ENVIRONMENTAL SENSITIVITY INDEX: LONG ISLAND SOUND

INTRODUCTION

This Environmental Sensitivity Index (ESI) atlas was developed for the marine and coastal areas of Long Island Sound. The ESI represents a compilation of information about three main categories: shoreline habitats, sensitive biological resources, and human-use resources. Though the data will be useful for many shoreline applications, the goal of the ESI data is to present a concise summary of resources that may be particularly vulnerable to spilled oil. The intent of the data should caveat other uses. As an example, the ESI is not intended to present a catalog or comprehensive listing of species present in an area, rather the focus is on species particularly sensitive to oiling and life stages where vulnerability may increase.

SHORELINE HABITAT MAPPING

The shoreline and classifications were fully updated using the following sources and methods. The shoreline and intertidal habitats were delineated using a mapped sequence of Light Detection and Ranging (LiDAR) and high resolution digital orthophotography datasets. The LiDAR data was acquired in 2014 as part of a post-Super Storm Sandy contract for the United States Geological Survey (USGS). This task required the LiDAR data be collected at a nominal pulse spacing (NPS) of 0.7 meters. The window for tidally impacted waters within the area of interest was mean low water (MLW) +/- 2 hours exclusive of neap tide. Seven (7) missions were flown between April 3, 2014 and April 21, 2014, as part of the USGS project.

The base shoreline was compiled at Mean Higher High Water (MHHW) first by LiDAR extraction, then refined within a Geographic Information System (GIS) utilizing high resolution digital orthophotos. After the shoreline was delineated, digital orthoimagery from various sources was used to classify shoreline segments using the standardized ESI rankings (see below). Imagery from the New York State Office of Information Technology Service (2013 and 2011), the New Jersey Office of Information Technology (2013), Connecticut Department of Transportation (2012), as well as various imagery sources for Google Earth and Bing Maps (2014) was used during the classification phase.

Shoreline features of 10 meters (m) or greater in length were classified. In addition, wetland polygon datasets originally created by the United States Fish and Wildlife Service National Wetland Inventory (NWI) were modified and updated to be used in conjunction with the ESI shoreline. The data was visually reviewed and classified against the aerial imagery and adjusted where necessary to allow for proper classification.

The ESI shoreline classification and ranking scale has been used to assess vulnerability of shoreline to spilled oil since the mid-1970s. Rankings range from 1 – least vulnerable, to 10 –

most vulnerable, with a variety of qualifiers unique to the geographic region. The scale incorporates the following considerations:

1) Shoreline type (substrate, grain size, tidal elevation, origin)
2) Exposure to wave and tidal energy
3) Biological productivity and sensitivity
4) Ease of cleanup

Prediction of the behavior and persistence of oil in intertidal habitats is based on an understanding of the dynamics of the coastal environments, not just the substrate type and grain size. The intensity of energy expended upon a shoreline by wave action, tidal currents, and river currents directly affects the persistence of stranded oil. The need for shoreline cleanup activities is determined, in part, by the slowness of natural processes in removal of oil stranded on the shoreline. The potential for biological injury and ease of cleanup of spilled oil are also important factors in the ESI shoreline ranking. Thus, shorelines exposed to high levels of physical energy, such as wave action and tidal currents, and low biological activity rank low on the scale, whereas sheltered shorelines with associated high biological activity have the highest ranking. The shoreline types delineated for Long Island Sound presented in order of increasing sensitivity to spilled oil, are listed below.

1A) Exposed Rocky Shores
1B) Exposed, Solid Man-made Structures
2A) Exposed, Wave-cut Platforms in Clay
2B) Exposed Scarps and Steep Slopes in Mud
3A) Fine- to Medium-grained Sand Beaches
3B) Scarps and Steep Slopes in Sand
4) Coarse-grained Sand Beaches
5) Mixed Sand and Gravel Beaches
6A) Gravel Beaches
6B) Riprap
7) Exposed Tidal Flats
8A) Sheltered Rocky Shores
8B) Sheltered, Solid Man-made Structures
8C) Sheltered Riprap
9A) Sheltered Tidal Flats
9B) Vegetated Low Banks
10A) Salt- and Brackish-water Marshes
10B) Freshwater Marshes
10C) Swamps
10D) Scrub-Shrub Wetlands

For each of these shoreline types, a photo and description of the physical attributes, predicted oil behavior, and response considerations is included at the end of the introductory pages.

SENSITIVE BIOLOGICAL RESOURCES

Biological information presented in this atlas was collected, compiled, and reviewed with the assistance of biologists and resource managers from the following institutions:

- Atlantic States Marine Fisheries Commission
- Coastal Research and Education Society of Long Island
- Connecticut Department of Agriculture
- Connecticut Department of Energy and Environmental Protection
- Connecticut Natural Diversity Database
- Cornell University Cooperative Extension Service
- Long Island Sound Study
- Manomet Center for Conservation Sciences
- National Audubon Society
- National Oceanic and Atmospheric Administration
- New York State Department of Environmental Conservation
- New York State Department of State
- New York State Natural Heritage Program
- Peconic Bay Estuary Program
- Riverhead Foundation for Marine Research and Preservation
- Saltmarsh Habitat and Avian Research Program
- The Maritime Aquarium at Norwalk
- The Nature Conservancy
- United States Fish and Wildlife Service
- United States Geological Survey

The above institutions provided the majority of the biological information included in the atlas. A full list of data contributors can be found in the sources table and also in the metadata accompanying the digital atlas product.

The biological resources shown in this atlas were extracted from the ESI GIS data compiled for this region. The extracted features were mapped at scale of 1:50,000 and appear on the maps referenced by a combination of number and letter. For example, Map 1B will show the biological features in conjunction with the ESI shoreline. The biology on these maps is “layered” in the PDF files. This allows the user to turn off the biological features to more clearly see the underlying shoreline and habitat polygons.

KEY BIOLOGICAL FEATURES ON ESI MAPS

1) Occurrences of animal and plant species that are at risk to spilled oil or may be impacted during a spill response are represented in the database by polygons, points, and lines.
2) To avoid clutter, the front of the map features occurrences that cover less than 10 kilometers of the map extent. A Map ID is associated with each of these polygonal, linear or point features.
3) Each map includes a tabular report summarizing the species found in the area. Features that are shown on the map are referenced by their Map ID. Features that cover more than 10 kilometers are presented in the report as Widespread in Mapped Area. Species occurrences that appear in the database as General Distribution are listed in a third category, Also Present in Mapped Area. To fully understand the diversity of species present, ALL sections of the map report should be reviewed.
4) Associated with each species in the table is the state (S) and federal (F) protected status as threatened (T) or endangered (E), as well as concentration, seasonality, and life-history information. Federal listings were provided by USFWS. State listings were provided by NatureServe.
5) The table includes a Mapping Qualifier with each species record (see table of mapping qualifiers and guidelines below). The mapping qualifier should help users understand particular vulnerabilities associated with the map data.
6) Feature level source information is included in the GIS database used to create these maps. The GIS data also provides the extent polygons for all mapped features; it can be queried, filtered, and used with other GIS datasets.
7) Species have been divided into groups and subgroups based on their behavior, morphology, taxonomic classification, and spill vulnerability and sensitivity. The icons below reflect this grouping scheme.
8) Colors depicting monthly seasonality roughly reflect Winter/Spring/Summer/Fall, but are primarily intended to ease readability.

MARINE MAMMAL


Dolphin


Pinniped


Whale

TERRESTRIAL MAMMAL


Bat


Small Mammal

HERPETOFAUNA


Amphibian/ Snake


Turtle

BIRD


Alcid/Pelagic


Diving Bird


Gull/Tern


Passerine


Raptor


Shorebird


Wading


Waterfowl

HABITAT


Upland /Wetland/Plant


FAV

INVERTEBRATE


Bivalve


Cephalopod


Crab/Invertebrate/ Shellfish


Gastropod


Insect


Shrimp


Lobster

FISH


Fish


Nursery

Mapping Qualifiers and Guidelines

Element	Qualifier	Guidelines
All	Concentration Area	Areas where concentrations are considerably higher than other records of the same species in the area of interest.
All	General Distribution	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features.
All	Vulnerable Occurrence	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response.
Birds, Herpetofauna, Marine Mammals, Fish, Invertebrates	Migration	Used when an area is a known staging area of high importance to the species for birds; and/or areas are potential or known migration corridors in the marine environment for other elements.
Birds, Herpetofauna	Nesting	Applicable to all nesting birds and herps. Should represent known nesting areas rather than all potential nesting habitat.
Birds	Rafting	Similar to 'Concentration Area' qualifier, but specific to large on-water concentrations.
Birds	Wintering	Designates known areas of importance to wintering birds.
Benthic	High Ecological Value	For use in areas where benthic organisms provide high ecological services, high quality habitat, or known areas of high biodiversity.
Fish and Invertebrates	Harvest Area	May be used as a qualifier for distributions in special cases, where the general distribution was not mapped and/or widespread and the distribution of the harvested resources is used to depict important areas.
Fish and Invertebrates	Nursery Area	Refers to specific areas of known importance to early life history stages (e.g., larvae, juveniles) of a species.
Fish and Invertebrates	Spawning Area	Areas where animals are spawning. Spawning is loosely defined as the release of gametes or eggs from the adult.

MARINE MAMMALS

Marine mammals depicted in this atlas include seals, dolphins and whales. The most common seal found in the atlas area is the harbor seal. Harbor seals have established several regular haul out sites in Long Island. Harbor seals generally start showing up in Long Island Sound around late August in small numbers and then in larger numbers later in the fall and will stay through the winter months and into March. By April most will have left the area but a few will still be present. The harbor seal population is noted to have been steadily increasing in recent years. In Long Island Sound, harbor seals typically haul out on the sheltered parts of offshore rocky ledges and boulders during low tide. Gray seals are also common but not nearly as abundant as the harbor seal, except on Little Gull Island where they have established a year round haul out. Gray seals may be expected to be sighted in low numbers wherever harbor seals haul out and may be present year round. Other seal species that may occasionally show up in Long Island but not mapped here are harp and hooded seals. When they are sighted, it is usually among the many harbor seals at seal haul out sites.

Small numbers of bottlenose dolphin sightings are possible throughout Long Island Sound from May through September. Large pods of dolphins (75 – 150 individuals) enter the sound on occasion, most likely attracted by large schools of bait fish. These larger occurrences are unpredictable and usually occur many years apart (2015 and 2009 most recently). Although harbor porpoises are known to frequent the waters of Long Island Sound, there are no existing surveys and very little is known about their actual numbers or distribution. The common dolphin, saddle-backed dolphin and Atlantic white sided dolphin are not considered common in Long Island Sound, although they may be occasionally sighted.

The only regular sightings of whales occur in the far eastern part of Long Island Sound, where humpback and right whales are known to occur with some frequency. For the most part whale occurrences are uncommon and unpredictable in rest of the sound. Humpback, beluga, minke, long finned pilot and finback whales all have been occasionally spotted, separated by many years at a time, and there is no predictability for when they might enter the sound.

Also, it should be noted that a Florida Manatee will occasionally (once every several years) stray into Long Island Sound during the warm summer months.

Expert contacts for Long Island Sound marine mammals* are:

Name	Agency	Location	Phone	Species
Arthur Kopelman	Coastal Research and Education Society of Long Island	West Sayville, NY	631-319-6003	Marine mammals
Robert DiGiovanni	Riverhead Foundation for Marine Research	Riverhead, NY	631-369-9840	Marine mammals
Joseph Schnierlein	The Maritime Aquarium at Norwalk	Norwalk, CT	203-852-0700	Marine mammals
Janelle Schuh	Mystic Aquarium	Mystic, CT	860-572-5955	Marine mammals

***Note: this list is not meant to represent all marine mammal experts for the region.**

Major Data Sources Used: Marine Mammals

Riverhead Foundation for Marine Research and Preservation. 2015. Seal haulout sites around Long Island, NY and CT. Riverhead, NY, PDF map.

Coastal Research and Education Society of Long Island, Dr. Arthur Kopelman. 2015. Whales, dolphins and seals of Long Island Sound. West Sayville, NY, expert knowledge.

The Maritime Aquarium at Norwalk. 2016. Seal cruise count data. Norwalk, CT, spreadsheet.

BIRDS

Birds displayed in this atlas include: alcids, diving birds, gulls, terns, passerines, pelagic birds, raptors, shorebirds, wading birds, and waterfowl. Species that are federally and state listed, and those that are considered at risk due to oil spills or other potential disasters are included. Particular focus was paid to identifying "special use areas" such as migratory or wintering areas, nesting sites, concentration areas, roosting areas, and vulnerable occurrences.

Colonial waterbirds, shorebirds, and wading birds – Data for this species group came primarily from US Fish and Wildlife Service, New York Natural Heritage Program, Saltmarsh Habitat and Avian Research Program, Connecticut Natural Diversity Database, International Shorebird Survey, and New York State Significant Coastal Fish and Wildlife Habitats.

Waterfowl – Data for these species came primarily from US Fish and Wildlife Service, Mid-Winter Waterfowl Survey, the US Geological Survey Compendium of Avian Occurrence Information, and New York Significant Coastal Fish and Wildlife Habitats.

Seabirds – Data on the distribution of Seabirds was primarily provided by the US Geological Survey Compendium of Avian Occurrence Information.

Expert contacts for Long Island Sound birds* are:

Name	Agency	Location	Phone	Species
Patrick Comins	Connecticut Audubon Society	Southbury, CT	203-405-9115	CT birds
Karen Zyko	CT Natural Diversity Database	Hartford, CT	860-424-3585	CT birds
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	NY birds
Chris Elphick	University of Connecticut	Storrs, CT	860-486-4547	Saltmarsh species

***Note: this list is not meant to represent all bird experts for the region.**

Major Data Sources Used: Birds

CT Department of Energy and Environmental Protection. 2015. CT Natural Diversity Database, vector digital data.

NYS Natural Heritage Program. 2015. NYS NHP Biodiversity Database, vector digital data.

Connecticut Audubon Society. 2014. Expert input.

Manomet Center for Conservation Sciences. 2014. International Shorebird Survey. Vector digital data.

Saltmarsh Habitat and Avian Research Program. 2014. Vector digital data.

New York Department of State. 2014. Significant Fish and Coastal Wildlife Habitats. Vector digital data.

U.S. Fish and Wildlife Service. 2014. Mid-Winter Waterfowl Survey. Vector digital Data.

U.S. Geological Survey. 2014. Compendium of Avian Occurrence Information for the Continental Shelf Waters Along the Atlantic Coast of the United States. Vector digital data.

New York State Department of Environmental Conservation. 2014. Long Island Coastal Waterbird Survey. Vector digital data.

HERPETOFAUNA

Reptiles - All of the sea turtles in the Long Island Sound atlas area are federally protected threatened/endangered species. Juvenile loggerhead, Kemp's ridley, and green sea turtles regularly migrate to the waters of Long Island Sound for foraging during the warmer months from late June through late fall. Leatherback sea turtles only make use of the far eastern end of the Long Island Sound atlas area (east of Fishers Island). Sea turtles are not known to nest in any of the Long Island Sound area.

Terrestrial turtles that are state species of special concern that were mapped for this atlas include the diamondback terrapin, spotted turtle, Eastern box turtle, and wood turtle. In addition, the Eastern mud turtle is a state endangered species in New York. The diamondback terrapin has also been identified as a species of greatest conservation need in the Northeast United States. The Eastern hog-nosed snake is a state species of concern in both New York and Connecticut. The common wormsnake is a species of concern in New York only.

Amphibians - The Southern leopard frog, Northern leopard frog, Eastern spadefoot toad, marbled salamander, and blue-spotted salamander are all state species of concern in one or both states. The tiger salamander is a state endangered species in the New York portion of the study area.

Expert contacts for Long Island Sound reptiles and amphibians* are:

Name	Agency	Location	Phone	Species
Arthur Kopelman	Coastal Research and Education Society of Long Island	West Sayville, NY	631-319-6003	Sea turtles
Robert DiGiovanni	Riverhead Foundation for Marine Research	Riverhead, NY	631-369-9840	Sea turtles
Janelle Schuh	Mystic Aquarium	Mystic, CT	860-572-5955	Sea turtles
Karen Zyko	CT Natural Diversity Database	Hartford, CT	860-424-3585	Reptiles and amphibians
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	Reptiles and amphibians
Russell Burke	Hofstra University	Hempstead, NY	516-463-5521	Terrapins
Mike Bottini	Long Island Nature Organization	Upton, NY	631-267-5228	Spotted Turtles

***Note: this list is not meant to represent all reptile/amphibian experts for the region.**

Major Data Sources Used: Reptiles and Amphibians

CT Department of Energy and Environmental Protection. 2015. CT Natural Diversity Database. Hartford, CT, vector digital data.

NYS Natural Heritage Program. 2015. NYS NHP Biodiversity Database. Albany, NY, vector digital data.

NYS Department of State. 2013. Significant Coastal Fish and Wildlife Habitats of New York. Albany, NY, vector digital data.

FISH

Species selected - Eighty nine species of fish are represented in this atlas, but this is not intended to include all species present within the study area. Fish species depicted in this atlas include select marine, estuarine, diadromous, and freshwater species. Species of conservation interest, ecological importance, or commercial or recreational importance are emphasized. In most cases, terms to describe species abundance include the commonly used terms of rare, common, and abundant.

Spatial framework – The central features of the study area include Long Island Sound, one of the Nation's largest estuaries, and adjacent waters. Fish polygons were created based on the natural geography of the estuarine, tidal, and fresh waters of the study area, combined with species information from published reports, field survey data (e.g. trawl and seine), and expert knowledge. The HYDROLOGY layer in this ESI digital atlas, derived from recent aerial imagery, defined the shoreline of Long Island Sound and tidal tributaries, generally up to the extent of tidal influence and/or the first barrier upstream. Rather than adopt a grid cell spatial framework, we divided the estuarine seascape of the study area into commonly

used units including Eastern, Western, and Central Basins of Long Island Sound; Western and Eastern Narrows; Fishers Island Sound; Gardiners Bay; Peconic Bay; and Block Island Sound. Coastal embayments were clipped from these mainstem areas and considered as distinct estuarine units along the New York and Connecticut shores. Major tributaries such as the Connecticut River were subdivided to reflect the salinity gradient within tidal areas, and to separate tidal from non-tidal waters upstream. Some areas were delineated based on known concentrations of high-priority species using GIS data provided by regional experts (CT DEEP 2015a,b,c,d; NYS NHP 2015). Additional non-tidal fresh water bodies (i.e. lakes and streams) were adopted from the HYDROLOGY layer in cases where information was available to attribute these inland polygons with fish species (Jacobs and O'Donnell 2009, 2012; NYS DEC 2015 a, b). In some cases, stream polygons were developed by buffering a stream line feature to create a 10m-wide polygon. In all, the distributions of 89 fish species within the study area are represented by 614 polygons. A total of 75 sources were cited to develop the FISH layer.

Atlantic and shortnose sturgeon – Atlantic and shortnose sturgeon (both Federal and State Endangered) were mapped to areas where they are known to occur in rivers and estuarine waters of the study area, primarily in Connecticut River (SSSRT 2010) and certain estuarine areas. Areas where Atlantic sturgeon are known to congregate in Long Island Sound are based on GIS data provided by CT DEEP and NYS DEC staff, published literature, and expert knowledge (CT DEEP 2015c, Anderson et al. 2015, Savoy and Pacileo 2003, Waldman et al. 2013).

Alewife, blueback herring, American shad, and other diadromous species - Alewife and blueback herring (collectively known as river herring), and American shad are anadromous fish that once supported large commercial and recreational fisheries on the Atlantic Coast, but have become depleted due to barriers to migration, habitat loss, and overfishing. Spawning runs were mapped using published information from NYS DEC and CT DEEP as well as knowledge from regional experts (Benway 2015, CRASC 2015; Greene et al. 2009; Hattala et al. 2011; Jacobs and O'Donnell 2009, 2012; Savoy et al. 2004; Young 2013). River herring runs were mapped to the first known barrier such as a dam or impassable gradient, unless a fish passage facility is known to exist. If the run went beyond the water features in the ESI HYDROLOGY layer, then it was mapped using stream line features and buffered to create a 10m-wide polygon feature. These areas are designated with "Spawning Area" and "Nursery Area" mapping qualifiers to emphasize these important life history stages. Tidal rivers and embayments that are important to early life stages of river herring and were included as nursery areas. River herring pre-spawning movements in certain rivers were mapped as migration areas. Timing of migration and spawning was based on published life history summaries. Other diadromous (migratory) species in the study area include American eel, striped bass, sea lamprey, hickory shad, and sea-run brown trout. These species were mapped using published information from CT DEEP, NYS DEC, and other sources.

Long Island Sound mainstem areas –Major sources of information for fish in Long Island Sound include the published reports from the Long Island Sound Trawl Survey, conducted by Connecticut's Marine Fisheries Division in Old Lyme, CT (Gotschall and Pacileo 2015, Gotschall et al. 2000). A recent study by

The Nature Conservancy is based on these trawl survey data, and reports results on a per-species basis (Anderson et al. 2015). These sources were used to attribute fish species to the spatial framework polygons for Long Island Sound.

Coastal embayments - For the coastal embayments on the New York shore, NYSDEC staff provided Western Long Island (WLI) beach seine data for 1984 – 2013 that was used to develop species lists and concentrations for individual bays (NYS DEC 2014b). The WLI surveys are conducted from May to October and sampling stations are fixed locations based on accessibility. Bays surveyed include Little Neck Bay, Manhassett Bay, Hempstead Harbor, Oyster Bay, Stony Brook Harbor, Port Jefferson Harbor, and Peconic Bay. Trawl survey data were also provided for Peconic Bay (NYS DEC 2014a), and results were used to identify fishes and invertebrates common to that estuary. New York Department of State has designated certain areas as "Significant Coastal Fish and Wildlife Habitat", and published assessments with information on fish, invertebrate, and wildlife species present (NYDS 2015). These narratives were used to supplement fish survey data for many areas, especially coastal embayments and shoals. For the coastal embayments and tidal tributaries on the Connecticut Shore, results of the Connecticut Beach Seine Surveys, Inshore Surveys, and other site-specific sources were applied (Molnar and Howell 2015, Howell 2015, Benway 2015).

Freshwater fishes in New York - Two state-listed freshwater fish species, the banded sunfish (NY state threatened), and swamp darter (NY state threatened), occur in the portions of the Peconic River system on Long Island and was mapped using New York State Natural Heritage Program data (NYS NHP 2015). Other fish species in freshwater streams, lakes, and ponds of Long Island were mapped using information published by New York Dept. Environmental Conservation (NYS DEC 2015 a, b), and also in the Bronx River (Rachlin et al. 2007, Bronx River Alliance 2015). Seasonality and was described using published summaries of life history parameters.

Freshwater fishes in Connecticut - State freshwater fish species within the study area that are either listed or special concern in Connecticut include the banded sunfish (CT state special concern), blueback herring (CT state special concern), American brook lamprey (CT state endangered), bridle shiner (CT state special concern), and rainbow smelt (CT state endangered). These species were mainly mapped using GIS data from Connecticut's Natural Heritage Program (CT DEEP 2015), supplemented with other sources (CT DEEP 2015a; Jacobs and O'Donnell 2009, 2012). Other fish species in freshwater streams, lakes, and ponds of Connecticut were mapped using information published by Connecticut's Dept. of Environmental Conservation and other sources (CT DEEP 2015e, Jacobs and O'Donnell 2009, 2012; Jacobs et al. 2004). Seasonality was described using published summaries of life history parameters.

Expert contacts for Long Island Sound fish* are:

Name	Agency	Location	Phone	Species
Penny Howell	CT Dept. Energy & Environmental Protection	Old Lyme, CT	860-447-4307	CT marine and estuarine fish
Deb Pacileo	CT Dept. Energy & Environmental Protection	Old Lyme, CT	860-447-4312	CT marine and estuarine fish
Karen Zyko	CT Natural Diversity Database	Hartford, CT	860-424-3585	CT marine and estuarine fish
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	NY marine and estuarine fish
Eileen O'Donnel	CT Dept. Energy & Environmental Protection	Hartford, CT	860-424-4177	CT freshwater and anadromous fish
Kim McKown	NY State Dept. Environmental Conservation	East Setauket, NY	631-444-0454	NY marine and estuarine fish
Byron Young	NY State Dept. Environmental Conservation (retired)	East Quogue, NY	631-294-9612	NY anadromous fish
John Maniscalco	NY State Dept. Environmental Conservation	East Setauket, NY	631-444-0437	NY marine and estuarine fish

***Note: this list is not meant to represent all fish experts for the region.**

Major Data Sources Used: Fish

Anderson, M., N. Frohling, K. Ruddock, S. Lloyd, and N. Maher. 2015. The Long Island Sound Ecological Assessment. The Nature Conservancy, New Haven CT. 89 pp. + appendices and digital data sets.

Benway, J.M. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 7: American shad monitoring and inshore seine surveys. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 22 pp.

Bronx River Alliance. 2015. Alewife Herring: An Anadromous Fish in the Bronx River. Bronx River Alliance. 16 pp.

CRASC. 2015. River Herring Restoration Status and Plans in the Connecticut River Basin. Connecticut River Atlantic Salmon Commission. U.S. Fish and Wildlife Service, Connecticut River Coordinator's Office, Sunderland MA. Technical Subcommittee for River Herring. February 10, 2015.

Connecticut Department of Energy and Environmental Protection. 2015a. Connecticut Freshwater Fish Distribution. GIS Data. Provided by E. O'Donnell, Hartford, CT

Connecticut Department of Energy and Environmental Protection. 2015b. Marine Recreational Fishing Areas in Connecticut. GIS Data. Provided by D. Pacileo, Old Lyme, CT.

Connecticut Department of Energy and Environmental Protection. 2015c. Sturgeon Gear Restriction Areas. GIS Data. Provided by D. Pacileo, Old Lyme CT.

Connecticut Department of Energy and Environmental Protection. 2015d. Connecticut Natural Diversity Database, vector digital data.

Connecticut Department of Energy and Environmental Protection. 2015e. 2015 Connecticut Angler's Guide – Inland and Marine Fishing. 60 pp. www.ct.gov/deep/fishing

Gephard, S., and J. McMenemy. 2004. An Overview of the Program to Restore Atlantic Salmon and Other Diadromous Fishes to the Connecticut River with Notes on the Current Status of these Species in the River. Pp. 287-317 in Jacobson, P.M. et al (eds). The Connecticut River ecological study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003. Monograph 9, American Fisheries Society, Bethesda MD.

Gotschall, K.F., and D. Pacileo. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 5: Marine Finfish Survey. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 142 pp.

Gotschall, K.F., M.W. Johnson, and D.G. Simpson. 2000. The Distribution and Size Composition of Finfish, American Lobster, and Long-Finned Squid in Long Island Sound Based on the Connecticut Fisheries Division Bottom Trawl Survey, 1984–1994. NOAA Technical Report NMFS 148. 195 pp.

Greene, K.E., J.L. Zimmerman, R.W. Laney, and J.C. Thomas-Blate. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. ASMFC Habitat Management Series No. 9. Report + CD-ROM with digital GIS data. Atlantic States Marine Fisheries Commission, Washington, DC.

Hattala, K.A., A. Kahnle, and R.D. Adams. 2011. Sustainable Fishing Plan for New York River Herring Stocks. New York State Dept. Environmental Conservation. Submitted for review to the Atlantic State Marine Fisheries Commission.

Howell, P., and D. Molnar. 2004. Stock Assessment of White Perch in the Lower Connecticut River. Pp. 379-390 in Jacobson, P.M. et al (eds). The Connecticut River ecological study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003. Monograph 9, American Fisheries Society, Bethesda MD.

Howell, P.T. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 9: Volunteer estuarine fisheries database. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 14 pp.

Jacobs, R.P., and E.B. O'Donnell. 2012. A Fisheries Guide to Lakes and Ponds of Connecticut, Including the Connecticut River and its Coves. Bulletin 35, Connecticut Dept. Environmental Protection, Hartford CT. 354 pp.

Jacobs, R.P., and E.B. O'Donnell. 2009. A Pictorial Guide to Freshwater Fishes of Connecticut. Connecticut Dept. Environmental Protection, Bulletin 42. Hartford CT. 242 pp.

Jacobs, R.P., W.A. Hyatt, N.T. Hagstrom, E.B. O'Donnell, E.C. Schluntz, P. Howell, and D.R. Molnar. 2004. Trends in Abundance, Distribution, and Growth of Freshwater Fishes from the Connecticut River in Connecticut (1988-2002). Pp. 319-343 in Jacobson, P.M. et al (eds). The Connecticut River ecological study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003. Monograph 9, American Fisheries Society, Bethesda MD.

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Socrates, J.B. 2010. A Study of Striped Bass in the Marine District of New York State. New York State Dept. Environmental Conservation, Bureau of Marine Resources, Albany NY. May 2010. 82 pp.

SSSRT. 2010. A Biological Assessment of shortnose sturgeon (Acipenser brevirostrum). Prep. By Shortnose Sturgeon Status Review Team. Report to National Marine Fisheries Service, Northeast Regional Office. November 1, 2010. 417 pp.

Stone, S.L., T.A. Lowery, J.D. Field, S.H. Jury, D.M. Nelson, M.E. Monaco, C.D. Williams, and L.A. Andreasen. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. ELMR Rep. No. 12. NOAA/NOS SEA Division, Silver Spring MD. 280 p.

Waldman, J.R., T. King, T. Savoy, L. Maceda, C. Grunwald, I. Wirgin. 2013. Stock Origins of Subadult and Adult Atlantic Sturgeon, Acipenser oxyrinchus, in a Non-natal Estuary, Long Island Sound. Estuaries and Coasts 36: 257-267.

Young, B. 2013. Alewife Monitoring Report for the Peconic River and Alewife Creek – 2013. Peconic River Fish Restoration Commission. 18 pp.

INVERTEBRATES

Thirty-three species of invertebrates are represented in this atlas, and this is not intended to include all species present within the study area. Species were selected based on conservation interest (i.e. endangered, threatened, or special concern), ecological importance, or commercial or recreational importance. Mollusk species include nine bivalves, one cephalopod (longfin squid), and one gastropod (channeled whelk). Ten insect species are included, most of which are considered rare, threatened, or endangered. Other arthropod species include seven decapod crabs, three shrimps, horseshoe crab, and American lobster. In all, a total of 698 polygons are used to represent the distributions of the 33 selected invertebrate species. A total of 29 sources were cited to develop the invertebrate data set.

Distributions of rare, endangered, or threatened invertebrate species (e.g., coastal barrens buckmoth, scarlet bluet) were represented by developing polygons based on information provided state Natural Heritage Programs in both Connecticut and New York (CT DEEP 2015, NYS NHP 2015). Locations of horseshoe crab spawning areas were identified from published reports and digital GIS data provided by regional experts (Cornell Univ. 2016, Molloy Coll. 2015, Sacred Heart Univ. 2016).

Bivalve shellfish species in inshore waters include blue and ribbed mussels, bay scallop, eastern oysters, quahog (hard clam), softshell clam, and Atlantic surf clam. In New York portions of Long Island Sound and embayments, these species were largely mapped based on landings data and harvest zone polygons provided by NYS Department of Conservation (NYS DEC 2013). Bivalve shellfish in areas along the

Connecticut shore were largely mapped using polygon representations of shellfish beds provided by CT Department of Agriculture – Bureau of Aquaculture (CT Dept. Ag. 2016).

In mainstem areas of Long Island Sound, information on invertebrate species was provided by published reports from the Long Island Sound Trawl Survey, conducted by Connecticut's Marine Fisheries Division in Old Lyme, CT (Gotschall and Pacileo 2015). A recent study by The Nature Conservancy is based on these trawl survey data, and presents results on a per-species basis (Anderson et al. 2015). Invertebrate species featured in these sources include American lobster, longfin squid, horseshoe crab, and others.

In coastal embayments of the New York shore, Western Long Island (WLI) beach seine survey data (provided by NYSDEC staff) reported catch of invertebrate species as well as fishes (NYS DEC 2014b). Areas surveyed include Little Neck Bay, Manhassett Bay, Hempstead Harbor, Oyster Bay, Stony Brook Harbor, Port Jefferson Harbor, and Peconic Bay. Beach seine methods are especially effective for inshore species including blue crab, green crab, horseshoe crab, and spider crabs. Trawl survey data were also provided for Peconic Bay, with lady crab, spider crabs, blue crab, mantis shrimp, horseshoe crab, and longfin squid prominent in the catch (NYS DEC 2014a). New York Department of State's assessments of "Significant Coastal Fish and Wildlife Habitat" provided additional information on invertebrate species present in specific areas (NYDS 2015). For the coastal embayments and tidal tributaries on the Connecticut shore, results of the Connecticut Beach Seine Surveys, Inshore Surveys, and other site-specific surveys were applied (Howell 2015, Molnar and Howell 2015, Fell et al. 2003).

Expert contacts for Long Island Sound invertebrates* are:

Name	Agency	Location	Phone	Species
David Carey	CT Dept. of Agriculture, Bureau of Aquaculture	Milford, CT	203-874-0696	CT Shellfish
Jennifer O'Dwyer	NY Department of Environmental Conservation	East Setauket, NY	631-444-0489	NY Shellfish
Kim McKown	NY State Dept. Environmental Conservation	East Setauket, NY	631-444-0454	NY Estuarine Invertebrates
John Tanacredi	Malloy College/CERCOM	Rockville Centre, NY	516-323-3591	NY Horseshoe Crabs
Matthew Sclafani	Cornell University Cooperative Extension	Riverhead, NY	631-727-7850	NY Horseshoe Crabs
Jennifer Mattei	Sacred Heart University	Fairfield, CT	203-365-7577	CT Horseshoe Crabs
Karen Zyko	CT Natural Diversity Database	Hartford, CT	860-424-3585	CT Rare Insects
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	NY Rare Insects

***Note: this list is not meant to represent all invertebrate experts for the region.**

Major Data Sources Used: Invertebrates

Anderson, M., N. Frohling, K. Ruddock, S. Lloyd, and N. Maher. 2015. The Long Island Sound Ecological Assessment. The Nature Conservancy, New Haven CT. 89 pp. + appendices and digital data sets.

Cornell University Cooperative Extension Service. 2016. New York horseshoe crab monitoring network sites, web site. http://www.nyhorseshoecrab.org.

Connecticut Department of Energy and Environmental Protection. 2015. Connecticut Natural Diversity Database, vector digital data.

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Gotschall, K.F., and D. Pacileo. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 5: Marine Finfish Survey. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 142 pp.

Gotschall, K.F., M.W. Johnson, and D.G. Simpson. 2000. The Distribution and Size Composition of Finfish, American Lobster, and Long-Finned Squid in Long Island Sound Based on the Connecticut Fisheries Division Bottom Trawl Survey, 1984–1994. NOAA Technical Report NMFS 148. 195 pp.

Howell, P.T. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 9: Volunteer estuarine fisheries database. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 14 pp.

Malek, A., M. LaFrance, and J. King. 2010. Fisheries Ecology in Rhode Island and Block Island Sounds for the Rhode Island Special Area Management Plan. University of Rhode Island, Narragansett RI. Technical Report #14. November 30, 2010. 57 pp.

Malloy College/CERCOM. 2015. Horseshoe crab spawning areas in Long Island, vector digital data.

Molnar, D.R., and P.T. Howell. 2015. A Study of Marine Recreational Fisheries in Connecticut. Job 8: Estuarine seine survey. Connecticut Dept. Energy and Environmental Protection, Bureau of Natural Resources, Marine Fisheries Division, Hartford CT. Federal Aid in Sport Fish Restoration, F-54-33 Annual Performance Report, March 1, 2013 – February 28,2014. 28 pp.

New York Department of State. 2015. Significant Coastal Fish and Wildlife Habitats – Long Island Sound and Long Island. New York State, Department of State, Office of Planning and Development. http://www.dos.ny.gov/opd/programs/consistency/scfwhabitats.html#li

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New York State Department of Environmental Conservation. 2014b. Western Long Island Sound Beach Seine Survey. Microsoft Access digital database, provided by J. Maniscalco, New York Dept. Environmental Conservation, Marine Fisheries Division, East Setauket, NY.

New York State Department of Environmental Conservation. 2013. New York shellfish harvest areas, vector digital data.

New York State Natural Heritage Program. 2015. New York State Natural Heritage Program, Biodiversity Database, vector digital data.

Sacred Heart University. 2016. Project Limulus juvenile horseshoe crab spawning density, document.

Stone, S.L., T.A. Lowery, J.D. Field, S.H. Jury, D.M. Nelson, M.E. Monaco, C.D. Williams, and L.A. Andreasen. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. ELMR Rep. No. 12. NOAA/NOS SEA Division, Silver Spring MD. 280 p.

HABITATS

Plant species that are threatened, endangered or species of concern were mapped in this atlas. Submerged aquatic vegetation was mapped under the Benthic section. The plant data included in the atlas is based primarily on digital data obtained from the state natural heritage programs.

Expert contacts for Long Island Sound habitats* are:

Name	Agency	Location	Phone	Species
Karen Zyko	CT Natural Diversity Program	Hartford, CT	860-424-3585	CT Plants
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	NY Plants

***Note: this list is not meant to represent all rare plant experts for the region.**

Major Data Sources Used: Habitats

CT Department of Energy and Environmental Protection. 2015. CT Natural Diversity Database, vector digital data.

NYS Natural Heritage Program. 2015. NYS NHP Biodiversity Database, vector digital data.

BENTHIC

Benthic plant species that are threatened, endangered or species of concern were mapped in this atlas.

Expert contacts for Long Island Sound benthic organisms* are:

Name	Agency	Location	Phone	Species
Ralph Tiner	US Fish and Wildlife Service Northeastern Region	Hadley, MA	413-253-8200	Eelgrass
Alison Branco	Peconic Estuary Program	Yaphank, NY	631-852-5805	Eelgrass
Karen Zyko	CT Natural Diversity Program	Hartford, CT	860-424-3585	CT rare benthic organisms
Nick Conrad	NY Natural Heritage Program	Albany, NY	518-402-8944	NY rare benthic organisms

***Note: this list is not meant to represent all benthic organism experts for the region.**

Major Data Sources Used: Benthic

CT Department of Energy and Environmental Protection. 2015. CT Natural Diversity Database, vector digital data.
NYS Natural Heritage Program. 2015. NYS NHP Biodiversity Database, vector digital data.
Peconic Estuary Program. 2014. Peconic Eelgrass Mapping 2014 Groundtruthed Final, vector digital data.

TERRESTRIAL MAMMALS

With regard to oil or chemical spills, the most noteworthy terrestrial mammals found in the Long Island Sound study area are the semi-aquatic mammals, which include the northern river otter, muskrat, mink and beaver. There are notable differences in populations of these mammals between the Connecticut coastal area and Long Island in New York.

The northern river otter (*Lontra Canadensis*) had previously been extirpated from Long Island, but recently has re-established a breeding population. The area from Oyster Bay east through the Nissequogue River have definite established populations and this area has been mapped as a vulnerable occurrence. Additionally, experts believe recolonization is actively occurring in the entire Long Island portion of the study area, so all bays, coves, marshes, tidal creeks and adjacent freshwater bodies should be considered to potentially have resident river otters, especially eastward all the way toward Orient Point. In Connecticut, the River Otter population is considered healthy and they should be considered as potentially present in all coastal areas where there are riverine, tidal creek, marsh and nearshore freshwater pond environments.

In both Connecticut and New York, the muskrat is considered ubiquitous in all nearshore aquatic environments including fresh and estuarine marshes, riverine environments and freshwater ponds and

upper reaches of salt ponds. Because of their ubiquitous nature, the muskrat is not mapped in this atlas, however, they should be considered as potentially present in all of the above mentioned environments.

Along the Connecticut coastal area, mink are less common than the muskrat, but may be present anywhere where muskrat are found. On Long Island they are also present wherever muskrat may be found, but very uncommon. Mink are not mapped in this atlas due to lack of reliable distribution information.

The beaver while widely distributed in Connecticut, has been extirpated from Long Island. Reliable distribution data for the Connecticut population is not available and therefore beaver is not mapped here. Beavers however should be considered possibly present in the riparian zone anywhere in the Connecticut portion of the study area.

Also noteworthy is the least shrew (*Cryptotis parva*), a state endangered small mammal found only in a small part of the Connecticut coastal area. The New England Cottontail is a US Fish and Wildlife Service candidate listing species. The red bat, silver-haired bat, and hoary bat all are a species of special concern in Connecticut.

Expert contacts for Long Island Sound terrestrial mammals* are:

Name	Agency	Location	Phone	Species
Karen Zyko	CT Natural Diversity Database	Hartford, CT	860-424-3585	CT Terrestrial Mammals
Mike Bottini	Long Island Nature Organization	Upton, NY	631-267-5228	NY Terrestrial Mammals

***Note: this list is not meant to represent all terrestrial mammal experts for the region.**

Major Data Sources Used: Terrestrial Mammals

CT Department of Energy and Environmental Protection. 2015. CT Natural Diversity Database, vector digital data.
Long Island Nature Organization. 2016. Terrestrial Mammals on Long Island, expert knowledge.

INVASIVE SPECIES

The spread of invasive or non-native species can degrade habitat, increase the potential for crop damage and diseases in humans, livestock and natural resources, reduce biodiversity through competition and limit recreational opportunities. Invasive species often opportunistically spread after disturbance events alter the natural landscape. Oil spill response and clean up often alters the landscape in a manner conducive to the spread of invasive species as crews often mobilize from all over the U.S. in response to large scale spill events. Boats, trailers, waders and clean up equipment can spread invasive species from waterbody to waterbody unless properly cleaned after use. Invasive species that were mapped are shown on the HUMAN-USE RESOURCE maps.

Boats, trailers, waders and other fishing equipment can spread invasive species from waterbody to waterbody unless properly cleaned after use. Regulations prohibit boats from launching from or leaving DEC launch sites without first draining the boat and cleaning the boat, trailer and equipment of visible plant and animal material. Many New York counties, towns and villages also have laws in place that prohibit the transport of aquatic invasive species on boats, trailers and equipment.

Asiatic sand sedge and water chestnut are invasive species of particular concern to land managers in this AOI. Asiatic sand sedge is an exotic plant that threatens beaches and the rare species that rely on them such as seabeach amaranth and piping plover. It was recently discovered in New York on Staten Island and Long Island following Hurricane Sandy and a large effort is underway to eradicate it. Invasive plants can also form dense monocultures that could impede oil spill response. Water chestnut, a freshwater invasive floating aquatic plant, forms thick, impenetrable mats in June and July. Invasive species are not included on the ESI maps as they are not priority resources for protection, but planners and responders should be aware of their presence and coordinate response activities with the appropriate invasive species coordinator and/or land manager to prevent the spread of these species.

New York Invasive Species Information: http://www.nyis.info/index.php

Connecticut Invasive Species Information:
http://www.ct.gov/deep/cwp/view.asp?a=2702&q=323494&deepNav_GID=1641%20

Invasive species that were mapped are shown on the HUMAN-USE RESOURCE maps.

WILDLIFE REHABILITATION

The following contact provides veterinary care and/or retrieval of wildlife adversely affected by an event:

Tri-State Bird Rescue & Research. 170 Possum Hollow Road, Newark, DE 19711. (302)-737-9543.

HUMAN-USE RESOURCES

The human-use resources shown in this atlas were extracted from the ESI GIS data compiled for this region. The extracted features were mapped at scale of 1:100,000 and appear on the maps referenced by a number. For example, Map 1 will show the human-use features in conjunction with the ESI shoreline.

Management areas such as wildlife refuges and state parks are mapped as polygons. Where the feature is a known point location (e.g., marinas, airports, water intakes), the specific location is displayed.

Map IDs can be found in the accompanying data tables for point and polygon features mapped. The Map ID may provide more information (i.e., name, contact) for that particular resource. The types of human use resources mapped in this atlas are depicted below.


Abandoned Vessel


Access


Airport


Anchorage

Aquaculture


Archaeological Sites

Army Corps of Engineers


Artificial Reef


Beach


Boat Ramp


Campground

Coast Guard


Commercial Fishing

EPA Facility

EPA Region


Essential Habitat

FEMA Region


Ferry


Fishery Area


Heliport


Historic Wreck


Historical Site


Landfill


Lock and Dam


Management Area


Marina


Military


Mine Site


National Landmark


Nature Conservancy

NOAA Facility


Park


Port


Recreational Fishing


Repeated Measurement Site


State Protected Area


Tribal Land


Waste Disposal


Water Intake


Wildlife Refuge

Abandoned Vessel: Data on locations of abandoned and derelict vessels comes from NOAA's Office of Coast Survey Automated Wrecks and Obstructions Information System (AWOIS)

Access: Vehicular or foot access locations to beach, wetland or river shoreline. Primarily public, but may include some private access points (as notated in the name).

Airport/Heliport: Refers to locations of airports, airfields, landing strips and standalone heliports, whether they are manned or unmanned.

Anchorage: Mapped as points or polygons, this refers to locations (or areas) where commercial vessels can be anchored offshore outside shipping lanes.

Aquaculture: Farmed and/or managed aquaculture/mariculture sites that may be impacted by oiling, natural disaster or cleanup activity.

Archaeological Site: Water, coastal, or wetland-associated archaeological sites.

Army Corps of Engineers: Mapped as polygons, this refers to the jurisdictional boundaries for the USACE.

Artificial Reef: Locations of reefs made out of man-made materials or natural materials purposely placed at a site for fishing or sport diving purposes.

Beach: High use recreational beach sites, typified by a nearby parking lot of substantial size, and likely (but not necessarily) other recreational beach amenities such as bath houses, life guard stations and food and drink concessions.

Boat Ramp: Publicly available boat ramps or launch sites.

Campground: Refers to public campgrounds.

Coast Guard: USCG jurisdictional boundaries (districts or sectors) and/or USCG stations locations.

Commercial Fishing: Important, high use sites, fished by commercial fishers on a regular basis.

Environmental Protection Agency Region: Jurisdictional boundaries for EPA regions.

Environmental Protection Agency Facility: Represents facilities required to file a Risk Management Plan (RMP) due to the presence of extremely hazardous substances that may result in a chemical accident. The data comes from the USEPA.

Essential Habitat: Significant habitats needed to support key life stages of ecological communities or species.

Federal Emergency Management Agency Region: Jurisdictional boundaries for FEMA regions.

Ferry: Mapped as points, this refers location of state and local ferry terminals. The data may come from state or local programs.

Ferry Route: Ferry routes were digitized by Quantum Spatial Inc. using the ESRI World Street Map.

Fishery Area: Mapped as points or polygons, this refers to defined areas or locations where fish or shellfish species are managed by a federal or state agency.

Historic Wreck: Abandoned and derelict vessels of historic significance.

Historic Site: Known historical sites that are found on the Registry of National Historic Places and state registries, and are sites that may be disturbed by oiling or cleanup activity.

Landfill: Permanent waste and debris disposal locations.

Lock and Dam: Marine lock systems and/or dams.

Management Area: Refers to lands that are managed at a local or agency level and may include managed lands that do not fall into another, more specific, human use type.

Marina: Refers to publically available marina locations. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. Also refer to: Boat Ramp (BR).

Mine Site: Refers to commodity mines such as for gravel.

Military: Military installation data were provided by the U.S. Census Bureau's MAF/TIGER geographic database.

National Landmark: Refers to locations of National Landmarks that are managed by the National Park Service that may be disturbed by oiling or disaster cleanup activities. These data come from the National Park Service, National Historic Landmarks Program. Also refer to: Historical Site.

Nature Conservancy: Areas that are managed by the Nature Conservancy.

National Oceanic Atmospheric Administration Facility: Locations of NOAA facilities.

National Park: Locations of National Parks that are managed by the National Park Service.

Park (Regional or State): Refers to jurisdictional boundaries of parks, natural preserves, recreation areas, etc. that are managed at the state, regional, local level.

Port: Locations of commercial docks and ports such as container ports.

Recreational Fishing: Locations that are fished for sport, either for pleasure or competition.

Repeated Measurement Site: Locations where oceanographic data is routinely recorded, and/or sites routinely visited by scientists to observe and record biological and contaminant trends. Some examples include: Data Buoys (DB), Tide Gauges (TG), Mussel Watch Sites (MWS), Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), Long-term Ecological Research Site (LTER), Water Quality Stations (WQ), etc.

Rail Route: Refers to train lines as part of a transit system.

Shipping Lane: The general flow of merchant shipping between two departure/terminal areas. These are normally found in oceans or large lakes as a regularly used route for vessels.

State Protected Area: Areas that receive varied levels of state protection. Examples of areas with this designation are wilderness areas and exploited areas.

State (or State Border): Refers to the official border between states.

State Waters: Refers to waters that a state has jurisdiction over, commonly derived from the low-water mark of each state extending approximately 3 nautical miles (nm) offshore.

Tribal Land: Areas managed by a Native American tribe under the United States Bureau of Indian Affairs (BIA).

Waste Disposal: These locations represent facilities for waste collection, compaction, recycling, and disposal.

Water Intake: Refers to locations where water is withdrawn from streams, lakes, rivers, and reservoirs, such as drinking water intakes, industrial intakes, and aquaculture intakes.

Wildlife Refuge: Government managed areas that provide species protection by heavily regulated hunting practices, wildlife and forestry management, and restrictions on human activity.

GEOGRAPHIC INFORMATION SYSTEM

All maps were produced using the ESI Geographic Information System (GIS) data compiled for this region. These data are stored as spatial data layers and associated databases. The format for the data varies depending on the type of information or features for which the data are being stored.
Under separate cover is a metadata document that details the data dictionary, processing techniques, data lineage, and other descriptive information for the digital datasets and maps that were used to create this atlas. Below is a brief synopsis of the information contained in the digital version. Refer to the metadata file for a full explanation of the data and its structure.

MAJOR ROADS

The major roads polyline layer represents major thoroughfares within the United States (ArcGIS Content Team (ESRI) and Tele Atlas North America Inc., U.S. Major Roads, ed. 10, published June 30, 2010, ESRI® Data & Maps series, Redlands, CA, USA). These roads are shown on the maps, but are not part of the underlying ESI GIS data.

SHORELINE CLASSIFICATIONS

The ESI shoreline habitat classification is stored as lines and polygons with associated attributes. In many cases, a shoreline may have two or three different classifications or colored lines on the shoreline. These multiple classifications are represented in the database by ESI#1/ESI#2, where ESI#1 is the landward-most classification and ESI#2 is the seaward-most classification. In addition to the line features, marshes (ESI=10A, ESI=10B), swamps (ESI=10C), and scrub-shrub wetlands (ESI=10D) are also stored as polygons.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as points, lines and polygons. Associated with each feature is a unique identification number that is linked to a series of data tables that further identify the resources. The main biological resource table consists of a list of species identification numbers for each site, the concentration of each species at each site, a mapping qualifier, and identification codes for seasonality and source information. This data table is linked to other tables that describe the seasonality and life-history time periods for each species (at month resolution) for the specified map feature. Other data tables linked to the first table include: the species identification table, which includes common and scientific names; the species status table, which gives information for state and/or federal threatened or endangered listings; and the source database, which provides source metadata at the feature-species level (specific sources are listed for each species occurring at each mapped feature in the biology feature classes).

HUMAN-USE FEATURES

Human-use features are represented as polygons, points or lines. Management areas such as wildlife refuges, national parks and state parks are mapped as polygons. Known locations such as marinas, high use beaches, airports and water intakes are displayed as points when security risks allow. Bridges and railroads are mapped as line features.

ACKNOWLEDGMENTS

This project was supported by the NOAA Office of Response and Restoration, Hazardous Materials Response Division, under the direction of Jill Petersen, NOAA's ESI Program Manager. The development of this atlas was part of a larger effort to update much of the Atlantic coast after the destruction caused by Hurricane Sandy in October 2012. Funding was provided by the Disaster Relief Appropriations Act of 2013.

The biological and human-use data included on the maps were provided by numerous individuals and agencies. Staff at the New York State Department of Environmental Conservation, New York State Natural Heritage Program, and Audubon of New York contributed a vast amount of information to this effort, including first-hand expertise, publications, maps, and digital data. Other agencies and organizations contributing to data development and review included: New Jersey Department of Environmental Protection, U.S. Fish and Wildlife Service, New York Office of Parks, Recreation and Historic Preservation, and the New York Department of State.

At Quantum Spatial (QSI), numerous scientific, GIS, and graphic staff were involved with different phases of the project. Jennifer Halleran was Project Manager. The biological and human-use data were collected, compiled, and produced into the geodatabase by Jennifer Bohannon, Tim Marcella, and Mark Yoders. Jennifer Bohannon, Tim Marcella, and Mark Yoders prepared the final text documents and metadata.

The basemap, shoreline and wetland habitat collection and classification was completed by Woolpert Inc.

APPROPRIATE USE OF ATLAS AND DATA

This atlas and the associated database were developed to provide summary information on sensitive natural and human-use resources for the purposes of oil and chemical spill planning and response. Although the atlas and database should be very useful for other environmental and natural resource planning purposes, it should not be used in place of data held any contributing agencies. Likewise, information contained in the atlas and database cannot be used in place of consultations with natural and cultural resource agencies, or in place of field surveys. This atlas should not be used for navigation.

SPECIES LIST

Common Name*	Scientific Name*
BIRDS	
ALCID	
Razorbill	*Alca torda*
DIVING	
Common loon	*Gavia immer*
Cormorants	*Phalacrocorax spp.*
Diving birds	
Double-crested cormorant	*Phalacrocorax auritus*
Great cormorant	*Phalacrocorax carbo*
Grebes	
Horned grebe	*Podiceps auritus*
Loons	*Gavia spp.*
Pied-billed grebe	*Podilymbus podiceps*
Red-necked grebe	*Podiceps grisegena*
Red-throated loon	*Gavia stellata*
GULL/TERN	
Black skimmer	*Rynchops niger*
Black tern	*Chlidonias niger*
Bonaparte's gull	*Larus philadelphia*
Common tern	*Sterna hirundo*
Forster's tern	*Sterna forsteri*
Great black-backed gull	*Larus marinus*
Herring gull	*Larus argentatus*
Laughing gull	*Larus atricilla*
Least tern	*Sternula antillarum*
Ring-billed gull	*Larus delawarensis*
Roseate tern	*Sterna dougallii*
Terns	
LAND FOWL	
Wild turkey	*Meleagris gallopavo*
PASSERINE	
Acadian flycatcher	*Empidonax virescens*
Acadian flycatcher	*Empidonax virescens*
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American robin	*Turdus migratorius*
Baltimore oriole	*Icterus galbula*
Bank swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Belted kingfisher	*Ceryle alcyon*
Black-and-white warbler	*Mniotilta varia*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Black-capped chickadee	*Poecile atricapillus*
Blue jay	*Cyanocitta cristata*
Blue-gray gnatcatcher	*Polioptila caerulea*
Blue-winged warbler	*Vermivora cyanoptera*
Boat-tailed grackle	*Quiscalus major*
Brown thrasher	*Toxostoma rufum*
Brown-headed cowbird	*Molothrus ater*
Carolina wren	*Thryothorus ludovicianus*
Cedar waxwing	*Bombycilla cedrorum*
Cerulean warbler	*Setophaga cerulea*
Chestnut-sided warbler	*Setophaga pensylvanica*
Chimney swift	*Chaetura pelagica*
Chipping sparrow	*Spizella passerina*
Chuck-will's-widow	*Antrostomus carolinensis*
Common grackle	*Quiscalus quiscula*
Common yellowthroat	*Geothlypis trichas*
Downy woodpecker	*Picoides pubescens*
Eastern kingbird	*Tyrannus tyrannus*
Eastern phoebe	*Sayornis phoebe*
Eastern towhee	*Pipilo erythrophthalmus*
European starling	*Sturnus vulgaris*
Fish crow	*Corvus ossifragus*
Grasshopper sparrow	*Ammodramus savannarum*
Gray catbird	*Dumetella carolinensis*
Great crested flycatcher	*Myiarchus crinitus*
Horned lark	*Eremophila alpestris*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
House wren	*Troglodytes aedon*
Indigo bunting	*Passerina cyanea*
Kentucky warbler	*Oporornis formosus*
Marsh wren	*Cistothorus palustris*

SPECIES LIST

Common Name*	Scientific Name*
BIRDS cont.	
Mourning dove	*Zenaida macroura*
Nelson's sparrow	*Ammodramus nelsoni*
Northern cardinal	*Cardinalis cardinalis*
Northern flicker	*Colaptes auratus*
Northern mockingbird	*Mimus polyglottos*
Northern parula	*Setophaga americana*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Orchard oriole	*Icterus spurius*
Passerine birds	
Pine warbler	*Setophaga pinus*
Prairie warbler	*Setophaga discolor*
Prothonotary warbler	*Protonotaria citrea*
Purple finch	*Carpodacus purpureus*
Purple martin	*Progne subis*
Red-bellied woodpecker	*Melanerpes carolinus*
Red-eyed vireo	*Vireo olivaceus*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Red-winged blackbird	*Agelaius phoeniceus*
Ruby-throated hummingbird	*Archilochus columbris*
Saltmarsh sparrow	*Ammodramus caudacutus*
Savannah sparrow	*Passerculus sandwichensis*
Scarlet tanager	*Piranga olivacea*
Seaside sparrow	*Ammodramus maritimus*
Song sparrow	*Melospiza melodia*
Swamp sparrow	*Melospiza georgiana*
Tree swallow	*Tachycineta bicolor*
Veery	*Catharus fuscescens*
Warbling vireo	*Vireo gilvus*
Whip-poor-will	*Antrostomus vociferus*
White-breasted nuthatch	*Sitta carolinensis*
Willow flycatcher	*Empidonax traillii*
Woodthrush	*Hylocichla mustelina*
Yellow warbler	*Setophaga petechia*
Yellow-billed cuckoo	*Coccyzus americanus*
Yellow-breasted chat	*Icteria virens*

Common Name*	Scientific Name*
PELAGIC	
Black-legged kittiwake	*Rissa tridactyla*
Cory's shearwater	*Calonectris diomedea*
Northern gannet	*Morus bassanus*
Wilson's storm-petrel	*Oceanites oceanicus*
RAPTOR	
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Barn owl	*Tyto alba*
Broad-winged hawk	*Buteo platypterus*
Eastern screech owl	*Megascops asio*
Great horned owl	*Bubo virginianus*
Long-eared owl	*Asio otus*
Northern goshawk	*Accipiter gentilis*
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Raptors	
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Short-eared owl	*Asio flammeus*
Snowy owl	*Nyctea scandiaca*
SHOREBIRD	
American oystercatcher	*Haematopus palliatus*
Black-bellied plover	*Pluvialis squatarola*
Dunlin	*Calidris alpina*
Greater yellowlegs	*Tringa melanoleuca*
Killdeer	*Charadrius vociferus*
Least sandpiper	*Calidris minutilla*
Lesser yellowlegs	*Tringa flavipes*
Pectoral sandpiper	*Calidris melanotos*
Piping plover	*Charadrius melodus*
Purple sandpiper	*Calidris maritima*
Red knot	*Calidris canutus*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Semipalmated plover	*Charadrius semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*

SPECIES LIST

Common Name*	Scientific Name*
BIRDS cont.	
Shorebirds	
Short-billed dowitcher	*Limnodromus griseus*
Spotted sandpiper	*Actitis macularia*
Upland sandpiper	*Bartramia longicauda*
Whimbrel	*Numenius phaeopus*
Willet	*Tringa semipalmata*
WADING	
American bittern	*Botaurus lentiginosus*
Black rail	*Laterallus jamaicensis*
Black-crowned night-heron	*Nycticorax nycticorax*
Cattle egret	*Bubulcus ibis*
Clapper rail	*Rallus longirostris*
Egrets	
Glossy ibis	*Plegadis falcinellus*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Green heron	*Butorides virescens*
Herons	
Ibises	*Threskiornithinae*
Least bittern	*Ixobrychus exilis*
Little blue heron	*Egretta caerulea*
Snowy egret	*Egretta thula*
Sora	*Porzana carolina*
Tricolored heron	*Egretta tricolor*
Virginia rail	*Rallus limicola*
Wading birds	
Yellow-crowned night-heron	*Nyctanassa violacea*
WATERFOWL	
American black duck	*Anas rubripes*
American coot	*Fulica americana*
American wigeon	*Anas americana*
Atlantic Brant	*Branta bernicla hrota*
Barrow's goldeneye	*Bucephala islandica*
Black brant	*Branta bernicla nigricans*
Black scoter	*Melanitta americana*
Blue-winged teal	*Anas discors*

Common Name*	Scientific Name*
Brant	*Branta bernicla*
Bufflehead	*Bucephala albeola*
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Common eider	*Somateria mollissima*
Common goldeneye	*Bucephala clangula*
Common merganser	*Mergus merganser*
Dabbling ducks	
Diving ducks	
Eurasian wigeon	*Anas penelope*
Gadwall	*Anas strepera*
Goldeneye	*Bucephala spp.*
Greater scaup	*Aythya marila*
Green-winged teal	*Anas crecca*
Harlequin duck	*Histrionicus histrionicus*
Hooded merganser	*Lophodytes cucullatus*
King eider	*Somateria spectabilis*
Lesser scaup	*Aythya affinis*
Long-tailed duck	*Clangula hyemalis*
Mallard	*Anas platyrhynchos*
Mergansers	
Mute swan	*Cygnus olor*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Red-breasted merganser	*Mergus serrator*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Ruddy duck	*Oxyura jamaicensis*
Scaup	*Aythya spp.*
Scoters	*Melanitta spp.*
Snow goose	*Chen caerulescens*
Surf scoter	*Melanitta perspicillata*
Waterfowl	
White-winged scoter	*Melanitta fusca*
Wood duck	*Aix sponsa*
FISH	
Alewife	*Alosa pseudoharengus*
American brook lamprey	*Lampetra appendix*

SPECIES LIST

FISH cont.

Common Name*	Scientific Name*
American eel	*Anguilla rostrata*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic moonfish	*Selene setapinnis*
Atlantic silverside	*Menidia menidia*
Atlantic sturgeon	*Acipenser oxyrinchus*
Atlantic tomcod	*Microgadus tomcod*
Banded killifish	*Fundulus diaphanus*
Banded sunfish	*Enneacanthus obesus*
Bay anchovy	*Anchoa mitchilli*
Black crappie	*Pomoxis nigromaculatus*
Black sea bass	*Centropristis striata*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Bluegill	*Lepomis macrochirus*
Bowfin	*Amia calva*
Bridle shiner	*Notropis bifrenatus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameiurus nebulosus*
Brown trout	*Salmo trutta*
Brown trout (sea run)	*Salmo trutta (sea run)*
Butterfish	*Peprilus triacanthus*
Central mudminnow	*Umbra limi*
Chain pickerel	*Esox niger*
Channel catfish	*Ictalurus punctatus*
Chubsucker	*Erimyzon sp.*
Common carp	*Cyprinus carpio*
Cunner	*Tautogolabrus adspersus*
Fourspine stickleback	*Apeltes quadracus*
Gizzard shad	*Dorosoma cepedianum*
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Grubby	*Myoxocephalus aenaeus*
Hickory shad	*Alosa mediocris*
Hogchoker	*Trinectes maculatus*
Inland silverside	*Menidia beryllina*
Inshore lizardfish	*Synodus foetens*
Largemouth bass	*Micropterus salmoides*
Little skate	*Leucoraja erinacea*
Mummichog	*Fundulus heteroclitus*
Naked goby	*Gobiosoma bosci*
Northern kingfish	*Menticirrhus saxatilis*
Northern pike	*Esox lucius*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculatus*
Northern searobin	*Prionotus carolinus*
Oyster toadfish	*Opsanus tau*
Pollock	*Pollachius virens*
Pumpkinseed	*Lepomis gibbosus*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*
Rainwater killifish	*Lucania parva*
Red hake	*Urophycis chuss*
Redbreast sunfish	*Lepomis auritus*
Redfin pickerel	*Esox americanus americanus*
Rock bass	*Ambloplites rupestris*
Scup	*Stenotomus chrysops*
Sea lamprey	*Petromyzon marinus*
Sheepshead minnow	*Cyprinodon variegatus*
Shortnose sturgeon	*Acipenser brevirostrum*
Silver hake	*Merluccius bilinearis*
Smallmouth bass	*Micropterus dolomieu*
Smooth dogfish	*Mustelus canis*
Spiny dogfish	*Squalus acanthias*
Spottail shiner	*Notropis hudsonius*
Spotted hake	*Urophycis regia*
Striped bass	*Morone saxatilis*

SPECIES LIST

Common Name*	Scientific Name*
FISH cont.	
Striped killifish	*Fundulus majalis*
Striped searobin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*
Swamp darter	*Etheostoma fusiforme*
Tautog	*Tautoga onitis*
Tessellated darter	*Etheostoma olmstedi*
Threespine stickleback	*Gasterosteus aculeatus*
Walleye	*Stizostedion vitreum vitreum*
Weakfish	*Cynoscion regalis*
White catfish	*Ameiurus catus*
White crappie	*Pomoxis annularis*
White perch	*Morone americana*
White sucker	*Catostomus commersoni*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pleuronectes americanus*
Winter skate	*Leucoraja ocellata*
Yellow perch	*Perca flavescens*
HABITATS	
PLANT	
American burnweed	*Erechtites hieraciifolia var. megalocarpa*
American knotweed	*Polygonum aviculare ssp. buxiforme*
American senna	*Senna hebecarpa*
Annual seepweed	*Suaeda linearis*
Appalachian stitchwort	*Minuartia glabra*
Arrowhead rattlebox	*Crotalaria sagittalis*
Arumleaf arrowhead	*Sagittaria cuneata*
Atlantic white cedar	*Chamaecyparis thyoides*
Awl-leaf arrowhead	*Sagittaria subulata*
Barratt's sedge	*Carex barrattii*
Beaked agrimony	*Agrimonia rostellata*
Bearded sprangletop	*Leptochloa fusca ssp. Fascicularis*
Beck's water-marigold	*Bidens beckii*
Black edge sedge	*Carex nigromarginata*
Bushy St. Johnswort	*Hypericum densiflorum*
Carey's smartweed	*Persicaria careyi*
Carolina clubmoss	*Lycopodiella caroliniana var. caroliniana*
Carolina redroot	*Lachnanthes caroliniana*
Cattail sedge	*Carex typhina*
Clasping water horehound	*Lycopus amplectens*
Clustered bluets	*Oldenlandia uniflora*
Clustered mountainmint	*Pycnanthemum*
Clustered sedge	*Carex cumulata*
Coastal goldenrod	*Solidago latissimifolia*
Combleaf mermaidweed	*Proserpinaca pectinata*
Common persimmon	*Diospyros virginiana*
Cosmopolitan bulrush	*Bolboschoenus maritimus ssp. Paludosus*
Creeping lespedeza	*Lespedeza repens*
Davis' sedge	*Carex davisii*
Devil's-tongue	*Opuntia humifusa*
Dillenius' ticktrefoil	*Desmodium glabellum*
Drumheads	*Polygala cruciata*
Dune sandspur	*Cenchrus tribuloides*
Dwarf bulrush	*Lipocarpha micrantha*
Dwarf saltwort	*Salicornia bigelovii*
Eastern grasswort	*Lilaeopsis chinensis*
Eaton's beggars-tick	*Bidens eatonii*
Engelmann's spikerush	*Eleocharis engelmannii*
Estuary pipewort	*Eriocaulon parkeri*
False Indian plaintain	*Hasteola suaveolens*
False mermaidweed	*Floerkea proserpinacoides*
Fernald's sedge	*Carex merritt-fernaldii*
Fibrous bladderwort	*Utricularia striata*

SPECIES LIST

HABITATS cont.

Common Name*	Scientific Name*
Field paspalum	*Paspalum laeve*
Giant orchid	*Pteroglossaspis ecristata*
Globefruit primrose-willow	*Ludwigia sphaerocarpa*
Golden dock	*Rumex maritimus*
Goldenclub	*Orontium aquaticum*
Goose tongue	*Plantago maritima var. juncoides*
Great Plains flatsedge	*Cyperus lupulinus ssp. Lupulinus*
Hairy small-leaf ticktrefoil	*Desmodium ciliare*
Hyssopleaf hedgenettle	*Stachys hyssopifolia*
Hyssopleaf thoroughwort	*Eupatorium hyssopifolium var. laciniatum*
Justiceweed	*Eupatorium leucolepis*
Large grass-leaved rush	*Juncus biflorus*
Leonard's skullcap	*Scutellaria parvula var. missouriensis*
Lesser snakeroot	*Ageratina aromatica*
Lizard's tail	*Saururus cernuus*
Longbeak beaksedge	*Rhynchospora scirpoides*
Long-tubercled spikerush	*Eleocharis tuberculosa*
Low frostweed	*Helianthemum propinquum*
Lowland rotala	*Rotala ramosior*
Lowland yellow loosestrife	*Lysimachia hybrida*
Manyflower marshpennywort	*Hydrocotyle umbellata*
Marsh fimbry	*Fimbristylis castanea*
Marsh straw sedge	*Carex hormathodes*
Meadow zizia	*Zizia aptera*
Midland sedge	*Carex mesochorea*
Mitchell's sedge	*Carex mitchelliana*
Nantucket serviceberry	*Amelanchier nantucketensis*
Narrowfruit horned beaksedge	*Rhynchospora inundata*
Narrowleaf lespedeza	*Lespedeza angustifolia*
Narrowleaf pinweed	*Lechea tenuifolia*
Narrowleaf willow	*Salix exigua*
Needletip blue-eyed grass	*Sisyrinchium mucronatum*
New England blazing star	*Liatris scariosa var. novae-angliae*
Northern coastal violet	*Viola brittoniana*
Nuttall's milkwort	*Polygala nuttallii*
Oakes' evening primrose	*Oenothera oakesiana*
Pennsylvania catchfly	*Silene caroliniana ssp. pensylvanica*
Peruvian dodder	*Cuscuta obtusiflora var. glandulosa*
Pilgrim grape	*Vitis × novae-angliae*
Pine barren flatsedge	*Cyperus retrorsus var. retrorsus*
Pink tickseed	*Coreopsis rosea*
Pitseed goosefoot	*Chenopodium berlandieri var. macrocalycium*
Purple milkweed	*Asclepias purpurascens*
Rare plant	
Reznicek's sedge	*Carex reznicekii*
Roland's seablite	*Suaeda rolandii*
Saltmarsh aster	*Symphyotrichum subulatum var. subulatum*
Saltmarsh bulrush	*Schoenoplectus novae-angliae*
Saltmarsh false foxglove	*Agalinis maritima*
Saltmarsh loosestrife	*Lythrum lineare*
Sand blackberry	*Rubus cuneifolius*
Sand dropseed	*Sporobolus cryptandrus*
Sandplain flax	*Linum intercursum*
Scotland orache	*Atriplex glabriuscula*
Scottish licorice-root	*Ligusticum scoticum ssp. Scoticum*
Seacoast angelica	*Angelica lucida*
Seaside goldenrod	*Solidago sempervirens var. mexicana*
Seaside sandplant	*Honckenya peploides*
Seaside threeawn	*Aristida tuberculosa*
Shortbeak beaksedge	*Rhynchospora nitens*
Sickleleaf silkgrass	*Pityopsis falcata*

SPECIES LIST

Common Name*	Scientific Name*
HABITATS cont.	
Silverweed cinquefoil	*Potentilla anserina ssp. anserina*
Slender arrowhead	*Sagittaria teres*
Slender blue flag	*Iris prismatica*
Slender crabgrass	*Digitaria filiformis*
Slender marsh-pink	*Sabatia campanulata*
Slender seapurslane	*Sesuvium maritimum*
Slender spikegrass	*Chasmanthium laxum*
Slender spikerush	*Eleocharis tenuis var. pseudoptera*
Slimspike threeawn	*Aristida longespica*
Small's yelloweyed grass	*Xyris smalliana*
Smartweed dodder	*Cuscuta polygonorum*
Smooth hedge-nettle	*Stachys tenuifolia*
Southern arrowwood	*Viburnum dentatum var. venosum*
Southern bladderwort	*Utricularia juncea*
Squarrose sedge	*Carex squarrosa*
Stiff ticktrefoil	*Desmodium obtusum*
Stiff-leaved goldenrod	*Solidago rigida*
Swamp cottonwood	*Populus heterophylla*
Swamp lousewort	*Pedicularis lanceolata*
Swamp sunflower	*Helianthus angustifolius*
Sweetbay	*Magnolia virginiana*
Tall cinquefoil	*Potentilla arguta*
Tapered rosette grass	*Dichanthelium acuminatum var. longiligulatum*
Terrestrial starwort	*Callitriche terrestris*
Texan flatsedge	*Cyperus polystachyos var. texensis*
Thicket sedge	*Carex abscondita*
Twining screwstem	*Bartonia paniculata ssp. Paniculata*
Velvety bush-clover	*Lespedeza stuevei*
Violet woodsorrel	*Oxalis violacea*
Water pygmyweed	*Crassula aquatica*
Welsh mudwort	*Limosella australis*
Whip nutrush	*Scleria triglomerata*

Common Name*	Scientific Name*
White boneset	*Eupatorium album var. subvenosum*
White edge sedge	*Carex debilis var. debilis*
White milkweed	*Asclepias variegata*
Whorled marshpennywort	*Hydrocotyle verticillata*
Widowsfrill	*Silene stellata*
Willdenow's sedge	*Carex basiantha*
Woolly beachheather	*Hudsonia tomentosa*
Yellow giant hyssop	*Agastache nepetoides*
Yellow thistle	*Cirsium horridulum*
UPLAND	
Bitter panicum	*Panicum amarum*
Bushy rockrose	*Helianthemum dumosum*
Sandplain gerardia	*Agalinis acuta*
Seaside knotweed	*Polygonum glaucum*
WETLAND	
Barton's St. John's-wort	*Hypericum adpressum*
Bog smartweed	*Polygonum setaceum*
Northern gamma grass	*Tripsacum dactyloides*
Red pigweed	*Chenopodium rubrum*
Saltmarsh spikerush	*Eleocharis halophila*
Scirpus-like rush	*Juncus scirpoides*
Sea pink	*Sabatia stellaris*
Short-fruited rush	*Juncus brachycarpus*
Spikerushes	*Eleocharis spp.*
Featherfoil	*Hottonia inflata*
Small floating bladderwort	*Utricularia radiata*
Spotted pondweed	*Potamogeton pulcher*
BENTHIC	
SUBMERGED AQUATIC VEGETATION	
Cutleaf watermilfoil	*Myriophyllum pinnatum*
Eelgrass	*Zostera marina*
Hornleaf riverweed	*Podostemum ceratophyllum*
Shortspike watermilfoil	*Myriophyllum sibiricum*

SPECIES LIST

Common Name*	Scientific Name*
BENTHIC cont.	
Small pondweed	*Potamogeton pusillus ssp. gemmiparus*
Vasey's pondweed	*Potamogeton vaseyi*
HERPETOFAUNA	
AMPHIBIAN	
Blue-spotted salamander	*Ambystoma laterale*
Eastern spadefoot	*Scaphiopus holbrookii*
Marbled salamander	*Ambystoma opacum*
Northern leopard frog	*Rana pipiens*
Rare amphibian	
Southern leopard frog	*Lithobates sphenocephalus*
SNAKE	
Common wormsnake	*Carphophis amoenus*
Eastern hog-nosed snake	*Heterodon platirhinos*
TURTLE	
Diamondback terrapin	*Malaclemys terrapin*
Eastern box turtle	*Terrapene carolina carolina*
Eastern mud turtle	*Kinosternon subrubrum*
Green sea turtle	*Chelonia mydas*
Kemp's ridley sea turtle	*Lepidochelys kempii*
Leatherback sea turtle	*Dermochelys coriacea*
Loggerhead sea turtle	*Caretta caretta*
Rare reptile	
Spotted turtle	*Clemmys guttata*
Wood turtle	*Glyptemys insculpta*
INVERTEBRATES	
BIVALVE	
Atlantic surfclam	*Spisula solidissima*
Bay scallop	*Argopecten irradians*
Blue mussel	*Mytilus edulis*
Eastern oyster	*Crassostrea virginica*
Endangered freshwater mussel	
Northern quahog	*Mercenaria mercenaria*
Rare freshwater mussel	
Ribbed mussel	*Geukensia demissa*
Softshell clam	*Mya arenaria*
CEPHALOPOD	
Longfin squid	*Loligo pealeii*
CRAB	
Atlantic rock crab	*Cancer irroratus*
Blue crab	*Callinectes sapidus*
Fiddler crab	*Uca sp.*
Green crab	*Carcinus maenas*
Horseshoe crab	*Limulus polyphemus*
Jonah crab	*Cancer borealis*
Lady crab	*Ovalipes ocellatus*
Spider crabs	*Libinia spp.*
GASTROPOD	
Channeled whelk	*Busycon canaliculatum*
LOBSTER	
American lobster	*Homarus americanus*
SHRIMP	
Grass shrimp	*Palaemonetes spp.*
Mantis shrimp	*Squilla empusa*
Sevenspine bay shrimp	*Crangon septemspinosa*
INSECTS	
Coastal barrens buckmoth	*Hemileuca maia ssp.*
Frosted elfin	*Callophrys irus*
Hessel's hairstreak	*Callophrys hesseli*
Jersey jair underwing	*Catocala jair ssp. 2*
Little bluet	*Enallagma minusculum*
Pine Barrens bluet	*Enallagma recurvatum*
Pine Barrens underwing	*Catocala herodias gerhardi*
Rare insect	
Scarlet bluet	*Enallagma pictum*
Threatened insect	

SPECIES LIST

Common Name*	Scientific Name*
MARINE MAMMALS	
DOLPHIN	
Bottlenose dolphin	*Tursiops truncatus*
Harbor porpoise	*Phocoena phocoena*
SEAL	
Gray seal	*Halichoerus grypus*
Harbor seal	*Phoca vitulina*
WHALE	
Humpback whale	*Megaptera novaeangliae*
North Atlantic right whale	*Eubalaena glacialis*
TERRESTRIAL MAMMALS	
BAT	
Eastern red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Silver-haired bat	*Lasionycteris noctivagans*
SMALL MAMMAL	
New England cottontail	*Sylvilagus transitionalis*
North American least shrew	*Cryptotis parva*
Northern river otter	*Lontra canadensis*

* Underlined species are listed as either threatened or endangered under the federal ESA, and/or are listed as threatened, endangered, or special concern by Connecticut and/or New York

SHORELINE DESCRIPTIONS

EXPOSED ROCKY SHORES — ESI = 1A

DESCRIPTION

- The intertidal zone is steep (greater than 30° slope), with very little width; solid and composed of bedrock
- Sediment accumulations are uncommon because waves and currents remove debris slumped from the eroding cliffs
- There is strong vertical zonation of intertidal biological communities in the estuarine parts of the river
- This shoreline type is regularly exposed to wave action and strong currents
- Wave reflection is a common phenomenon along these shorelines
- Species density and diversity vary greatly depending on exposure and salinity, but barnacles, snails, mussels, amphipods, and macroalgae can be abundant

PREDICTED OIL BEHAVIOR

- Oil is held offshore by waves reflecting off the steep, hard surfaces
- Any oil that is deposited is rapidly removed from exposed faces
- The most resistant oil would remain as a patchy band at or above the high-water line
- Impacts to intertidal communities are expected to be short-term in duration; An exception would be where heavy concentrations of a light refined product comes ashore very quickly

RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- Access can be difficult and dangerous

SHORELINE DESCRIPTIONS

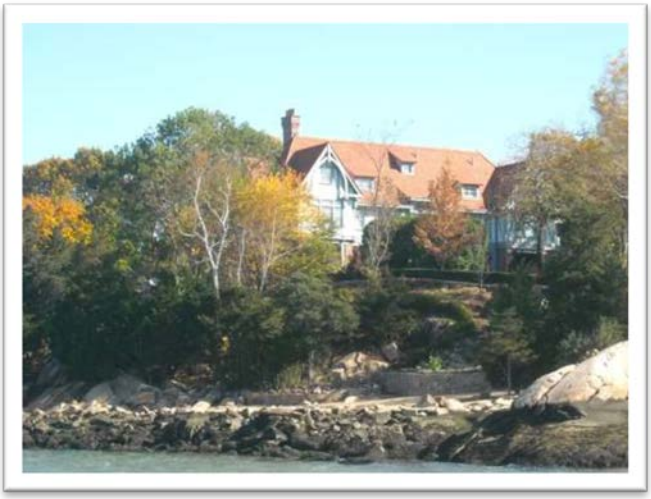
XPOSED, SOLID MAN-MADE STRUCTURES — ESI = 1B

DESCRIPTION

- These structures are solid, man-made structures such as seawalls, jetties, breakwaters, groins, revetments, piers, and port facilities
- Many structures are constructed of concrete, wood, or metal
- Often there is no exposed substrate at low tide, but multiple habitats are indicated if present
- They are built to protect the shore from erosion by waves, boat wakes, and currents, and so are exposed to rapid natural removal processes
- Attached animals and plants are sparse to moderate
- Present in highly developed industrial and port areas and scattered along residential waterfronts

PREDICTED OIL BEHAVIOR

- Oil is held offshore by waves reflecting off the steep, hard surface in exposed settings
- Oil readily adheres to the dry, rough surfaces, but it does not adhere to wet substrates
- The most resistant oil would remain as a band at or above the high-tide line



RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- High-pressure water spraying may be conducted to:
  - remove persistent oil in crevices;
  - minimize aesthetic damage; and
  - prevent chronic leaching of oil from the structure

SHORELINE DESCRIPTIONS

EXPOSED, WAVE-CUT PLATFORMS IN BEDROCK — ESI = 2A

DESCRIPTION

- They are characterized by a narrow shelf or platform that can be flooded depending on water levels
- The substrate is solid and portions of the platform may be covered by a relatively thin veneer of sand or gravel
- The surface of the platform is irregular and the presence of tidal pools is common
- Species density and diversity vary greatly, but barnacles, snails, mussels, polychaetes, and macroalgae are often very abundant
- Attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure
- They are often found with gravel and mixed sediment beaches along the high tide line and are common at the foot of exposed rocky shores

PREDICTED OIL BEHAVIOR

- Oil will not adhere to the wet rock surface, but could penetrate crevices, sediment veneers, or associated beaches if present

- Persistence of oil is usually short-term, except in wave shadows or where the oil was deposited high above normal wave activity

RESPONSE CONSIDERATIONS

- Cleanup is usually not required except for areas of high recreational use
- Where the high-tide area is accessible, it may be feasible to manually remove heavy oil accumulations and oiled debris

SHORELINE DESCRIPTIONS

EXPOSED SCARPS AND STEEP SLOPES IN CLAY **ESI = 2B**

DESCRIPTION

- Scarp heights vary from about 1 to 3 feet and usually consist of a heavily rooted, loamy or peaty soil
- May be fronted by a narrow beach of fine- to medium-grained sand
- Low biological utilization due to strong currents
- Typically backed by wetland vegetation
- Uncommon in study area

PREDICTED OIL BEHAVIOR

- Oil is not expected to adhere to the wet, impermeable clay surface but may adhere to roots or become entrapped in depressions or irregularities on the scarp surface near the high tide line. This oil may persist in small amounts, despite high wave energy
- There may be a thin band of oil left at or above the high water line
- Biological impacts can be immediate and severe, particularly if oil is left to pool on the landward side of scarp

RESPONSE CONSIDERATIONS

- Cleanup is usually not required, because oil is quickly removed by wave action
- Access may be difficult and dangerous
- Where the high-tide area is accessible, it may be feasible to remove heavy oil accumulations and oiled debris in order to protect a nearshore marine resource, such as marine birds

SHORELINE DESCRIPTIONS

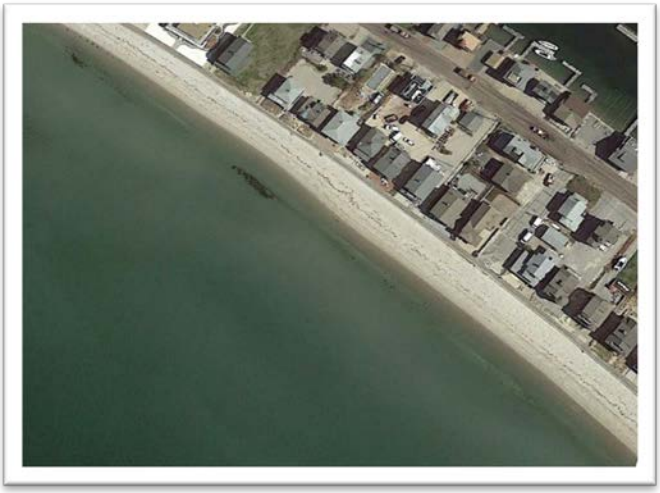
FINE- TO MEDIUM-GRAINED SAND BEACHES **ESI = 3A**

DESCRIPTION

- These beaches are flat to moderately sloping and relatively hard packed
- They are composed of quartz sand
- There can be heavy accumulations of wrack present
- They are utilized by birds and turtles
- Upper beach fauna include ghost crabs and amphipods; lower beach fauna can be moderate, but are highly variable
- They are generally areas of heavy recreational use

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide
- Maximum penetration of oil into fine- to medium-grained sand is about 10-15 cm
- Burial of oiled layers by clean sand within the first week after a spill typically will be less than 30 cm along the upper beach face
- Organisms living in the beach sediment may be killed by smothering or lethal oil concentrations in the interstitial water
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas



RESPONSE CONSIDERATIONS

- These beaches are among the easiest shoreline types to clean
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore
- Traffic through dune areas should be severely limited to prevent contamination of clean areas
- Manual cleanup, rather than road graders and front-end loaders, is advised to minimize the volume of sand removed from the shore and requiring disposal
- All efforts should focus on preventing the mixing of oil deeper into the sediments by vehicular and foot traffic
- Mechanical reworking of lightly oiled sediments from the high-tide line to the upper intertidal zone and be effective along outer beaches

SHORELINE DESCRIPTIONS

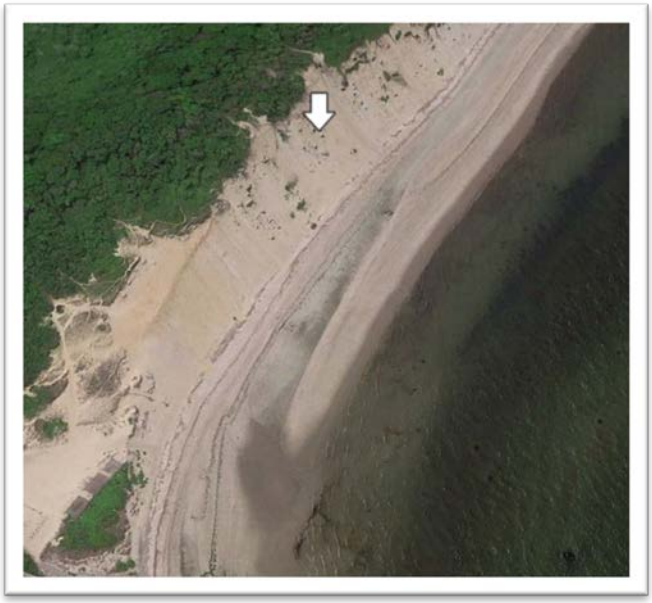
SCARPS AND STEEP SLOPES IN SAND **ESI = 3B**

DESCRIPTION

- This shoreline type occurs where sandy bluffs are undercut by waves or currents and slump
- Some scarps are fronted by narrow beaches, if the erosion rates are moderate and episodic
- Trees growing at the top of these slopes are eventually undercut and woody debris can accumulate at the base of the scarp
- Biological utilization by birds and infauna is low

PREDICTED OIL BEHAVIOR

- Any stranded oil will concentrate at the high-water line and may penetrate sandy sediments if a beach is present
- Oil will also adhere to the dry surfaces of any woody debris that has accumulated at the base of the scarp
- Burial risk is low except when slumping of the bluff occurs
- Active erosion of the scarp will remove the oil



RESPONSE CONSIDERATIONS

- In most cases, cleanup is not necessary because of the short residence time of the oil
- The need for removal of oiled sediments and debris should be carefully evaluated because of the potential for increased erosion
- Closely supervised manual labor should be used so that the minimal amount of material is removed during cleanup

SHORELINE DESCRIPTIONS

COARSE-GRAINED SAND BEACHES — ESI = 4

DESCRIPTION

- These beaches are moderately sloping, are of variable width, and are composed of soft sediments. These characteristics combine to lower their trafficability
- Species density and diversity is generally lower than on fine-grained sand beaches
- Substrate permeability is moderate
- They are very common along the shoreline of the bay and banks of major rivers

Photo Credit: Panoramio, Brian Craig

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited primarily as a band along the high-tide line
- Under very heavy accumulations, oil may spread across the entire beach face, though the oil will be lifted off the lower part of the beach with the rising tide
- Penetration of oil into coarse-grained sand can reach 25 cm
- Burial of oiled layers by clean sand can be as rapid as one tidal cycle and to depths of 60 cm or more
- Burial to depths of over one meter is possible if the oil comes ashore at the start of a depositional period
- Organisms living in the beach sediment may be killed by mothering or lethal oil concentrations in the interstitial water
- Biological impacts include temporary declines in infaunal populations, which can also affect important shorebird foraging areas

RESPONSE CONSIDERATIONS

- Removed oil primarily from the upper swash lines
- Removal of sediment should be limited to avoid erosion problems
- Mechanical reworking of the sediment into the surf zone may be used as a final polishing step to treat stained sand without sediment removal
- Activity in the oiled sand should be limited to prevent mixing oil deeper into the beach
- Use of heavy equipment for oil/sand removal may result in the removal of excessive amounts of sand; manual cleanup may be more effective

SHORELINE DESCRIPTIONS

MIXED SAND AND GRAVEL BEACHES **ESI = 5**

DESCRIPTION

- Moderately sloping beaches composed of a mixture of sand and gravel (gravel component comprises between 20 to 80 percent of total sediments)
- Because of the mixed sediment sizes, there may be some areas on the beach of pure sand, pebbles, or cobbles
- There can be large-scale changes in the sediment distribution patterns depending upon season, because of transport of the sand offshore during storms
- Substrate has medium-to-high permeability

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited along and above the high-tide swash
- Large spills will spread across the entire intertidal area
- Oil penetration into the beach sediments may be up to 50 cm; however, the sand fraction can be quite mobile, and oil behavior is much like on a sand beach if the sand fraction exceeds about 40 percent
- Burial of oil may be deep at and above the high-tide line, where oil tends to persist, particularly where beaches are only intermittently exposed to waves
- In sheltered pockets on the beach, pavements of asphalted sediments can form if there is no removal of heavy oil accumulations because most of the oil remains on the surface
- Once formed, these asphalt pavements can persist for years

RESPONSE CONSIDERATIONS

- Remove heavy accumulations of pooled oil as soon as possible
- All oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing can be used to float liquid oil away from the sediments for recovery by skimmers or sorbents. High-pressure spraying should be avoided because of potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the middle intertidal zone can be effective in areas regularly exposed to wave activity (as evidenced by storm berms). However, oiled sediments should not be relocated below the mid-tide-zone
- In-place tilling/excavation may be used to reach deeply buried oil in layers in the middle zone on exposed beaches

SHORELINE DESCRIPTIONS

GRAVEL BEACHES **ESI = 6A**

DESCRIPTION

- Gravel beaches can be steep, with multiple wave-built berms forming the upper bench
- Gravel beaches have the lowest trafficability of all beach types and may contain shell and woody debris
- Because of the high mobility of sediments on exposed gravel beaches, there are low densities of animals and plants
- Most permeable of all beach types

PREDICTED OIL BEHAVIOR

- Deep penetration of stranded oil is likely on wave-built gravel beaches because of their high permeability
- On exposed beaches, oil can be pushed over the high-tide and storm berms, pooling and persisting above the normal zone of wave wash
- Deeply penetrated oil can become sources of choric sheening
- Long-term persistence will be controlled by the depth of the routine reworking by waves or boat wakes

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beach
- All oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing can be used to float fresh oil away from the sediments for recovery by skimmers or sorbents
- High-pressure spraying should be avoided because of the potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones
- Mechanical reworking of oiled sediments from the high-tide line to the upper intertidal zone can be effective in areas regularly exposed to wave activity (as evidenced by storm berms). However, oiled sediments should not be relocated below the mid-tide-zone.
- In-place tilling may be used to reach deeply buried oil layers along the mid-intertidal zone on exposed beaches

SHORELINE DESCRIPTIONS

RIPRAP **ESI = 6B**

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of granite, limestone, or concrete
- Riprap structures are used for shoreline protection and tidal inlet stabilization
- Attached biota are sparse to moderate on exposed riprap
- Common along highly developed commercial waterfronts and residential areas

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the blocks is likely
- Oil adheres readily to the rough surfaces of the blocks
- Uncleaned oil can cause chronic leaching until the oil hardens

RESPONSE CONSIDERATIONS

- When the oil is fresh and liquid, high-pressure spraying and/or water flooding may be effective, making sure to recover all mobilized oil
- Heavy and weathered oils are more difficult to remove, requiring scraping and/or hot-water spraying
- It may be necessary to remove and replace heavily oiled blocks in high-use areas

SHORELINE DESCRIPTIONS

EXPOSED TIDAL FLATS **ESI = 7**

DESCRIPTION

- Exposed tidal flats are broad, flat, intertidal areas composed primarily of sand and minor amounts of gravel (in a few areas)
- The presence of sand indicates that tidal currents and waves are strong enough to mobilize the sediments
- They are often associated with another shoreline type on the landward side of the flat, though they can occur as separate shoals; they are commonly associated with tidal inlets
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and by foraging fish
- Sediments usually remain water-saturated, with only the topographically higher ridges drying out during low tide
- Sediments are generally too soft for vehicular traffic

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of exposed tidal flats, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil does not penetrate water-saturated sediments

- Biological damage may be severe, primarily to infauna, thereby reducing food sources for birds and other predators

RESPONSE CONSIDERATIONS

- Currents and waves can be very effective in natural removal of the oil
- Cleanup is very difficult (and possible only during low tides)
- The use of machinery should be restricted to prevent mixing of oil into the sediments

SHORELINE DESCRIPTIONS

SHELTERED ROCKY SHORES **ESI = 8A**

DESCRIPTION

- The substrate is solid and composed of bedrock
- Sediments (rock debris, etc.) may accumulate at the base of this shoreline type
- The slope of the intertidal zone is generally moderate to steep (greater than 15˚) with little width
- This shoreline type is found on the northern coast of Long Island Sound

PREDICTED OIL BEHAVIOR

- Stranded oil will persist because of low energy setting

RESPONSE CONSIDERATIONS

- Low-pressure flushing at ambient temperatures is most effective when the oil is fresh and still liquid

- Care must be taken during flushing operations to prevent oily effluents from affecting biologically rich, lower intertidal levels
- Where the high-tide area is accessible, it may be feasible to remove heavy oil accumulations and oiled debris

SHORELINE DESCRIPTIONS

SHELTERED, SOLID MAN-MADE STRUCTURES **ESI = 8B**

DESCRIPTION

- These structures are solid man-made structures such as seawalls, groins, revetments, piers, and port facilities
- Most of the structures are designed to protect a single lot, thus their composition, design, and condition are highly variable; most are constructed of concrete, wood, or metal
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present
- High densities of attached biota may be present at lower tidal elevations
- Common in highly developed commercial areas and along residential waterfront areas throughout the bays

PREDICTED OIL BEHAVIOR

- Oil will adhere readily to rough surfaces, particularly along the high-tide line, forming a distinct oil band
- If the oil is not removed, it may cause chronic sheening until the oil hardens
- The lower intertidal zone usually stays wet (particularly if algae-covered), preventing oil from adhering to the surface

RESPONSE CONSIDERATIONS

- Cleanup of seawalls is usually conducted for aesthetic reasons or to prevent sheening
- Low- to high-pressure spraying at ambient water temperatures is most effective when the oil is fresh

SHORELINE DESCRIPTIONS

SHELTERED RIPRAP **ESI = 8C**

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of granite, limestone, or concrete
- These structures are found inside harbors and bays in developed areas, sheltered from direct exposure to waves
- High densities of attached biota may be present at lower tidal elevations
- Common in highly developed commercial and residential waterfront areas

PREDICTED OIL BEHAVIOR

- Oil adheres readily to the rough surfaces
- Deep penetration of oil between the blocks is likely
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens

RESPONSE CONSIDERATIONS

- High-pressure spraying may be required to remove oil for aesthetic reasons and to prevent leaching of oil from the structure
- Cleanup crews should make sure to recover all released oil
- It may be necessary to remove and replace heavily oiled riprap in high-use areas

SHORELINE DESCRIPTIONS

SHELTERED TIDAL FLATS — ESI = 9A

DESCRIPTION

- Sheltered tidal flats are composed primarily of mud with minor amounts of sand and shell
- They are present in calm-water habitats, sheltered from regular wave activity, and are usually backed by marshes
- The sediments are very soft and cannot support even light foot traffic in many areas
- Sheltered tidal flats can be sparsely to heavily covered with algae and/or seagrasses
- They can have heavy wrack deposits along the upper fringe
- Large concentrations of shellfish, worms, and snails can be found on and in the sediments
- Bird life is seasonally abundant and flats are heavily utilized by birds for feeding
- Common within sheltered coves and bays

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of sheltered tidal flats, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil will not penetrate the water-saturated sediments, but could penetrate burrows or other crevices in muddy sediments
- In areas of high suspended sediments, sorption of oil can result in deposition of contaminated sediments on the flats
- Biological damage may be severe

RESPONSE CONSIDERATIONS

- These are high-priority areas necessitating the use of spill protection devices to limit oil-spill impact; deflection or sorbent booms and open water skimmers should be used
- Cleanup of the flat surface is very difficult because of the soft substrate; many methods may be restricted
- Low-pressure flushing, vacuum, and deployment of sorbents from shallow-draft boats may be helpful

SHORELINE DESCRIPTIONS

VEGETATED LOW BANKS **ESI = 9B**

DESCRIPTION

- These habitats are either low banks with grasses or trees and tree roots exposed to the water
- They are flooded occasionally by high water
- Sporadic along many tidal channels

PREDICTED OIL BEHAVIOR

- During low water stages there is little impact, with the oil coating a narrow band of sediment at the water level
- During high water stages, the oil could cover and coat the vegetation
- Oiling may cause loss of the grasses, but the trees should survive unless oil penetrates and persists in the substrate

RESPONSE CONSIDERATIONS

- Low-pressure flushing of oiled areas is effective in removing moderate to heavy accumulations of fresh oil from along the banks

- Sorbent and containment boom should be placed on the water side of the cleanup operations to contain and collect oil outflow
- Low- to high-pressure flushing can be used to remove weathered oil from tree roots and trunks, if deemed necessary in areas of high-use area

SHORELINE DESCRIPTIONS

SALT- AND BRACKISH-WATER MARSHES ESI = 10A

DESCRIPTION

- Intertidal wetlands containing emergent, herbaceous vegetation
- Width of the marsh can vary widely, from a narrow fringe to extensive areas; many have been extensively ditched
- Sediments are composed of organic muds except on the margins of barrier islands and other exposed areas where sand is abundant
- Exposed areas are located along bays with wide fetches and along heavily trafficked waterways
- Sheltered areas and tidal creeks are not exposed to significant wave or boat wake activity
- Resident flora and fauna are abundant and diverse, with high utilization by birds, fish, and shellfish

PREDICTED OIL BEHAVIOR

- Oil adheres readily to intertidal vegetation
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation; there may be multiple bands
- Large slicks will persist through multiple tidal cycles and coat the entire stem from the high-tide line to the base
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper, to the limit of tidal influence
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or penetrate into burrows
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to 1 meter)

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is natural recovery; natural removal processes and rates should be evaluated prior to conducting cleanup
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore
- Cleanup activities should be carefully supervised to avoid vegetation damage
- Any cleanup activity must not mix the oil deeper into the sediments; trampling of the roots must be minimized
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place

SHORELINE DESCRIPTIONS

FRESHWATER MARSHES **ESI = 10B**

DESCRIPTION

- These are grassy wetlands composed of emergent herbaceous vegetation
- They occur upstream of brackish vegetation along major rivers and tributary creeks
- Those along major channels are exposed to strong currents and boat wakes; smaller channels tend to be sheltered
- The sediment substrate is seldom exposed because daily water level changes are low; greater changes result from floods and wind-generated tides
- Resident flora and fauna are abundant and diverse, with high utilization by birds and fish

PREDICTED OIL BEHAVIOR

- Oil adheres readily to the vegetation
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation; there may be multiple bands
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or penetrate into burrows

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is natural recovery; natural removal processes and rates should be evaluated prior to conducting cleanup
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing
- Cleanup activities should be carefully supervised to avoid vegetation damage
- Any cleanup activity must not mix the oil deeper into the sediments; trampling of the roots should be minimized through the use of walking boards
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place

SHORELINE DESCRIPTIONS

SWAMPS **ESI = 10C**

DESCRIPTION

- Swamps consist of shrubs and hardwood forested wetlands, essentially flooded forests; vegetation is taller, on average, greater than 6 meters
- The sediment tends to be silty clay with large amounts of organic debris
- They are seasonally flooded, though there are many low, permanently flooded areas
- Resident flora and fauna are abundant with numerous species

PREDICTED OIL BEHAVIOR

- Oil behavior depends on whether the swamp is flooded or not
- During floods, most of the oil passes through the forest, coating the vegetation at the waterline, which changes levels throughout the flood event
- Woody vegetation is less sensitive than grasses to oil coating
- Some oil can be trapped and pooled on the swamp floodplain as water levels drop
- Penetration into the floodplain soils is usually limited because of high water levels, saturated soils, muddy composition, surface organic debris, and vegetation cover
- There can be large amounts of oily debris
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas
- Oily debris can be removed where there is access
- Any cleanup activity must not mix the oil deeper into the sediments

SHORELINE DESCRIPTIONS

SCRUB-SHRUB WETLANDS **ESI = 10D**

DESCRIPTION

- Scrub-shrub wetlands consist of woody vegetation less than 6 m tall including true shrubs, small trees, and trees and shrubs that are stunted due to environmental conditions
- The sediments are silty clay mixed with organic debris
- They are seasonally flooded, though there are many low, permanently flooded areas
- Resident flora and fauna are abundant and diverse
- Present along sheltered portions of bays and tidal channels

PREDICTED OIL BEHAVIOR

- Oil behavior depends on water level
- During high water, most of the oil passes through the wetland, coating the vegetation above the waterline
- Woody vegetation is less sensitive than grasses to oil
- Some oil can be trapped and pooled on the surface as water levels drop
- Penetration into the soils is usually limited because of high water levels, muddy composition, surface organic debris, and vegetation cover
- Large amounts of oily debris can remain
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is natural recovery
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas
- Oily debris can be removed where there is access
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized
- Woody vegetation should not be cut