

SECTION 1. INTRODUCTION

Authority

This report is provided under authority of Section 2(b) of the Fish and Wildlife Coordination Act (FWCA) of 1958 (48 Stat. 401, as amended; 16 U.S.C. 661-667d). The FWCA essentially established fish and wildlife conservation as a coequal purpose or objective of federally funded or permitted water resources development projects.

The Bogue Banks Shore Protection Feasibility Study was authorized by a U.S. House of Representatives Committee on Transportation and Infrastructure resolution (Docket 2578) on July 23, 1998, which stated:

“Resolved by the Committee on Transportation of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers dated November 27, 1984, on Bogue Banks and Bogue Inlet, North Carolina, and other pertinent reports, to determine whether any modifications of the recommendations contained therein are advisable at the present time in the interest of shore protection and related purposes and for Bogue Banks, North Carolina.”

In order to fully incorporate the conservation of fish and wildlife resources in the planning of water resources development, the FWCA mandates that federal agencies consult with the U. S. Fish and Wildlife Service (Service) and the state agency with the responsibility for fish and wildlife resources in the project area. The state agency with this responsibility is the North Carolina Wildlife Resources Commission (NC WRC).

Consultation during project planning is intended to allow state and federal resource agencies to determine the potential adverse impacts on fish and wildlife resources and develop recommendations to avoid, minimize, and/or compensate for detrimental impacts. Therefore, this report will:

1. Describe the fish and wildlife resources at risk in the project area;
2. Evaluate the potential adverse impacts, both direct and indirect, on these resources;
3. Develop recommendations to avoid, minimize, or compensate for any unavoidable, adverse environmental impacts; and,
4. Present an overall summary of findings and the position of the Service on the project.

This draft report will be submitted to the NC WRC for their review and comments. The report, when finalized, will include a letter of concurrence from the NC WRC and will constitute the formal report of the Service under Section 2(b) of the FWCA.

Subject of This Report

The Wilmington District, U. S. Army Corps of Engineers (Corps) has contacted the Service regarding a potential shore protection project along ~24 miles of oceanfront shoreline of Bogue Banks in Carteret County, North Carolina. The Bogue Banks Shore Protection Feasibility Study is being carried out under the U.S. Army Corps of Engineers' (Corps) General Investigation Program. In November 2001 the Wilmington District of the Corps initiated coordination with the Service for the Bogue Banks Shore Protection Project.

This report focuses on soft shoreline stabilization methods utilizing a large-scale dredge and fill project. Hard stabilization alternatives (i.e., groins, jetties, seawalls, offshore breakwaters) are not reviewed in this report due to the North Carolina prohibition on hard structures on ocean beaches. If the National Economic Development (NED) Plan contains a hard stabilization alternative, this report will require revision and supplemental sections.

Acronyms used in this report will be defined when first used. A list of all acronyms used is given in Appendix A.

Scope

The geographic scope of this report includes all areas that would be directly or indirectly impacted by the proposed project. The project area includes Bogue Sound, Bogue Inlet, Beaufort Inlet, Bogue Banks, and the marine areas up to 5 miles seaward of Bogue and Shackleford Banks.

The project area includes not only the beaches seaward of the communities requiring storm damage protection, but those areas into which sand could be transported by natural forces, the offshore and estuarine areas which are the most likely sand sources, and all areas likely to be impacted by the secondary development resulting from storm damage reduction measures. The project area also includes uplands that could be used to relocate structures away from the most vulnerable oceanfront area.

The temporal scope of this report extends from direct, immediate impacts of potential storm damage reduction measures to long-term, indirect impacts that may occur as a result of these measures. The report also considers the cumulative impacts of shoreline stabilization alternatives.

Prior Studies and Reports

The Service issued a Planning Aid Report (PAR) for the Bogue Banks Shore Protection Project on February 14, 2002. The PAR will be referenced as:

U.S. Fish and Wildlife Service (USFWS). 2002a. *Planning Aid Report on the Bogue Banks Shore Protection Project, Carteret County, North Carolina*. Raleigh, NC: USFWS Raleigh Ecological Services Field Office. 58 p.

The Corps has conducted other studies in the project area. A Section 933 report is currently under development regarding the possible expansion of the dredge disposal of maintenance material from the Morehead City navigational channel(s) from Atlantic Beach into Pine Knoll Shores. In June 2001 the Wilmington District issued a Section 111 Study on the dredging of the Morehead City Harbor and its potential effects on shoreline erosion at Pine Knoll Shores. The Section 111 study will be referenced as:

U.S. Army Corps of Engineers (USACE). 2001. *Summary of Morehead City Harbor Section 111 Study and Status Report on Other Projects Related to Beach Erosion at Bogue Banks*. Wilmington, NC: USACE Wilmington District. 199 p.

A locally-sponsored beach fill project was initiated in November 2001 under Corps Regulatory Permit No. 200000362. Phase I of this project placed beach fill along ~6 miles of oceanfront beach in Pine Knoll Shores, Indian Beach and Salter Path. The material was removed from three dredge sites located on the nearshore seafloor immediately south of Pine Knoll Shores, Indian Beach and Emerald Isle. The Environmental Impact Statement (EIS) prepared for the state regulatory permit for this project summarizes project features and fish and wildlife resources in the project area. These reports will be referenced as:

Coastal Science & Engineering, LLC (CSE) and Stroud Engineering PA. 2000. *Bogue Banks Beach Restoration Plan, Environmental Impact Statement, Draft #2*. Columbia, SC. Various paginations.

Coastal Science & Engineering, LLC (CSE). 2001. *Final Environmental Impact Statement [for the] Bogue Banks Beach Restoration Plan*. Coastal Science & Engineering. P.O. Box 8056 Columbia, South Carolina 27611-7687. Various paginations.

SECTION 2. STUDY AREA DESCRIPTION

The Bogue Banks Shore Protection Project study area encompasses several types of coastal ecosystems, which have been incorporated into this report as Bogue Banks Interior, Bogue Banks Oceanfront Shoreline, Bogue Banks Estuarine Shoreline, Bogue Sound, Bogue Inlet, Beaufort Inlet, and Offshore Marine. The study area is in Carteret and Onslow Counties, North Carolina, south of Cape Lookout. Bogue Banks is an approximately 24 mile long barrier island with a relatively unique east-west orientation. Beaufort Inlet borders the island to the east and separates Bogue Banks from Shackleford Banks. Bogue Inlet borders Bogue Banks to the west and separates the island from Bear Island. Shackleford Banks is part of the Cape Lookout National Seashore, and Bear Island is part of the Hammocks Beach State Park; therefore Bogue Banks is a developed barrier island between two undeveloped, preserved islands. Bogue Sound separates Bogue Banks from the mainland and Onslow Bay (Atlantic Ocean) faces south. The study area includes Bogue Banks, Bogue Sound, Beaufort and Bogue Inlets, and the seafloor out to 5 miles seaward of Shackleford and Bogue Banks. Figure 1 shows the location of the project area and its surrounding landscape.

The natural history of Bogue Banks has been described in Pilkey et al. (1975), Stanczuk (1975), Steele (1980), Mallette (1986), Flint (1988), Moslow and Heron (1994) and Pilkey et al. (1998). The barrier island is one of the most studied in North Carolina due to its proximity to the Duke University Marine Lab, the Institute of Marine Sciences at the University of North Carolina, Chapel Hill, and federal laboratories of the National Oceanic and Atmospheric Administration (NOAA). Section 5 of this report summarizes the more salient features of the natural history of the study area. Appendix B lists the federally-threatened and endangered species for Onslow and Carteret Counties, North Carolina.

Biological Communities

The Service has described the various coastal biological communities previously in other FWCA reports: USFWS (1999) and USFWS (2001) for the Dare County Beaches (Bodie Island Portion) Hurricane Protection and Beach Erosion Control, Dare County, North Carolina; USFWS (2000a) for the Brunswick County Beaches (Oak Island and Holden Beach Portions) Project; USFWS (2000b) for the Wilmington Harbor, North Carolina, 96 Act; and USFWS (2002a) for this project. The Planning Aid Report (PAR) for the Bogue Banks Shore Protection Project (USFWS 2002a) and the Draft Fish and Wildlife Coordination Act Report (DFWCAR) for the Brunswick Beaches Storm Damage Reduction Project (USFWS 2000a) summarized the characteristics of barrier island communities for southern North Carolina and are incorporated by reference into this report. Specific biological information is contained in Section 5 of this report.

Figure 1 insert

SECTION 3. FISH AND WILDLIFE CONCERNS AND PLANNING OBJECTIVES

The involvement of the Service in this planning process is in response to a Congressional mandate through the FWCA which directs that the conservation of fish and wildlife resources shall receive full and equal consideration and be coordinated with other features of federal projects. Fish, wildlife, and their habitats are valuable public resources which are conserved and managed for the people by state and federal governments. If proposed land or water developments may reduce or eliminate the public benefits that are provided by such natural resources, then state and federal resources agencies have a responsibility to recommend means and measures to mitigate such losses. In the interest of serving the public, it is the policy of the Service to seek to mitigate losses of fish, wildlife, and their habitats and to provide information and recommendations that fully support the Nation's needs for fish and wildlife resource conservation as well as sound economic and social development through balanced, multiple use of the Nation's natural resources.

Shore protection projects that aim to reduce storm damages may impact a variety of fish and wildlife resources and their habitats. These impacts can be direct and immediate, indirect and continuing after project completion, and long-term or permanent. The Service has summarized concerns regarding general and specific impacts potentially resulting from large-scale shoreline stabilization and storm damage reduction projects in USFWS (1999), USFWS (2000a), USFWS (2000b), USFWS (2001) and USFWS (2002a). These reports are hereby incorporated by reference.

Potential Positive Consequences of the Project

In addition to the potential environmental impacts associated with a shore protection project, there may be opportunities for fish and wildlife resource conservation and enhancement. Benefits to fish and wildlife include the creation of sea turtle and shorebird nesting habitat and possibly the creation of reef habitat as sand is removed from hard bottoms offshore. Specific recommendations to create, restore or enhance fish and wildlife resources are outlined in the sections of this report on Conservation Measures.

Planning Objectives

Careful planning and a conscientious balancing of economic considerations with environmental concerns can produce a project with minimal, short- and long-term environmental impacts. The Service's Mitigation Policy (January 23, 1981, Federal Register v. 46, n. 15, pp. 7644-7663) allows for the Service to support a proposed project if the following criteria are met:

- 1) The project is ecologically sound;
- 2) The least environmentally damaging alternative is selected;
- 3) Every reasonable effort has been made to avoid or minimize damage or loss of fish and wildlife resources and uses;

- 4) All important recommended means and measures have been adopted with guaranteed implementation to satisfactorily compensate for unavoidable damage or loss consistent with the appropriate mitigation goal; and
- 5) For wetlands and shallow water habitats, the proposed activity is clearly water dependent and there is a demonstrated public need.

The Service uses these five criteria as planning objectives in this report and will support a project if it meets these five criteria. In accordance with the FWCA, as amended, these planning objectives allow the Service to formulate recommendations that give full and equal consideration to fish and wildlife resources with the economic benefits expected from the project.

SECTION 4. EVALUATION METHODS

Descriptions of natural resources present within the study area and the preliminary assessment of the environmental impacts of the proposed project are based on previous studies for similar projects, published literature, and personal communications with knowledgeable individuals. Published reports and studies were examined to determine their relevance to the proposed project. Material which described potential environmental impacts of similar projects and methods of reducing these impacts are incorporated by reference in this report.

Several field site investigations have been conducted by the Service in the project area. Field visits include surveys following Hurricanes Bertha (1996), Fran (1996), Bonnie (1998), Dennis (1999) and Floyd (1999). Numerous field site investigations have been conducted in relation to Corps Regulatory permits throughout the project area. Other field surveys and data collection were conducted more recently in June 2000, April 2001, May 2001, June 2001, September 2001, February 2002, March 2002, May 2002, June 2002, and August 2002. Investigations were documented with photographs, field notes, measurements and physical samples. These records are available in the Raleigh Ecological Services Field Office.

Additional analyses were conducted using remote sensing data and Geographic Information Systems (GIS), primarily using ArcView 3.2a software. GIS data from the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), North Carolina Center for Geographic Information and Analysis (CGIA), the Service and various internet resources were used to compile landscape level analyses of habitats in the project area. These analyses were then ground-truthed during field surveys. Data were also gathered from the North Carolina Wildlife Resources Commission (NC WRC) and Division of Marine Fisheries (NC DMF) regarding specific biological resources in the project area. These data are presented in tables, figures and technical appendices throughout this report and are available upon request except where it is proprietary by the NC DMF.

Nomenclature in this report follows Tiner (1993) and Duncan and Duncan (1987) for coastal plants; Robins and Ray (1986) for fish; Martof et al. (1980) for amphibians and reptiles; Sibley (2000) for birds; Webster et al. (1985) for mammals; Turgeon et al. (1988) for mollusks; Ruppert and Fox (1988) for invertebrates; and Williams et al. (1989) for decapod crustaceans.

Both common and scientific names from cited literature follow the original publication. If the Service is aware of a widely accepted synonym for the common name, that synonym is given in brackets. If the Service is aware of a change in the scientific name of a given species, the revised nomenclature is included in brackets following the published name.

Resource category determinations were prepared for all habitat types in the project area as per the Service's Mitigation Policy (January 23, 1981, Federal Register v. 46, n. 15, pp. 7644-7663). All of the data sources listed above were incorporated into the resource category determinations. The determinations were coordinated with the NC WRC, NC DMF, National Marine Fisheries Service (NMFS) and the Corps. Where data are limited or not available, best professional judgement erring on the conservation of the resource(s) was also used. These limitations are

clearly noted in this report. The resource category determination approach allows an objective evaluation of the functions and values of each habitat, utilizing data on the status and trends of the evaluation species both regionally and nationally. Some habitats may be harmed or enhanced by the proposed shore protection project, and the individual habitat values allow unique and high value areas to be identified prior to any action.

The four resource categories, ranked 1 to 4 with 1 being the most valuable, are described below. The conservation measures and recommendations in Sections 9, 10 and 11 follow the mitigation goals associated with each resource category, as defined in the Service's Mitigation Policy (Federal Register v. 46, n. 15, pp. 7644-7663).

Resource Category 1

Resource Category 1 habitats have high value for evaluation species and are unique and irreplaceable on a national basis or in the ecoregion section. These habitats include areas with high biodiversity, an unusual assemblage of species, high species endemism, or are pristine, rare or relict habitats. Resource Category 1 determinations will emphasize wetland and coastal areas but do not include transitory habitats and geologic features without endemic species. The mitigation goal for Resource Category 1 habitats is no loss of existing habitat value. Resource Category 1 habitats must be designated by the Regional Director.

Resource Category 2

Resource Category 2 habitats have high value for evaluation species and are relatively scarce or becoming scarce on a national basis or in the ecoregion. The mitigation goal for these habitats is no net loss of in-kind habitat value.

Resource Category 3

Resource Category 3 habitats have high to medium value for evaluation species and are relatively abundant on a national basis. The mitigation goal for Resource Category 3 habitats is no net loss of habitat value while minimizing loss of in-kind habitat value.

Resource Category 4

Resource Category 4 habitats have medium to low value for evaluation species and a mitigation goal of minimizing loss of habitat value.

In addition to the Service's guidance on resource values and mitigation, the Corps Planning Guidance provides for an incremental analysis and mitigation for project impacts that are determined to be significant (ER 1105-2-100). Significance is "derived from institutional, public or technical recognition. Institutional recognition of a resource or effect means its importance is recognized and acknowledged in the laws, plans and policies of government and private groups.

Technical recognition ... is based upon scientific or other technical criteria that establishes its significance. Public recognition means some segment of the general public considers the resource or effect to be important ... [and] may manifest itself in controversy, support or opposition expressed in any number of formal or informal ways” (ER 1105-2-100, p. 2-13). The Endangered Species Act, Marine Mammals Protection Act, Migratory Bird Treaty Act, Magnuson-Stevens Fishery Conservation and Management Act, the Colonial Waterbird Conservation Plan, U.S. Shorebird Conservation Plan and Executive Orders 13186 and 11990 constitute institutional recognition. The request by various non-governmental organizations for a cumulative impacts analysis and/or Programmatic Environmental Impact Statement for coastal projects in North Carolina constitutes public recognition of the significance of the coastal ecosystem.

Therefore the following fish and wildlife resources are considered significant and are utilized as evaluation species for this report. Federally threatened or endangered species are not considered evaluation species for the purpose of assessing the resource categories of a project area. An assessment of the significance of each potential impact (positive or negative) to these species and their habitats is provided throughout Sections 8 and 9. This report divides the project area into the following ecological sections: Bogue Sound, Bogue Inlet, Beaufort Inlet, Estuarine shoreline (of Bogue Banks), Oceanfront shoreline (of Bogue Banks), Bogue Banks interior, Nearshore marine (less than 30 feet water depth) and Offshore marine (greater than 30 feet water depth).

Table 1. Evaluation species for this report and their occurrence in the project area.

Species	Community	Occurrence in Project Area
King mackerel <i>Scomberomorus cavalla</i>	Migratory pelagic fish	Nearshore and offshore marine
Spanish mackerel <i>Scomberomorus maculatus</i>	Migratory pelagic fish	Nearshore and offshore marine
Bluefish <i>Pomatomus saltatrix</i>	Migratory pelagic fish	Nearshore and offshore marine
Gag <i>Mycteroperca microlepis</i>	Migratory demersal fish from snapper-grouper complex	Nearshore and offshore marine
Gulf kingfish <i>Menticirrhus littoralis</i>	Migratory surf zone (demersal) fish	Oceanfront shoreline and nearshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Florida pompano <i>Trachinotus carolinus</i>	Migratory surf zone (demersal) fish	Oceanfront shoreline and nearshore
Bottlenose dolphin <i>Tursiops truncatus</i>	Marine mammal	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound

Southern flounder <i>Paralichthys lethostigma</i>	Migratory demersal	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Spot <i>Leiostomus xanthurus</i>	Migratory demersal fish	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Red drum <i>Sciaenops ocellatus</i>	Resident demersal fish	Nearshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
American shad <i>Alosa sapidissima</i>	Anadromous fish	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
American eel <i>Anguilla rostrata</i>	Catadromous fish	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Atlantic menhaden <i>Brevoortia tyrannus</i>	Migratory pelagic fish	Nearshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Hogchoker <i>Trinectes maculatus</i>	Resident demersal fish	Bogue Sound
Striped mullet <i>Mugil cephalus</i>	Migratory demersal fish	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Atlantic croaker <i>Micropogonias undulatus</i>	Migratory demersal fish	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound
Horseshoe crab <i>Limulus polyphemus</i>	Migratory arthropod	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Blue crab <i>Callinectes sapidus</i>	Decapod crustacean	Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Shrimp (brown, white and pink) <i>Penaeus</i> sp.	Migratory decapod crustacean	Nearshore and offshore marine; Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Diamondback terrapin <i>Malaclemys terrapin</i>	Reptile	Bogue Sound; Estuarine shoreline
Sand dollar <i>Mellita quinquiesperforata</i>	Benthic echinoderm	Nearshore and offshore marine

<i>Scoleleipsis squamata</i>	Benthic polychaete worm	Oceanfront and inlet shorelines; Nearshore and offshore marine
Moon snail <i>Polinices</i> sp.	Benthic gastropod	Nearshore and offshore marine; Bogue Sound
Star coral <i>Astrangia danae</i>	Encrusting epifauna	Nearshore and offshore marine
Quilling piddock <i>Jouanettia quillingi</i>	Rock-boring, endolithic bivalve mollusk	Nearshore and offshore marine
Coquina clam <i>Donax variabilis</i>	Benthic bivalve mollusk	Oceanfront shoreline; Bogue Inlet; Beaufort Inlet; Nearshore marine
Mole crab <i>Emerita talpoida</i>	Benthic arthropod crustacean	Oceanfront shoreline; Bogue Inlet; Beaufort Inlet; Nearshore marine
Ghost crab <i>Ocypode quadrata</i>	Burrowing arthropod	Oceanfront shoreline; Bogue Inlet; Beaufort Inlet
Eastern oyster <i>Crassostrea virginica</i>	Sessile bivalve mollusk	Bogue Sound
Hard clam (Northern quahog) <i>Mercenaria mercenaria</i>	Burrowing bivalve mollusk	Bogue Sound; Nearshore marine
Bay scallop <i>Argopecten irradians</i>	Bivalve mollusk	Bogue Sound
Marsh periwinkle <i>Littorina irrorata</i>	Gastropod	Bogue Sound; Estuarine shoreline
Cordgrass <i>Spartina</i> spp.	Marsh grass	Estuarine shoreline; Bogue Inlet; Beaufort Inlet; Bogue Sound
Eelgrass <i>Zostera marina</i>	Submerged aquatic vegetation	Bogue Inlet; Beaufort Inlet; Bogue Sound
Widgeon grass <i>Ruppia maritima</i>	Submerged aquatic vegetation	Bogue Inlet; Beaufort Inlet; Bogue Sound
Sargassum <i>Sargassum filipendula</i>	Marine algae	Oceanfront shoreline; Nearshore and offshore marine
Live oak <i>Quercus virginiana</i>	Evergreen canopy tree	Bogue Banks interior
Red bay <i>Persea palustris</i>	Evergreen wetland shrub	Bogue Banks interior; Estuarine shoreline

Atlantic white cedar <i>Chamaecyparis thyoides</i>	Maritime wetland tree	Bogue Banks interior
Sea oats <i>Uniola paniculata</i>	Dune grass	Oceanfront shoreline
Boat-tailed grackle <i>Quiscalus major</i>	Migratory landbird	Bogue Banks interior; Estuarine shoreline
Eastern painted bunting <i>Passerina ciris ciris</i>	Migratory landbird	Bogue Banks interior; Bogue Sound; Estuarine shoreline
Marsh wren <i>Cistothorus palustris</i>	Migratory landbird	Bogue Sound; Estuarine shoreline; Bogue Banks interior
American oystercatcher <i>Haematopus palliatus</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Wilson's plover <i>Charadrius wilsonia</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound
Red knot <i>Calidris canutus</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Nearshore marine
Sanderling <i>Calidris alba</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline
Willet <i>Catoptrophorus semipalmatus</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline
Dunlin <i>Calidris alpina</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline
Short-billed dowitcher <i>Limnodromus griseus</i>	Migratory shorebird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline
Gull-billed tern <i>Sterna nilotica</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline
Common tern <i>Sterna hirundo</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline
Black skimmer <i>Rynchops niger</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline

Least tern <i>Sterna antillarum</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Oceanfront shoreline; Estuarine shoreline
Brown pelican <i>Pelecanus occidentalis</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Nearshore marine; Estuarine shoreline
Snowy egret <i>Egretta thula</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Little blue heron <i>Egretta caerulea</i>	Colonial waterbird	Bogue Inlet; Beaufort Inlet; Bogue Sound; Estuarine shoreline
Red phalarope <i>Phalaropus fulicarius</i>	Migratory shorebird	Nearshore and offshore marine
Cory's shearwater <i>Puffinus diomedea</i>	Migratory seabird	Nearshore and offshore marine
Northern gannet <i>Morus bassanus</i>	Migratory seabird	Nearshore marine
Black rail <i>Laterallus jamaicensis</i>	Migratory waterfowl	Bogue Sound; Estuarine shoreline
Common loon <i>Gavia immer</i>	Migratory waterfowl	Bogue Sound
Canvasback <i>Aythya valisineria</i>	Migratory waterfowl	Bogue Inlet; Beaufort Inlet; Bogue Sound
Red-breasted merganser <i>Mergus serrator</i>	Migratory waterfowl, sea duck	Bogue Inlet; Beaufort Inlet; Bogue Sound

Tables 2 through 5 summarize the ecological niche and the available population status information for each of the evaluation species used in the resource category determination process. Table 2 lists the fishery resources. Table 3 contains vegetation evaluation species. Table 4 describes the avian species. Table 5 itemizes the invertebrate species used in the evaluation.

Table 2. Aquatic evaluation species in the Bogue Banks Shore Protection Project study area utilized in this report for the assessment of resource category determinations.

Species	Ecological Niche	Population Status [†]	Management [‡]
King mackerel <i>Scomberomorus cavalla</i>	Migratory, pelagic Live 22-26 yrs Found offshore, nearshore, inlets, and uncommonly in estuaries and rivers Present offshore year-round, nearshore April to November	Viable	SAFMC, NMFS, NC DMF
Spanish mackerel <i>Scomberomorus maculatus</i>	Migratory, pelagic Short-lived (5-8 yrs) Present from early April to November Spawn May to September Found offshore, nearshore, inlets, and estuaries (juveniles)	Viable	ASMFC, SAFMC, NMFS, NC DMF
Bluefish <i>Pomatomus saltatrix</i>	Migratory, pelagic, schooling Live 12-14 yrs Present year-round due to location between two populations Overwinter in project area High position in food web: adults are visual, piscivorous predators; juveniles feed on plankton and invertebrates Nearshore and estuarine nursery areas	Recovering	ASMFC, MAFMC, NMFS, NC DMF
Gag <i>Mycteroperca microlepis</i>	Migratory, demersal Live to 22 yrs Reef/hardbottom feeder Estuarine-dependent nursery in SAV or oyster reefs Juveniles emigrate in fall to nearshore reefs/hardbottoms	Viable	SAFMC, NMFS, NC DMF
Gulf kingfish <i>Menticirrhus littoralis</i>	Migratory Short-lived (6-9 yrs) Spawn April to August Estuarine and surf-zone dependent nursery areas	Unknown	NC DMF
Florida pompano <i>Trachinotus carolinus</i>	Migratory Surf zone feeding and nursery areas		

<p>Bottlenose dolphin <i>Tursiops truncatus</i></p>	<p>Marine mammal Long-lived (40-50 yrs) Likely present year-round Live-births in spring and summer High position in food web Found in estuaries, inlets and nearshore (separate offshore and near-shore population)</p>	<p>Depleted</p>	<p>NMFS</p>
<p>Southern flounder <i>Paralichthys lethostigma</i></p>	<p>Migratory, groundfish Short-lived (6-8 yrs) Spawn nearshore November to March Estuarine nursery areas (prefer muddy bottoms, low salinity) Adults usually return to estuaries post-spawning Found in estuaries, inlets and nearshore</p>	<p>Overfished, population is down 32% in last decade</p>	<p>NC DMF</p>
<p>Spot <i>Leiostomus xanthurus</i></p>	<p>Migratory, benthic-feeding, schooling Short-lived (5 yrs) Spawn offshore (75-90 km) in late fall to early spring, peak December to January Pelagic larvae and post-larvae drift to estuaries, likely peak February to March Congregate along beaches before offshore spawning migration Middle position in food web: larvae feed on plankton, juveniles and adults feed on benthic infauna and epifauna (partly olfactory predators) Estuarine nursery areas in SAV, marshes and tidal creeks Found in estuaries, inlets, nearshore and offshore Sensitive to temperature and salinity changes, pipe intakes One of most abundant species in project area</p>	<p>Viable</p>	<p>ASMFC, NC DMF</p>
<p>Atlantic croaker <i>Micropogonias undulatus</i></p>	<p>Migratory Spawn offshore fall through spring Larvae drift through inlets to estuaries Estuarine nursery areas Found in rivers, estuaries, inlets, nearshore and offshore areas One of most abundant species caught in survey trawls of project area</p>	<p>Concern</p>	<p>ASMFC, NC DMF</p>

<p>Red drum <i>Sciaenops ocellatus</i></p>	<p>Migratory, North Carolina state saltwater fish Long-lived (up to 62 yrs) Present year-round Spawn in Pamlico Sound and at inlets and beaches in late summer to early fall Middle position in food web: feed on zooplankton, invertebrates and small fish Estuarine larvae (grassy or muddy bottoms) and juveniles (marshes) Congregate in surf zone during spring and fall Found in estuaries, inlets and nearshore areas</p>	<p>Overfished</p>	<p>ASMFC, SAFMC, NMFS, NC DMF</p>
<p>Atlantic menhaden <i>Brevoortia tyrannus</i></p>	<p>Migratory, schooling Short-lived (8-10 yrs) Present year-round; as larvae: January - March; juveniles: April - December, and adults: May - December (estuarine) and year-round (oceanic) Spawn offshore during fall and winter in NC, peaking from December to February, concentrating from north of Cape Hatteras to south of Cape Lookout; spawn in ocean during spring and early summer north to Long Island Near bottom of food web as adults: filter feed phytoplankton and detritus, are fed upon by many larger fish Estuarine nursery areas, especially marshes and small creeks; occur well upstream in coastal rivers Found in estuaries, inlets, nearshore and offshore areas Commercially valuable for fishmeal (used for animal feed), fish oil (used as an industrial and food base), and bait</p>	<p>Viable</p>	<p>ASMFC, NMFS, NC DMF</p>
<p>American shad <i>Alosa sapidissima</i></p>	<p>Migratory, anadromous Short-lived (4-10 yrs) Spawn from March to mid-June Typically die after spawning once Middle position in food web: feed dominantly on plankton and insects, are fed upon by American eel, striped bass, porpoises, kingfish, tuna and birds Freshwater-dependent for spawning Found in rivers, estuaries, inlets, nearshore and offshore areas</p>	<p>Concern</p>	<p>ASMFC, NC DMF</p>

<p>American eel <i>Anguilla rostrata</i></p>	<p>Migratory, catadromous Long-lived (up to 85 yrs) Spawn from winter to early spring offshore in Sargasso Sea Typically die after spawning once Middle position in food web: feed on invertebrates, small fish Utilize many aquatic habitats for different life stages, preferring soft bottoms with vegetation Found in rivers, estuaries, inlets, nearshore and offshore areas</p>	<p>Unknown</p>	<p>ASMFC, NC DMF</p>
<p>Hogchoker <i>Trinectes maculatus</i></p>	<p>Demersal Present on mud, silt or sand bottoms of estuaries Spawns from late spring to summer Young may move upstream in freshwater rivers over 100 miles Low position in food web, feeding mostly on worms and small crustaceans Not economically important Found in estuaries and rivers</p>		
<p>Striped mullet <i>Mugil cephalus</i></p>	<p>Migratory Short-lived (< 11 yrs) Spawn from September to January, peaking October through early December Spawn near inlets, nearshore or offshore in groups High fecundity Middle position in food web: feed on microorganisms, algae and decaying plant material, are fed upon by birds, fish, dolphin and sharks Found in rivers, estuaries, inlets, nearshore and offshore areas</p>	<p>Concern</p>	<p>NC DMF</p>
<p>Horseshoe crab <i>Limulus polyphemus</i></p>	<p>Migratory, arthropod Bottom-feeder and source of bioturbation Lay eggs on sandy estuarine beaches Eggs very important food source for migratory shorebirds Medically valuable species for its blood Found in estuaries, inlets, nearshore and offshore areas</p>		<p>ASMFC, NC DMF</p>

<p>Blue crab <i>Callinectes sapidus</i></p>	<p>Decapod crustacean Short-lived (2-3 yrs) Present year-round Spawns at inlets during the summer, larvae are pelagic Middle position in food web: is an omnivore scavenger and detritivorous, is fed upon by birds and fish Estuarine nursery areas in SAV and marshes Found in inlets and estuaries Utilize many microhabitats for different life stages and seasons</p>	<p>Concern</p>	<p>NC DMF</p>
<p>Shrimp <i>Penaeus</i> spp. (Three economically important species: brown, pink and white shrimp)</p>	<p>Migratory, decapod crustacean Short-lived (< 1.5 yrs) Present year-round Spawn nearshore and offshore throughout the year (different species at different seasons) Post-larvae drift into estuaries, adults are burrowers Low position in food web: benthic omnivores of organic matter microalgae, and small invertebrates, are prey for birds and fish Estuarine nursery areas, preferring marsh, SAV and tidal creeks Found in estuaries, inlets, nearshore and offshore areas Sensitive to dredge material and hard stabilization of shorelines</p>	<p>Viable</p>	<p>SAFMC, NMFS, NC DMF</p>
<p>Diamondback terrapin <i>Malaclemys terrapin</i></p>	<p>Reptile Present year-round Nests May through July on sandy beaches, dunes and islands Forage on mollusks, worms, crabs, dead fish and marsh plants Found in estuaries, especially salt marshes</p>	<p>Rare or uncommon in NC; State and Federal Species of Concern</p>	<p>NC WRC</p>

† The most recent population or stock status as designated by the relevant management authority.

‡ Management authority acronyms: ASMFC - Atlantic States Marine Fishery Commission; MAFMC - Mid-Atlantic Fishery Management Council; NC DMF - North Carolina Division of Marine Fisheries; NC WRC - North Carolina Wildlife Resources Commission; NMFS - National Marine Fisheries Service; SAFMC - South Atlantic Fishery Management Council.

Data sources: ASMFC (www.asmfc.org), E-nature (www.enature.com), Facey and Van Den Avyle (1986), Hales and Van Den Avyle (1989), Larson et al. (1989), LeGrand and Hall (1999), Meyer (1994), Muncy (1984), NC DMF (www.ncfisheries.net), NMFS (www.nmfs.noaa.gov), Oliver et al. (1989), Rogers and Van Den Avyle (1983), Rogers and Van Den Avyle (1989), Van Den Avyle and Fowler (1984), VIMS (www.fisheries.vims.edu/femap/), and Wilson (1995).

Table 3. Vegetation evaluation species in the Bogue Banks Shore Protection Project study area utilized in this report for the assessment of resource category determinations.

Species	Ecological Niche	Distribution Status	Abundance Status	Management ^b
Cordgrass <i>Spartina</i> spp.	Saltwater or brackish marsh	Regional (southeast) Locally fragmented by shoreline stabilization on individual properties	Declining Loss of 60,000 acres regionally 1970s to 80s ¹	USACE
Eelgrass <i>Zostera marina</i>	Submerged aquatic vegetation (SAV), freshwater to saltwater, densest in spring	Temperate, cold water species; NC is southern most distribution	Unknown, possibly stable or declining	NMFS, NC DMF, NC Coastal Resources Commission
Widgeon grass <i>Ruppia maritima</i>	SAV, food for migratory waterfowl, freshwater to saltwater, densest in summer	Temperate species	Unknown, possibly stable or declining	NMFS, NC DMF, NC Coastal Resources Commission
Sargassum <i>Sargassum filipendula</i>	Marine algal meadows on hardbottoms, also free-floating when ripped from moorings; nursery and juvenile habitat for fish and sea turtles	Unknown	Unknown	SAFMC, NMFS
Live oak <i>Quercus virginiana</i>	Maritime forest; evergreen canopy hardwood	Very limited in NC ²	Declining due to lot clearing for development	Local
Red bay <i>Persea palustris</i>	Maritime scrub-shrub wetlands	Wetland type is very rare to extremely rare in NC ²	Declining habitat, down 3.1 million acres regionally ¹ ; NC leads region in palustrine forest wetland loss	

Atlantic white cedar <i>Chamaecyparis thyoides</i>	Maritime swamp forest	Thought to be less than 5% of historical distribution	Declining	USACE, NC DCM
Sea oats <i>Uniola paniculata</i>	Dune colonizer and builder	Cape Henry, VA, to Texas	Common ³ Native species that is being replaced by American beachgrass in landscaped dune plantings	

¹ Trends as cited in Hefner et al. (1994)

² Distribution as cited in Shafale and Weakley (1990)

³ Abundance as cited in Duncan and Duncan (1987)

Data sources: Duncan and Duncan (1987), Fonseca et al. (1998), Hefner et al. (1994), Graetz (1994), Meyer (1994), Riggs et al. (1998), and Shafele and Weakley (1990).

Table 4. Avian evaluation species in the Bogue Banks Shore Protection Project study area utilized in this report for the assessment of resource category determinations.

Species	Ecological Niche	National Population Status	Regional or State Population Status
Boat-tailed grackle <i>Quiscalus major</i>	Migratory landbird Present year-round Colonial nester Ground gleaner and hawkler omnivore Found in coastal marshes and adjacent open habitats		
Eastern painted bunting <i>Passerina ciris ciris</i>	Migratory landbird Nests in trees and shrubs Ground and foliage gleaner Found in terrestrial vegetation habitats Males are highly territorial	Federal Species of Concern	Significantly Rare ³
Marsh wren <i>Cistothorus palustris</i>	Migratory landbird Present year-round Nests in marsh grasses, a polygynous breeder Ground and foliage gleaner, hawkler Found in fresh and brackish marsh habitats Destroys competitive nests of marsh-nesting blackbirds		
American oystercatcher <i>Haematopus palliatus</i>	Migratory shorebird Present year-round Nests on bare ground Aquatic gleaners/sweepers and probers/priers Found in estuaries, inlets, beachfront habitats Project area has notable concentration of wintering population Long parental care period (up to 1 yr) to teach young foraging techniques	Species of High Concern ¹	Extremely High Priority ⁴ Region extremely important for breeding, very important to species for wintering ⁴

Wilson's plover <i>Charadrius wilsonia</i>	Migratory shorebird Present during spring, summer and fall Nests on sand beaches and tidal mud flats Loosely colonial with terns and oystercatchers Terrestrial and aquatic gleaners, a visual predator Found in estuaries, inlets and beachfront habitats	Species of High Concern ¹	Significantly rare ³ High Priority ⁴ Region extremely important to species for breeding ⁴
Red knot <i>Calidris canutus</i>	Migratory shorebird Present during spring and fall migrations, sporadic in winter Aquatic and terrestrial prober/gleaners Found in estuaries, inlets and beachfront habitats Forage in large flocks during winter Have large territories	Species of High Concern ¹ (known to be in decline)	Extremely High Priority ⁴
Sanderling <i>Calidris alba</i>	Migratory shorebird High concentration of wintering population Aquatic and terrestrial prober/gleaners Found in inlet and beachfront habitats Strong fidelity to wintering grounds, defends foraging territory	Species of High Concern ¹ (known to be in decline)	Moderate Priority ⁴
Willet <i>Catoptrophorus semipalmatus</i>	Migratory shorebird Present year-round Nests on bare ground Aquatic gleaner, visual predator, wader Found in salt marshes, tidal mud or sand flats Strong fidelity to foraging territory, defend winter territories	Species of Moderate Concern ¹	Moderate Priority ⁴
Dunlin <i>Calidris alpina</i>	Migratory shorebird Present during winter Aquatic and terrestrial prober/gleaners Found in beachfront, inlet and estuarine habitats Has large territories, breeding site fidelity Wintering populations may have sex separation with males concentrated more to the north of the wintering range	Species of Moderate Concern ¹ (known to be in decline)	Moderate Priority ⁴

Short-billed dowitcher <i>Limnodromus griseus</i>	Migratory shorebird High concentration during winter Aquatic and terrestrial prober/gleaner, wader Found in estuarine, inlet, and beachfront habitats Forage in large flocks with sandpipers and plovers during winter	Species of High Concern ¹ (known to be in decline)	High Priority ⁴
Gull-billed tern <i>Sterna nilotica</i>	Colonial waterbird Present spring, summer and fall Nests on bare ground in colonies with other terns and black skimmers Forages by hovering and pouncing on prey Found in salt marshes, inlets and estuarine habitats	Species of Low Concern ²	State Threatened
Common tern <i>Sterna hirundo</i>	Colonial waterbird Present spring, summer and fall Nests on bare ground in colonies with other terns and black skimmers Courtship feeding ritual Forages by high-diving for fish Defend foraging territories during breeding season Found in estuaries, inlets, beachfront, and nearshore habitats	Species of Moderate Concern ² (apparent stable population)	Significantly Rare ³
Least tern <i>Sterna antillarum</i>	Colonial waterbird Present spring, summer and fall Nests on bare ground and rooftops in colonies with other terns and black skimmers Courtship feeding ritual Forages by plunge diving for prey Found in freshwater, marine, and estuarine waters, oceanfront beaches, sand flats and open dunes Nesting vulnerable to degradation	Species of High Concern ² (apparent population decline)	Significantly Rare ³ Species of Concern ³
Brown pelican <i>Pelecanus occidentalis</i>	Colonial waterbird Present year-round Nests in trees, shrubs or on the ground Forages by high-diving for fish Found in estuaries, inlets and nearshore habitats Long-lived (25-30 yrs)	Species of Moderate Concern ² (apparently stable population) Remains listed on Gulf Coast	Species of Concern ³ Removed from Endangered Species list in 1985

<p>Black skimmer <i>Rynchops niger</i></p>	<p>Colonial waterbird Present year-round Nests on bare ground in colonies with terns Forages by skimming water for prey (tactile hunter) Found in estuaries, inlets and beachfront habitats Sensitive to any human disturbance of colony Roosts in flocks on sandbars, shoals and beaches</p>	<p>Species of High Concern² (apparently population decline)</p>	<p>Species of Concern³</p>
<p>Snowy egret <i>Egretta thula</i></p>	<p>Colonial wading bird Present year-round Nests in colonies in shrubs and deciduous trees Diverse foraging techniques for aquatic and terrestrial fauna, usually wading with active pursuit of prey (stalk and strike) Found in estuaries and inlet habitats Communal roosts at night</p>	<p>Species of High Concern² (apparent population decline)</p>	<p>Species of Concern³</p>
<p>Little blue heron <i>Egretta caerulea</i></p>	<p>Colonial wading bird May be present year-round Nests in colonies in shrubs and deciduous trees; Diverse foraging techniques, usually stalk and strike prey Found in estuaries and inland habitats</p>	<p>Species of High Concern² (apparent population decline)</p>	<p>Species of Concern³</p>
<p>Red phalarope <i>Phalaropus fulicarius</i></p>	<p>Migratory shorebird Present during spring and fall migrations, sporadic in winter Aquatic gleaner for marine invertebrates, larvae, plankton Found in nearshore and offshore marine habitats</p>	<p>Species of Moderate Concern¹ (thought to be in decline)</p>	<p>Species of High Concentration⁴</p>
<p>Cory's shearwater <i>Puffinus diomedea</i></p>	<p>Migratory seabird Regionally high concentration in NC waters Present April to late November, peak mid-July to early August Forages by skimming, scavenging and diving for fish, squid, crustaceans, seaweed, and refuse May flock in rafts in nearshore and offshore areas Usually flies just above ocean surface</p>	<p>Species of Moderate to Low Concern² (apparently stable population)</p>	

Northern gannet <i>Morus bassanus</i>	Migratory seabird Present during spring and fall migrations and winter Forages by high diving (often from > 90 ft) for fish and squid Found in nearshore areas, often visible from shore	Species Not at Risk ² (biologically significant population increase)	
Black rail <i>Laterallus jamaicensis</i>	Migratory waterfowl Present year-round Nest in marsh grasses that are irregularly flooded Aquatic gleaner Found in fresh, brackish and salt marsh habitats (more common in extensive marshes) Beaufort and Cedar Island areas are two known resident areas Secretive		Significantly Rare ³ High Priority ⁵
Common loon <i>Gavia immer</i>	Migratory waterfowl Present year-round with highest abundance during spring and fall migrations and winter Piscivorous, forages by surface diving Found in estuaries Raft at night		Moderate Priority ⁵
Red-breasted merganser <i>Mergus serrator</i>	Migratory waterfowl or sea duck Present during spring and fall migrations and winter Piscivorous, forages by surface diving Found in estuaries and inlet areas	Unknown, may be increasing population ⁶	
Canvasback <i>Aythya valisineria</i>	Migratory waterfowl, diving duck Present during spring and fall migrations and winter Forages on SAV Found in estuarine and inlet areas	Steady, but below long-term average ⁶	Moderate Priority ⁵

¹ Population status as designated in the U.S. Shorebird Conservation Plan. ² Population status as designated in the North American Waterbird Conservation Plan. ³ Status as designated by the North Carolina Natural Heritage Program. ⁴ Status as designated by the Southeastern Coastal Plains - Caribbean Regional Shorebird Plan. ⁵ Status as designated by the Partners in Flight Bird Conservation Plan for the South Atlantic Coastal Plain. ⁶ Status as described in USFWS (2002b).

Data sources: Bent (1964), Brown et al. (2000), Ehrlich et al. (1988), Fussell (1994), Hunter (2001), Hunter et al. (2001), Kushlan and Steinkamp (2001), LeGrand and Hall (1999), Peterson (1980), Root (1988) and USFWS (2002b).

Table 5. Invertebrate evaluation species in the Bogue Banks Shore Protection Project study area utilized in this report for the assessment of resource category determinations.

Species	Ecological Niche	Population Status	Management ⁶
Sand dollar <i>Mellita quinquiesperforata</i>	Benthic echinoderm Found in nearshore and offshore areas Feed on organic material Prey for flounder and starfish Reproduce via planktonic fertilization and larvae Move through top layer of sand		
<i>Scolelepis squamata</i>	Benthic polychaete worm Most abundant polychaete worm in oceanfront beach and inlet areas Filter-feeder Prey for fish and birds		
Moon snail <i>Polinices</i> sp.	Benthic gastropod Found in estuarine, nearshore and offshore soft bottom Carnivorous predator		
Star coral <i>Astrangia danae</i>	Encrusting epifauna Found in nearshore and offshore hardbottom areas Filter-feeder		
Quilling piddock <i>Jouanettia quillingi</i>	Rock-boring, endolithic bivalve Found in nearshore and offshore hardbottom areas Dominant source of bio-erosion at 23-mile Rock offshore Wrightsville Beach		
Coquina clam <i>Donax variabilis</i>	Benthic bivalve infauna Found in intertidal inlet and beach areas and nearshore Substrate sensitive (to grain size and geomorphology) Filter-feeder Prey for ghost crabs, birds, and fish		

<p>Mole crab <i>Emerita talpoida</i></p>	<p>Benthic arthropod crustacean infauna Found in intertidal inlet and beach areas and nearshore Sensitive to grain size and geomorphology Filter-feeder Prey for ghost crabs, birds, fish</p>		
<p>Ghost crab <i>Ocypode quadrata</i></p>	<p>Arthropod infauna Found in dunes and dry beach Nocturnal burrower Scavenger Reproduces with planktonic larvae that become amphibious Sensitive to human disturbance and beach cleaning</p>	<p>Less common</p>	
<p>Eastern oyster <i>Crassostrea virginica</i></p>	<p>Sessile bivalve mollusk; keystone species Found in estuaries in intertidal and subtidal habitats Filter-feeder Reef builder and source of carbon sequestration Provides habitat for many other species Long-lived (up to 40 yrs) Spawn from May to September Pelagic larvae, require hard substrate to settle upon Commercially valuable</p>	<p>Concern</p>	<p>NC DMF</p>
<p>Hard clam <i>Mercenaria mercenaria</i></p>	<p>Bivalve mollusk (minimal locomotion) Found dominantly in estuaries and some nearshore Suspension feeder Long-lived (up to 45 yrs) Spawn from May to September, highly fecund Pelagic larvae of very high density in water column Burrower in sandy and vegetated bottoms, often with small rocks or shells, intertidal and subtidal Prey for fish, crabs, starfish, birds and other mollusks Sensitive to turbidity and dredging</p>	<p>Unknown</p>	<p>NC DMF</p>

<p>Bay scallop <i>Argopecten irradians</i></p>	<p>Bivalve mollusk, capable of limited swimming as adults Found in estuaries, especially in eel grass beds and shallow flats Filter-feeder Short-lived (1-2 yrs) Spawn September to November (major) and March to April (minor); hermaphroditic with planktonic fertilization and larvae Prey for rays, blue crab, starfish, and herring gulls Population may be susceptible to high ray predation in Bogue and Core sounds Very young juveniles sensitive to silt, prefer some structure (grass, shell, rock, etc.) on which to settle/attach</p>	<p>Concern</p>	<p>NC DMF</p>
<p>Marsh periwinkle <i>Littorina irrorata</i></p>	<p>Gastropod Found in estuaries on marsh grasses Forages on algae Prey for birds and blue crabs</p>		

‡ Management authority acronyms: ASMFC - Atlantic States Marine Fishery Commission; MAFMC - Mid-Atlantic Fishery Management Council; NC DMF - North Carolina Division of Marine Fisheries; NC WRC - North Carolina Wildlife Resources Commission; NMFS - National Marine Fisheries Service; SAFMC - South Atlantic Fishery Management Council.

Data sources: Alexander et al. (1993), Bowman and Dolan (1985), Donoghue (1999), Fay et al. (1983a, 1983b), Meyer (1994), NC DMF (www.ncfisheries.net), Riggs et al. (1998), Ruppert and Fox (1988), and Turgeon et al. (1988).