, it became widespread by the mid-twentieth century. Since about 1970, its numbers have declined in parts of the breeding range

Justification for Species Selection
Listed on all three Bird Conservation Regions (28,29,30) within Maryland/Delaware as a bird of Conservation Concern and listed as a U.S. Fish and Wildlife Service Region 5 Bird of Conservation Concern. Analysis of total Breeding Bird Survey data set found significant declines in Maryland, both over long term (1966–1988: change of –3.53%/yr) and over short term (1978–1988: change of –2.32%/yr).

Threats and Assessment:
- Old fields converted to housing developments and commercial development
- Suppression of fire which sets back later successional forest stages.
- Collisions with TV and cell towers, and with large glass windows
- Nest predation and parasitism (brown-headed cowbird)
- Effects of use of herbicides such as Arsenal used to eradicate deciduous trees/shrubs in forests regenerating after a timber harvest

Research/Actions Needed
For basic understanding of the species and its conservation, valuable additions can be expected from long-term study of winter populations, e.g., segregation of sex and age classes geographically, by habitat, or by feeding ecology. Future findings about winter ecology and population dynamics, complemented by breeding-season data should promote our understanding of the biology of migrant passerines (compare Marra et al. 1998 and citations therein).

The prairie warbler appears to be a promising candidate for comparative experimental investigation of differences between a migratory generalist subspecies and a sedentary specialist subspecies. Examples might be studies of habitat selection and of genetic, developmental, and physiological bases for the expression of migratory behavior.

Potential Funding
Utilities and Grassland Reserve Program

Population Goal for Maryland/Delaware
Increase current population

Conservation Design

- Work with power companies on adopting Integrated Vegetation Management (IVM) to maintain old field habitat.
- Identify and work with owners of abandoned strip mines to facilitate old field habitat management.
- Identify areas where the Grassland Reserve Program can be used to maintain open fields

Conservation Delivery

- Work with Baltimore Gas and Electric on the South River Greenway IVM pilot project, Right-of-Way management and at Patuxent National Wildlife Refuge
- Provide federal agency comments on wind power and other projects that could impact migrating birds.
- Develop survey protocols to document breeding prairie warblers in Right-of-Ways where IVM is practiced.

Outreach

The Chesapeake Bay Field Office and its partners (Baltimore Gas and Electric, Integrated Vegetation Management partners, Scenic Rivers Land Trust) will continue to promote Integrated Vegetation Management as a beneficial tool for habitat management on utility rights-of-way through enewsletters, social media, websites and factsheets.

Monitoring

The North American Breeding Bird Survey, managed by U.S. Geological Survey, is a long term monitoring program that dates back to 1966. This is the most comprehensive long term monitoring for North American Birds and provides that basis for the trends of the prairie warbler. In addition, the Maryland Breeding Bird Atlas occurs every 10 years and provides more detailed distribution for breeding birds in Maryland. The second Atlas (2002-2006) was published in November 2010. In addition to these monitoring programs, the Chesapeake Bay Field Office is working with the Anne Arundel County Bird Club to monitor breeding birds along a 5-mile stretch of utility right-of-way. The density of prairie warblers will be closely watched over time as Integrated Vegetation Management techniques are employed.

Partners
Baltimore Gas and Electric
Delmarva Power
Maryland Department of Natural Resources
Natural Resources Conservation Service

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Prothonotary Warbler (*Protonotaria citrea*) Species Action Plan

Focus Areas
Anacostia Watershed, Blackbird Millington, Chincoteague Bay, Lower Potomac Patuxent, Lower Rappahannock River, Nanticoke Choptank, Pocomoke River Cypress Swamp

Other Species Benefitting
American black duck (Anas rubripes), American eel (*Angilla rostrata*), hooded warbler (*Wilsonia citrine)*, Louisiana waterthrush (*Seiurus motacilla)*, red-shouldered hawk (*Buteo lineatus*), wood duck (*Aix sponsa*), wood thrush (*Hylocichla mustelina*)

Biological Planning

Species Information
The prothonotary warbler inhabits mature deciduous floodplain, riverine, and swamp forests The center of abundance is the South Atlantic Coastal Plain physiographic area. Little is known of winter habitat on the Caribbean slope of Central America, Colombia, and northern Venezuela.

Essential habitat requirements are water, shade, and older trees that provide nesting holes. Habitat characteristics include a relatively low, open canopy with a high density of small stems (Kahl et al. 1985). Although this species will utilize the drier portion of the forested wetland gradient, flooded habitats have been shown elsewhere to be preferred and of higher quality (Petit and Petit 1996). Prothonotary warblers commonly breed in the southeastern U.S wherever there is suitable habitat: wooded wetlands, bottomland hardwood forests, and cypress swamps. They are secondary cavity nesters so cavity availability may serve as a constraint on habitat use. Prothonotary warblers are widespread and common throughout the extensive swamps and riverine forested wetlands within the Mid-Atlantic Coastal Plain physiographic region. The center of abundance is the South Atlantic Coastal Plain physiographic area. Little is known of winter habitat on the Caribbean slope of Central America, Colombia, and northern Venezuela.

The Mid-Atlantic Coastal Plain physiographic region extends from the Atlantic Ocean, south of Long Island, to the Fall Line, where the hilly Piedmont begins. The area was formed by shifting sea levels and alluvial deposition from rivers draining mountains to the west. Water continues to be a dominant feature of the landscape, creating forested wetlands and salt marsh and shaping barrier island and bay complexes. Upland forests on the remaining land graded in composition from pine dominated areas on the outer Coastal Plain (nearer the coast) to hardwood forests on the inner Coastal Plain. This was the site of the first successful English settlement in North America, and the natural landscape has been altered by European culture for nearly four centuries. The current human population approaches 11 million and is expected to continue to expand into the future, placing ever-increasing demands on the region's natural resources.

Justification for Species Selection

Most studies indicate a steady decline in populations of this neotropical migrant since the 1970s. The prothonotary warbler is listed as a species of high global priority in the Partners in Flight Bird Conservation plan for the Mid-Atlantic Physiographic region. This designation is indicative of population vulnerability for the species throughout its range. The Maryland and Delaware Wildlife Action Plans also list the species as a "species of conservation concern" along with the habitats that the species inhabit.

Threats and Assessment

Forested wetlands have experienced dramatic reductions in area and changes in plant composition due to hydrology modifications over the past several decades. Nationwide, forested wetlands account for the greatest amount of wetland loss. Between the 1950's and 1970's, nearly 2.5 million ha of forested wetland were lost. Much of this loss was due to the harvest of wetland forests or to filling or draining of forested wetlands for conversion to agriculture or urban development. In 1991, the mid-Atlantic Coastal Plain contained more than 550,000 ha of forested wetlands or nearly 7.4% of the Nation's total (Field et al. 1991). As with upland forests, occupation of forested wetlands by birds is influenced by a number of factors including patch size, vegetation structure, and hydrology. Prothonotary warblers are neo-tropical migrants and are therefore also very vulnerable to habitat destruction issues outside of the breeding range of the mid-Atlantic. Some of the current threats to the species long-term survival are related to:

- Loss, degradation and fragmentation of habitat on breeding grounds as many wetlands are either permanently drained or flooded
- Rapid deforestation on wintering grounds
- Minimal or reduced federal protection of isolated forested wetlands in light of recent Supreme Court decisions.
- Conversion of broad-leafed deciduous forested wetlands into pine plantations.
- Nest predation and parasitism (brown-headed cowbird) exacerbated by forest fragmentation
- Competition with other species for nest sites

Research/Actions Needed:

- Priority monitoring action - Breeding Bird Survey (BBS) provides acceptable data at the continental level; however more localized monitoring data is needed
- Second priority monitoring action – improve the BBS
- Supplemental Surveys - more intensive survey work that penetrate this species' habitat to better understand population trends and patterns
- Determine factors contributing to forest and riparian bird population stability, including associations between

landscape factors and indices of reproductive success and the effectiveness of the CWCA model in sustaining populations of high priority species including prothonotary warbler (Upper Great Lakes Plain); identify cost-effective methods for identifying bird population sources in forested habitats (Upper Great Lakes Plain)
- Identify/inventory suitable_ - identify large tracts of forest habitats in this region as a basis for conservation planning (Mid-Atlantic Coastal Plain Region)

Potential Funding
Wetland Reserve Program, Coastal Wetlands Grant, North American Wetlands Conservation Act

Population Goal for Maryland/Delaware
Maintain current population

Conservation Design
- Develop protocols to rank habitats for their importance to migrating and nesting Kentucky warblers
- Using GIS, identify the most important site-specific areas to be protected and/ or restore

Conservation Delivery
- Permanently protect large blocks of forested wetlands
- Protect and restore riparian corridors
- Restore hydrology and native plant assemblages to degraded forested wetlands
- Restore forested wetlands on "prior converted" agricultural lands.

Outreach
Continue to contact and work with landowners on enrollment in land conservation programs, especially Natural Resources Conservation Service's Wetland Reserve Program.

Monitoring
The North American Breeding Bird Survey, managed by U.S. Geological Survey, is a long term monitoring program that dates back to 1966. This is the most comprehensive long term monitoring for North American Birds and provides that basis for the trends of the Kentucky warbler. In addition, the Maryland Breeding Bird Atlas occurs every 10 years and provides more detailed distribution for breeding birds in Maryland. The second Atlas (2002-2006) was published in November 2010.

Partners
Delaware Department of Natural Resources and Environmental Control
Land trusts
Maryland Department of Natural Resources
Natural Resources Conservation Service

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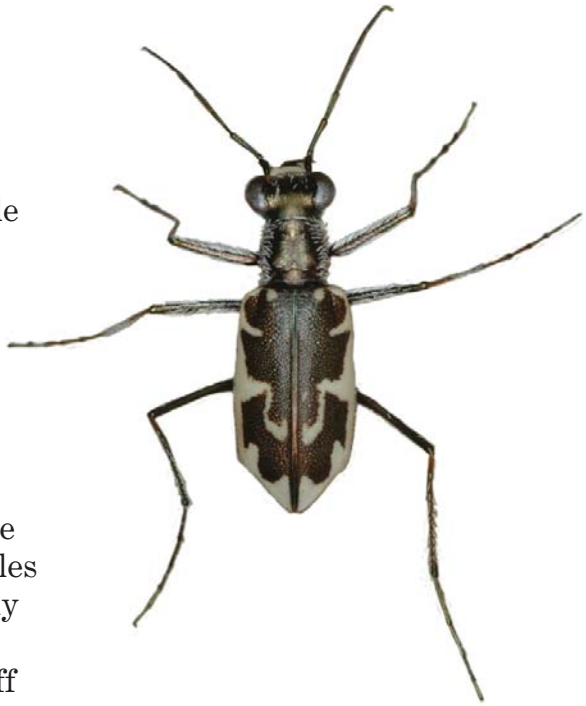
Puritan Tiger Beetle (*Cicindela puritana*) Species Action Plan



Focus Area
Chesapeake Bay Shorelines

Other Species Benefitting
Bank swallows (Riparia riparia), belted kingfishers (Megaceryle alcyon), non-threatened tiger beetles (Cicindela repanda, Cicindela hirticollis, Cicindela marginata), northeastern beach tiger beetle (Cicindela dorsalis dorsalis)

Biological Planning

Species Information

The Chesapeake Bay contains only two metapopulations of Puritan tiger beetles along its shorelines, both in Maryland, one on the western shore and one on the eastern shore. These beetles have very specific habitat requirements. The larvae occupy only naturally eroding cliffs, where they live in deep burrows after digging in sandy deposits on non-vegetated portions of the bluff face or at the base of the cliffs. They are most abundant at sites where the bluffs are long and high with little or no vegetation and composed in part of yellow or red sandy soil. Erosion results in the loss of some larval beetles, but is necessary to maintain the bare bluff faces they require.

Along the Chesapeake Bay, adult Puritan tiger beetles are first seen in June and July when they emerge to feed and mate along the beach area. After mating the females move up onto the cliffs to deposit their eggs. Newly hatched larvae construct burrows in the cliffs and pass through 3 larval stages before metamorphosing into the adult form. It takes two years for the Puritan tiger beetle to complete its life cycle.

Justification for Species Selection

This species was listed as federally threatened under the Endangered Species Act in 1990 primarily due to the threat to its habitat from shore erosion control projects. Since 1990 Puritan tiger beetles have declined in population size and distribution within their Chesapeake Bay range. The remaining Chesapeake Bay populations are highly susceptible to habitat loss or degradation.

A 2007 Status Review for this species indicated that its status had become more precarious and recommended uplisting to endangered status. Some improvement in population numbers has occurred since the 2007 status review and may be reflected in a new Status Review which is to begin in 2011.

State Contribution to Overall Species Population
Approximately 90% of the total Puritan tiger beetle population occurs in the state of Maryland (USFWS 2007). The remaining 10% is supported by the Connecticut River populations in Connecticut and Massachusetts.

Threats and Assessment:
- Shoreline development and bluff stabilization are the most serious threats. Shoreline structures have been found to destroy the larval habitat directly or by promoting vegetation on cliff faces making them unsuitable for the larvae. Natural threats include sea level rise, invasive vegetation, flooding, parasites and insect predators.

Research/Actions Needed:
- Protect as much undeveloped occupied habitat as possible through conservation easements or acquisition.
- Implement the current Project Review Process in concert with the Maryland Department of Natural Resources to provide off-setting habitat protection for all shoreline erosion control projects in Puritan tiger beetle habitat.
- Continue to control vegetation at locations which benefit the Puritan tiger beetle.
- Develop management strategies to improve habitat quality and quantity for this species. This includes refining methods to reverse vegetation encroachment on important cliff and beach habitat.
- Work with researchers to determine if an experiment can be designed to test man-made habitat containment structures placed in suboptimal cliff habitats. Studies might determine whether such structures would be used by ovipositing females and support larval development.
- Continue annual counts of tiger beetle populations to allow further analysis of population trends and effects of shoreline structures on the beetles.

Potential Funding
Section 6 of the Endangered Species Act, Maryland Department of Natural Resources

Conservation Design
- Refine GIS analysis of land ownership and lands available for conservation in areas supporting this species and develop a more accurate mapping of lands currently protected from development.
- Use the GIS analysis to identify and prioritize areas where easements or acquisition will benefit the Puritan tiger beetle. Coordinate with Maryland Department of Natural Resources and county personnel in this identification.
- Develop a Safe Harbor (or similar) Agreement with corporate landowners to proactively manage and protect Calvert Cliffs Nuclear Plant subpopulation.

Conservation Delivery

- Conservation delivery will consist primarily in protecting sites with easements, but other tools may be used where appropriate. A high priority will be given to identifying private landowners who are willing to enter into conservation easements for the protection and management of their shoreline habitats supporting Puritan tiger beetles.
- Reverse vegetation encroachment on important cliff and beach habitat.
- Work with the state of Maryland, Federal Emergency Management Agency and Maryland Emergency Management Agency to develop a buyout program for homes in Puritan tiger beetle habitat most threatened by erosion.
- Develop a programmatic Habitat Conservation Plan for the species
- On a yearly basis, develop and submit Section 6 Land acquisition Grant proposals to protect the remaining 3 large subpopulations in the Chesapeake Bay.

Outreach

Develop awareness of the Puritan tiger beetle in the public through more info on the Chesapeake Bay Field Office website and Maryland websites. Postings already include:

- Scientific publications, including species recovery plan
- Survey and monitoring data

Partners

Army Corps of Engineers, Baltimore District
Calvert County, Maryland
Cecil County, Maryland
Eastern Shore Land Conservancy
Maryland Environmental Trust
Maryland Department of Natural Resources

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Red Knot (*Calidris canutus*) Species Action Plan

Focus Area
Delaware Bay Shoreline

Other Species Benefitting
Diamondback terrapin (Malaclemys terrapin), horseshoe crab (Limulus polyphemus), ruddy turnstone (Arenaria interpres), semi-palmated sandpiper (Calidris pusilla)

Biological Planning

Species Information
The red knot is the largest of the beach sandpipers (9 inches long) and has a red belly and neck while in its breeding plumage. It migrates more than 9,300 miles from its wintering grounds along the coast of Patagonia and Tierra del Fuego in Argentina to its breeding habitat in the Canadian arctic and repeats this feat again in the fall. During its spring migration, it stops along the beaches of Delaware Bay to feed on the abundant horseshoe crab eggs. The migration is perfectly timed to coincide with the horseshoe crab nesting period. The red knot arrives emaciated and doubles its weight before continuing its migration north.

Justification for Species Selection
The red knot is a candidate species for listing under the Endangered Species Act (ESA) and is classified as threatened under the New Jersey Threatened Species Act and as a Species of Conservation Concern in Delaware and Maryland.

Threats and Assessment
Reduced availability of horseshoe crab eggs because of past harvesting of horseshoe crabs for bait in eel pots.

- Habitat loss from development, shoreline stabilization, erosion, and sea level rise
- Human disturbance to foraging and roosting birds.
- Vulnerability to site-specific threats because of small population size.
- Wind turbines
- Oil spill and other contaminants
- Climate change

Research/Actions Needed:

- Maintain and increase red knot population
- Maintain and increase horseshoe crab egg forage base
- Maintain, enhance, restore, and create Delaware Bay and Atlantic Coast foraging beaches
- Maintain, enhance, restore, and create coastal roost sites
- Reduce competition with gulls
- Minimize human disturbance on foraging areas and roosts during spring stopover

Potential Funding
National Fish and Wildlife Foundation and other grant programs.

Population Goal
The Manomet Shorebird Recovery Project received a grant from National Fish and Wildlife Foundation to double the size of the red knot population (from 30,000 to 60,000) within 10 years.

Conservation Design
- Coordinate with Atlantic States Marine Fisheries Commission and state fisheries managers to ensure horseshoe crab harvest levels do not result in insufficient horseshoe crab egg availability for red knot.
- Monitor red knot stopover population in Delaware Bay as key component in ongoing status review of red knot to determine priority for listing species under the Endangered Species Act.
- Work with conservation partners to implement the Red Knot Spotlight Species Action Plan and National Fish and Wildlife Foundation Red Knot Business Plan.
- Coordinate with existing partners to pursue regional efforts to maintain and enhance red knot habitat.
- Find additional partners through the Partners and Coastal Programs that are interested in habitat restoration and then assist with designing, funding, and constructing wetland habitat.
- Coordinate with state, federal, and local agencies to provide regulatory protection to red knot and its habitat.
- Address resource loss and restoration through the Natural Resource Damage Assessment and Restoration (NRDAR) program where appropriate.
- Develop Candidate Conservation Agreements/Candidate Conservation Agreements with Assurances, as appropriate.

Conservation Delivery
- Through the Endangered Species Program, provide technical assistance to Atlantic States Marine Fisheries Commission and state fisheries managers in developing horseshoe crab harvest regulations.
- Through the Endangered Species Program, coordinate with state biologists, conservation groups, and land managers to identify and abate site-specific threats; seek funding opportunities through National Fish and Wildlife Foundation or other grant programs to support conservation actions.
- Continue to address coastal beach and wetland habitats in Conservation Planning Assistance reviews under authority of Fish and Wildlife Coordination Act, Migratory Bird Treaty Act, and other authorities to minimize decisions resulting in shoreline hardening, coastal development, and filling of wetlands.

- Through the Partners Program, provide landowners, land trusts, municipalities, and counties with technical assistance, equipment, grant finding assistance, plant material, and construction for habitat restoration and enhancement projects; assist with reducing the populations of common reed and other invasives through herbicide use, manipulation of local hydrology, and biocontrol efforts.
- Through Conservation Planning Assistance reviews, continue to address potential adverse effects from communication towers and wind projects.

Outreach

Continue to educate public and stakeholders about the red knot and the importance of horseshoe crabs. Increase awareness of migration stopovers, wintering and nesting habitat requirements, and the threats to the red knot throughout its range.

Monitoring

Coordinate with state biologists and International Shorebird Team to monitor red knot numbers and body condition during migration stopover in Delaware Bay. Research is needed to understand and predict impacts to the red knot population from climate change (e.g. changes in habitat quality and quantity, prey availability, and plant community; changes in timing of shorebird stay vs. horseshoe crab spawning; and changes in the ranges of horseshoe crabs and/or prey species).

Partners

Atlantic Coast Joint Venture
Atlantic States Marine Fisheries Commission and state fisheries managers
National Fish and Wildlife Foundation
Natural Lands Trust
New Jersey Department of Environmental Protection
New Jersey Audubon Society
New Jersey Natural Lands Trust.
Partnership for the Delaware Estuary
U.S. Department of Agriculture
U.S. Fish and Wildlife Service, Delaware Bay Estuary Program
U.S. Fish and Wildlife Service, Migratory Bird and Fisheries Programs
U.S. Fish and Wildlife Service, National Wildlife Refuges

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Western Hemisphere Shorebird Reserve Network, http://www.whsrn.org/news/article/funding-hemispheric-red-knot-conservation.

Saltmarsh Sparrow (Ammodramus caudacutus) Species Action Plan

Focus Areas
Chincoteague Bay, Delaware Bay Shoreline, Nanticoke Choptank

Other Species Benefitting
Black rail (*Laterallus jamaicensis)*, seaside sparrow *(Ammodramus maritimus)*

Biological Planning

Species Information
The saltmarsh sparrow is a small, secretive, stocky sparrow with brownish upperparts, grey on the crown and nape, a cream-colored breast with dark streaks, and a white throat and belly. It has an orange face with grey cheeks and a short pointed tail.

Saltmarsh sparrows nest in grassy salt marsh habitats that are vulnerable to frequent high tides, which in turn can cause a high level of nest loss. Very high tides can occur every four weeks which corresponds to the same length of time it takes for the sparrow to raise a family. Hence if a nest is lost, re-nesting must occur almost immediately if the new set of young is to survive. This lack of time to re-nest causes the saltmarsh sparrow to have the highest documented rate of extra-pair mating (Hill et al. 2010).

Occupying a narrow region along the east coast of the United States, the saltmarsh sparrow breeds from Maine south to North Carolina. In the winter this species' range shifts southward, with its southern limit in Florida and northern limit in Maryland.

Justification for Species Selection
The saltmarsh sparrow is listed on the American Bird Conservancy and the National Audubon Society Watch Lists in the highest "Red" category for conservation due to declining populations. It is listed as "HH", the highest category for conservation, in the priority species for bird conservation region (BCR 30) by the U.S. Fish and Wildife Service. It is listed as globally vulnerable on the International Union of Conservation of Nature (IUCN) red list due to its breeding range being restricted to the northeast United States (the only bird species so restricted).

State Contribution to Overall Species Population
The conservation status of the saltmarsh sparrow in Maryland is poorly known partly due to its secretive nature. The Atlas of Breeding Birds of Maryland (Robbins 1996) documents the loss of breeding populations from upper Chesapeake Bay and lower

Potomac River. The saltmarsh sparrows' current range in Maryland is within the extensive salt and brackish marshes of southern Dorchester and western Somerset counties, and the coastal marshes of southern Worcester County.

Threats and Assessment

Saltmarsh sparrows breed only in extensive high salt marshes dominated with grasses. These habitats face a high rate of loss due to inundation resulting from climate change through sea level rise.

- Encroachment of non-native plant species such as common reed (Phragmites australis) into high marsh habitat areas have resulted in a loss of salt marsh habitat.
- Highly developed coastal areas have resulted in a loss of salt marsh habitat and created fragmentation among saltmarsh sparrow populations in the range.
- Commercial development in coastal areas has led to pollution of salt marsh habitats resulting in significant mercury levels in saltmarsh sparrows (Shriver 2006).

Research/Actions Needed

Little population data has been collected on this maritime sparrow. Christmas Bird Counts from 1997 to 2005 record significant fluctuations. Thus, range-wide surveys for this secretive marsh bird are needed to get a better grasp on current population numbers.

Range-wide mapping of the saltmarsh sparrow's high salt marsh habitat is needed to determine availability of the extensive grassy high salt marsh areas necessary for nesting. Gap Analysis Program (GAP) land cover Geographic Information Systems (GIS) data layers are available for the multi-state range of the saltmarsh sparrow. However, the high marsh vegetation classification within this data set contains other high marsh plant species such as black needlerush which is not conducive for saltmarsh sparrow nesting. Thus, using the GAP land cover data may result in an inflated acreage value of nesting habitat availability. A more detailed species level salt marsh vegetation data set is needed to more accurately map only grassy salt marsh habitats to obtain the most accurate measure of habitat availability.

The affects of sea level rise on coastal marshes is complex and not fully understood in part due to the many variables of the accretionary process. The Sea Level Affecting Marshes Model (SLAMM) simulates sea level rise scenarios over time based on 30 meter resolution elevation data. Results from this model are appropriate to use for a regional perspective of estimating salt marsh loss but not at local levels. Modeling sea level rise using highly accurate light detection and ranging (LiDAR) elevation data will help yield results more suitable for calculating habitat loss for the saltmarsh sparrow at a population level.

Conservation Design

- Conduct secretive marsh bird surveys to obtain the most accurate population figures for saltmarsh sparrows to set benchmarks for comparison over time of population trends.
- Maryland's land protection program, Rural Legacy, has a focus area on the southern coast of Worcester county within the saltmarsh sparrows breeding range. The goal is to protect large, contiguous tracts of land from sprawl development and enhance natural resource, agricultural, forestry and environmental protection through cooperative efforts among state and local governments and land trusts.
- Another grant program with potential to protect salt marsh habitat paramount to the conservation of the saltmarsh sparrow is the North American Wetlands Conservation Act (NAWCA). The purpose of this program is to provide funding for wetlands conservation or restoration projects for the benefit of wetlands-associated migratory birds and other wildlife.
- Map the extent and condition of vegetation classes on tidal marsh at Blackwater National Wildlife Refuge and Fishing Bay Wildlife Management Area which will produce new aerial imagery and a classification of vegetation types including low emergent marsh, high emergent marsh, tidal shrublands, and Phragmites australis cover. Results of these detailed land cover classifications will provide a much more accurate acreage value for potential saltmarsh sparrow grassy high marsh habitat availability in these areas
- Audubon Maryland-DC will conduct marsh bird surveys in tidal marshes throughout Maryland and Virginia under contract from Maryland Department of Natural Resources, as part of a northeast regional marsh bird study funded by a State Wildlife Grant. The survey will use passive and broadcast surveys designed by the North American Secretive Marsh Bird Monitoring Program (2011-2012). The protocol and sampling framework will assess the distribution and abundance of four diurnal species that nest primarily in the high marsh zone, one of which is saltmarsh sparrow. The field protocol also includes a brief vegetation survey at each survey point which can be used to determine the validity of using the GAP land cover data for a range-wide estimate of grassy salt marsh habitat availability for saltmarsh sparrow.

Conservation Delivery

- Permanently protect salt marsh habitats from development and pollution through fee simple purchases or conservation easements to allow for landward migration of salt marshes to compensate for habitat loss due to inundation from sea level rise.
- Control invasion of common reed (Phragmites australis) using

chemical spraying and/or burning to prevent encroachment into saltmarsh sparrow high salt marsh habitats.
- Restore high marsh grassy wetlands to provide additional nesting habitat for saltmarsh sparrows
- In conjunction with partner organization, the National Audubon Society Maryland-DC, efforts to identify properties for a NAWCA grant proposal within the range of saltmarsh sparrow in southern Dorchester and western Somerset counties are planned for 2011.
- Using the results of the Audubon marsh bird survey for saltmarsh sparrow and the Service's Phragmites mapping, a GIS analysis can identify potential encroachment areas of Phragmites into saltmarsh sparrow habitat to target for Phragmites control.

Outreach

- Engage the public, local bird clubs, and other non-profit organizations to join in the effort to report observations of the secretive saltmarsh sparrow through a website known as eBird anytime, in the Great Backyard Bird Count in February, and promote participation in the Christmas Bird Count in December and early January (Audubon website 2010).
- With partner organizations, development of a secretive marsh bird fact sheet can bring forward the plight of lesser known birds like the saltmarsh sparrow to reach a broader audience of concerned citizens other than just the scientific community.

Monitoring

- Continuation of secretive marsh bird surveys, like the ones being conducted in 2011 by partner organizations, in all areas of Maryland where saltmarsh sparrows breed will allow biologists to monitor population trends. More frequent surveys will also lend knowledge to whether or not the land protection efforts undertaken in this species breeding habitat range have stabilized the decline in population numbers.
- Monitoring of Phragmites stands adjacent to saltmarsh sparrow nesting habitat is important to ensure that the extensive grassy high marsh habitats required by the saltmarsh sparrow aren't lost to invasion by this non-native plant species.

Partners

Maryland Coastal Bays Program
Maryland Department of Natural Resources
The National Audubon Society
U.S. Fish and Wildlife Service National Wildlife Refuges Program

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Snowy Egret (*Egretta thula*) Species Action Plan

Focus Areas
Chesapeake Bay Islands, Chincoteague Bay

Other Species Benefitting
little blue heron (*Florida caerulea*), tricolored heron (*Hydranassa tricolor*)

Biological Planning

Species Information
The snowy egret is most commonly observed foraging along the water's edge of estuarine wetlands such as salt marshes. Within the Mid-Atlantic region, snowy egrets both breed and overwinter, with wintering occurring mostly along the coast. Preferred nesting habitats include isolated estuarine areas such as islands containing thick vegetation that includes shrubs such as bayberry (Myrica pensylvanica), wax myrtle (Myrica cerifera), high tide bush (Iva frutescens), and groundsel tree (Baccharis hamlifolia). This species usually nests in mixed-species heronries that contain little blue herons, cattle egrets (Bubulcus ibis), tricolored herons, and/or great egrets (Casmerodius albus).

Justification for Species Selection
The species is listed as a U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern (BCC) within Bird Conservation Region 30 (New England-Mid Atlantic coastal area; USFWS 2008). The snowy egret is also listed by Maryland Department of Natural Resources as a species of Greatest Conservation Need (GCN) in the Maryland Department of Natural Resources Maryland (MDNR) Wildlife Diversity Conservation Plan (MDNR 2005). Survey data within the Chesapeake Bay region has found that Snowy Egret populations are on the decline. In the 10-year period (1993-2003), the Chesapeake Bay snowy egret regional population had experienced a 28 percent decline (Williams et al. 2007), with little evidence of any recent recoveries.

State Contribution to Overall Species Population
The latest Bay-wide survey (2003) indicated the presence of approximately 3,236 nesting pairs of snowy egret distributed among 32 colonies, suggesting that there are more colonies than in the late 1970s, however they are much smaller (Williams et al. 2007).

Threats and Assessment
Loss of isolated nesting habitats such as estuarine islands

- Degradation of suitable habitat (i.e double-crested cormorant (Phalocrocorax auritus) and associated vegetation destruction)
- Colony disturbance (human) during nesting season
- Raccoon (Procyon lotor) populations in many areas of the Chesapeake Bay have expanded their range, resulting in greater exposure of snowy egrets to this predator.

Conservation Goals

Erwin (2010b) recommended using a population goal 4,176 nesting pairs, a value which based on data gathered during population surveys conducted in 1977 (Erwin and Korschgen 1979).

Research/Actions Needed

As identified by Parsons and Masters (2000), future research should focus on:

- Colony-site dynamics; competitive interactions with other wading birds.
- Foraging requirements (area used, proximity requirements to nesting colonies)
- Use of aquaculture facilities as foraging areas
- Population genetics and wintering distribution

Erwin (2010a) of the USGS/PWRC identified these additional research needs:

- Documentation of movement patterns within colonies on a local and regional scale
- Gain greater understanding of mortality sources (i.e. percent of mortality due to predation, weather, and disturbance)
- Establish avian and mammalian predator control on selected islands

Overall, snowy egrets face accelerated threats to their existence throughout their range in the twenty-first century due to continued wetland degradation and loss, environmental contaminants, and control measures at aquaculture facilities. Scientists should provide resource managers with information on nesting- and foraging-site requirements for restoration efforts that may be warranted in the future. Similarly, conservation of the species may be improved with knowledge of population genetic (e.g. gene flow) factors likely to help determine reintroduction success (Parsons and Masters 2000).
Potential Funding: U.S Army Corps of Engineers

Conservation Design

- Identify island habitats that have the potential to support nesting snowy egrets
- Habitat enhancement of historic, active or potential snowy egret nesting sites.
- Attract nesting pairs to selected sites using decoys.

The latter two strategies have been very successful at the Paul S. Sarbanes Environmental Restoration Project at Poplar Island.

Conservation Delivery

- Coordinate with Maryland Department of Natural Resources and U.S. Geological Survey personnel in identifying historic, current, and potential Snowy Egret nesting sites within the Chesapeake Bay.

- Coordination will include ground truthing of selected island sites to verify if sites could maintain nesting colonies.
- Enhancement of nesting habitat in active snowy egret nesting sites would be conducted by placement of additional nesting substrates into and surrounding areas of the current colonies as a measure to increase colony nesting size. Nesting substrates would include: used Christmas trees and other shrub species; snag a materials such as large sections of driftwood; possible planting of shrub species on larger island habitats.
- Sites that have the potential to support new nesting colonies would incorporate the above actions but on a larger scale.
- As an aid in attracting nesting pairs of snowy egret to selected nesting sites, plastic egret decoys will be placed in historic, current, and potential nesting sites. This approach has worked well at the Paul S. Sarbanes Environmental Restoration Project at Poplar Island, and island restoration project located in Chesapeake Bay (Erwin and Beck 2007; McGowan and Guy 2010).

Outreach

- Develop awareness of the importance of island habitats and species benefits to school age children by presenting at various schools from grades 5-12. Boy/Girl Scouts of America or similar groups could be used as volunteers in collection of used Christmas trees during the winter holiday break.
- Development of joint federal/state fact sheets on colonial waterbirds and islands

Monitoring

Monitoring Snowy Egret populations at restored or habitat enhanced island sites within the Chesapeake Bay would be conducted using similar protocols being used by Maryland Department of Natural Resources and U.S Geological Survey biologists that currently conduct colonial waterbird surveys within the Chesapeake Bay (Erwin 2010a). In Maryland and Virginia, coordinated surveys are conducted on a five-year basis.

Partners

Maryland Department of Natural Resources
U.S Geological Survey, Patuxent Wildlife Research Center
U.S Army Corps of Engineers

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Wood Thrush (*Hylocichla mustelina*) Species Action Plan

Focus Areas
Anacostia Watershed, Blackbird Millington, Chincoteague Bay, Lower Chester River, Lower Potomac Patuxent, Lower Rappahannock River, Lower Western Shore Rivers, Nanticoke Choptank, Pocomoke River Cypress Swamp, Shenandoah Upper Rappahannock, Western Highlands

Other Species Benefitting
Black-billed cuckoo (*Coccyzus erythropthalmus*), hooded warbler (*Wilsonia citrine*), red-shouldered hawk (*Buteo lineatus*)

Biological Planning

Species Information
The wood thrush is a common neotropical migrant found in deciduous and mixed forests throughout the eastern and mid-western United States and Canada during the spring and summer months.

Nesting occurs in deciduous or mixed forests with a dense canopy and a well-developed deciduous understory, especially in moist bottomlands and hardwood forests (Bertin 1977, Roth 1987, Roth et al. 1996). The wood thrush also nests in pine forests with a deciduous understory and well-wooded residential areas (Hamel et al. 1982). Bertin (1977) found wood thrushes require one or more trees at least 12 m tall, possibly for song perches and Morse (1971) reported nesting in stands of young white pine with a canopy under 9 m in height.

Justification for Species Selection: The wood thrush is listed as a U.S. Fish and Wildlife Service Region 5 Bird of Conservation Concern, as a priority bird species in three Bird Conservation Regions (28, 29, and 30), and as a Species of Conservation Need in Delaware and Maryland Wildlife Action Plans. The North American Breeding Bird Survey (BBS) data indicated a significant 1.9% annual decline (29% overall) in North America from 1966 to 1999, and the last half of this period (1980-1999) showed a significant 1.5% annual decrease (15.3% overall) (Nature Serve 2010).

Threats and Assessment
Forest fragmentation and deforestation on breeding grounds
- Deforestation of tropical wintering grounds and conversion shade coffee plantations to sun coffee plantations
- Over abundant deer denude forest understory and impact nesting habitat
- Nest predation and parasitism (brown-headed cowbird)

Research/Actions Needed

Annual surveys of suitable habitat and known populations using point count censusing techniques are probably the best way to monitor wood thrush populations. Long-term studies are preferred. Studies should monitor breeding productivity to provide critical information of factors affecting population recruitment and dynamics. It is imperative to determine why reproductive success may be low and why numbers of birds may be low.

Minimum area requirements for source populations seem to be the least understood aspect of wood thrush management. Vegetation characteristics associated with nest-site selection and reproductive success needs to be quantified. Research is needed into the role of that tropical deforestation and habitat fragmentation may have on the decline of regional thrush populations in temperate breeding grounds.

Potential Funding

Wetland Reserve Program, Coastal Wetlands Grant, North American Wetland Conservation Act grants, *Conservation Reserve Enhancement Program*, Wildlife Habitat Incentive Program, Forest Legacy Program

Population Goal for Delaware/Maryland: Maintain or increase current population

Conservation Design

- Permanently protect large blocks of forests and riparian corridors
- Restore hardwoods and mixed forest in open fields adjacent to large forest blocks to increase suitable nesting habitat
- Restore riparian corridors to facilitate dispersal between large forest blocks
- Reduce impacts to forest interior through the regulatory process
- Promote silviculture practices that minimize the impacts to the forest during logging operations

Conservation Delivery

Forest Fragmentation – breeding and migration

- Permanently protect large blocks of forested upland and wetland habitat by the Partners and Coastal Programs using the Wetland Reserve Program, Coastal Wetlands Grant, and North American Wetland Conservation Act grants. Most of the work will be carried out on private land
- Restore or manage riparian forests to provide migration corridors
- Restore forest in open fields especially those adjacent to existing large blocks of forest

- Provide federal agency comments on proposed federal actions that are likely to impact forest interior habitat
- Provide federal agency comments on wind power and other projects that could impact migrating birds

Forestry

The effects of silvicultural practices such as clear cutting and selective logging on migratory songbirds may depend upon the landscape context (Robinson and Wilcove 1994). Preliminary evidence suggests that using low-volume selective logging as an alternative to clear cutting can have relatively little impact on wood thrushes (Robinson and Wilcove 1994). In addition to selective logging, logging roads should be closed and revegetated soon after harvest, and rotation times should be lengthened to permit regeneration of large, old trees (Robinson and Wilcove 1994).

Outreach

Continue to contact and work with landowners on enrollment in land conservation programs, especially Natural Resources Conservation Service's' Wetland Reserve Program. Promote deer management to ensure understory vegetation is not denuded by high deer populations.

Monitoring

The North American Breeding Bird Survey, managed by U.S. Geological Survey, is a long term monitoring program that dates back to 1966. This is the most comprehensive long term monitoring for North American Birds and provides that basis for the trends of the wood thrush. In addition, the Maryland Breeding Bird Atlas occurs every 10 years and provides more detailed distribution for breeding birds in Maryland. The second Atlas (2002-2006) was published in November 2010.

Partners

Delaware Division of Fish and Wildlife Land Trusts
Delaware Forest Service
Maryland Department of Natural Resources
Natural Resources Conservation Service

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