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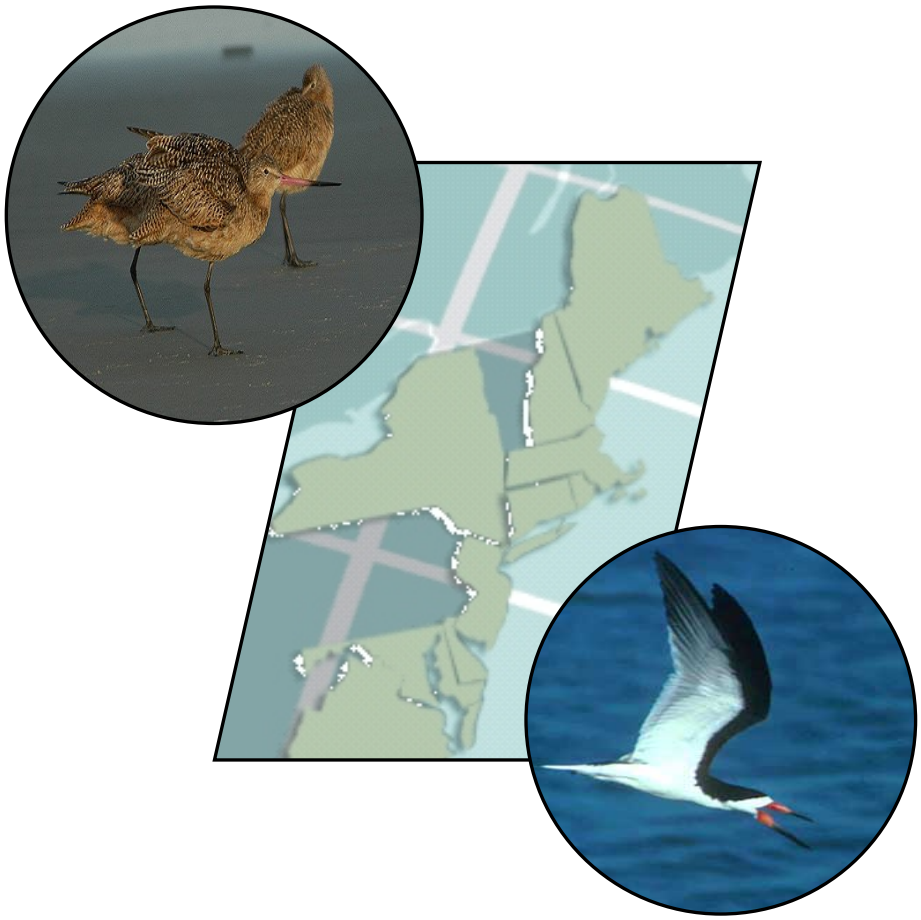
Dredging Operations and Environmental Research Program

Summary of Second Regional Workshop on Dredging, Beach Nourishment, and Birds on the North Atlantic Coast

Michael P. Guilfoyle, Richard A. Fischer, David N. Pashley,
and Casey A. Lott, Editors

November 2007



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Final report

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Abstract: The U.S. Army Corps of Engineers, the American Bird Conservancy, and the U.S. Fish and Wildlife Service organized a workshop on October 25–27, 2005, in Long Island, NY. The goal of the workshop was to disseminate information on the beneficial use of dredged material deposition along the North Atlantic Coast for the purpose of improving beach nourishment and other Corps operations to increase coastal habitat quality, and to improve the management and conservation of colonial and non-colonial waterbirds and shorebirds. This region involves the operations of four Corps Districts including the Baltimore, Philadelphia, New York, and New England Districts. The workshop consisted of a series of presentations from numerous federal, state, and conservation organizations actively involved in the monitoring and managing of dredged material deposition for habitat improvement for birds and other wildlife species. In general, the presentations highlighted the status of current efforts to promote bird conservation in Corps operations and emphasized areas where improvements can be made. These areas include (1) identifying important inlets and other areas for birds along the North Atlantic Coast; (2) linking current conservation of birds in the North Atlantic Coast regions with regional bird conservation plans already developed; (3) improving data acquisition, database storage and accessibility; (4) engaging local communities to promote conservation alongside recreational and economic interests; and (5) improving our abilities to integrate issues of scale including local, regional, and national impacts of Corps activities on the conservation of waterbird and shorebird populations.

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Preface

This technical report summarizes the results of the second regional workshop dealing with coastal dredging and beach nourishment operations of the U.S. Army Corps of Engineers (Corps) and bird conservation held during October 25-27, 2005, in Eastern Long Island, New York. The information presented is derived from presentations made during the workshop by representatives of the Corps, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS) (Biological Resources Division), American Bird Conservancy (ABC), and various state agencies, universities, and non-government organizations (See Appendix A for author names and affiliations). These presentations can be viewed at http://el.erdc.usace.army.mil/dots/coastalbirds.html, and represent the views and opinions of the presenters and do not necessarily reflect the views or policies of the Corps. The workshop was organized jointly by ABC, the Corps Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), and the USFWS.

COL Richard B. Jenkins was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

1 Introduction

The U.S. Army Corps of Engineers is responsible for managing and maintaining navigable coastal and inland waterways of the United States. It is also the primary agency responsible for shoreline protection. Activities associated with waterways maintenance or shoreline protection, including dredging, dike construction, dredged material disposal operations, beach nourishment, and variable dam discharge actions, potentially conflict with federal, state, and interagency mandates to protect populations of breeding, wintering and migratory waterbird and shorebird populations, several species of which are listed as federal or state endangered, threatened, or species of regional concern. Conflicts between Corps operations and bird conservation can result in a lack of operational flexibility and increased costs for Corps projects. However, many of these projects often provide excellent opportunities for bird habitat creation, maintenance, or restoration. Whether these projects become conflicts or opportunities for bird conservation is strongly influenced by communication among agencies and organizations involved in the planning, construction, and post-construction monitoring phases of Corps projects. Increased education among agencies regarding bird habitat requirements and project-oriented logistical considerations will help improve communication and coordination among agencies and lead to more positive benefits for bird conservation during large coastal projects.

This workshop is the second of three planned regional workshops that address issues concerning Corps coastal activities and bird conservation. This workshop covers the North Atlantic Coast from Maine to Virginia and was held in Long Island, NY, during October 25-27, 2006. The first workshop covered the South Atlantic Coast from the Virginia-North Carolina border south to Florida and was held at Jekyll Island, GA, during February 1-4, 2005 (Guilfoyle et al. 2006). A subsequent workshop (March 14-16, 2006) was held in Corpus Christi, TX, and covered the Gulf of Mexico Coast (http://el.erdc.usace.army.mil/06mar-birdwksp-agenda.pdf). Workshop participants represent a diverse group of ornithologists, engineers, project planners, coastal ecologists, geomorphologists, state and federal regulators, and other specialists. Numerous representatives of many federal, state, and local agencies and non-governmental organizations attended the Long Island workshop. The primary objective of the workshop was to

expand the capabilities of the Corps to contribute to various bird conservation efforts, to make the bird conservation community aware of opportunities that exist through working with the Corps, and to address and reduce areas of conflict.

This 3-day workshop consisted of 38 presentations and facilitated discussions during eight sessions. This technical report summarizes the presentations from the workshop that focus on dredging, beach nourishment, and bird conservation. These presentations represent the views and opinions of the presenters and do not necessarily reflect the views or policies of the Corps. Presentations are summarized in their chronological order and PowerPoint files for many of the presentations are available online at http://el.erdc.usace.army.mil/dots/coastalbirds.html.

2 Session I: North Atlantic Coastal Birds: Status, Distribution, and Habitat

Conservation Priority Bird Species of the Mid-Atlantic and New England Coast – *Mitch Hartley and Melanie Steinkamp*

During the last five to ten years there has been an increased amount of coordination and cooperation in bird conservation planning at continental, regional, and state scales. The origin of most of these efforts can be traced back to the development of the North American Waterfowl Management Plan (NAWMP) in 1986. This initiative was notable for its biological foundation and its comprehensive scope, which included the following:

- A continental assessment of populations and habitats for species of interest
- Setting target population levels with species- and habitat-specific objectives
- Establishing geographic focus areas of continental importance to populations
- Establishing regional partnerships to deliver habitat conservation (i.e., joint ventures)
- Annual congressional appropriations for habitat conservation (e.g., NAWCA).

The North American Wetlands Conservation Act (NAWCA) established a competitive grants program to protect, enhance, and restore wetland habitats vital to sustaining waterfowl populations in the U.S., Canada, and Mexico. NAWCA funding has grown in the last decade and now contains some non-appropriated tax revenues. These revenues are currently estimate at $70 million/year, making it one of the country's most important funding sources for bird habitat protection (for more information see http://www.fws.gov/birdhabitat/NAWCA/grants.htm).

The success of NAWMP has spurred considerable interest in the broader bird conservation community and led to similar continental conservation initiatives aimed at landbirds, waterbirds, and shorebirds. These four continental initiatives, considered together, encompassed all North

American bird species and related habitats. These groups and new species-specific conservation initiatives (e.g., http://www.bobwhiteconservation.org/index.html) have formed a partnership to better coordinate their efforts: the North American Bird Conservation Initiative, or NABCI (see http://www.nabci-us.org/nabci.html). One of the major products that came from the NABCI collaboration is a unified ecological map of Bird Conservation Regions (BCRs) in North America (see http://www.nabci-us.org/map.html). Although bird conservation planning has been and will continue to be done at multiple political scales (e.g., individual states, the Great Lakes region, New England), much bird conservation planning work is currently being done at the BCR-scale. Most of the original waterfowl joint ventures and newly designated joint ventures (see http://www.fws.gov/birdhabitat/NAWMP/jvdir.htm) are now working at the BCR-scale, and most have expanded their focus to the conservation of all bird species and habitats.

In each BCR along the Atlantic Coast, conservation planners and bird experts from around the region convened a series of workshops and worked through committees to assess and prioritize bird species in need of conservation action, discuss population and habitat objectives, and establish focus areas of particular importance to one or more bird groups. These BCR-level efforts are largely based on and informed by the existing continental and regional conservation initiatives (e.g., Partners in Flight, the continental and regional waterbird plans). The result of these efforts is a BCR-specific list of priority species and priority conservation actions needed in the region. Table 1-1 lists priority coastal bird species (listed by habitat suite) for the three BCRs in the northeast Atlantic Coast: the Atlantic Northern Forest (BCR 14), Southern New England/Mid-Atlantic Coast (BCR 30), and the Lower Great Lakes/St. Lawrence Plain (BCR 13). Only one of these regions (i.e., BCR 14) has a finalized conservation plan, so the species lists for BCR 13 and BCR 30 are considered preliminary, pending further review by experts within those regions. Also, other habitats not strictly associated with the coast (e.g., upland forest, grasslands) were not included for this meeting, so the species lists below are a subset of a much larger list of species.

Table 1-1. Priority bird species and degree of concern for three Northeastern BCRs in selected coastal habitats. They include the New England/Mid-Atlantic Coast (BCR 30), Atlantic Northern Forest (BCR 14), and the Lower Great Lakes/St. Lawrence Plain (BCR 13). Note: Only BCR 14 list has been finalized, so the species listed under BCR 30 and BCR 13 are draft lists. Updates can be obtained at http://www.acjv.org.

Species	BCR 30	Species	BCR 14	Species	BCR 13
Beach, Sand, Mud Flats					
American Oystercatcher	Highest	Piping plover	Highest	Piping Plover	Highest
Gull-billed Tern	Highest	Semipalmated Sandpiper	Highest	American Golden Plover	High
Piping Plover	Highest	Ipswich Savannah Sparrow	Highest	Buff-breasted Sandpiper	High
Red Knot	Highest	American Golden Plover	High	Common Tern	High
Roseate Tern	Highest	Black-bellied Plover	High	Little Gull	High
Ruddy Turnstone	Highest	Common Tern	High	Short-billed Dowitcher	High
Sanderling	Highest	Red Knot	High	Solitary Sandpiper	High
Whimbrel	Highest	Roseate Tern	High	Black-bellied Plover	Moderate
American Golden Plover	High	Ruddy Turnstone	High	Bonaparte's Gull	Moderate
Black-bellied Plover	High	Short-billed Dowitcher	High	Dunlin	Moderate
Buff-breasted Sandpiper	High	Whimbrel	High	Greater Yellowlegs	Moderate
Dunlin	High	American Oystercatcher	Moderate	Hudsonian Godwit	Moderate
Greater Yellowlegs	High	Hudsonian Godwit	Moderate	Least Sandpiper	Moderate
Hudsonian Godwit	High	Least Sandpiper	Moderate	Marbled Godwit	Moderate
Least Tern	High	Sanderling	Moderate	Pectorial Sandpiper	Moderate
Marbled Godwit	High	Semipalmated Plover	Moderate	Red Knot	Moderate
Semipalmated Sandpiper	High	Willet	Moderate	Sanderling	Moderate
Short-billed Dowitcher	High			Semipalmated Sandpiper	Moderate
White-rumped Dowitcher	High			Whimbrel	Moderate
Willet	High				

Species	BCR 30	Species	BCR 14	Species	BCR 13
Beach, Sand, Mud Flats (Continued)					
Wilson's Plover	High				
American Avocet	Moderate				
Black Skimmer	Moderate				
Common Tern	Moderate				
Least Sandpiper	Moderate				
Lesser Yellowlegs	Moderate				
Royal Tern	Moderate				
Semipalmated Plover	Moderate				
Western Sandpiper	Moderate				
Ipswich Savannah Sparrow	Moderate				
Marine Open Water					
Red-throated Loon	Highest	Common Eider	Highest	Long-tailed Duck	Highest
Audubon's Shearwater	High	Greater Shearwater	Highest	Little Gull	High
Black Scoter	High	Red-necked Phalarope	Highest	Common Tern	High
Bridled Tern	High	Arctic Tern	High	White-winged Scoter	Moderate
Common Eider	High	Black Guillemot	High	Common Loon	Moderate
Greater Shearwater	High	Black Scoter	High		
Long-tailed Duck	High	Northern Gannet	High		
Northern Gannet	High	Razorbill	High		
Red-necked Phalarope	High	Red Phalarope	High		
Surf Scoter	High	Red-necked Grebe	High		
White-winged Scoter	High	Atlantic Puffin	Moderate		

Species	BCR 30	Species	BCR 14	Species	BCR 13
Marine Open Water (Continued)					
Cory's Shearwater	Moderate	Black-legged Kittiwake	Moderate		
Razorbill	Moderate	Common Loon	Moderate		
Red Phalarope	Moderate	Leach's Storm Petrel	Moderate		
Harlequin Duck	Moderate	Long-tailed Duck	Moderate		
Manx Shearwater	Moderate	Red-throated Loon	Moderate		
		Surf Scoter	Moderate		
Rocky Coast (and Islands)					
Roseate Tern	Highest	Common Eider	Highest	Semipalmated Sandpiper	Highest
Ruddy Turnstone	Highest	Great Cormorant	Highest		
Clapper Rail	High	Harlequin Duck	Highest		
Common Eider	High	Purple Sandpiper	Highest		
Northern Gannet	High	Semipalmated Sandpiper	Highest		
Purple Sandpiper	High	Arctic Tern	High		
Semipalmated Sandpiper	High	Black Guillemot	High		
Common Tern	High	Common Tern	High		
Harlequin Duck	High	Herring Gull	High		
Razorbill	High	Northern Gannet	High		
		Razorbill	High		
		Roseate Tern	High		
		Ruddy Turnstone	High		
		Atlantic Puffin	Moderate		
		Leach's Storm Petrel	Moderate		

Species	BCR 30	Species	BCR 14	Species	BCR 13
Estuarine Emergent					
American Black Duck	Highest	American Black Duck	Highest	American Black Rail	Highest
Black Rail	Highest	Nelson's Sharp-tailed Spar.	Highest	King Rail	High
Gull-billed Tern	Highest	Black-crowned Night Heron	High	Short-billed Dowitcher	High
Saltmarsh Sharp-tailed Spar.	Highest	Short-billed Dowitcher	High	Solitary Sandpiper	High
Seaside Sparrow	Highest	Whimbrel	High	Black-crowned Night Heron	Moderate
Whimbrel	Highest	Hudsonian Godwit	Moderate	Greater Snow Goose	Moderate
Bufflehead	High	Least Sandpiper	Moderate	Greater Yellowlegs	Moderate
Clapper Rail	High	Short-eared Owl	Moderate	Hudsonian Godwit	Moderate
Forester's Tern	High	Willet	Moderate	Least Sandpiper	Moderate
Greater Yellowlegs	High			Whimbrel	Moderate
Hudsonian Godwit	High				
Mallard	High				
Marsh Wren	High				
Short-billed Dowitcher	High				
Willet	High				
American Avocet	Moderate				
American Wigeon	Moderate				
Black-crowned Night Heron	Moderate				
CP Swamp Sparrow	Moderate				
Gadwall	Moderate				
Green-winged Teal	Moderate				
Least Bittern	Moderate				

Species	BCR 30	Species	BCR 14	Species	BCR 13
Estuarine Emergent (Continued)					
Least Sandpiper	Moderate				
Little Blue Heron	Moderate				
Nelson's Sharp-tailed Spar.	Moderate				
Northern Pintail	Moderate				
Red-breasted Merganser	Moderate				
Ruddy Duck	Moderate				
Short-eared Owl	Moderate				
Snowy Egret	Moderate				
Sora	Moderate				
Spotted Sandpiper	Moderate				
Yellow-crowned Night Heron	Moderate				
Estuary and Bay					
American Black Duck	Highest	American Black Duck	Highest	American Black Duck	Highest
Atlantic Brant	Highest	Barrow's Goldeneye	Highest	Canada Goose – NAP	Highest
Red-throated Loon	Highest	Common Eider	Highest	Common Goldeneye	Highest
Roseate Tern	Highest	Harlequin Duck	Highest	Lesser Scaup	Highest
Black Scoter	High	Red-necked Phalarope	Highest	Long-tailed Duck	Highest
Bufflehead	High	Black Scoter	High	Barrow's Goldeneye	High
Canada Goose – NAP	High	Canada Goose – NAP	High	Canvasback	High
Canvasback	High	Common Tern	High	Common Tern	High
Common Eider	High	Herring Gull	High	Greater Scaup	High
Glossy Ibis	High	Red Phalarope	High	Northern Pintail	High

Species	BCR 30	Species	BCR 14	Species	BCR 13
Estuary and Bay (Continued)					
Greater Scaup	High	Red-necked Grebe	High	Bonaparte's Gull	Moderate
Long-tailed Duck	High	Roseate Tern	High	Common Loon	Moderate
Red-necked Phalarope	High	Atlantic Brant	Moderate	White-winged Scoter	Moderate
Surf Scoter	High	Bald Eagle	Moderate		
Tundra Swan – Eastern	High	Common Goldeneye	Moderate		
White-winged Scoter	High	Common Loon	Moderate		
Common Goldeneye	Moderate	Greater Scaup	Moderate		
Common Tern	Moderate	Horned Grebe	Moderate		
Green-winged Teal	Moderate	Long-tailed Duck	Moderate		
Harlequin Duck	Moderate	Surf Scoter	Moderate		
Hooded Merganser	Moderate	Red-throated Loon	Moderate		
Northern Pintail	Moderate				
Red Phalarope	Moderate				
Red-breasted Merganser	Moderate				
Royal Tern	Moderate				

International Shorebird Survey data from the southeastern U.S. indicate that some species prefer inlets to other coastal habitats during migration and wintering. These preferences were noted for some of the highest priority species, including American Oystercatcher (common and scientific names are listed in Table 1-2), Piping Plover, and Red Knot. Other high priority species include Wilson's Plover and Short-billed Dowitcher. Inlets should not be targeted for dredging or beach sand removal without considering the important role they may play for these and other species.

Table 1-2. Common and scientific names of priority bird species identified for three Northeastern BCRs. The BCRs include the New England/Mid-Atlantic Coast, Atlantic Northern Forest, and the Lower Great Lakes/St. Lawrence Plain.

Common Name	Scientific Name	Common Name	Scientific Name
Common Loon	*Gavia immer*	Black Scoter	*Melanitta nigra*
Red-throated Loon	*Gavia Stellata*	Common Goldeneye	*Bucephala clangula*
Horned Grebe	*Podiceps auritus*	Barrow's Goldeneye	*Bucephala islandica*
Red-necked Grebe	*Podiceps grisegena*	Bufflehead	*Bucephala albeola*
Manx Shearwater	*Puffinus puffinus*	Hooded Merganser	*Lophodytes cucullatus*
Audubon's Shearwater	*Puffinus Iherminieri*	Red-breasted Merganser	*Mergus serrater*
Greater Shearwater	*Puffinus gravis*	Ruddy Duck	*Oxyura jamaicensis*
Cory's Shearwater	*Calonectris diomedea*	Bald Eagle	*Haliaeetus leucocephalus*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Clapper Rail	*Rallus longirostris*
Northern Gannet	*Morus bassanus*	King Rail	*Rallus elegans*
Great Cormorant	*Phalacrocorax carbo*	Sora	*Porzana Carolina*
Least Bittern	*Ixobrychus exilis*	Black Rail	*Laterallus jamaicensis*
Snowy Egret	*Egretta thula*	Black-bellied Plover	*Pluvialis squatarola*
Little Blue Heron	*Egretta caerulea*	American Golden-Plover	*Pluvialis dominica*
Black-crowned Night Heron	*Nycticorax nycticorax*	Semipalmated Plover	*Charadrius semipalmatus*
Yellow-crowned Night Heron	*Nyctanassa violacea*	Piping Plover	*Charadrius melodus*
Glossy Ibis	*Plegadis falcinellus*	Wilson's Plover	*Charadrius wilsonia*
Tundra Swan – Eastern	*Cygnus columbianus*	American Oystercatcher	*Haematopus palliatus*
Greater Snow Goose	*Chen caerulescens*	American Avocet	*Recurvirostra americana*
Canada Goose NAP	*Branta canadensis*	Greater Yellowlegs	*Tringa melanoleuca*
Atlantic Brant	*Branta bernicla*	Lesser Yellowlegs	*Tringa flavipes*
Mallard	*Anas platyrhynchos*	Solitary Sandpiper	*Tringa solitaria*
American Black Duck	*Anas rubripes*	Spotted Sandpiper	*Actitis macularia*
Gadwall	*Anas strepera*	Willet	*Catoptrophorus semipalmatus*

Common Name	Scientific Name	Common Name	Scientific Name
Northern Pintail	*Anas acuta*	Marbled Godwit	*Limosa fedoa*
American Wigeon	*Anas americana*	Hudsonian Godwit	*Limosa haemastica*
Green-winged Teal	*Anas crecca*	Whimbrel	*Numenius phaeopus*
Canvasback	*Aythya valisineria*	Buff-breasted Sandpiper	*Bartramia longicauda*
Lesser Scaup	*Aythya affinis*	Ruddy Turnstone	*Arenaria interpres*
Greater Scaup	*Aythya marila*	Purple Sandpiper	*Calidris maritima*
Common Eider	*Somateria mollissima*	Sanderling	*Calidris alba*
Harlequin Duck	*Histrionicus histrionicus*	Red Knot	*Calidris canutus*
Long-tailed Duck	*Clangula hyemalis*	Dunlin	*Calidris alpine*
Pectoral Sandpiper	*Calidris melanotos*	Artic Tern	*Sterna paradisaea*
White-rumped Sandpiper	*Calidris fusciollis*	Roseate Tern	*Sterna dougalli*
Semipalmated Sandpiper	*Calidris pusilla*	Least Tern	*Sterna antillarum*
Western Sandpiper	*Calidris mauri*	Bridled Tern	*Sterna anaethetus*
Least Sandpiper	*Calidris minutilla*	Black Skimmer	*Rynchops nigra*
Short-billed Dowitcher	*Limnodromus griseus*	Razorbill	*Alca torda*
Red-necked Phalarope	*Phalaropus lobatus*	Black Guillemot	*Cepphus grille*
Red Phalarope	*Phalaropus fulicarius*	Atlantic Puffin	*Fratercula arctica*
Black-legged Kittiwake	*Rissa tridactyla*	Short-eared Owl	*Asio flammeus*
Little Gull	*Larus minutus*	Marsh Wren	*Cistothorus palustris*
Bonaparte's Gull	*Larus philadelphia*	Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*
Herring Gull	*Larus argentatus*	Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Gull-billed Tern	*Sterna nilotica*	Seaside Sparrow	*Ammodramus maritimus*
Royal Tern	*Sterna maxima*	*Ipswich* Savannah Sparrow	*Passerculus sandwichensis*
Common Tern	*Sterna hirundo*	CP Swamp Sparrow	*Melospiza georgiana*
Forster's Tern	*Sterna forsteri*		

Many coastal species use a specific habitat type (e.g., sandy beach or island) for nesting but forage in a much larger marine "landscape." The quality of foraging habitat is directly related to the birds' annual breeding productivity and, thus, to supporting their populations over time. Least Terns, for example, routinely forage 3-12 km from breeding colonies in a variety of shallow water habitats including coastal bays, lagoons, estuaries,

river and creek mouths, tidal marshes, lakes, and occasionally offshore. Roseate Terns forage up to 30 km from their nesting grounds. Many seabirds nest in colonies close to shore but feed far offshore and concentrate their feeding efforts over shoals. When planning offshore dredge activities, impacts to marine bird foraging habitats must be incorporated into any decision-making framework.

Coastal activities by the Corps and other agencies and organizations have negatively affected some coastal bird species. However, Corps efforts also provide major benefits to some species, including the many coastal birds that rely on dredged-material islands or nourished beaches as their primary nesting or non-breeding habitat. There are many potential projects that could have an even greater impact on coastal birds, such as restoring historic saltmarsh habitat that has been degraded by tide restrictions over extensive areas. Remaining coastal habitats that are in or near pristine condition should be protected from development and degradation; maintaining their integrity should be a major consideration in any coastal projects that the Corps or other agencies are planning.

Major threats to coastal birds include habitat loss and degradation due to development or encroachment by humans both near and offshore; beach disturbance by pets, pedestrians, and off-road vehicles; unsuitable nesting habitat due to growth of vegetation or increases in predator populations; pollution and contamination; fishing net entanglement; collision impacts with structures; oil spills; and lack of food due to decreased water quality, competition with commercial fisheries, or climate change. These myriad threats mean that sustaining populations of many coastal species will require increased attention and ongoing management to reduce or mitigate the many different problems facing coastal bird species. Assessing threats or potential impacts for some coastal species is made very difficult because of a paucity of data on their abundance and distribution. This is especially true for pelagic species, which lack historic, comprehensive data sets to examine population trends over time, assess immediate or long-term impacts of proposed offshore projects, or identify marine reserve areas.

Bird conservation partnerships exist across the continent, including the entire Atlantic Coast and Great Lakes regions. New partnerships are being formed to address proposed offshore development and to establish monitoring programs for poorly understood pelagic bird species.

Managers of any projects with the potential to impact coastal habitats either positively or negatively should engage and involve bird conservation partners on both a long-term (strategic) and short-term (project-specific) basis, so that priority bird species and their habitats can be explicitly considered in coastal project planning. This way, critical population and habitat needs can be better integrated into coastal management activities to better accommodate bird habitat conservation. Finally, both short- and long-term (cumulative) project assessments should be carried out using new and existing bird monitoring programs to help reduce potential conflicts with birds and indicate better ways of doing projects in the future.

National Audubon Society's Program for Coastal Bird Conservation in the U.S. – *Scott Hecker*

Audubon's Coastal Bird Conservation Program (CBCP) was established in March 2003 to assist all interested partners, including Audubon chapters and other non-profit organizations, government agencies, property owners, and coastal citizens. The objective of the program is to reverse the declines of threatened coastal birds in North America. In its first three years, efforts focused on breeding beach-nesting birds, including plovers (*Charadrius* spp.), terns (*Sterna* spp.), oystercatchers (*Haematopus* spp.), and the Black Skimmer (*Rynchops niger*); wintering plovers and other shorebirds.

The CBCP office is in Duxbury, MA, but is part of the National Audubon Society's Science Division, based in Ivyland, PA. The CBCP Director, Scott Hecker, works with partners to assess and prioritize coastal bird conservation needs at the national and state levels. Once priorities are identified, by species and region, the CBCP works with partners to implement field-based conservation work state-by-state. The CBCP Field Director, Margo Zdravkovic, works with all interested partners to increase the collection of critical data and protect priority species and sites.

Since March 2003 the CBCP has done the following:

- Established a national office in Duxbury, MA, and assisted partners in Maine, Massachusetts, Connecticut, New York, North Carolina, South Carolina, Florida, Alabama, Mississippi, Louisiana, Texas, California, Canada, and Mexico

- Coordinated and conducted the first complete survey of breeding Snowy Plovers (*C. alexandrinus*) and Wilson's Plovers (*C. wilsonia*) along the entire Texas, Louisiana, and Mississippi coastline. CBCP staff and partners located, monitored, and mapped thousands of nesting pairs of Snowy and Wilson's Plovers
- Assisted Audubon North Carolina and others increase monitoring and protection efforts for Piping Plovers (*C. melodus*) and other beach-nesting species in North Carolina, partly contributing to a reverse in the decline of Piping Plovers from an all-time low of 20 pairs in 2004 to 37 pairs in 2005
- Conducted extensive surveys on wintering Piping Plovers from North Carolina to Florida, collecting more records on color-banded Piping Plovers than any other single effort.

Audubon CBCP Goals are as follows:

- Maintain core staffing and expand field program state-by-state.
- Continue to focus the field program on monitoring and protection of Piping, Snowy, and Wilson's Plovers; Roseate Tern (*S. dougalli*), Least Tern (*S. antillarum*), and Gull-billed Terns (*S. nilotica*); American Oystercatchers (*H. palliatus*), and Black Skimmers. Consider adding new initiatives that include nesting Reddish Egrets (*Egretta rufescens*) and wintering Red Knots (*Calidris canutus*).
- Play a significant role conducting and coordinating census work in the southeastern U.S. and Mexico for wintering and breeding Piping and Snowy Plovers during the international census in 2006.
- Participate in the Cape Hatteras National Seashore off-road vehicle rulemaking process to establish new management plans concerning the protection of threatened species on the Outer Banks.
- Continue to draft annual reports on CBCP comprehensive surveys of Gulf of Mexico and Atlantic coastal regions with the aim of publishing new information and producing regionally important management plans.
- Increase CBCP partnerships with every governmental and non-governmental colleague interested in the long-term conservation of threatened coastal birds in North America.
- Work with all Audubon Important Bird Area Programs to implement and increase the levels of on-the-ground conservation work for threatened species of coastal birds throughout the Western Hemisphere.

- Establish, systematically, long-term conservation plans and programs for species and sites, including the acquisition of the local funds necessary to sustain these efforts.

Island Nesting Sites for Colonial Waterbirds: A Critically Limiting Resource in the Predator-Rich Northeast – *Kathy Parsons*

Since 1985, the Manomet Center for Conservation Sciences has collaborated with conservation organizations and wildlife agencies in the New York metropolitan area to develop science-based management plans for colonially nesting wading birds and seabirds. Wading birds, including herons (e.g., *Nycticorax* spp., *Butorides* spp., and *Ardea* spp.), egrets (*Egretta* spp.), and ibises (e.g., *Plegadis* spp., and *Eudocimus* spp.), colonized many islands in New York Harbor following passage of the Clean Water Act and the consequent reduction of raw sewage in urban waterways. During the 1980s and early 1990s, abundance of wading birds increased in the harbor by 15% annually. Since the mid-1990s, colonially nesting waterbirds have abandoned several core nesting sites within the harbor, and populations within the greater Northeast coastal region have declined by as much as 30%. Manomet's long-term studies of avian foraging and nesting ecology in New York Harbor and elsewhere in the Northeast show that the birds are exposed to contaminants throughout the region. Despite abundant foraging resources, the embryo-toxic effects of industrial contaminants in New York Harbor (such as PCBs, dioxins, and metals) contribute to low fledging success in wading birds and seabirds. Unsustainable population losses have resulted in abandoned but viable nesting sites. Early gains in heron populations in New York Harbor were due to the exodus of herons from suburban and rural estuaries, where evidence shows birds are exposed to pesticides, behaviorally compromised, and vulnerable to predators. This pattern of large-scale population shifts from non-urban to urban estuaries, and subsequent population declines, is being repeated in other important urban estuaries such as Boston Harbor, Tampa Bay, and San Francisco Bay. Manomet is working with partners regionally and at larger scales to mitigate the effects of contaminants on waterbird populations.

Shorebird Migration Biology and the Importance of Stopover Sites – *Brian Harrington*

There are roughly 50 species of shorebirds common to North America, about one-third of which are projected to reach endangerment status

within the next century, and some within the next 10 years. Causes of declines are largely unknown, but disruption of key food resources during migration is suspect in at least one case.

This presentation reviews some general principles about conservation and relationships to the biology of shorebird migration between North and South America. Shorebirds have biological attributes that make them unusually vulnerable to loss of strategic migration stopover sites. In a variety of species, large fractions of entire populations may use a small number of migration stopover locations that apparently are critical to the success of migration. For most of these species, the stopover locations are used traditionally; however, some species may change stopover locations over a span of decades, and for a smaller number of species, the location of key staging areas may switch from year to year.

Most major shorebird stopover sites constitute migration staging areas, where numbers of visiting shorebirds will increase over a period of time. Individual birds typically will spend several days (often about 10 days or more) at a major stopover site, feeding very intensively and adding on fat. Sometimes individual birds will double their weight during stopover, and this stored fat is used as fuel during a long-distance, nonstop flight to their next staging area, which may be 1,000–2,000 miles (1,600–3,200 km) away. It is this single requirement—a location where food is so abundant that a shorebird can quickly gain weight—that is at the core of conservation issues surrounding shorebird migration biology.

Red Knots (*Calidris canutus*) have become a conservation "poster child" for threatened shorebirds in North America. Like many other shorebirds, Red Knots live on a global—not national—scale, breeding in the Canadian Arctic, wintering in the U.S., Brazil, and Argentina, and having strategic migration habitats in almost every Western Hemisphere nation along the Atlantic and Pacific coastlines. The knot population has declined by more than 60% within the last 5 years and potentially will reach endangerment levels within the next few years.

Although causes for decline of the knot population are not fully known, lower abundance of food resources at one of their traditionally used migration staging areas, Delaware Bay, is suspect. Knots arrive in Delaware Bay during May, making landfall following a direct flight from South America. They feed intensively to add fat, consuming tens of

thousands of eggs of horseshoe crabs (*Limulus polyphemus*), many of which come ashore to nest during late May. After adding fat, knots fly in a direct trip to Canadian breeding grounds, mostly north of the Arctic Circle.

Due to heavy harvesting of horseshoe crabs, and to fewer eggs being available to shorebirds, many of the knots apparently are unable to make weight, and do not survive their northern flight and Arctic breeding attempt. These birds are so dependent upon stopover conditions that if resources at one or more stopover sites are deficient, the population will likely experience an increase in mortality rates.

So the take-home message of this presentation is that many kinds of shorebirds that are traveling the world's "hemispheric highways" can be threatened by the loss of a single fuel station that may be located in any one of a number of potential nations that are separated by thousands of miles. Protection of key sites, whether in Argentina or Alaska, is critical to sustaining their populations.

Are Atlantic Coastal Inlets a Sustaining Habitat of Nonbreeding Migratory Shorebirds? – *Brian Harrington*

Estuary and inlet sandbars are an important wildlife resource. Inlets are known to be important to migratory birds yet are increasingly used as sand sources during beach nourishment operations. To exemplify the importance of inlets, data were analyzed from the International Shorebird Survey (ISS). This volunteer program monitors coastal areas in the Western Hemisphere. In the U.S., through the assistance of 800 cooperators, over 50,000 surveys have been conducted since 1979. Surveys were conducted by volunteers every 10 days, from July 1 through October 1, using standard protocols. Additional information was obtained from a winter study of American Oystercatchers (*Haematopus palliatus*). From these data, numbers and distribution of coastal shorebirds during the nonbreeding season were evaluated along the Atlantic coast in several southeastern states including North Carolina, South Carolina, Georgia, and Florida. Over 360 sites were compared, with 107 sites classified as inlets, and 254 sites classified as beach or other.

Results identified five species that consistently preferred inlets ("Inlet-loving Species") to other habitats. Although inlets represented a fraction of the habitat available, these species consistently had higher counts on inlets. These species include the American Oystercatcher, Piping Plover

(*Charadrius melodus*), Wilson's Plover (*C. wilsonia*), Red Knot (*Calidris canutus*), and the Short-billed Dowitcher (*Limnodromus griseus*). Data from wintering American Oystercatchers indicate there were significantly more birds on sand islands and spits associated with inlet and estuary habitats. Some species were detected more often in coastal habitats (e.g., Black-bellied Plover [*Pluvialis squatarola*]), while other species were detected more often in other habitats types, such as marsh areas (e.g., Black-necked Stilt [*Himantopus mexicanus*]). Species richness and overall counts were also higher on inlets during the survey period. As a group, abundance and richness of coastal species were significantly higher on inlets than non-inlet habitats. These results also suggest that inlets provide important habitat to migrating and wintering shorebirds. Continued use of sand from inlet sources during beach restoration and nourishment activities needs to be reevaluated and studied. Removal of sand from inlets may reduce a highly important and limited habitat resource vital to many imperiled shorebirds during the non-breeding season.

Waterbird Use of Offshore Shoals and Possible Species-Specific Impacts of How Shoals are Removed – *Doug Forsell and Mark Koneff*

Sand from offshore shoals is increasingly being mined to replace sand eroded from beaches. Offshore shoals do not accrete material over time; once gone, they are gone for good. Offshore shoals often provide important foraging grounds for numerous waterbirds, including seabirds, loons (*Gavia* spp.), and seaducks (e.g., *Melanitta* spp.). These birds are already impacted by human activities such as overfishing of forage fish, by catch in gillnets, contaminants, overharvest, and collisions with lighted structures and boats. Waterbirds may soon also be impacted by other man-made structures such as wind power turbines proposed for offshore waters.

Current Concern: Waterbirds are strongly tied to resources provided by offshore shoals. Many species winter in large numbers along the Atlantic Coast and approximately 10-20 million birds migrate through Atlantic coastal waters each year, some utilizing the shoals. These birds are often difficult to survey due to their ephemeral use of areas during migration. It is more important to identify bird concentration areas, flyways, and temporal patterns of habitat use than to estimate populations. This study focused on winter use of shoals by birds.

Shipboard surveys using 300-m-wide transects are the best method for surveying seabirds. This method permits data collection on foraging

behavior and better detection of diving birds. However, for large areas and shallow waters it is not practical or cost-effective to use ships. Forsell and Koneff conducted aerial surveys of a 120-m-wide strip from an altitude of 45 m for two winters from December 2001 through March 2003 along the Atlantic eastern coast from Virginia to New York.

In the offshore waters, gulls (*Larus* spp.) were more abundant in the northern areas, loons were distributed relatively evenly throughout the study area, and Northern Gannets (*Morus bassanus*) were most abundant in Virginia's waters. Scoters (*Melanitta* spp.) were most abundant near the mouths of Delaware and Chesapeake Bays and used the outer coastal waters primarily during migration. Results showed that all bird groups were at least twice as abundant in the vicinity of shoals than non-shoal areas and that scoters were 10 times more abundant in shoal areas than the non-shoal areas.

Sand mining efforts are managed by the U.S. Minerals Management Service (MMS). This agency has jurisdiction beyond 3 nautical miles from shore. Some states, the Corps, and MMS are developing 40-year shoal mining plans.

Mining should be limited in areas such as (1) bird foraging areas, (2) bird concentration areas, (3) bird wintering areas, and (4) migration stopover areas. Efforts are needed to determine bird usage of shoals and to better understand ecological linkages of birds to the shoals.

Also, there is a need to formalize, develop, and plan a method of mining that minimizes impacts on the quality of foraging habitat. Several options may be available:

- Mine top of the shoal: This method would likely reduce upwellings potentially impacting foraging quality for gannets, gulls, and pelicans (*Pelecanus* spp.). Also, it would increase the diving depth for many seaducks with unknown prospects for recovery of benthic invertebrates.
- Mine side of the shoal: This method would maintain upwellings but would reduce shallow water area of the shoal, lowering the benthic foraging area available to scoters. Disturbing the sides of the shoals may have unknown but important impacts on habitat for benthic organisms.

- Mine the middle of the shoal: This would maintain the upwellings; could potentially impact sedimentation patterns resulting in change of substrate and benthic food availability; and would likely increase the diving depth for seaducks.
- Remove entire shoal: Removal should occur far from the shoreline and far from where birds forage. Since the ecological linkages between birds and shoals are not fully understood, researchers may be better off to completely remove a few minor shoals until the impacts on birds can be predicted. In this case, shoals should be chosen as far offshore as possible and shallow shoals should be avoided.

Recommendations are as follows:

- Identify bird use of shoals (3 years minimum), including the seasonal and annual pattern, and the magnitude of bird use.
- Determine why birds are attracted to shoals.
- Determine the prey items selected by birds on the shoals and the impact of shoal removal on these organisms.
- Develop models to predict the results of sand mining on shoals.
- Test the model and develop plans that minimize impacts to birds.

3 Session II: Coastal Processes, Coastal Engineering, and Sediment Management

A Primer on Coastal Erosion and Solutions – *Tim Kana*

Coastal erosion is often thought of as inevitable. The forces of winds, waves, and currents on the shore are uncontrollable. Tiny particles, like the sands that make up the great recreational beaches of the world, will move inexorably from place to place. As sediment moves, so does the coastline. But viewed in human time scales of decades to centuries, many beaches are moving imperceptibly. In fact, the majority of developed beaches are eroding at less than 3 feet per year. This is because they have had thousands of years to evolve into forms that are nearly in balance with the local wave and tide conditions. They may erode during storms but often rebuild naturally in a continuing cycle. Human activities such as the stabilization of inlets or construction of shore protection structures have exacerbated erosion in many areas but so have large-scale phenomena such as channel avulsions or natural openings of inlets.

This presentation outlines some of the causes of coastal erosion and puts into perspective their scales and consequences. Sea-level rise is a concern, but it is not necessarily the most important or underlying cause of erosion at a site at century time scales. There are no uniform causes, just as there are no uniform solutions. Erosion tends to be site-specific. Yet, with careful observation and measurement, a particular problem can be placed in context and drawn from the experience of similar sites. Restoration of eroded beaches is a primary management tool, along with development setbacks, relocation of buildings, or installation of sand-retaining structures. The economics of each alternative is fundamentally linked to the underlying erosion rate at a site. Therefore, understanding the cause of erosion and knowing its rate is the basis of sound coastal zone management. The question is not so much whether the coast is eroding but how erosion should be accommodated from place to place.

An Overview of the U.S. Army Corps of Engineers' Coastal Inlets Research Program – *Julie D. Rosati and Nicholas C. Kraus*

The Corps has a mission to maintain the navigability of federal coastal and inland channels. Coastal inlet systems can be dynamic and hazardous,

requiring dredging of coastal channels to prevent excessive shoaling. The Coastal Inlets Research Program (CIRP)[1] is supporting the Corps, private industry, and academia in addressing engineering and science problems at coastal inlets. Progress is reported on the CIRP Web site (http://cirp.wes.army.mil/cirp/cirp.html) (Figure 3-1), which describes CIRP activities, contains publications for downloading, and gives directions on how to obtain or access products and technology such as models, analysis procedures, and data. CIRP publications are posted on its Web site, often in draft form prior to the release of final versions. Publications include technical reports, journal articles, conference papers, and Coastal and Hydraulics Engineer Technical Notes (CHETNs). Electronic versions of technical reports and journal and conference papers in PDF format can be downloaded. The CIRP Web site also includes case study applications of major CIRP numerical modeling technologies together with several simple online applications, announcements of upcoming workshops, summaries of past technology transfer events, and planned research activities of the CIRP.

Figure 3-1. CIRP home page – http://cirp.wes.army.mil/cirp/cirp.html.

[1] Adapted in part from Holliday et al. (2002).

Research and development in the CIRP covers field data collection, numerical modeling, physical modeling, lessons learned, and basic research on hydrodynamics (waves, currents, and water level), sediment transport, and morphology change as required to progress in the product-oriented applied research. This paper highlights CIRP products of potential interest to the ecological community for evaluating existing and predicting future coastal habitat. Of particular relevance for breeding and nesting of some types of shorebirds is the availability of exposed, unvegetated sediment, whether created by breaching and new inlet formation, development of inlet shoals, or placement of dredged material.

The CIRP is being conducted at ERDC, Coastal and Hydraulics Laboratory (CHL), located in Vicksburg, MS. The CIRP collaborates with other Corps research programs to leverage funds and avoid duplication. Two such programs are the Dredging Operations and Environmental Research (DOER) program (http://el.erdc.usace.army.mil/dots/doer/), where fine-grained sediment transport is investigated, and the System-Wide Water Resources Program (SWWRP) (https://swwrp.usace.army.mil) that has a direct link with inlets because of regional-scale barrier island and inlet modeling, dredging, and sediment bypassing. The CIRP also collaborates with Corps Districts in their ongoing or upcoming inlet studies.

Several of the CIRP's and SWWRP's products of potential interest to the birding community are listed at Inlets Online (http://www.oceanscience.net/inletsonline) and are discussed below.

Inlets Online is a web-based information and analysis resource on tidal inlets and adjacent beaches, Great Lake entrances, navigation channels, and Corps operation and maintenance activities at these sites. Inlets Online is intended to provide technical guidance for non-specialists and to serve as an information center for specialists in the areas of coastal engineering, coastal geology, oceanography, and coastal zone management. Presently, the Web site includes technical documentation related to aerial photographic interpretation, historical information on federally maintained inlets, and examples of features interpreted from photographs (Byrnes et al. 2002). Inlets Online includes a database of historical aerial photography for federally maintained inlets, and it is being expanded to non-federal inlets.

Inlets Online includes a tutorial for identifying coastal features from aerial photography, how they are measured and analyzed, and how they are related to specific inlet/beach processes. It is also a historical aerial photography database for inlets around the U.S. Inlets Online is organized into seven components within the framework listed in Table 3-1.

Table 3-1. Framework for Inlets Online.

Inlet/Beach Processes	Inlet/Beach Morphology	Engineering Activities	Glossary of Terms	Select a Site	Analysis Methods	Analytical Toolbox
Wave-current interaction	Storm response	Structure placement	Coastal engineering	Documents 154 federal inlets and many non-federal inlets	Interpretation of aerial photography	Links to screening codes and decision-support tools
Channel navigability	Shoals	Structure performance	Geology			
Sediment transport	Hard bottom	Structure rehabilitation	Oceanography			
Wave diffraction	Channel orientation	Channel dredging	Coastal zone management			
		Deposition basin				
		Beneficial uses of dredged material				
		Sand transfer plant				

The CIRP's *Database of Inlet Navigation Projects and Structures* is a web-server-hosted database accessed via a customized Web interface (Hughes 2000). The database contains more than 1,230 individual records of navigation structures and tidal inlets located around the coastlines of the United States and its territories, including 330 records from the U.S. Great Lakes. Figure 3-2 shows the Web interface and a partial listing of records beginning with the letter C.

The original database was extended by adding more than 900 digitized historic photographs of tidal inlets and associating them with a database record. Users can construct custom queries and download the tabulated results. Recently, extensive inlet data have been gathered for 154 federally maintained inlets and channels. Work is underway to separate the inlets and structures databases and add cross-links between each inlet and its associated navigation structures. The database will be expanded by including additional data fields and populating vacant fields where possible.

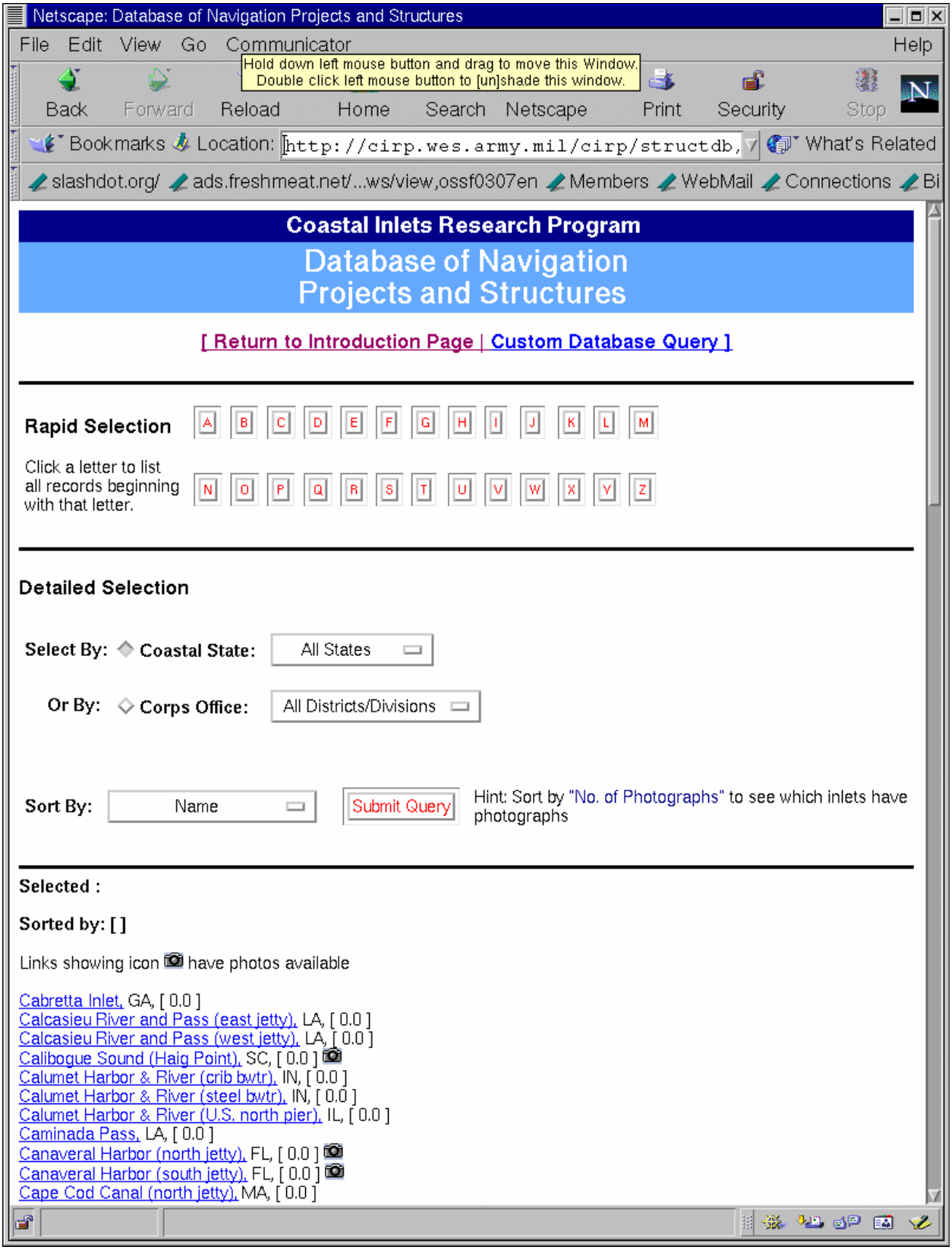

Figure 3-2. Inlets database sample record query.

Each record has fields for parameters related to the inlet or to the inlet structure. Data fields are grouped into three categories:

- **Geographic information:** Includes inlet or structure name, state and coast where located, and which Corps District has responsibility over the region
- **Structure parameters:** Data related to the inlet structures such as date built, structure length, crown elevation and width, core elevation, side slope, and jetty offset for dual-jetty systems
- **Inlet parameters:** Includes parameters such as project width and depth, tidal prism, throat cross-sectional area, bay surface area, ebb shoal volume, tide and current gauge locations, and maximum average flood and ebb currents and direction. Each database field is described on a separate Web page linked to the database Web application.

Sediment Budget Analysis System (SBAS): The SBAS is a method for calculating and displaying local and regional sediment budgets including single and multiple inlets, estuaries, bays, and adjacent beaches (Rosati and Kraus 1999, 2001; Rosati 2002; Dopsovic et al. 2002) (Figure 3-3). It is avaliable for PC on the Windows operating systems and for ARCVIEW 8.x and is free of charge from CHL (see the CIRP Web site for obtaining SBAS). SBAS allows many local (project-level) sediment budgets to be characterized within one or more regional sediment budgets. Features of SBAS have been designed to facilitate creation, display, and calculation of both local and regional sediment budgets.

SBAS is operated within a graphical user interface to solve the conservation of volume (or volume rate of change) equation for each sediment budget cell and any connecting cells through sediment paths. The user drags-and-pulls the mouse to form squares or rectangles (sediment budget cells) and arrows (sources and sinks into and out of each cell). Volume changes (or volume change rates) are entered in a cell menu that is accessed by double clicking at a cell. Engineering activities (placement and removal volumes or rates) can be entered with tools appearing on the upper toolbar. Color-coding of the cells indicates whether the cell is balanced or not. Sediment budgets such as calculated in SBAS typically range from a decade to more than a century, and the spatial scale can vary from the vicinity of an inlet to hundreds of kilometers of connected beaches interspersed with sediment sources and sinks.

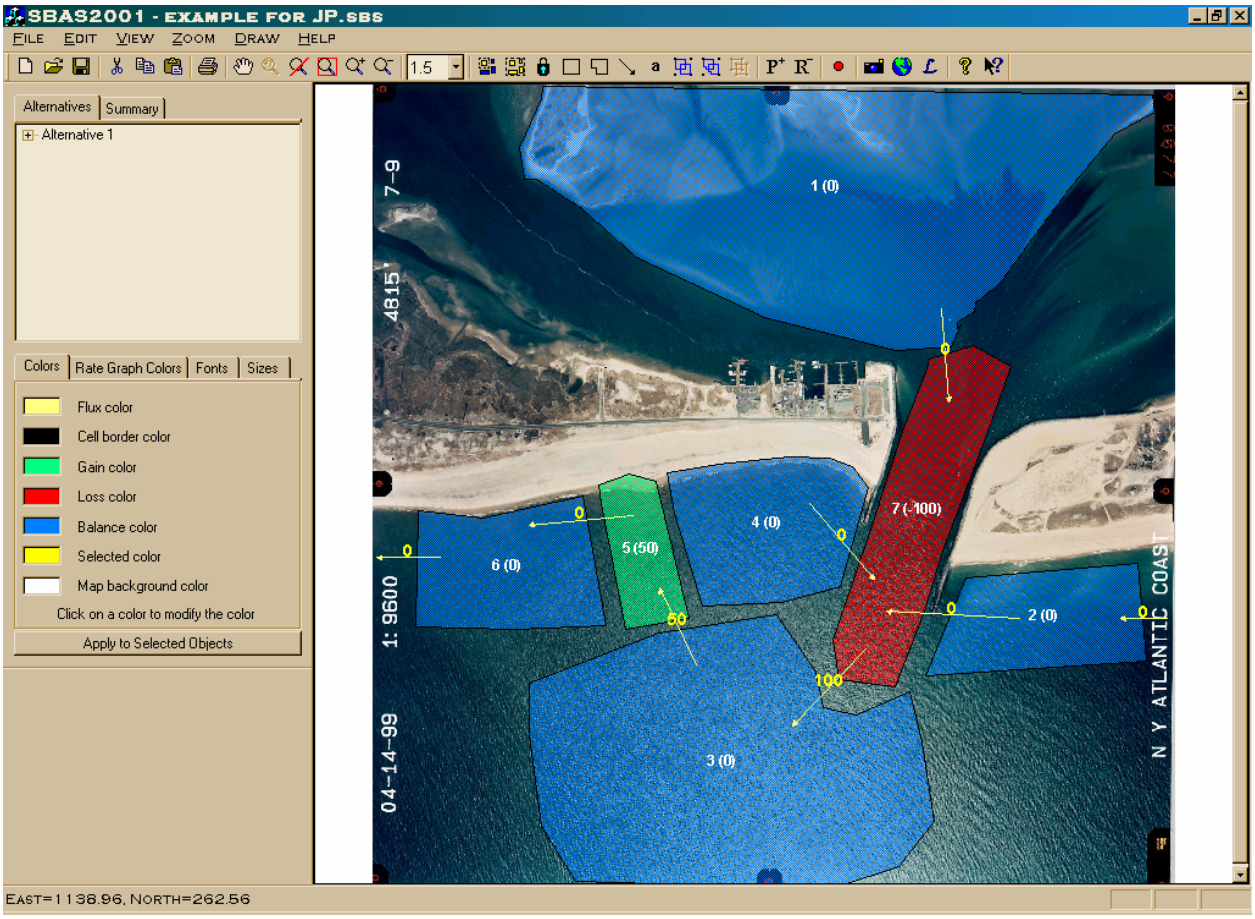

Figure 3-3. Sediment budget visualization in SBAS, Shinnecock Inlet, Long Island, NY.

SBAS organizes the user's workspace and facilitates development and visualization of alternative sediment budgets. Within the right-hand side of the screen, called the Topology Window, SBAS formulates a sediment budget by allowing the user to create a series of cells and arrows representing sources and sinks that characterize the budget. Georeferenced and non-referenced photographs may be incorporated as background to the budget.

The left-hand side of the screen organizes alternatives within a particular project. Alternatives may represent various time periods, different boundary conditions for the same time period, or modifications to assumptions within the budget reflecting a sensitivity analysis (uncertainty analysis). Alternatives can be copied and modified. Once a sediment budget alternative has been defined, and the user has created sediment budget cells with sources and sinks, values can be assigned to the various components of the sediment-budget topology.

The Cascade Model: Cascade is a numerical model being developed in the SWWRP that simulates regional sediment transport and coastal evolution (Larson et al. 2002). It can account for multiple sediment sources and sinks, such as dredging at inlets, dredged material placement on adjacent beaches, longshore and cross-shore transport, inlet breaching, and wind-blown sand transport (Figure 3-4). Processes are simulated at local and regional scales, and the interaction between the scales is described in a cascading manner (Larson et al. 2002). Of potential interest to the shorebird community is the capability to predict inlet breaching and the evolution of dredged sediment that is placed on the beach or in the nearshore. Shorebirds such as plovers (*Charadrius* spp.) and terns (*Sterna* spp.) can use the unvegetated sediment formed through these activities as breeding and roosting habitat.

A Piping Plover (*C. melodus*) population dynamics model will be linked to Cascade (Kraus 2006), relating the area of unvegetated sediment that is formed via inlet breaching and placement of dredged sediments to the number of breeding pairs possible in the region. Upgrading Cascade to predict ecological habitat formation and evolution will create a holistic approach to managing sediments and improving the environment in the coastal zone.

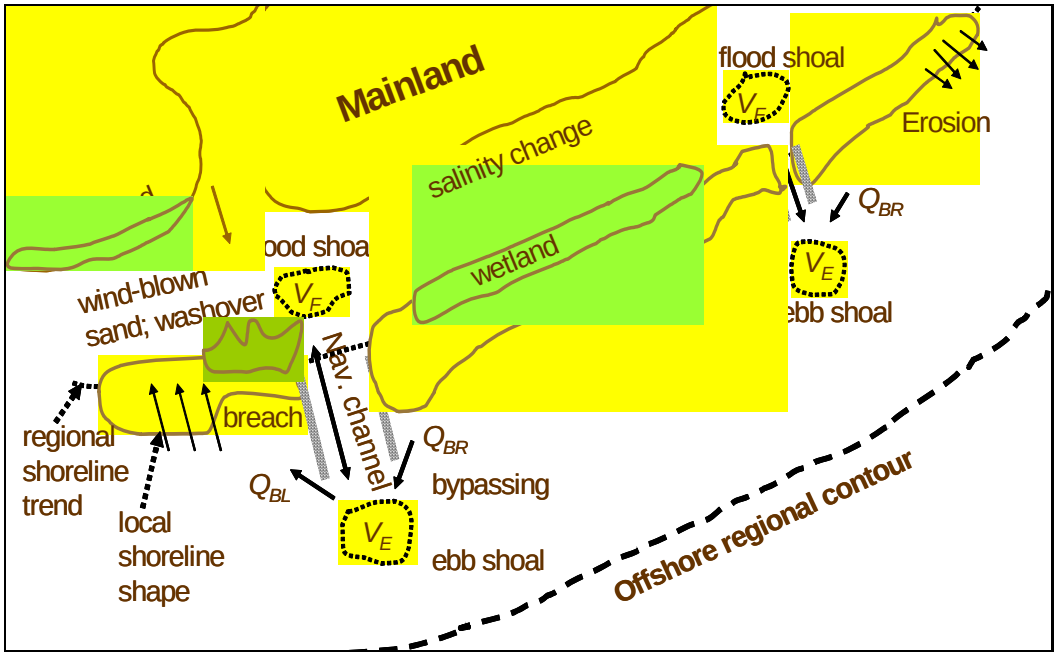

Figure 3-4. Conceptual diagram showing simulation capabilities of Cascade.

The CIRP and the SWWRP have several tools and models available for reference and application by the coastal bird community, and work continues in this area. Researchers involved with these programs at ERDC are actively seeking ways to integrate the engineering and ecological disciplines in Corps products and invite discussion and partnership with ecological scientists, engineers, and planners.

Sand Extraction for Coastal Restoration Projects and the Citing of Alternative Energy Structures on the Federal Outer Continental Shelf: Past, Present, and Future – *William Waskes and Barry Drucker*

The MMS Marine Minerals Program provides access to sand, gravel, and shell resources on the federal Outer Continental Shelf (OCS) through negotiated agreements provided that the resource is used for federal, state, or local government shore protection, beach restoration, or coastal wetlands restoration projects. In 1994, Congress amended the Outer Continental Shelf Lands Act (OCSLA) authorizing the program. Since that time, the MMS has provided over 23 million cubic yards of OCS sand for 16 coastal projects. These projects have restored over 90 miles (145 km) of the nation's coastline, protecting critical military installations, national parkland, and billions of dollars of infrastructure.

A key strategy to ensure environmental protection, safe operations, and issue resolution for decisions regarding access to OCS sand and gravel material has been the closely coordinated partnerships between the federal government, coastal states, and local communities. The MMS has developed cooperative agreements with Alabama, California, Delaware, Florida, Louisiana, Maine, Maryland, Massachusetts, New Jersey, North Carolina, South Carolina, Texas, and Virginia. These partnerships rely primarily on state Geological Surveys, in cooperation with other state and federal agencies, to identify future renourishment needs and conduct geological studies that encompass the collection of shallow seismic data, vibracore data, and volume estimates of usable and compatible sand available for beach renourishment. The state/federal partnerships have focused primarily on isolated, relict submerged shoals and surficial sand sheets, buried paleochannels and shoreface-attached sand ridges. The use of sand in federal waters is becoming more important and more viable due to the general diminishing supply of onshore and nearshore sand and the renourishment cycles for beaches or coastal areas requiring quantities of sand not currently available from state sources.

MMS has focused on integrating resource data provided through state/federal cooperative efforts to provide needed environmental information to make decisions regarding the use of federal sand for future beach nourishment activities. Since 1992, MMS has expended over $14 million for marine mineral environmental studies. Site-specific, interdisciplinary studies have been conducted in identified sand borrow areas to provide basic information on the biological characterization of resident benthic communities, as well as the evaluation of potential dredging effects on the local wave frequencies and current hydrologic regime. Sand sources that are to be used repeatedly may require biological and physical monitoring to ensure that unacceptable impacts to the marine and coastal environments do not occur. To this end, MMS funded studies to develop and field test long-term monitoring protocols.

The passing of the Energy Policy Act of 2005 expanded the OCSLA giving authority to the U.S. Department of the Interior to issue leases, easements, and rights of way on the OCS for energy and related purposes for which MMS is currently developing a program. In many cases, sand shoals that are desirable as potential borrow areas for beach nourishment are also being considered for the citing of alternative energy structures, particularly offshore wind farms. As both the MMS Marine Mineral and Alternative Energy Programs expand, the necessity of managing offshore resources to support and sustain multiple types of use on the OCS is increasing.

Regional-Scale Understanding of the Geologic Character and Sand Resources of the Atlantic Inner Continental Shelf, Maine to Virginia – *S. Jeffress Williams*

The seafloor regions that fringe the continental margins of the U.S. mainland are the product of a complex geologic history and dynamic oceanographic processes, dominated by the Holocene marine transgression over the past 20,000 years. The area of the Exclusive Economic Zone, which extends 200 nautical miles from the coast, is larger than the continental U.S. and contains submerged landforms that provide a variety of natural functions and benefits for all citizens, such as the following: critical habitats for fisheries and coastal birds; ship navigation; home-land security; and engineering activities (e.g., oil and gas platforms, pipeline and cable routes, possible wind-energy-generation sites). Some parts of the continental margins also contain unconsolidated hard-mineral deposits such as sand and gravel that can be regarded as potential aggregate resources to

meet needs not met by onshore sand and gravel deposits (Williams 1992). As demonstrated recently by Hurricanes Katrina, Rita, and Wilma, coastal erosion resulting from a combination of acute natural processes (i.e., storms, sea-level rise, sediment starvation, land subsidence) and anthropogenic activities (i.e., dams, dredging, coastal engineering structures) is pervasive for all U.S. coastal regions, where more than 150 million people live.

Development in the coastal zone continues to increase, and demographic projections show that people will continue moving to the coast to live and recreate, placing more people and development at increasing risk. With the prospects of future global climate change causing increased number of storm events and accelerating global sea-level rise, coastal regions are likely to experience even greater erosion, inundation, and storm-surge flooding in the next 50 years.

Beach nourishment, a method of dredging sand from offshore areas and pumping ashore to widen and elevate the beach and dune has been in use since the 1920s when the beach at Coney Island was created. Nourishment is increasingly viewed as a cost-effective and environmentally acceptable method for developed coasts to mitigate coastal erosion, reduce storm and flooding risk, and restore degraded coastal ecosystems. Over the past 80 years about 650 million cubic meters of sand have been used throughout the U.S. coastal zone to nourish beaches. For beach nourishment to be viable, however, large volumes of high quality sand are necessary. Also, the sand deposits must be located reasonably close to the beaches being considered for nourishment and in water depths ranging from approximately 10 to 40 meters.

Sand bodies on inner continental shelf regions are often the most attractive sand sources for beach nourishment. Demand for offshore sand and gravel is likely to increase over the next 50 years as accelerated sea-level rise and increased number of storm events increase both erosion and the vulnerability of coastal development. In addition, growing shortages of onshore supplies of aggregate in some parts of the country might be met using marine aggregates. However, for many regions offshore aggregates are sparse or unknown and sand volumes needed to meet requirements and sustain long-term nourishment are uncertain.

Examples of the variety of marine sand bodies present on the seafloor or buried in the subbottom on U.S. continental shelves are shown in Figure 3-5.

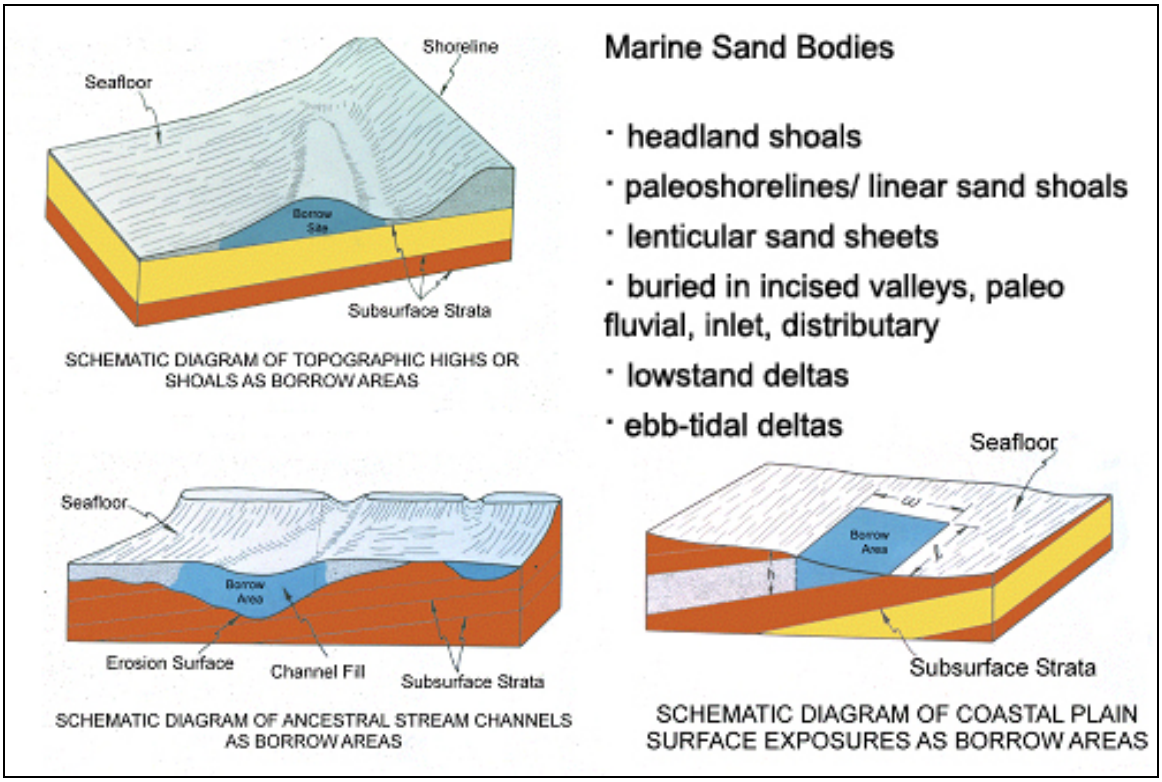

Figure 3-5. Marine sand bodies, having diverse geologic histories, are buried and exposed on continental shelves and often have been greatly modified by marine processes associated with sea-level rise since the end of the Ice Age. Nearshore marine sand bodies of the types shown above offer the best potential sources for high quality sand for beach nourishment (Williams et al. 2003).

Because offshore areas of the U.S. are increasingly important, comprehensive, up-to-date and integrated computer databases are needed for a variety of purposes. A major product is geographic information system (GIS)-type base maps displaying thematic information such as seafloor physiography, geology, sediment character and texture, seafloor roughness, and engineering properties. Digital geologic maps, based on unified national data sets, showing the sedimentary character of U.S. continental margins, are critical for scientists to be able to better understand and interpret the geologic history and sedimentary processes that formed and continue to modify the continental margins. These products are useful to planners and managers for regulating, protecting, and managing coastal and offshore environments.

The USGS, in collaboration with other federal agencies (e.g., Navy/Office of Naval Research, MMS, USACE, National Oceanic and Atmospheric Administration (NOAA)), coastal states, and universities, is leading a nationwide program to gather existing marine geologic data for use in conducting assessments of offshore sand and gravel resources and for producing interpreted GIS map products that can serve many needs (Williams et al. 2004). Assessments are in progress for offshore Louisiana, the Gulf of Maine and offshore New York and New Jersey. Figure 3-6, a gridded map of the New York bight depicting sedimentary character, is one example of GIS map products being produced from USGS studies. The seabed character is the product of the underlying framework geology, the Holocene marine transgression, and oceanographic processes. A wide variety of such GIS maps are possible using the usSEABED database. This map is generated from the Atlantic Coast data release recently published in Reid et al. (2005).

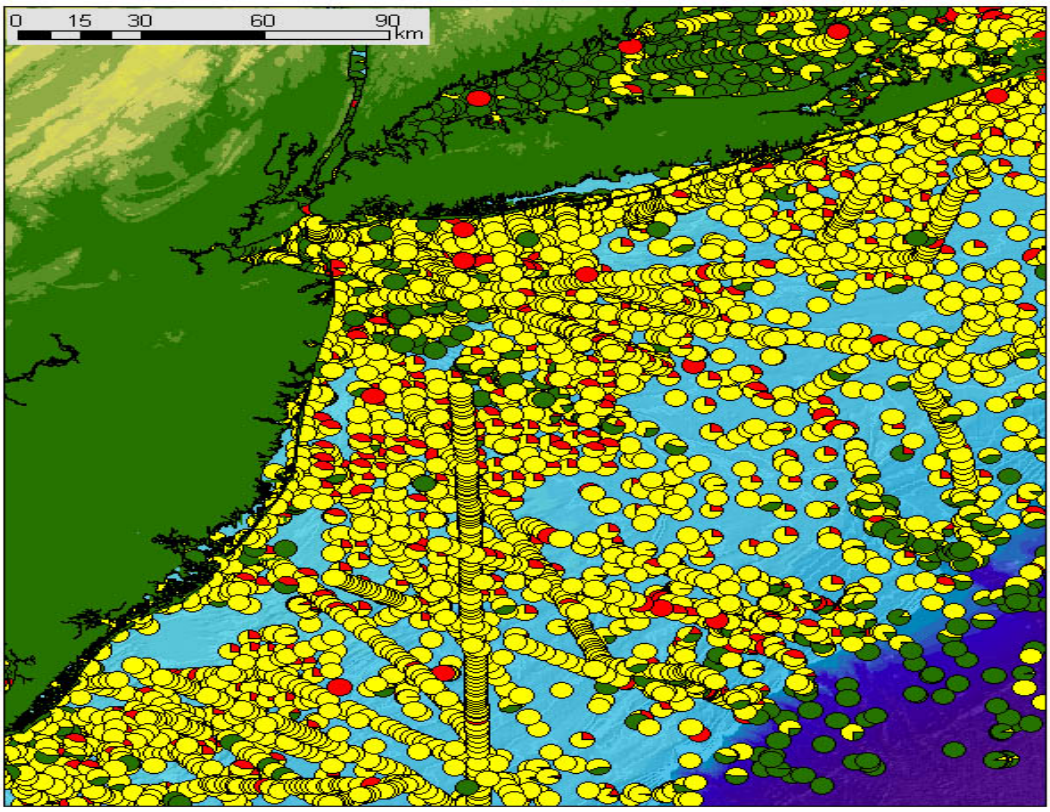

Figure 3-6. Provisional sediment character map of the New York-New Jersey offshore region showing the three main sediment classes (red-gravel, yellow-sand, green-mud) comprising the seafloor.

In addition, products were done for the Gulf of Maine, Hawaii, and the Long Island shelf (Schwab 2002). Four sediment database reports were completed and published by the USGS in 2005. The GIS seafloor maps and regional aggregate assessments for Louisiana and New York-New Jersey were scheduled to be completed in 2006. The interpreted maps being produced in this study are providing fresh scientific insights into the geologic character and development of U.S. continental margins and the assessments are providing useful information about the quality and potential availability of offshore sand and gravel aggregates.

Additional information about the study is available at the following sites:

http://woodshole.er.usgs.gov/project-pages/aggregates/index.htm

http://marine.usgs.gov/

http://soundwaves.usgs.gov/

http://woodshole.er.usgs.gov/

4 Session III: Biological Effects of Beach Nourishment

The Effects of Beach Nourishment Projects on Coastal Ecosystems – *Tracy M. Rice*

The environmental impacts to the coastal ecosystems from dredged material disposal or beach nourishment projects can be significant and long-lasting. The severity and duration of impacts depends on the sediment compatibility between the dredged material and the native beach sediments, seasonal timing, type of equipment used, scale of the project, and frequency of renourishment. Impacts can be avoided through appropriately timed construction outside of peak biological seasons, minimized use of hopper dredges that can take federally-listed sea turtles, use of appropriate sand sources, and avoiding biologically sensitive areas such as reefs and hardbottoms. Environmental impacts can be minimized by incorporating natural design features such as overwash gaps in the levee-dune system, allowing segments of undisturbed refugia within the project length, avoiding construction of deep mine pits on the seafloor, monitoring the fill material during construction for excessive turbidity and incompatible materials (allowing for shutdowns to move mining operations to better locations), using sand fencing to construct dunes instead of bulldozers, and planting native vegetation instead of monocultures. Although compensatory mitigation has not been incorporated into project designs, potential mitigation measures for significant environmental impacts include introduction of lab-raised bivalves and amphipods that lack pelagic dispersal mechanisms to recolonize artificially constructed beaches, acquisition and/or conservation easements of undisturbed beaches, removing disturbances such as off-road vehicles and pets, removal of structures and the restoration of natural coastal processes, creation of overwash gaps and flats in existing levee-dune systems, and funding of scientifically rigorous research of the coastal ecosystem, physical-biological predictive modeling, and cumulative impacts.

Geomorphic-Biotic Interactions on Beach Foreshores in Estuaries – *Nancy Jackson*

Sandy beaches in estuaries are recognized for their importance as habitat. The beaches in Delaware Bay serve as a spawning ground for horseshoe crabs (*Limulus polyphemus*) and a stopover site for migratory shorebirds that feed on exhumed crab eggs. Understanding beach morphodynamics is important for identifying potential relationships between biological productivity and beach change and predicting the effects of shore management strategies on habitat sustainability. Human alteration of sandy beaches occurs to protect private property from erosion or flood hazards. Bulkheads and beach nourishment are the leading options for shore protection. Bulkheads decrease available spawning areas by truncating or eliminating the intertidal beach foreshore. Beach nourishment is preferable to bulkhead construction, but nourishment can lead to changes in sedimentary characteristics, wave-sediment interaction, and geometry of the beach foreshore. Federal, state, and private agencies are interested in using beach nourishment projects to enhance habitat while protecting human development, but knowledge of the interaction between beach and biological processes in estuaries is still rudimentary.

Field studies were undertaken in Delaware Bay to determine how waves and bioturbation contribute to sediment activation and egg exhumation for shorebirds and how human alteration of the shoreline affects horseshoe crab habitat. Results of an investigation conducted over six consecutive tidal cycles during spawning show that bioturbation by horseshoe crabs can be greater than sediment activation by waves, revealing the importance of crab digging in releasing eggs to the water column and making them available for shorebirds.

The limited amount of reworking by estuarine waves also affects sediment characteristics of nourished beaches. Sediment analysis of four nourished and four unnourished beaches reveals that mean grain size at a depth of 0.15 m below the sand surface on the nourished beaches is finer and better sorted than at a depth of 0.30 m, implying that waves have not reworked the sediments at deeper depths. Sediments on the unnourished beaches are well mixed. Low frequency, high magnitude storm events during winter months can cause much greater depths of wave reworking and profile change, but unreworked fill may exist close to the sand surface during spawning if erosion persists on nourished beaches.

Beach nourishment is likely to preserve habitat value better than hard protection structures, but nourishment can decrease habitat value as well as enhance it, depending on morphology and sediment characteristics (Jackson et al. 2005). The possibility of decreasing habitat value is of concern because the application of nourishment will be more widespread in the future.

Fisheries Considerations for Beach Nourishment and Dredging Projects on the North Atlantic Coast: Virginia to Maine – *Stanley W. Gorski and Peter Colosi*

There is broad interest in the beneficial use of dredged materials as a means to address the challenging, perennial issue of dredged material management to accomplish natural resource enhancements. A typical example of a beneficial use application includes the placement of dredged material on an unvegetated shoreline or in subtidal and intertidal locations. Depending upon the pre-existing functions and values of those tidal locations, the placement of dredged material may or may not preserve or enhance the habitat of living marine resources.

The NOAA National Marine Fisheries Service (NMFS) provides consultation and review to federal agencies regarding their activities of dredging, dredged material disposal, and beneficial use in relation to specific legal mandates, which we explain. NMFS's primary interest in the discussion of beneficial use is to conserve and enhance habitat functions for living marine resources under NOAA's trust.

Developing acceptable applications of dredged material for beneficial use requires an appreciation and reverence to the various interests and concerns of those who wish to employ the practice, and those whose interests are affected by it. Actions that preserve important natural resources, habitat functions, and ecosystem integrity have the best potential for broad support. NOAA's interests include preserving pre-existing habitat functions that support living marine resource, and promoting practices that enhance these resources. Proposals involving habitat creation should be considered cautiously since tradeoffs between subtidal and intertidal resources tend to be poorly justified and untested. Mutual benefits and opportunities arise when actions do not compromise existing functional dependencies or force accommodation of individual agency authorities. Some applications will be appropriate, while others will not, even though the latter may serve the immediate interest of one party.

Planning and early coordination is emphasized as a key element in the overall beneficial use discussion and afford the opportunity for agencies to be proactive in representing their authorities and mandates. This is where overarching precepts and guiding standards can and should be established for application in later case-by-case permit considerations. Planning helps avoid or resolve conflict; prevents reactive, time-constrained decisions during the regulatory phase; fosters resourcefulness and creativity without compromise of individual agency authorities; aligns well with the permitting agencies' internal budgeting and planning processes; and helps ensure that resulting actions are indeed beneficial among all interests.

Responses of Fishes and Benthic Invertebrates to Beach Nourishment Operations on the Atlantic Coast of New Jersey – *Douglas G. Clarke, Gary Ray, and Mark Burlas*

The impacts of beach nourishment were studied on fishes and benthic organisms along 15.9 km of New Jersey's Atlantic Coast, including the beach area between the Shark River and Manasquan Inlet. Unnourished segments of beach were also selected as reference sites for comparison during the study. The study areas were monitored along the intertidal beach and surf zone, nearshore, and offshore borrow areas during 3 years of pre-construction (1994–1996), 1 year of beach nourishment activities (1997), and 2 years of post-construction (1999–2000). Design of the monitoring program involved a collaborative effort between the Corps, NMFS, the New Jersey Department of Environmental Protection (NJDEP), USFWS, and the U.S. Environmental Protection Agency (USEPA).

Benthic invertebrates were sampled biannually (May and September) in the intertidal (1994–2000) and the nearshore zones (1995–2000) to detect long-term impacts. Additionally, intertidal benthic invertebrates were monitored on a monthly basis during the construction period (1997 and 1999) to detect impacts on small spatial and short temporal scales. Surf zone fishes were sampled using a beach seine during the late summer and early fall from 1995 to 1999.

Results of the benthic invertebrate sampling were similar to those of several other studies of Atlantic Coast beach infauna, with organisms such as rhynchocoels, polychaetes (*Scolelepis squamat*), *Protodriloides*, *Microphthalmus* spp., oligochaetes, mole crabs (*Emerita talpoida*), and haustoriid amphipods dominating the benthic community. Recovery rates

were also similar to those reported in other studies, with the benthic community recovering from nourishment operations within 6 to 5 months. Notably, abundance and biomass values were not significantly lower after beach nourishment than values encountered during baseline (unnourished) conditions.

During baseline years of sampling, surf zone fish communities were dominated by silversides (*Menidia menidia*), but in 1997, coincident with beach nourishment, bluefish (*Pomatomus saltatrix*) became the numerically dominant species. However, bluefish were not captured at active beach nourishment sites and were more common at reference sites. In contrast, northern kingfish (*Menticirrhus saxatilis*) were more abundant in proximity to discharges during beach nourishment operations. Foraging behaviors of the fish were consistent throughout the study, with no detectable reductions in prey volume evidenced in stomach content samples.

Turbidity and suspended-sediment plumes associated with beach nourishment operations were monitored because organisms may be impacted through physiological effects (e.g., gill abrasion) or behavioral effects (e.g., plume avoidance). Suspended sediment conditions were monitored during 1997 and 1998 in the swash, surf, and nearshore zones near the discharge pipe. In addition, samples were collected at reference sites north and south of the beach nourishment activities. Swash zone suspended-sediment concentrations were significantly higher at sites of active discharge; however, plume dimensions in the surf and nearshore zones were relatively small. No long-term differences in total suspended-sediment concentrations were detected between nourished and unnourished sites in the surf zone and nearshore habitats. The observed absence of large-scale impacts suggests that the objectives of beach nourishment monitoring programs need to be refined. A new focus on detection at smaller-scale impacts and an evaluation at the ecological meaning of such impacts appears to be warranted. Filling knowledge gaps, such as surf zone functions for early life history stages of fishes, would be useful.

5 Session IV: Habitat Restoration

Habitat Restoration Projects in the Corps of Engineers' North Atlantic Division – Virginia to Maine – *John S. Wright*

This presentation provides a brief overview on the uses of dredged material in the North Atlantic Division, with specific examples emphasizing ecosystem restoration. In 2004, over 29 million cubic yards of material were dredged in the North Atlantic Division. Much of this material was used for ecosystem restoration purposes. An example includes the Scarborough River Federal Navigation Project, where 82,000 cubic yards of sand was deposited to create a 6-acre (2.4-ha) beach. Within the first year, this beach attracted three pairs of Piping Plovers (*Charadrius melodus*) and over 20 pairs of Least Terns (*Sterna antillarum*). On Bird Island, located in Buzzards Bay, MA, deposition of dredged material doubled the 1.5-acre nesting site. This island was already supporting 25%-30% of the North American population of Roseate Terns (*S. dougallii*). With the additional acreage, Roseate Terns increased from 2,000 to 4,000 pairs, and Common Terns (*S. hirundo*) increased from 1,200 to 2,300 pairs. Large ongoing projects include the use of dredged material to reconstruct Popular Island, in Maryland's Chesapeake Bay. This island was a hunting preserve in the 1930s. But since then, the island has eroded to less than one-fourth of its original size. This large, multi-agency project is using 38 million cubic yards of dredged material from the Baltimore Harbor Approach Channels to increase the island to its 1847 size (about 1,140 acres). In Virginia, a large project on Craney Island Disposal Site has also succeeded in creating breeding habitat for the Least Tern.

For the North Atlantic Division, these examples serve to illustrate key features in obtaining funds for the use of dredged material in bird habitat restoration efforts. First, in order for the project to function as a best buy for the federal dollar, the project must be science-based, and it must provide long-term cumulative benefits. Decisions to fund a project may also depend on the national significance of the project, and third, partnering with other government agencies and non-government organizations will provide an incentive for continued federal funding. Evaluating the potential or existing performance of a project should be based on the following factors:

- Scarcity (regionally or nationally) of the habitat or value provided by the project
- The connectivity the project serves in the region or national context (e.g., key stopover area for migrating birds)
- The special status of selected species the project will serve (e.g., endangered species such as the Bald Eagle [*Haliaeetus leucocephalus*])
- The recognition and broad support for the project both regionally and nationally.

In conclusion, several take-away points should be made: (1) restoration activities in the North Atlantic Division are diverse and range from simple to large, complex efforts; (2) the Division focuses on those projects deemed as win-win scenarios based on the beneficial use of the project and the cumulative actions by others in a watershed context; and (3) funding decisions for projects will depend upon the supported scientific value and performance ranking of the proposed project.

The History of Avian Habitat Creation Through Dredged Material Deposition by the U.S. Army Corps of Engineers: Implications for the North Atlantic Coast – *Michael P. Guilfoyle, Richard A. Fischer, and Mary C. Landin*

Since the 1890s, the U.S. Army Corps of Engineers has created over 2,000 islands using dredged material deposition. Most of these islands were created during construction of the Intercoastal Waterway System. The large increase in human development along coastal areas during the past 50 years has greatly reduced the availability of natural beach and island habitat used by breeding, migrating, and roosting waterbirds and shore-birds. Currently, many of these birds are now dependent upon these artificial islands, with some islands supporting large proportions of the regional populations for some species. During the 1970s, the Corps' Dredged Material Research Program (DMRP) conducted extensive research on avian use of dredged material islands in seven regional studies. In this presentation, Guilfoyle, Fischer, and Landin summarize results of DMRP-funded research conducted between 1974 and 1977 along the entire coastal and estuarine waterways of New Jersey, North Carolina, Florida, Texas, Washington and Oregon, as well as the shoreline and islands of the Great Lakes; and along the Upper Mississippi River from Alton, IL, to St. Paul, MN. The results of this research effort are pertinent to management issues along the North Atlantic Coast. A thorough summary of these results is outlined in Guilfoyle et al. (2006).

During the research, over 600,000 nesting colonial waterbirds of 35 species were detected. In addition, 59 species of non-colonial birds were observed nesting on dredged material islands. Importance of these islands to populations of breeding waterbirds ranged from critical breeding habitat (e.g., for Gull-billed Tern [*Sterna nilotica*], Common Tern [*S. hirundo*], Least Tern [*S. antillarum*], Sandwich Tern [*S. sandvicensis*], and Royal Tern [*S. maxima*], to relatively unimportant habitat (e.g., for Double-crested Cormorant [*Phalacrocorax auritus*], Anhinga [*Anhinga anhinga*], Glaucous-winged Gull [*Larus glaucescens*], Great Black-backed Gull [*L. marinus*], Western Gull [*L. occidentalis*], Roseate Tern [*S. dougallii*], and Black Tern [*Chlidonias niger*]). Factors consistently important in predicting waterbird use included

- isolation from predators and humans;
- diversity of available habitats;
- available nesting substrates and stability; and
- Species-specific behavioral characteristics, particularly foraging diet and behavior.

Dredged material islands provide important breeding and roosting habitat for many waterbirds. Managing current dredged disposal islands and the creation of new islands where appropriate should be a priority for dredging operations along the North Atlantic Coast. The DMRP effort identified numerous characteristics of dredged material islands that should be included in the design and implementation of island creation to benefit waterbird populations. These characteristics are provided in this presentation and are summarized in Guilfoyle et al. (2006); plus, 21 conclusions of Soots and Landin (1978) outlined in this presentation are likely pertinent to management of dredged material along the North Atlantic Coast. Finally, interagency and intra-agency cooperation is essential in developing and implementing management guidelines for dredged disposal islands and these efforts should be linked with national and regional waterbird conservation plans.

The Use of Decoys and Sound Systems to Attract Marine Birds to Restored Habitats – *Richard Podolsky*

Social attraction, the technique of encouraging birds to establish new nesting sites through the use of decoys, mirrors, sound recordings, and artificial burrows, has been used worldwide in at least 12 countries for at least 39 land and waterbird species by 66 agencies and organizations.

While social attraction alone does not always result in new or relocated colonies, the chance of success increases when habitat such as dredged disposal islands are provided and when predators and competitors are simultaneously excluded. The importance of these techniques for establishing or relocating nests to habitat that is safer from predators, lower in human disturbance, and safer from flooding is on the increase as human development increases along lake shores and maritime coastlines.

Social attraction provides coastal land managers with a tool that allows them to attract threatened, endangered, or other species of special concern to new habitat and thereby give them a competitive advantage.

A Plea for More Habitat Restoration During Beach Nourishment Projects – *Karl F. Nordstrom*

Naturally functioning beaches and coastal dunes can be restored or maintained, even in human-altered areas, given appropriate management actions. The ability to preserve or restore dunes in developed areas depends on the amount of sediment available on beaches, the space available seaward of human structures, the direct actions of humans to trap sand or move sand by mechanical means, and the tolerance of people for natural features. On the east coast of the U.S., the alternative types of environmental gradients across the beach and dune include

- a natural gradient that contains all of the microhabitats achievable in undeveloped segments of the shore, from pioneer species on incipient dunes to trees and woody shrubs in the stable backdunes;
- a truncated gradient that represents the seaward dynamic zone that would occur naturally in the restricted space available;
- a compressed gradient, where species diversity is achievable through ongoing efforts to maintain a stable protective dune;
- an expanded gradient, where diversity is achievable by allowing the dune to migrate onto private property;
- a fragmented gradient, where the dune is interrupted by human development; and
- a decoupled dune, where the seaward portion of the foredune is eliminated, but the landward portion of the dune can survive as a result of shore protection structures.

Restored dunes in many locations probably cannot be as wide as landforms in undeveloped areas, but judicious use of bulldozing, sand fences, and vegetative plantings can re-create the types of habitats lost through development. In some cases, both the area and spatial relationships of habitats can be restored to undisturbed or un-eroded conditions. Beach nourishment is often critical in creating areas for new natural environments to form, but it is not axiomatic that nourishment alone will lead to formation of new natural environments. Areas subjected to beach nourishment will require maintenance and specific management actions to restore high quality dunes and associated habitats.

6 Session V: Beach Nourishment and the Restoration of Barrier Island Dynamics

The Assateague Island Beach Restoration Projects: The Balance of Stability and Habitat Diversity – *Jack Kumer*

Northern Assateague Island is the focus of a restoration project associated with management of the Ocean City Inlet, MD. The restoration project includes a one-time infusion of sand to replace a portion of the sediment lost due to the effects of the inlet jetties, and a long-term sand management component to address ongoing and future effects of the jetties by reestablishing the sediment supply for northern Assateague. The goal of the program is to restore Assateague Island to as natural a condition as possible.

The challenge to the restoration program lies in the ability to engineer a beach profile and sediment supply that will allow the damaged portion of the island to respond to storms in a manner similar to the remainder of the island. The reestablishment of sediment transport should address long-term concerns. The beach construction, on the other hand, needs to correct a highly destabilized landscape in a way that will not impact the diversity of habitat conditions, particularly features that support protected species.

The linchpin of the beach restoration is a storm berm constructed along the most degraded portion of the project area. Adjacent to the primary breeding habitat for the threatened Piping Plover (*Charadrius melodus*), the storm berm structure will be assessed for a 5-year period to insure both structural integrity and benign impacts to plover breeding.

Three years into the restoration program, the storm berm has proved resilient to natural alteration, but there are growing concerns about potential impacts to Piping Plovers and their foraging habitat. Two structural issues have surfaced. First, the berm sediment is coarser than native island sand and has resisted aeolian transport. Second, the berm was modeled from a period with comparatively higher winter storm frequencies and intensities; the expected 1-2 year washover events for which the berm was modeled have not occurred during the past 7 years.

An initial alteration to the berm was made in January 2005 by placement of a series of notches. The performance of those features, along with the remaining berm conditions and impacts continue to be assessed. This is a work in progress, but one that all partners believe could provide an ideal compromise between stability and habitat diversity.

Restoring Barrier Beach Dynamics to the Breezy Point Tip: A Habitat Manipulation Experiment – *Kim Tripp*

A terminal jetty was constructed in the early 1930s on the westernmost tip of Long Island (i.e., Breezy Point). The jetty has been collecting sediment for over 70 years and has altered the barrier island topography. The inlet is no longer bounded on its eastern margin by a migrating sandy beach but by a stationary rock wall that assures the general position of the inlet and its channel. The natural shifting of sand through the seasons has been obstructed. The sand drift no longer extends the shoreline profile seaward, but rather the profile is building in elevation. In 1972, Breezy Point became part of the National Park Service (NPS) - Gateway National Recreation Area and has been managed as a natural system with protected shorebird nesting grounds. With the building of the dunes, vegetation is becoming dense and is limiting early successional plant communities that support a suite of shore-nesting bird species. This situation has resulted in decreased nesting success as well as constricting areas for visitor access and use. With the technical assistance of biologists from St. Johns University, and input from coastal geomorphologists at from Rutgers University and NPS Regional science staff, Gateway has decided to pursue an Environmental Assessment to determine whether a habitat manipulation experiment (i.e., vegetation removal) will result in restoring barrier beach dynamics to the Breezy Point tip.

Beach Nourishment and Bird Habitat Restoration in Southern New Jersey – *Beth E. Brandreth*

The Philadelphia District of the Corps is currently involved in 10 Beach Nourishment projects along the Atlantic Coast of southern New Jersey from Manasquan Inlet to Cape May Point. Five of these projects (four of which have already been constructed) contain active Piping Plover (*Charadrius melodus*) nesting habitat within their boundaries. During the course of these projects, the Corps has been working closely with the USFWS and NJDEP, Division of Fish and Wildlife, to design and manage projects to protect and enhance plover nesting and foraging habitat.

Many factors are currently affecting the recovery efforts of the Piping Plover population in New Jersey. In 2005, flooding was the leading cause of nest failure, followed by heavy predation and nest abandonment, resulting in an 18% reduction of the number of birds. Additional impacts from recreation and beach management impacts have all led to an average statewide fledgling rate of 0.77 in 2005, which is well below the rate needed to sustain or recover the population.

Two of the Philadelphia District's beach nourishment projects which were originally constructed in the early 1990s have consistently supported nesting populations of plovers with varied degrees of success. Average fledgling rates within the Ocean City project area between 1987 and 2004 averaged 0.98 in the northern nesting area and 0.51 in the center nesting area. Average fledgling rates in Cape May City during the same time period was 0.95 in the Coast Guard nesting area and 1.00 in the Cape May City nesting area, closely matching the statewide average for this time of 1.01.

In 2004, the Corps initiated construction on the Lower Cape May Meadows project, the District's first large-scale coastal ecosystem restoration project. Since Piping Plovers were present within the project prior to construction, and since the project area is a protected natural area with little development, special features were added to the project specifically to enhance plover habitat. These enhancements include the construction of three "plover crossovers" over the dunes which were 100 feet (30.5 m) wide with a 1 on 10 side slope. These areas were designed to remain unvegetated and to allow plovers access to the freshwater feeding areas behind the dune. The project also featured the creation of two new "plover ponds" behind the dune that provided additional feeding habitat away from much of the recreational beach activities. Modifications were made to the berm elevation in a portion of the project, including the planting of dune grass and the addition of fences along the berm. The lower berm elevation is expected to allow periodic overwash of the upper berm area to provide secondary feeding habitat, while the grass and fencing modifications will help to facilitate access to the dunes and freshwater habitat. These modifications showed immediate results at the site during the 2005 nesting season. All broods used the new plover ponds for feeding (some exclusively), and both plover chicks and adults utilized the unvegetated portions of the dune, resulting in 8 plover chicks fledging from 5 pairs. This equates to a fledgling rate of 1.6, compared to the average rate of 0.83 between 1987 and 2004.

The Corps is continuing its efforts to maintain and enhance plover habitat through an additional coastal ecosystem restoration project at Stone Harbor Point. Continued consultations with state and federal agencies are ongoing to implement local beach nesting management plans, and the Corps is finalizing a programmatic Section 7 Consultation with USFWS for the District's 10 coastal projects.

Piping Plover Habitat Considerations for Beach Nourishment Project Designs – *James D. Fraser and Jonathon B. Cohen*

This presentation discusses beach nourishment impacts on Piping Plover (*Charadrius melodus*) habitat and provides ideas to minimize these impacts. These are simple in concept but are often difficult to put in action.

The Piping Plover is a bird of the intertidal zone, and the interspersion/juxtaposition of key habitats is an important element of high-quality habitat for the species. This species tends to forage in moist substrate habitat (MOSH) on the bayside intertidal zone, where ephemeral pools and moist overwash zones exist. During the winter, this species prefers mudflats, sand flats, and algal flats approximately 74%-93% of the time. During the breeding season, these birds foraged 85% of the time in protected MOSH areas during the pre-nesting stage. During the nesting stage, higher densities, higher foraging rates, faster growth, and sometimes even better survival is evident for birds nesting near MOSH areas. During the post-nesting stage, fledglings often move to MOSH areas to gain weight prior to migration. These critical MOSH areas are formed by over-wash of sediments from oceanside of the bay and they can be impacted by beach nourishment activities.

Specific beach conditions found to be important for breeding Piping Plovers include

- a beach width range of 30-200 m; mean=140 m along Atlantic Coast;
- a beach slope of around <5%-8% low; and
- an area of sparse vegetation for nesting.

During the winter months, birds tend to use wide beaches with intertidal flats. General recommendations include

- keeping nourishment substrate similar to original substrate;
- keeping vegetation sparse (Sparse vegetation is good for nesting, while dense vegetation is bad.);
- maintaining rack/algae (Rack/algae is good habitat for providing foraging cover.); and
- keeping open beach and mud flat foraging habitat together in the area. (Natural inlets tend to have both habitats available and in close proximity.)

When conducting beach nourishment activities, isolate potential habitat from the mainland as much as possible; this will reduce predation. Also, avoid heavily used recreation sites. Overall axiom: If you build it (proper habitat), they will come; but, if you do not practice wise management, they will go.

7 Session VI: Piping Plovers and Beaches in Areas of High Population Density

Designing Beach Nourishment Projects and Beaches in Areas of High Population Density – *Anne Hecht, Jonathon B. Cohen, and James D. Fraser*

Disturbance from beach recreation activities is one of several categories of direct and indirect adverse effects on Piping Plovers (*Charadrius melodus*) from beach nourishment and other coastal stabilization projects. Artificially stabilizing barrier beaches often contributes to public access by preventing the formation of new inlets and islands and by protecting roads, bridges, parking lots, and other infrastructure. Another important indirect effect is the shift in habitat use by Piping Plovers that occurs when construction of artificial dunes, planting and fertilization of beach grass and other vegetation, and installation of sand-trapping fences impede the formation of wide, sparsely vegetated upper beaches with blowouts and overwash fans. These features constrain plover nests and broods to narrow sections of beach close to the ocean where human recreation also concentrates. Shifting patterns of Piping Plover nest distribution following beach nourishment at the Village of Westhampton Dunes illustrate this problem, which is exacerbated by the presence of multiple walkways onto the beach.

Disturbance to Piping Plovers can be reduced by project design features that include wide low beaches and that do not artificially accelerate formation of mature, heavily vegetated dunes. Shifting developments, roads, and parking lots as far away from the shoreline as possible will allow the formation of Piping Plover habitats. Critical habitat features include sparse vegetation, overwash fans, blowouts, and ephemeral pools that comprise highly suitable Piping Plover habitat but are less attractive to human beach users. Low density of walkways and other beach access points may also reduce the percentage of habitat that is degraded by disturbance. At some Atlantic Coast beaches, parking lots, restrooms, and other visitor facilities have been designed to require minimum protection during coastal storms and to accommodate barrier island migration.

On beaches where artificially stabilized dunes constrain Piping Plovers to the same portion of the beach where human recreation concentrates,

competition for space and conflicts are intensified. Protection of Piping Plovers through symbolic fencing of courtship, nesting, and brood-rearing habitat and restrictions on pets, kites, fireworks, and vehicles is still feasible, but conflicts may occur more frequently. Negotiating, maintaining, and enforcing plover protection on artificially stabilized beaches often requires more staff time than on beaches formed by natural coastal processes. The cost and effort required to implement needed protections on these sites should be anticipated during project planning and regulatory reviews.

Piping Plover Management on Nourishment Beaches in Areas of High Human Use – *Joe Jannsen*

Beach nourishment is often the preferred option to address beach erosion, particularly in areas where infrastructure is threatened. The creation of wide, open beach habitat is often colonized by beach-nesting bird species, including the Piping Plover (*Charadrius melodus*). Unfortunately, these wide, open expanses of sandy habitat also attract humans for recreational purposes.

There is a definitive need in beach nourishment planning to allow for the natural formation of preferred shorebird habitat wherever possible in order to minimize the conflicts that arise when birds and humans compete for space. If a wide nourished beach is created that attracts birds and humans, there is an obligation to manage for the protection of the birds.

Therefore, as part of planning for a beach nourishment project, a comprehensive management and monitoring plan for Piping Plovers and other beach-dependent species will need to be developed. Items to be considered are as follows: Who will monitor and at what level of monitoring? Who will manage and can the managing organization provided qualified staff? Who will fund the monitoring and management, and can the necessary commitment of funding beyond Year 1 of the project be met?

Additionally, the management and monitoring plan will need to identify strategies to reduce disturbance from human recreation, pets, off-road vehicles, beach-cleaning/raking activities, predation, fireworks and kites, and other site-specific activities that may adversely impact nesting.

One of the most critical components of any management plan is landowner and stakeholder buy-in, resulting in a need to secure long-term

management agreements. One example is The Nature Conservancy's Registry Program where private landowners sign an agreement to allow Conservancy staff to access the beach through their property and allow posting and fencing of nesting areas on their property. Other examples include the cooperative beach management plan developed for the Wells/Drakes Island, ME, nourishment project, as well as the Scarborough/Western Beach management plan. Utilization of a Landowner Incentive Program may be a management tool to secure landowner buy-in.

A Multiple-Scale Analysis of Piping Plover Distribution, Abundance, and Productivity on the Barrier Islands of New York – *Jennifer Seavey, Thomas Litwin, and Kevin McGarigal*

The Corps is obligated under the Endangered Species Act (1973) to protect federally listed species from jeopardy or loss. For Corps projects on New York's barrier islands, this obligation extends to the federally endangered Piping Plover (*Charadrius melodus*). The management efforts of the Corps and other land managers are producing positive results, as reflected by the steady increase in the New York plover population since listing in 1986. However, recovery success is jeopardized by the natural tendency to conduct research and develop recovery actions that focus on short-term temporal and spatial scales. The current focus on local-scale research for plovers may lead researchers to overlook ecological patterns that occur at broader scales and even between scales. A broad-scale/multiple-scale understanding is necessary for developing long-term/landscape-level alternatives to augment current recovery efforts.

This missing broad-scale/multiple-scale knowledge is the target of this ongoing research. The authors' multiple-scale approach explicitly examines broader environmental scales than previously observed and will allow the researchers to examine ecological patterns over a range of scales from nest site to an entire ecosystem. The current study is exhaustively sampling plover habitat and broad-scale environmental data on the barrier islands of New York. Once data collection is complete, the researchers will derive models that explain the distribution, abundance, and productivity of plovers based on environmental patterns at multiple spatial scales. Results will contribute to Piping Plover recovery efforts throughout the barrier island system, improve knowledge of plover ecology, and enhance understanding of how environmental patterns vary across spatial and temporal scales of observation.

Effects of the West Hampton Interim Storm Damage Protection Project on Piping Plover Habitat and Ecology – *Lawrence M. Houghton, Jonathon B. Cohen, and James D. Fraser*

Piping Plovers (*Charadrius melodus*) colonized the village of West Hampton Dunes following a winter storm in 1992. This storm breached the barrier island in two places, washed away a substantial portion of the existing human structures and dense vegetation, and formed a sandspit and intertidal sandflats in Moriches Bay. The Corps repaired the breach in 1994 and commenced work on the Westhampton Interim Storm Damage Protection Project in 1996. The project was designed to protect the redeveloping village from storm damage via an artificial dune and periodic beach nourishment. The addition of sand to the ocean beach initially increased the available nesting habitat for the plover population, which grew to 39 pairs by 2000. Vegetative succession and human development, however, nearly eliminated nesting habitat on the bayside by 2004. Furthermore, predation management was greatly reduced from 2001 to 2004. The plover population consequently decreased to 18 pairs. Other effects on the plover population that resulted indirectly from the Interim Project were predation by cats, mortality of chicks and adults in the village road, and loss of access to bayside foraging habitat. The Interim Project demonstrated the possibility of successfully building attractive plover habitat through sediment management, but it also illustrated that the indirect effects of beach stabilization can negate the benefits of habitat creation. Opportunity exists at West Hampton Dunes to increase the size and productivity of the Piping Plover population through predator control and vegetation thinning.

Response of Piping Plover to the New Jersey Beach Nourishment Project – *Mark H. Burlas*

The Corps, in partnership with NJDEP, received Congressional authority to provide hurricane and storm damage reduction for 21 miles (33.8 km) of coastline in northern New Jersey. The construction plan included elements intended to restore the natural littoral drift and coastal features using beach nourishment. Prior to construction of the project, Piping Plover (*Charadrius melodus*) nesting in northern New Jersey was limited to habitat within the Gateway National Park in Sandy Hook, NJ, which is immediately north of the project area. In the course of biological monitoring for the project, the presence of the Piping Plover was confirmed in locations that had received beach nourishment. Pursuant to coordination

with USFWS with respect to the Endangered Species Act, an interagency Team (USACE, USFWS and the NJDEP, Division of Fish and Game) under the leadership of the Corps conducted monitoring for the presence of the Piping Plover. The Piping Plover continued to appear and successfully nest within the project area in 1996 and every year thereafter to the present (2005). This represents 9 years of successful nesting within the project area. The total 9-year monitoring effort identified 73 nests that resulted in the fledging of 103 Piping Plover chicks. The 9-year fledge rate (number of fledged chicks/nesting pairs) within the project area is 1.41, which is near the Atlantic Coast Population (ACP) recovery goal fledge rate of 1.5, and above the ACP stable population fledge rate of 1.25 and the New York/New Jersey region of 1.19. The highest seasonal fledge rate of 1.78 was achieved during a beach renourishment operation and was most likely due to intensive monitoring and the implementation of expansive (1,000-m) buffer areas as defined in the Programmatic Biological Opinion issued by the USFWS in September 2002. The average annual stewardship cost per Piping Plover fledged chick is estimated at $647.00. In addition, within the created and expanded nourished beaches, increased nesting by the state-listed Least Tern (*Sterna antillarum*) has been documented. Furthermore, the federally listed seabeach amaranth (*Amaranthus pumilus*) was rediscovered in 2000 after a 90-year absence in New Jersey. An estimated total of 2,825 Least Tern chicks have fledged and approximately 28,000 seabeach amaranth plants have been identified growing within the project area since the initiation of the 9-year endangered species stewardship effort. Pending the availability of funds, the interagency team plans to continue monitoring on an annual basis. Using the Corps project performance measures of scarcity, plan recognition, connectivity, special species status and sustainability, a reasonable conclusion can be made that beach nourishment operations that include intensive stewardship goals may be a viable alternative to restore Piping Plover, Least Tern, and seabeach amaranth habitat, in addition to providing shore protection benefits.

Enhancing Piping Plover Foraging Habitat in New Jersey – *Chris Kisiel and David Jenkins*

New Jersey faces distinctive challenges in managing nesting Piping Plover (*Charadrius melodus*) in the face of intense beach recreational use. The Piping Plover population in New Jersey has remained relatively steady over the past 20 years, but the authors' ultimate goal is to increase the population so that the New Jersey Division of Fish and Wildlife can contribute to regional recovery. One way to accomplish this is to improve

foraging habitat for adults and young. Large-scale projects, such as the ponds created behind the protective dune at Cape May Point, show great potential. At Barnegat Inlet's south jetty, the authors proposed to restore tidal foraging habitat lost during jetty construction by channeling water from pools along the inside of the jetty to a shallow pond. In conjunction with vegetation removal, this would help restore the site to habitat conditions similar to those which existed prior to jetty construction. There is also potential for small-scale projects not associated with larger restoration efforts. Previous research has indicated that shallow pools or moist sand areas created by pumping water into shallow sand pits fertilized with organic material may draw a stable prey base consisting mostly of Dipteran species. The authors intend to create similar areas within the boundaries of fenced nesting sites to provide a foraging site apart from the crowded intertidal zone. Pumping water from shallow on-site wells with solar powered pumps would create the moist sand areas. The combination of these large and small-scale efforts will hopefully aid in increasing the reproductive rates for New Jersey's Piping Plovers and contribute to regional recovery.

8 Session VII: Shoreline Protection, Dredged Material Placement, and Bird Populations

Beach Nourishment and Dredged Material Islands in Relation to Black Skimmers and Common Terns Nesting in New Jersey – *David Jenkins and R. Michael Erwin*

Human activities have caused losses in functional values and direct losses of natural barrier island habitat resulting in loss of suitable nesting sites for beach nesting bird species. Loss of nesting habitat may result in population declines of beach nesting birds and/or shifts to other secondary nesting habitats (e.g., primarily estuarine island wrack and dredged material islands). Furthermore, there is evidence that use of secondary habitats and concomitant declines in populations is declining. Erwin et al. (2003) examined distribution of terns and skimmers among different nesting habitat types in New Jersey, Virginia, and North Carolina, comparing 1977 with 1993–1995 data and found declines in proportional use of dredged material sites and decline in combined species populations in all three states. To gain a better understanding of site dynamics and habitat use changes in New Jersey, Jenkins and Erwin examined Black Skimmer (*Rynchops niger*) nesting populations and site use from 1976 to 2005 averaged over six 5-year periods. During this period, Black Skimmer populations increased in New Jersey while the number of nesting colonies declined, resulting in an increase in the average size of colonies. This occurred mostly through an increase in the number of birds nesting in very large (>1,000 birds) colonies concomitant with a decline in the number of small colonies. The proportion of birds nesting on barrier island beaches remained relatively constant while the proportion nesting on wrack or dredged material varied. Notably, the proportion nesting on dredged material declined from a high of 18% during the 1976–1980 period to only 2% during the 2001–2005 period. No similar detailed analysis of Common Tern (*Sterna hirundo*) numbers was possible due to inconsistent survey effort. In general, terns nested predominately on wrack since the late 1970s, although they occasionally nested on beaches in large colonies. With some notable exceptions, dredged material islands have not been a significant nesting habitat for Common Terns in New Jersey. Large barrier

beach colonies of both Black Skimmers and Common Terns have not been located on nourished beaches, although some of the sites have probably indirectly benefited from nearby beach nourishment projects. The relationship between predation and site/habitat use needs consideration and further investigation in evaluating and developing habitat enhancement and creation strategies. Other factors that must be considered include size, vegetation management, and competition with gulls. An integrated approach that provides a diversity of sites and habitats is needed, and sites must be managed to reduce human disturbance, predation, and vegetation encroachment. Managers should try to anticipate indirect/off-site effects of beach nourishment and seek to establish protective policies for new areas before they form.

The Distribution of Piping Plover and Coastal Birds in Relation to Federal Beach Nourishment and Inlet Maintenance Activities on the Southern Coast of Long Island: Implications for Project Impact Assessment and Habitat Management – *Steve Papa*

Distribution of Piping Plover (*Charadrius melodus*) and other coastal birds were assessed on Corps projects on Long Island, using information obtained from digital data sources and agency reports. In addition, implications resulting from the close spatial relationship between the Corps projects and these species were discussed in terms of analyzing project impacts and habitat management plans. On the southern coast of Long Island, the breeding areas of the federally listed Piping Plover often coincide with the Corps project areas, based on an assessment of New York State Department of Environmental Conservation's Long Island Colonial Waterbird and Piping Plover Survey Data and the Corps' Digital Project Notebook. An understanding of the distribution and abundance of these species across the landscape is necessary to develop appropriate mitigation strategies or, in the case of endangered species, conservation measures during all phases of project planning. This information is also important in developing habitat management activities such as restoration planning. The USFWS identified a number of factors or activities that the Corps should implement to improve the environmental analysis and habitat management planning associated with federal projects, including inviting resource agencies early in planning process, considering the impacts of cross-program activities, assembling/incorporating regional physical and biological databases/conservation plans, incorporating research design/results into project plans, developing case studies to assist in future planning, and developing funding commitments.

Response of Roseate Tern to a Shoreline Protection Project on Falkner Island, Connecticut – *Catherine J. Rogers and Jeff Spendelow*

Construction was initiated following the 2000 tern breeding season for Phase 1 of a planned two-phase "Shoreline Protection and Erosion Control Project" at the Falkner Island Unit of the USFWS Stewart B. McKinney National Wildlife Refuge located in Long Island Sound off the coast of Guilford, CT. When the Common Tern (*Sterna hirundo*) and federally endangered Roseate Tern (*S. dougallii*) arrived in spring 2001, they encountered several major habitat changes from what had existed in previous years. These changes included

- a rock revetment covering most of the former nesting habitat on the beach from the northwestern section around the northern tip and covering about 60% of the eastern side;
- an elevated 60- × 4-m shelf covering the beach and lower bank of the southwestern section; and
- about 2,000 sq m of devegetated areas on top of the island on the northeast side above the revetment, and about one-third of the southern half of the island.

The southwest shelf was created by bulldozing and compacting extra construction fill and in situ materials. This shelf differed in internal structure from the main revetment on the north and eastern sections of the island because it lacked the deep internal crevices of the revetment. The deep internal crevices were created from the large stones and boulders (up to 2 tons) used in the construction of the main revetment. Small rock and gravel was used to fill the crevices to within 3 feet (0.9 m) of the surface of the revetment.

Because half-buried tires and nest boxes for the six Roseate Tern (*Sterna dougallii*) sub-colony areas were deployed in similar patterns on the remaining beach, and nest boxes were placed on the newly elevated shelf areas several meters above previous locations on the now-covered beach areas, the distribution of Roseate Tern nests did not change much from 2000 to 2001. However, the movements of Roseate Tern chicks – in many cases led by their parents towards traditional hiding places – into the labyrinth of subterranean channels, especially in the main revetment area, made it difficult to measure chick growth and productivity as had been done for more than 12 years prior to construction. Also, observations of

color-banded adults that were unable to locate and feed their young inside the main revetment, and of adults returning to courtship behavior and renesting after having hatched chicks from their initial clutches, indicated that a minimum of 20% of the chicks (mostly first hatched A-chicks, which usually have high rates of survival to fledging) that entered the main revetment died after doing so in 2001. The mortality rate of Roseate Tern chicks that entered the secondary revetment on the southwest shelf, however, was not unusually high in 2001.

In an attempt to reduce the likelihood of nesting and chick losses in these sub-colonies, a research team led by the USGS in 2002-2003 did not put nest boxes on the northeast and east shelf areas where previous losses had been high. However, losses of tern eggs and young chicks to predatory Black-crowned Night Herons (*Nycticorax nycticorax*) were so great in 2002–2003 that few Roseate Tern chicks survived long enough to move into the main revetment area and little comparative survival data were collected. The USFWS continues to remove predatory night herons, to monitor the location and success of nesting Roseate Terns and to fill in some of problem areas near the tern nests in the main revetment. The extensive chick-searching fieldwork and observational procedures used by the USGS-led research team to determine the growth and survival of the Roseate Tern chicks at Falkner Island were not used in 2004–2005. The number of chicks lost in the revetment during these years is not known. Without additional fill, loss of chicks of this endangered species in the main revetment may rise again even though the night heron predation problem has been reduced.

Management Methods to Optimize Breeding Success in Roseate and Common Terns on a Remote Privately Owned Sand Spit Island in the Peconic Estuary – *Larry Penny and Lisa D'Andrea*

Cartwright Island, also known as Cartwright Shoals, is the southernmost extension of Gardiners Island (3,300 acres, 1,335.5 ha) situated in East Hampton Town and Gardiners Bay, part of the Peconic Estuary of eastern Long Island, New York. Because of the ephemeral nature of the island—some years entirely submergent, other years, as high as 4 or 5 feet (1.22 or 1.52 m) above sea level—colonial waterbirds have not been able to establish permanent rookeries. However, since about 1997, the shoal has been an island and terns and other waterbirds have reestablished nesting colonies. During 1997–1999, about 200 pairs of Common Terns (*Sterna hirundo*) nested on the island. In 2000, Roseate Terns (*S. dougallii*)

nested alongside of the Common Terns. Common Terns may have not peaked yet; around 1,500 pairs nested on the shoals in 2005. During 2004, approximately 250 breeding pairs of Roseate Terns nested on the island, but this number declined to around 100 pairs in 2005. Pairs of the Least Tern (*S. antillarum*) peaked in 2004 with approximately 210 nesting pairs observed. However, Least Terns have not been successful on the shoals; predation on eggs and chicks has repeatedly caused the colony to be abandoned early in the season. Two nor'easter storms overwashed the island in October 2005. It is not known whether the shoals will be suitable for breeding in 2006.

Hicks Island is a small sandy island forming the northern border of Napeague Harbor that has been used off and on over the years for breeding by Least Terns, Common Terns, and Roseate Terns, but no chicks have been fledged since the early 1980s. About 40,000 cubic yards (30,582 cubic meters) of clean dredge material from the west inlet-channel was deposited on the western half of the island in spring 2004 in hopes that tern species would repopulate the fresh deposition area. Subsequent to the dredged material, no terns bred in 2004 and 2005, but Piping Plover (*Charadrius melodus*) fledglings increased to 7 in 2004 and 12 in 2005. The deposition area will be kept devegetated in hopes that tern species will come to breed on it in 2006.

Sammys Beach is a sand spit separating Three Mile Harbor and Gardiners Bay. Three tern species formerly bred on the spit, but none have bred since 1982. In 1999 the inlet and channel to Three Mile Harbor was dredged and the spoil was deposited on Sammys Beach covering about 26 acres (10.5 ha). About 25 acres (10.12 ha) of spoil was replanted with beachgrass in spring 2000. A bare area of more than 1 acre (2.5 ha) was left to attract Least Terns. In 2000, 50 Least Tern nesting pairs were observed. The number of breeding pairs peaked in 2001 when about 100 pairs nested in the bare sand area. The breeding population steadily diminished to only five pairs in 2005. Following dredged material placement in 1999, Piping Plovers (*Charadrius melodus*) repopulated the sandy area after an absence of several years. The number of observed fledglings during the 1999–2005 nesting seasons, is 3, 5, 10, 6, 0, 6, and 8, respectively. The nesting area will be devegetated before the 2006 breeding season in hopes that the terns will return.

The Baltimore District's Beneficial Uses of Dredged Material Program – *Robert N. Blama*

The Corps' Baltimore District has responsibility for almost 100 small navigation projects that require periodic maintenance dredging. As with most dredged material projects, the most difficult aspect is the identification of environmentally acceptable placement sites. Maryland does not allow open water placement, so deposited material must be contained. The first choice for disposal of dredged material in the Baltimore District is beneficial use. A variety of uses have been constructed over the years to include beach nourishment, wetland construction, oyster bar creation and others. Three projects will be discussed creating wetlands with different methods of containment.

The first project is at Blackwater Refuge where the Baltimore District used thin layering and open-pipe discharge to create wetlands behind straws bales and within existing wetlands. Contractors and volunteers were used to plant the area with *Spartina* ssp. and *Scirpus* ssp. Another project was fringe wetland development on the Anacostia River in Washington, DC. Dredged material was pumped behind vinyl sheet piling and biologs then planted with a variety of freshwater species. Sheet piling was notched to allow tidal flushing. Another project entailed pumping dredged material behind stone breakwaters at Barren Island in the Chesapeake Bay. Fine grain material was planted by volunteers with *Spartina* ssp., *Juncus* ssp., and *Disticilis* ssp. using a different design.

All projects were developed and supported by a variety of federal, local, and private organizations. Cooperation and trust are the foundation of good relationships to allow thinking outside the box to develop new methods for habitat creation.

Long-Term Bird Use of the Craney Island Dredged Material Site in Portsmouth, Virginia – *Ruth A. Beck*

Craney Island is a dredged material confined disposal facility (CDF) located approximately 2.25 to 2.5 miles (3.6 to 4 km) inland along the James and Elizabeth Rivers near Portsmouth, VA. The island was established in 1950 by the Corps to accept the dredged material obtained through routine dredging operations along the navigational portion of the rivers. Long-term monitoring of the avian communities has occurred on

these islands since 1974. Data collected during monitoring efforts include avian use during the breeding, migratory, and wintering seasons.

Brief History of Bird Management Efforts:

1974–1987: There was a mutual lack of understanding and cooperation between Corps and biologists. Varying degrees of avian nesting success occurred during this period.

1988: The Corps initiated the Bird Habitat Management effort. This led to the establishment of appropriate Least Tern (*Sterna antillarum*) habitat.

- Corps created five sites with habitat for terns.
- Personnel from William and Mary College, using decoys, attracted terns to three of five sites.
- The Corps initiated a strong public outreach effort.

1989: First pair of nesting Piping Plovers (*Charadrius melodus*) led to management efforts and a memorandum of understanding between the Corps and William and Mary College.

1989 to present: There is close cooperation among the Corps and William and Mary College with periodic planning meetings.

Present: Threats to Least Terns and long-term bird survival still exist. Current threats to nesting birds include

- changing habitats;
- avian and mammalian predators;
- human disturbance (dredging contractors);
- flooding; and
- some fishermen activities.

The Craney Island CDF consists of three large cells: north cell, center cell, and south cell. There is 3-year cell rotation for dredged material deposition activities. Dredged material deposition can create good habitat with suitable substrates for the Least Tern. Furthermore, vegetation is controlled by re-applying dredged material. However, the location of the birds on the island can change year-to-year depending upon the rotation schedule of the deposition activities. When the Least Terns arrive in April,

areas are closed to the public, buffer zones are established to protect the nesting birds where possible, and signs are posted to keep the public out of critical nesting sites. Observations during the nesting season have documented the use of many shells in the tern nests, and based on foraging observations, the vicinity around Craney Island has an excellent prey base promoting a high reproductive success rate for nesting terns.

Continuous dredged material deposition activities occur at the Craney Island facility year-round. It has been the researchers' experience that dredged material deposition operations and nesting birds can coexist. Management efforts include plans for all seasons, including managing cells for nesting, migrating, and wintering seasons. For example, water levels in the cells can be raised during the migration season and lowered during the wintering season. On occasion, the site has supported large numbers of birds; for example, on one evening approximately 18,000 birds (mixed species flock) spent an evening at the site. Other management concerns include a *Phragmities* removal program to protect vital wetland habitats from this noxious, introduced plant.

Predation on nesting birds has become a challenging management problem. Four years ago, the Red Fox (*Vulpes vulpes*) population undertook a large population increase and became a problem on the island. Other predators include the Herring Gulls (*Larus argentatus*), Laughing Gulls (*L. atricilla*) (a problem on another site because of the large population) and even Ruddy Turnstones (*Arenaria interpres*) that occasionally prey on terns during migration.

The current management approach includes seven principal features:

- Yearly joint planning sessions with Corps' representatives
- The creation of suitable habitat for beach nesting species using dredged material
- Continued maintenance of sites
- Identifying, posting, and protection of all active nesting sites
- Frequent monitoring of the seasonal bird communities
- Predator management and control
- Production of weekly reports and recommendations to on-site management of cells.

Summary of avian management efforts on the Chaney Island CDF: The good, the bad, and the ugly:

Good: Habitat creation using dredged material works. The maximum of 287 pairs of nesting Least Terns constitutes the most successful Least Tern site in Virginia. Also there were five pairs of nesting Piping Plovers.

Bad: Predation has been significant, especially from foxes, feral cats, and wild dogs. Predation control has had limited or no success.

Ugly: Greater than half of the shoreline foraging area has been removed due to the addition of riprap; this is particularly important for the Piping Plover. Moreover, increased dredging operations are removing the 3-year rotational cell concept; now all three cells receive dredged material every year. This practice is adversely impacting previously successful nesting sites.

Savannah Harbor Navigation Project Management to Benefit Birds – *J. Steve Calver*

The Savannah Harbor Navigation Project is responsible for maintaining the Savannah Harbor navigation channel at Savannah, GA. The port consists of 21 miles (33.8 km) of inner harbor channel and 11 miles (17.7 km) of bar channel. The project includes seven active CDFs that provide approximately 4,800 acres (1,942 ha) for containment of sediments. These disposal facilities receive about 6 million cubic yards (4.6 million cubic meters) of dredged material each year. Over the years, these disposal facilities have become renowned for supporting great numbers and diversity of birds; 289 species have been documented on the sites, and tens of thousands of shorebirds and waterfowl may be observed on the sites at any one time during the spring or fall. These areas are known for attracting very rare birds such as the Curlew Sandpiper (*Calidris ferruginea*), Ruff (*Philomachus pugnax*), and Red-necked Stint (*Ca. ruficollis*), and unusual birds such as the Roseate Spoonbill (*Platalea ajaja*) and the Reddish Egret (*Egretta rufescens*). Occasionally, a few western species may be detected, including the Western Kingbird (*Tyrannus verticalis*) and the Vermillion Flycatcher (*Pyrocephalus rubinus*). Several state or federally listed endangered and threatened species and state species of special concern are known to utilize habitats and nest on the disposal facilities, including the Least Tern (*Sterna antillarum*), Wilson's Plover (*Charadrius wilsonia*), Ground Dove

(*Columbina passerina*), Gull-billed Tern (*S. nilotica*), Little Blue Heron (*E. caerulea*), Black Skimmer (*Rynchops niger*), and Glossy Ibis (*Plegadis falcinellus*), plus several terrestrial species of regional concern including the Bobwhite (*Colinus virginianus*) and the Painted Bunting (*Passerina ciris*).

Although the CDFs are well known in the birding community as valuable areas for attracting birds, until relatively recently there has been little interest in the Savannah District in management for migratory birds. Past management focused on compliance with the Migratory Bird Treaty Act (MTBA). Furthermore, it was difficult to justify the use of navigation project funds to promote conservation of migratory birds. Even the recent Executive Order 13186 that directs federal agencies to conserve migratory bird populations has had little impact because guidelines for implementing the order have not been established. Because of these constraints, efforts were made to develop a management program to benefit migratory birds at a relatively low cost to the project. This program includes past restrictions to comply with the MBTA and adds additional features based on requirements in a wetland mitigation plan.

The program developed out of a need for additional dredged material disposal capacity. Since few practicable sites were available for a new CDF, an existing area previously used for disposal operations was selected. However, this existing area still contained over 300 acres (121.4 ha) of important wetlands. No practical mitigation sites for the loss of these wetlands could be located, so the specific values of the wetlands were identified, and separate mitigation actions were developed to compensate for the wetland function and values lost by construction of the CDF. The mitigation plan identified two primary functions of the wetlands: fisheries and wildlife habitat that should be compensated for. It was decided that bird foraging habitat would be replaced by conducting disposal operations through a rotation plan that actually created more feeding areas for birds. Also, the plan called for the creation of a bird nesting island to increase the value of the area for nesting birds. The mitigation efforts were incorporated into a Long-Term Management Strategy (LTMS).

Several aspects of dredged material deposition operations are accounted in the plan. For example, when dredged material is pumped into a diked CDF, the area will attract many birds as long as the area remains wet. Nesting success of the birds often depends upon the dredging operation

continuing through the nesting season; if dredging operations stop, then the area dries out and the nesting efforts of the birds may fail. If disposal operations create large sand areas, then many nesting birds may be attracted to the site. These nesting birds may impede disposal and borrow activities. However, depending on the timing and extent of the dredging operations, managers may use stakes and flagging to make these sandy areas less attractive to nesting birds. Creating protected nesting islands for birds avoids these potential impacts to project operations. Also, the CDFs contain many dikes and roads that must be maintained by mowing. The operations and management guidelines contain a mowing schedule to benefit birds. Many areas along the grassy roads will attract nesting Willets (*Catoptrophorus semipalmatus*). Therefore, mowing schedules were designed to avoid the Willet nesting season when possible, and required mowing during the nesting season is restricted to mowing to the actual road surface in order to minimize impacts on Willet eggs, nests, and young. Specific elements pertaining to the rotation plan include the following:

- Within the seven CDFs to receive dredged material, areas will be identified and paired. Where one area is used for dredged material deposition for 3 years, the other area will be allowed to dry for the same period.
- During the use period, water levels will be managed to maximize wildlife habitat value while ensuring minimal impacts to the disposal operations.

The rotation/mitigation plan provides several environmental benefits. First, the plan creates excellent habitat for resting, foraging, and nesting shorebirds. For example, the Semipalmated Sandpiper (*Ca. pusilla*) feeds in the diked areas; this species is very abundant in spring (totals once approached 35,000 birds), and lower abundance in fall (usually less than 5,000 birds). Other species benefited by the mitigation plan include the Least Sandpiper (*Ca. minutilla*), which is very abundant in spring (almost 10,000 birds in one spring); Western Sandpiper (*Ca. mauri*) (almost 7,000 birds in one spring); Lesser Yellowlegs (*Tringa flavipes*); Stilt Sandpiper (*Ca. himantopus*); Peregrine Falcon (*Falco peregrinus*); Northern Shoveler (*Anas clypeata*); Green-winged Teal (*A. crecca*); Blue-winged Teal (*A. discors*); Ring-necked Duck (*Aythya collaris*); Ruddy Duck (*Oxyura jamaicensis*); and the Bald Eagle (*Haliaeetus leucocephalus*).

Improved bird nesting habitat for shorebirds, waterfowl, and waterbirds (waders) was accomplished by creation of bird islands that provided undisturbed and predator-free beach nesting habitats:

- Two 1-acre (0.6-ha) nesting islands were built inside each approximately 1-sq-mile (2.6-sq-ha) disposal area.
- One 4-acre (1.4-ha) island was built in the nearshore waters north of the entrance channel to increase coastal bird nesting habitat.

Important birds nesting on the interior islands include Wilson's Plover, Least Tern, Gull-billed Tern, and the Black Skimmer. The CDFs themselves also support the largest population of breeding Black-necked Stilt (*Himantopus mexicanus*) in the state. The new nearshore island provides a resting place for many species, with especially large numbers of Brown Pelicans (*Pelecanus occidentalis*) roosting on the site before construction was completed. During its first nesting season, the island supported over 1,700 Royal Tern (*S. maxima*) nests, along with lesser numbers of Sandwich Tern (*S. sandvicensis*), Gull-billed Tern, and American Oystercatcher (*Haematopus palliatus*) nests. During the winter season, these islands are also expected to be used by the endangered Piping Plover (*Ch. melodus*).

9 Session VIII: Red Knots, Horseshoe Crabs, and Beach Nourishment in Delaware Bay

Are Horseshoe Crabs Limiting Resource for Red Knots? – *Sarah Karpanty*

A decline in Red Knots (*Calidris canutus*) has been attributed to horseshoe crab (*Limulus polyphemus*) egg shortages on the Delaware Bay, an important foraging area for migrating knots. Virginia Tech University researchers studied the movements and distribution of 65 radio-tagged Red Knots on Delaware Bay in May–June 2004 and related movements to the distribution and abundance of horseshoe crab eggs and other prey, and to other habitat characteristics. The number of horseshoe crab eggs was the most important factor determining the use of sandy beaches by Red Knots (AIC_c w = 0.99)[1]. The importance of crab eggs was also apparent in a landscape-level shift from emergent marsh and peat-beaches to sandy Delaware Bay beach when crab eggs became abundant. While sandy beach zones were used by Red Knots more than expected given their availability, 44% of Red Knot low tide locations were in bay and coastal emergent marsh. Researchers found the abundance of *Donax variablis* and *Mytilus edulis*, both supplemental food sources for Red Knots, to be significant factors driving Red Knot use of sandy beaches. Levels of disturbance and the abundance of Laughing Gulls *(Larus atricilla*) also were important factors in Red Knot sandy beach use, although secondary to prey resources (AIC_c w < 0.4). This study indicates that the abundance of horseshoe crab eggs on sandy beaches is driving movement and distribution of Red Knots and that there is little alternative food during migratory stopover in Delaware Bay. Horseshoe crab eggs are a keystone resource for Red Knots stopping on Delaware Bay.

Preliminary Inventory Status of *Limulus* Populations on Long Island: From Anecdote to Annual Survey – *John T. Tanacredi and Russell Ainbinder*

Considerable concern regarding the abundance of American horseshoe crabs (HSC) (*Limulus polyphemus*) along the coasts of New Jersey and Delaware prompted past moratoriums on collecting HSC for bait in New

[1] AIC = Akaike Information Criterion.

Jersey. The parallel population decline in migratory shorebirds such as Red Knots (*Calidris canutus*), Ruddy Turnstones (*Arenaria interpres*), and others that seasonally feed on the copious quantities of HSC eggs laid along this shoreline resulted in reduced HSC collection permits to numbers considered sustainable. In New York's Marine District, which is mostly comprised of the Long Island coastline, there is no reliable or routine inventory network existing for determining HSC populations. Shorebird data, which have been collected by Audubon Chapters, the National Park Service and the UFSWS, as well as academia, have hinted at a declining HSC population. However, due to the lack of a formal and extensive or reliable inventory network, assessing changing trends in HSC population levels is unattainable or mostly of uncertain accuracy. Anecdotal information from these same sources, as well as coastal enthusiasts and recreationalists (e.g., Shorewalkers, Inc., American Littoral Society, etc.) all provided strong support for a declining population of HSC in the metropolitan New York City area; however, all were unreliable and inaccurate. In 2003, Tanacredi and Ainbinder established at Dowling College the "Long Island HSC Network," which provides for a hot-line telephone number, survey form, and Web site to

- collect data on Long Island sites which support HSC (coordinates for all sites were recorded using GPS units for repeated sampling);
- count and tag HSC to create a reliable and practical estimate of the HSC population on Long Island;
- determine sex and age of individual HSC at each site; and, most importantly,
- establish a network that can be repeated annually to detect precipitous changes in HSC population numbers and distributions.

Data collection for HSC Network will aid in protecting the HSC population as well as other species which require HSC eggs as food during significant migratory periods. Results of the first two years reveal the following:

- There was a significant reduction of HSC.
- Sites along the Long Island coastline commonly believed to support HSC were found to have few to modest numbers of HSC.
- There were about 15,000 adult breeding individuals of HSC on Long Island. However, this is a very preliminary (approximate) number.

Ensuring Habitat Considerations in Beach and Shoreline Management Along Delaware Bay – A Bay-wide Perspective – *David B. Carter, Kimberly B. Cole, and Patricia Arndt*

The Delaware Bay is an exceptional estuary of unique biological importance and is internationally recognized as a critical staging area for migratory shorebirds. Each spring, up to 1.5 million shorebirds time their arrival in the bay to coincide with the world's largest spawning event of horseshoe crabs (*Limulus polyphemus*). Approximately 30 species of shorebirds utilize Delaware Bay resources each spring. The bay is particularly important for Semipalmated Sandpipers (*Calidris pusilla)*, Ruddy Turnstones (*Arenaria interpres)*, Red Knots (*Calidris canutus)*, Sanderling (*Calidris alba)*, Dunlin (*Calidris alpina)*, and Short-billed Dowitchers (*Limnodromus griseus*), which make up the majority (95%-99%) of the feeding shorebirds.

The Delaware Department of Natural Resources and Environmental Control, Division of Soil & Water Conservation has been responsible for the management and protection of Delaware's shoreline for over 30 years. Much of their activity involves shoreline stabilization and beach nourishment. These activities have historically been conducted for storm hazard protection and justified almost entirely on the basis of public and personal property damage costs. However, opportunities exist to remediate some of the habitat losses occurring due to coastal erosion such as the beneficial use of dredged material. Little attention has been given to the potential environmental benefits of this type of project for shorebird habitat creation and enhancement. In fact, based on the known Delaware Bay shoreline erosion rates of 2 to 6 meters each year, a consequence of natural forces such as wind and wave action, and human-influenced forces such as sea-level rise and development activities, bay beach replenishment could be an effective management tool for ensuring protection of the Delaware Estuary resources that are a critical link to the long-term success of this internationally recognized shorebird migration stopover site.

The Delaware Coastal Programs (DCP) is responsible for coordination of coastal management efforts that will lead to the protection and wise use of Delaware's irreplaceable coastal resources. Successfully integrating these conservation efforts into the state's public works projects will require knowledge of the species involved and their specific management needs. Moreover, DCP will need information on the impacts of management activities on coastal resources and to identify any links with between

management and public policy issues that may have subsequent or indirect impacts on these resources.

Ongoing research efforts on shorebirds, horseshoe crabs, and benthic habitats have provided critical insights to coastal managers. The research will also provide key operational considerations for the state program of beach nourishment and management. It promises to provide the scientific basis for construction guidelines and specifications that will ensure that these projects have the optimal grain size, slope, and wave energy attenuation to significantly improve the habitat quality. In areas with high levels of human disturbance, other management approaches may be needed to prevent attracting birds.

The DCP has a vested interest in providing coastal managers and scientists with information on new management alternatives for shorebird and horseshoe crab habitats. The DCP is working to establish a framework where managers can become directly involved in designing management strategies to ensure that habitat considerations are incorporated into beach and shoreline management.

10 Summary

The U.S. Army Corps of Engineers, American Bird Conservancy, and the U.S. Fish and Wildlife Service organized a workshop on October 25-27, 2005 in Long Island, NY. The goal of the workshop was to disseminate information on the beneficial use of dredged material deposition along the North Atlantic Coast for the purpose of improving approaches to beach nourishment and other Corps operations, to increase coastal habitat quality, and to improve the management and conservation of colonial and non-colonial waterbirds and shorebirds. The North Atlantic Coast region involves the operations of four Corps Districts including the Baltimore, Philadelphia, New York, and the New England Districts. The workshop consisted of a series of presentations from numerous federal, state, and conservation organizations actively involved in the monitoring and managing of dredged material deposition for habitat improvement for birds and other wildlife species. The workshop began with several presentations that identified birds of conservation concern and their habitat relationships along the North Atlantic Coast (Session I), then focused on coastal processes, sediment management, and the impacts of beach nourishment (Sessions II–III), the application of dredged material for the purpose of habitat restoration and the use of beach nourishment to restore barrier islands (Sessions IV–V), the relationship of Piping Plovers (*Charadrius melodus*) populations and beach nourishment operations (Session VI), and impacts of shoreline protection and dredged material placement on bird populations (Session VII). The final Session (Session VIII) focused on the interrelationships between Red Knots (*Calidris canutus*), horseshoe crabs (*Limulus polyphemus*), and beach nourishment on the Delaware Bay. In general, the presentations highlighted the status of current efforts to promote bird conservation in Corps operations and emphasized areas where improvements can be made. These areas include (1) identifying important inlets and other areas for birds as breeding, wintering, and migratory stopover areas along the North Atlantic Coast; (2) linking current conservation of birds in the North Atlantic Coast regions with regional bird conservation plans already developed; (3) improving data acquisition, database storage and accessibility; (4) engaging local communities to promote conservation alongside of recreational and economic interests; and (5) improving the Corps' abilities to integrate issues of scale,

including local, regional, and national impacts of Corps activities on the conservation of many waterbirds and shorebird populations.

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Appendix A: Table of Presenters, Affiliations, and E-mail Contact Information

This provides a list of workshop presenters, affiliations, and e-mail contact information from the Second Regional Workshop on Dredging, Beach Nourishment, and Birds on the North Atlantic Coast, Long Island, NY, October 24–27, 2005.

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14. ABSTRACT

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