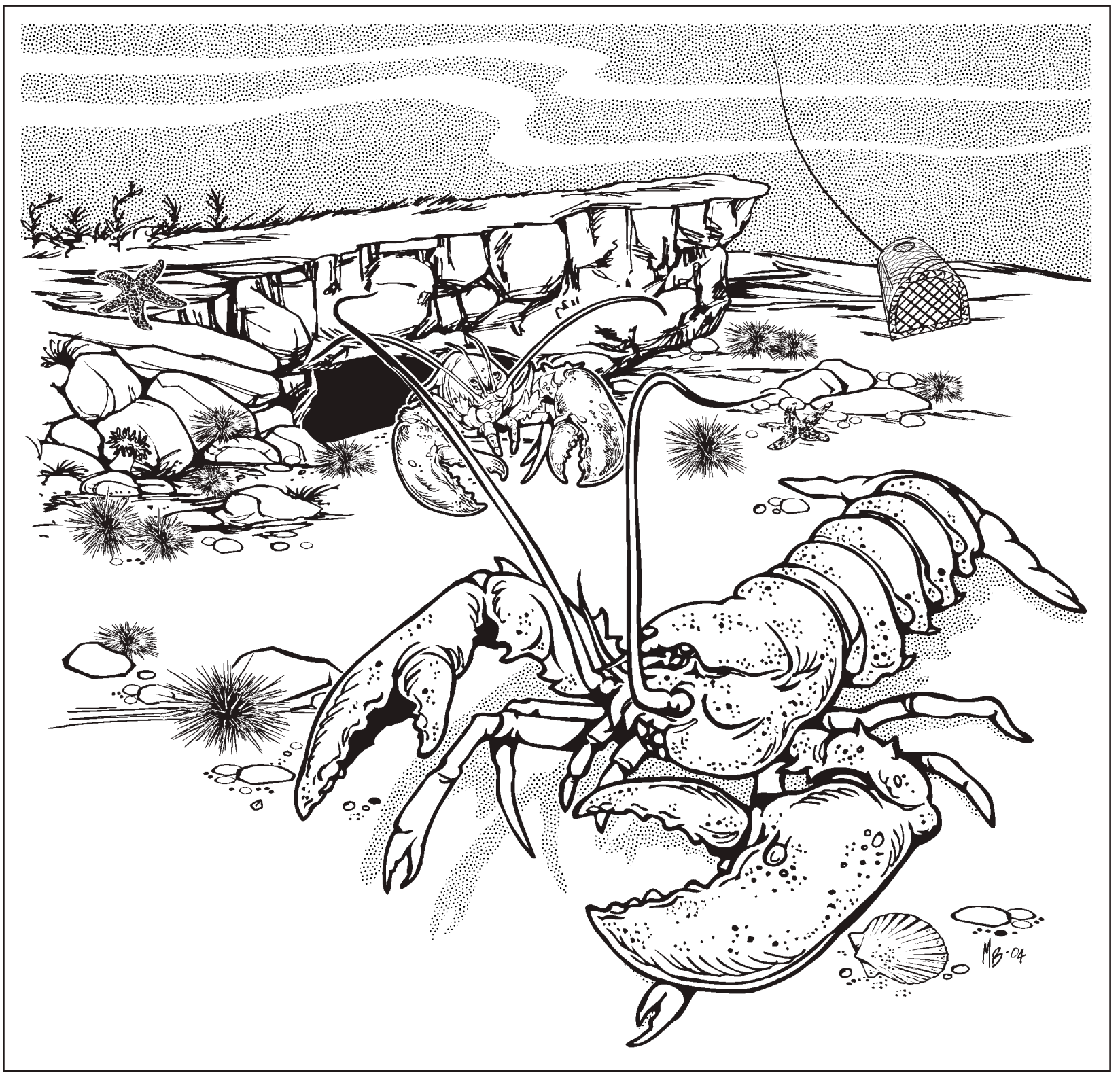
Sensitivity of Coastal Environments and Wildlife to Spilled Oil

NEW HAMPSHIRE

ATLAS



Supported by:

NewHampshire EstuariesProject
Portsmouth, NH

NEW HAMPSHIRE DEPARTMENT OF Environmental Services
Concord, NH

MARCH 2004

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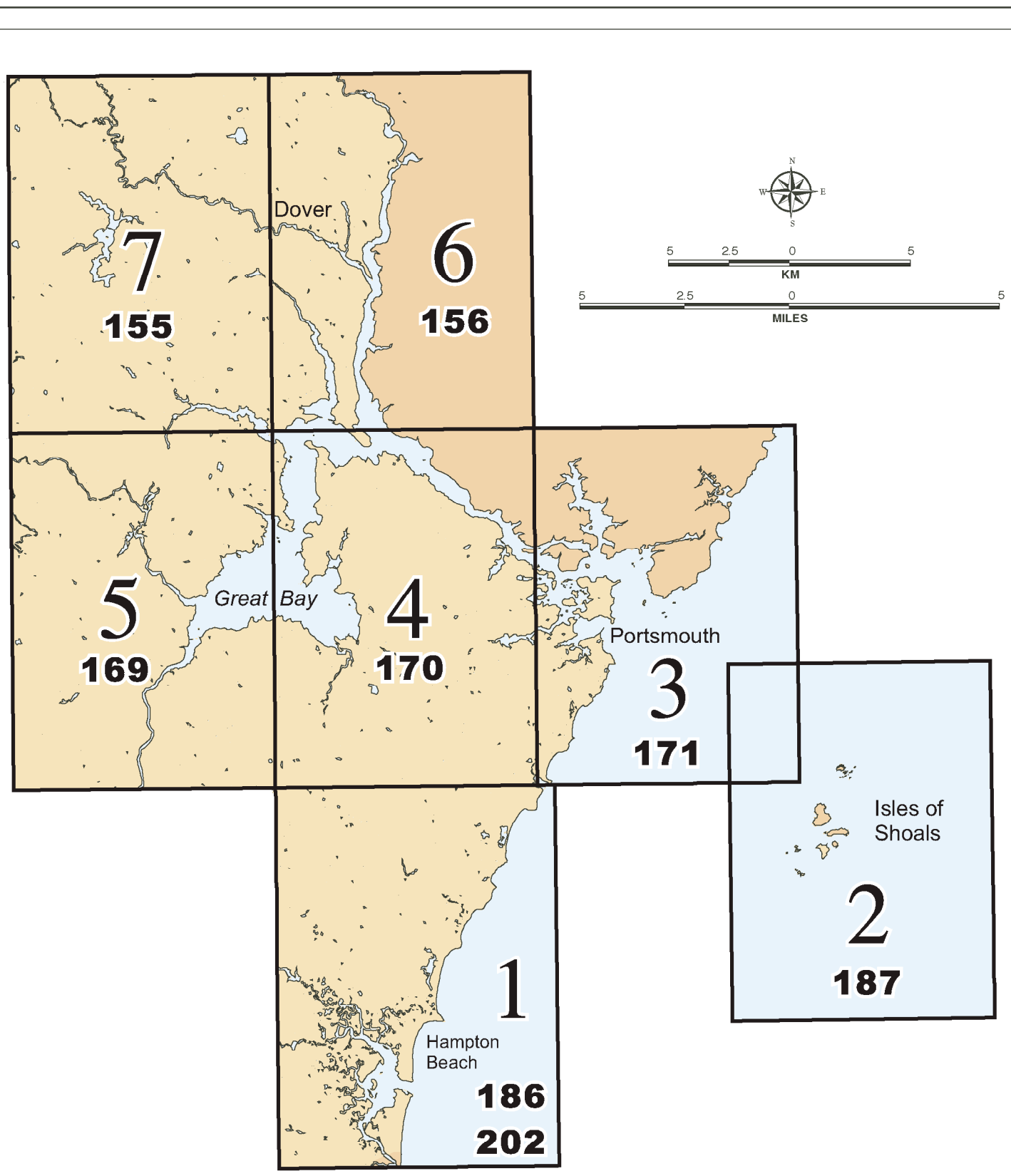

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ENVIRONMENTAL SENSITIVITY INDEX: NEW HAMPSHIRE

INTRODUCTION

Environmental Sensitivity Index (ESI) maps have been developed for the marine and coastal areas of New Hampshire. The ESI maps are a compilation of information from three main categories: shoreline habitats; sensitive biological resources; and human-use resources.

The individual map pages in this atlas are divided according to the U.S. Geological Survey (USGS) topographic quadrangle index. Black and white scanned images of these maps are used as a backdrop for each map page in the atlas. The name and date on the bottom right of each map page refer to the corresponding USGS quadrangle and its publication or latest photorevision date. The number of the corresponding tiles used in the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) index is also placed within the ESI index at the bottom right of each map (blue).

SHORELINE HABITAT MAPPING

Original ESI maps, published in 1983, were re-examined and fully updated using the sources and methods described below. The intertidal shoreline habitats of New Hampshire were mapped during overflights and ground surveys conducted by an experienced coastal geologist in October 2003. The overflights were conducted at elevations of 400-600 feet and slow air speed. During this work, the ESI ranking of observed intertidal shoreline habitats was denoted directly onto the shoreline depicted on 1:24,000-scale USGS topographic maps. Where appropriate, revisions to the existing shoreline were made and, where necessary, multiple habitats were described for each shoreline segment.

To determine the sensitivity of a particular intertidal shoreline habitat, the following factors are integrated:

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 affect 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 ranking. Generally speaking, areas 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 areas with associated high biological activity have the highest ranking. The list below includes the shoreline habitats delineated for New Hampshire, presented in order of increasing sensitivity to spilled oil.

1A) Exposed Rocky Shores
1B) Exposed, Solid Man-made Structures
2A) Exposed Wave-cut Platforms in Bedrock
3A) Fine- to Medium-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
10A) Salt- and Brackish-water Marshes
10B) Freshwater Marshes
10C) Swamps
10D) Scrub-Shrub Wetlands

Each of the shoreline habitats are described on pages 6-11 in terms of their physical description, predicted oil behavior, and response considerations.

In addition to the field mapped ESI shoreline habitats, all of the wetland habitat types derived from the USGS 1:24,000 scale topographic maps were plotted on the maps. These polygonal wetland types were not checked or edited extensively as a part of this project. Swamps and freshwater marshes occur only in inland areas and, therefore, were not mapped as part of the ESI shoreline classification.

SENSITIVE BIOLOGICAL RESOURCES

Biological information presented in this atlas was collected, compiled, and reviewed with the assistance of biologists and resource managers from the New Hampshire Department of Environmental Services (NHDES), the New Hampshire Estuaries Program, the University of New Hampshire (UNH), the New Hampshire Fish and Game (NHFG), the Audubon Society of New Hampshire, the U.S. Fish and Wildlife Service (USFWS), the Office of State Planning and New Hampshire Coastal Program, and other agencies, organizations, and groups (see acknowledgments). Information collected and depicted on the maps denotes the key biological resources that are most likely at risk in the event of an oil spill. Six major categories of biological resources are included in this atlas: marine mammals, terrestrial mammals, birds, fish, invertebrates, reptiles, and habitats.

Polygons and points represent the spatial distribution of biological resources on the maps. Associated with each of these representations is an icon depicting the types of species or habitats that are present. 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. The groups are color coded, and different icons represent the subgroups:

MARINE MAMMAL
- Pinniped
- Porpoise
- Whale

BIRD
- Alcid
- Diving Bird
- Gull / Tern
- Passerine Bird
- Raptor
- Shorebird
- Wading Bird
- Waterfowl

TERRESTRIAL MAMMAL
- Small Mammal

REPTILE
- Turtle

FISH
- Fish

INVERTEBRATE
- Bivalve
- Crab
- Lobster
- Shrimp

HABITAT
- Eelgrass

The polygon color and pattern are generally the same for all species in each major group (e.g., birds are green) and match the icon colors. Also associated with each biological polygon or point feature on the map is a resources at risk identification number (RAR#), located under each icon or group of icons. The RAR# references a table on the reverse side of the map with a complete list of species associated with the polygon or point feature, and the state and federal protected status (T&E), concentration, seasonality, and life-history information for each species. The RAR# can contain one or more species and a species can occur in more than one RAR# on the same map. A single RAR# placed under several icons indicates the presence of several subgroups within the polygon or point.

There are some species that are found throughout specific geographical areas or habitat types on certain maps. Displaying the polygons for these species would cover large areas or would obscure the shoreline, ESI classification, or other biological features, making the maps very difficult to read. Thus, species which occur over the majority of certain geographic areas or habitats are often identified in a small box on the maps which states that they are "Present in ..." (e.g., "Present in Great Bay" or "Present in Marshes"). This approach informs the user of the presence of these species, while maintaining readability of the map. The use of this strategy is implemented on a map per map basis, depending on the location, size, and number of polygons present on each map.

MARINE MAMMALS

Marine mammals depicted in the New Hampshire atlas include whales, porpoise, and seals. General distributions of cetaceans, with the exception of harbor porpoise, are depicted on the maps, as specific concentration areas are not well known. Known pupping and haul-out sites for seals are shown on the maps as polygons extrapolated from aerial survey data from the Northeast Fisheries Science Center (NEFSC) and other expert sources. Other cetaceans were mapped based on interviews with local resource experts or reports from UNH, Woods Hole Oceanographic Institute (WHOI), NOAA Fisheries Northeast Region Stranding Program, the New England Aquarium, and the Massachusetts Division of Marine Fisheries (MADMF). Areas

where seals or cetaceans are frequently sighted swimming in coastal waters are designated by larger polygons.

Expert contacts for marine mammals in New Hampshire include: Nicole Cabana (NMFS-NEFSC), 508/495-2361; Ed Lyman (MADMF), 978/282-0308; Peter Duley (WHOI); and Connie Merigo (New England Aquarium), 617/973-6551.

Marine mammal areas are displayed on the maps as polygons with a brown-hatched pattern. In cases where multiple resource types occupy the same polygon (such as birds and seals), a black-hatched multi-group pattern is used rather than a brown-hatched pattern. A brown icon with a whale, porpoise, or seal silhouette is used to indicate the presence of marine mammals and is associated with all polygons containing these resources.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column gives the species name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is usually represented as the number of animals associated with a polygon feature. In many cases, concentration values have not been used, often because this level of information is not known. Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species is present at a location in a particular month, an "X" is placed in the month column. The final columns list the time periods for sensitive life-history activities, such as pupping for seals.

Birds

Birds in this atlas are divided into several species subgroups based on taxonomy, morphology, behavior, and oil spill vulnerability and sensitivity. The species table lists all the birds included on the maps, sorted by subgroup. These species are included either because of their likelihood of direct or indirect impacts by an oil spill or similar incident, their general rarity or imperilment, or their special protection status as threatened or endangered. Rare/endangered species nesting sites, waterbird nesting colonies, osprey nesting sites, and migratory waterfowl and shorebirds are especially emphasized. General distribution and concentration areas for most bird species, as well as rare/endangered species, were provided by the Audubon Society of New Hampshire. The Audubon Society also provided important data for waterfowl, bald eagle roosting sites, and osprey nesting sites for Great Bay and the Hampton-Seabrook Estuaries, as part of the Important Bird Area (IBA) program. The USFWS provided species distribution and abundance data for the Great Bay National Wildlife Refuge (GBNWR).

An expert contact for threatened and endangered birds, osprey nesting sites, waterbirds, and shorebirds is Pam Hunt (Audubon Society of New Hampshire), 603/229-9909 and the NHFG Nongame Program, 603/271-2461. An expert contact for waterfowl is Edward Robinson (NHFG), 401/789-0281. An expert contact for birds of GBNWR is Jim Reynolds (USFWS), 603/431-7511.

Birds are shown on the maps as polygons with a green-hatched pattern. Osprey nests and bald eagle roosting sites are shown as green points. In cases where multiple resource types occupy the same polygon (such as birds and marine mammals), a black-hatched, multi-group pattern is used rather than a green-hatched polygon. A green icon (or icons) with the appropriate subgroup silhouette(s) is used to indicate the presence of different bird types (shorebirds, waterfowl, wading birds, etc.). The appropriate icons are associated with all polygons and points containing birds.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column contains the species common name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration was typically represented as the number of breeding pairs or birds associated with a point or polygon feature, although descriptive terms were also used such as "low," "medium," or "high." Descriptive concentrations are based on the opinion of local resource managers or experts concerning relative concentrations within the study area. Concentration values have not been used if the information was not available. Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species or resource is present at a location in a particular month, an "X" is placed in the month column. The last four columns denote the nesting, migrating, and molting time-periods for each species, if one or more of these stages occurs in the particular area or site in question.

Reptiles

Semi-aquatic turtles, including Blanding's turtle, spotted turtle, and wood turtle, are present in New Hampshire and are shown on the maps because they are species of special concern for the state. Locations were determined based on expert knowledge provided by NHFG. These turtles are found mainly in freshwater marshes and non-tidal rivers. Nesting data were not available.

An expert contact for turtles is Michael Marchand (NHFG), 603/271-2605.

Reptiles are depicted as polygons with a red-hatched pattern. In cases where multiple resource types occupy the same polygon, a black-hatched, multi-group pattern is used rather than a red-hatched polygon. A red icon with a turtle silhouette is used to indicate the presence of reptiles, and is associated with all polygons containing these resources.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column contains the species common name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration was represented using a descriptive term (i.e. "low"). Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species or resource is present at a location in a particular month, an "X" is placed in the month column. The final columns denote different life-history time-periods for reptiles, such as nesting, hatching, juveniles, and adults.

Terrestrial Mammals

The terrestrial mammals depicted in this atlas are limited to muskrat, beaver, and northern river otter. Larger, more general areas where terrestrial mammal habitat exists were mapped based largely on local expert opinion provided by NHDES, USFWS, NHFG, and UNH.

Terrestrial mammals are shown on the maps as polygons with a brown-hatched pattern. In cases where multiple resource types occupy the same polygon (such as terrestrial mammals and birds), a black-hatched multi-group pattern is used rather than a brown-hatched polygon. A brown icon with the appropriate silhouette is used to indicate the presence of terrestrial mammals. This icon (or icon group) is associated with all polygons features containing terrestrial mammals.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column contains the species common name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is usually represented as a descriptive term, "low" or "medium." Descriptive concentrations are based on the opinion of local resource managers or experts concerning relative concentrations within the study area. In many cases, concentration values have not been used, often at the request of data providers. Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species or resource is present at a location in a particular month, an "X" is placed in the month column.

Fish

Finfish depicted in this atlas include selected marine, estuarine, and anadromous species. Species of commercial, recreational, ecological, and/or conservation interest are emphasized. Fish distributions are based largely on expert opinion and incorporate a combination of hardcopy reports, resource survey data, field experience, and habitat-based designations provided by NHEP, UNH, and NHFG.

An expert contact for marine and estuarine finfish is Dr. Rich Langan (UNH), 603/862-0190. An expert contact for anadromous fish is Brian Smith (NHFG, Great Bay National Estuarine Research Reserve), 603/868-1095.

Estuarine and marine fish species were mapped using broad distributions on most maps. Some important spawning areas were noted for anadromous and key commercial species (i.e., striped bass, Atlantic salmon). A lock and dam icon was placed on the maps for several of the rivers within the study area that also indicates the head of tide for the estuarine environment. This

feature was also used to establish the location of spawning anadromous fish in New Hampshire. Fish species were mapped using polygons to delineate the portions of rivers and streams where spawning occurs, and where juveniles and adults are likely to pass through at some point during their life cycles.

Fish polygons were mapped with a blue-hatched pattern. In cases where multiple resource types occupy the same polygon (such as fish and invertebrates), a black-hatched, multi-group pattern is used rather than a blue-hatched polygon. A blue icon with a fish silhouette is used to indicate the presence of fish. This icon is associated with all polygon features containing fish.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column contains the species common name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is usually represented as a descriptive term, such as "high" or "low" for fish species. Descriptive concentrations are based on the opinion of local resource managers or experts concerning relative concentrations within the study area. In many cases, concentration values have not been used, often at the request of data providers. Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species or resource is present at a location in a particular month, an "X" is placed in the month column. The last columns denote different life-history time-periods for fish, including spawning, eggs, larvae, juveniles, and adults.

Invertebrates

Invertebrates depicted in this atlas include selected marine and estuarine species. Species of commercial, recreational, ecological, and/or conservation interest are emphasized. Several known invertebrate concentrations, as well as larger, more general areas where invertebrate habitat exists, were mapped. Invertebrate distributions are based largely on expert opinion provided by the UNH and NHEP. A 2002 digital polygon dataset for softshell clam and Eastern oyster was also provided by UNH and NHFG.

Expert contacts for marine and estuarine invertebrates are Dr. Rich Langan and Ray Grizzle (UNH), 603/862-0190 and 603/862-5130. An expert contact for lobsters is Win Watson (UNH), 603/862-1629. An expert contact for mollusks is Chris Nash (NHEP), 603/430-7900.

Invertebrates are shown on the maps as polygons with an orange-hatched pattern. In cases where multiple resource types occupy the same polygon (such as fish and invertebrates), a black-hatched multi-group pattern is used rather than an orange-hatched polygon. An orange icon with the appropriate silhouette is used to indicate the presence of different types of invertebrates (bivalves, crabs, lobsters, etc.). This icon (or icon group) is associated with all polygons features containing invertebrates.

The RAR# under the icon (or icon group) on the maps references a table on the reverse side of the map. In this table, the first column contains the species common name. The second column indicates whether the species is listed as threatened (T), endangered (E), or special concern (C) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is usually represented as a descriptive term, "medium" or "high." Descriptive concentrations are based on the opinion of local resource managers or experts concerning relative concentrations within the study area. In many cases, concentration values have not been used, often at the request of data providers. Note that concentration should not be interpreted as the "level of concern" or "importance" associated with a certain site or particular resource.

The seasonality for each species or resource is shown in the next twelve columns, corresponding to the months of the year. If a species or resource is present at a location in a particular month, an "X" is placed in the month column. The last columns denote different life-history time-periods for invertebrates, including spawning, eggs, larvae, juveniles, and adults.

Habitats

Eelgrass distribution included in this atlas is based on 1996 digital data provided by the UNH Seagrass Ecology Group. Eelgrass data are shown in the atlas as polygons with a purple hatch pattern. No icons or RAR#s are used for eelgrass.

An expert contact for eelgrass is Dr. Fred Short (UNH-Jackson Estuarine Laboratory), 603/862-2175.

HUMAN-USE RESOURCES

Most human-use resources in this atlas are mapped as point features and indicated by a black and white icon (see legend). Management areas such as wildlife refuges, state parks, and state forests are mapped as polygons, with the boundaries indicated as a black dot-dash line with the corresponding icon placed near the center of the polygon. Where the feature is a known point location (e.g., water intake, marina), the exact location is shown as a small black dot and a leader line is drawn from it to the icon. Recreational beaches, surfing, and recreational fishing are usually indicated by an icon placed in the general area, without any points or polygons, since the boundaries for these resources are not readily defined. Some human use resources (e.g., historical and aquaculture sites) do have boundary lines and were mapped using those outlines.

A human use number (HU#) can be found below the icon for some resources (such as marinas and locks and dams). The HU# references a table on the reverse side of the map and may provide more information (i.e., name, contact, or dam code) for that particular resource.

The atlas and digital data DO NOT represent all archaeological and historic resources present in the state of New Hampshire. For more specific information on sites that were not included in this atlas due to sensitivity concerns contact Richard Boisvert of the NH Division of Historical Resources (603/271-6433). Commercial fishing was not depicted on the maps because it occurs in nearly all New Hampshire waters.

Airport: Locations of airports, airfields, landing strips, helipads, etc., whether they are manned or unmanned. This information was gathered from the Geographic Names Information System (GNIS) developed by the U.S. Geological Survey. The information was provided by NH GRANIT.

Aquaculture: Locations of aquaculture sites. When known, the site name, owner/manager, and contact information are provided on the data tables for each map. This information was provided by UNH.

Aquaculture Area Boundary: Location of aquaculture areas or boundaries. This information was provided by UNH.

Archaeological/Historical Site: Location of archaeological and historic sites for coastal areas. These resources include known and potential archaeological/historical sites documented by the New Hampshire Division of Historic Resources, the New Hampshire Office of State Planning, and the National Park Service. The exact location and extent of these sites are not represented on the maps due to their sensitivity to disturbance and vandalism; instead, sites are depicted on the maps with an icon placed in the general vicinity of the site (or group of sites). This information was provided by NH GRANIT.

Coast Guard: Location of the U.S. Coast Guard station. This information was provided by NHDES.

Groundwater Wells: Locations of groundwater wells. This information was provided by the NHDES.

Historical Site Boundary: Location of historical sites. This information was provided by NH GRANIT.

Lock and Dam: Locations of lock and dam sites in the coastal zone. This information was provided by NH GRANIT.

Management Area: Locations of conservation areas or lands. Property names are provided in the data tables of each map.

Marina: Location of marinas. This information was gathered from overflight observations, aerial photographs, and a digital point coverage provided by NHDES.

Nature Preserve: Locations of lands managed by The Nature Conservancy. This information was provided by NH GRANIT.

Recreational Beach: Locations of recreational beaches used for activities such as swimming, sunbathing, boating, picnicking, etc. Water activities and use of recreational beaches may occur along

all shoreline areas where access is possible. This information was gathered from local experts.

Recreational fishing: Locations of recreational fishing sites. This information was provided by local experts.

Staging Areas: Locations of access points (e.g., boat ramps) and staging locations for response personnel, boats, vessels, and equipment. This information was provided by NHDES.

State/Regional Park: Locations of areas managed by the State Parks and Recreation Division as state parks, state forests, and related properties. Property names are provided in the data tables for each map. This information was gathered from a digital polygon coverage provided by NHDES.

Surfing: Locations of popular surfing areas. This information was provided by local experts.

Water Intake: Locations of surface water intakes. When known, the site name, owner/manager, and telephone number are provided on the data tables for each map. This information was provided by NHDES.

Wildlife Refuge/Management Area: Areas managed by USFWS as National Wildlife Refuges and other management area locations provided by NHDES. Site names are provided on the data tables for each map.

GEOGRAPHIC INFORMATION SYSTEM

The entire atlas product is stored in digital form in a Geographic Information System (GIS) 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 data sets 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.

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 on the maps by double and triple line patterns and 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, exposed wave-cut platforms (ESI = 2A), tidal flats (ESI = 7, ESI = 9A), marshes (ESI=10A, ESI=10B), swamps (ESI=10C), and Scrub-Shrub Wetlands (ESI = 10D) are also stored as polygons. Therefore, the legend on each map may contain two patterns depicted on a map: a linear feature as well as a polygonal feature.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as polygons or points. 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, 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 coverages).

HUMAN-USE FEATURES

Human-use features are represented as lines, points, or polygons. The resource name, the owner/manager, a contact person, and phone number are included in the database for management areas, water intakes, marinas, and aquaculture sites when available. All metadata sources are documented at the feature level.

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Listed below are the major hardcopy reference materials used during this project.

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ACKNOWLEDGMENTS

This project was financially supported by the New Hampshire Department of Environmental Services and the New Hampshire Estuaries Project. Phillip Trowbridge, Lynn Woodard, and Carroll Brown assisted greatly in all aspects of the project's completion.

The biological and human-use data included on the maps were provided by numerous individuals and agencies. New Hampshire Department of Environmental Services staff from several divisions and programs, as well as staff from the New Hampshire Estuaries Project, contributed a vast amount of information to this effort, including first-hand expertise, publications, maps, and data. Other agencies and organizations contributing to data development and review included: Audubon Society of New Hampshire, University of New Hampshire, New Hampshire Fish and Game, U.S. Fish and Wildlife Service, Northeast Fisheries Science Center, New Hampshire Coastal Program, Massachusetts Division of Marine Fisheries, Woods Hole Oceanographic Institute, NOAA Fisheries Northeast Region Stranding Program, and the New England Aquarium.

At Research Planning, Inc. (RPI) of Columbia, South Carolina, numerous scientific, GIS, and graphic staff were involved with different phases of the project. Heidi Hinkeldey was Project Manager. Shoreline habitat mapping was conducted by Colin Plank. The biological and human-use data were collected and compiled onto base maps by Heidi Hinkeldey. Lee Diveley entered, processed, and produced the GIS data and hardcopy atlas under the supervision of Mark White, GIS Director. Graphic art production was conducted by Joe Holmes. Vermell Pyatt, Heidi Hinkeldey and Lee Diveley prepared the final text documents and metadata.

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 by the NHDES Estuaries Project, Audubon Society of New Hampshire, University of New Hampshire, New Hampshire Fish and Game, U.S. Fish and Wildlife Service, Northeast Fisheries Science Center, New Hampshire Coastal Program, Massachusetts Division of Marine Fisheries, Woods Hole Oceanographic Institute, New England Aquarium, or other 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. Also, this atlas should not be used for navigation.

SPECIES LIST

Common Name*	Species Name*
BIRD	
ALCID	
Black guillemot	*Cepphus grylle*
DIVING	
Common loon	*Gavia immer*
Double-crested cormorant	*Phalacrocorax auritus*
Pied-billed grebe	*Podilymbus podiceps*
Great cormorant	*Phalacrocorax carbo*
GULL/TERN	
Herring gull	*Larus argentatus*
Ring-billed gull	*Larus delawarensis*
Bonaparte's gull	*Larus philadelphia*
Common tern	*Sterna hirundo*
Arctic tern	*Sterna paradisaea*
Least tern	*Sterna antillarum*
Great black-backed gull	*Larus marinus*
Roseate tern	*Sterna dougallii*
Laughing gull	*Larus atricilla*
PASSERINE	
Marsh wren	*Cistothorus palustris*
Seaside sparrow	*Ammodramus maritimus*
Saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*
RAPTOR	
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Northern harrier	*Circus cyaneus*
Red-tailed hawk	*Buteo jamaicensis*
SHOREBIRD	
Whimbrel	*Numenius phaeopus*
Spotted sandpiper	*Actitis macularia*
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Least sandpiper	*Calidris minutilla*
Dunlin	*Calidris alpina*
Short-billed dowitcher	*Limnodromus griseus*
Sanderling	*Calidris alba*
Semipalmated plover	*Charadrius semipalmatus*
Black-bellied plover	*Pluvialis squatarola*
Ruddy turnstone	*Arenaria interpres*
Piping plover	*Charadrius melodus*
Willet	*Catoptrophorus semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*
Solitary sandpiper	*Tringa solitaria*
Purple sandpiper	*Calidris maritima*
White-rumped sandpiper	*Calidris fuscicollis*
Hudsonian godwit	*Limosa haemastica*
WADING	
Great blue heron	*Ardea herodias*
Little blue heron	*Egretta caerulea*
Great egret	*Ardea alba*
Snowy egret	*Egretta thula*
Black-crowned night-heron	*Nycticorax nycticorax*
Glossy ibis	*Plegadis falcinellus*
Tricolored heron	*Egretta tricolor*
Green heron	*Butorides virescens*
Least bittern	*Ixobrychus exilis*
American bittern	*Botaurus lentiginosus*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
WATERFOWL	
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Green-winged teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Greater scaup	*Aythya marila*
Common goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
Harlequin duck	*Histrionicus histrionicus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Common eider	*Somateria mollissima*
Gadwall	*Anas strepera*
American wigeon	*Anas americana*
American black duck	*Anas rubripes*
Blue-winged teal	*Anas discors*
Wood duck	*Aix sponsa*
Hooded merganser	*Lophodytes cucullatus*
Scoters	*Melanitta spp.*
FISH	
FISH	
Alewife	*Alosa pseudoharengus*
Blueback herring	*Alosa aestivalis*
American shad	*Alosa sapidissima*
American eel	*Anguilla rostrata*
Striped bass	*Morone saxatilis*
Atlantic salmon	*Salmo salar*
Ninespine stickleback	*Pungitius pungitius*
Sea lamprey	*Petromyzon marinus*

Common Name*	Species Name*
FISH cont.	
Bluefish	*Pomatomus saltatrix*
Winter flounder	*Pleuronectes americanus*
Atlantic menhaden	*Brevoortia tyrannus*
White perch	*Morone americana*
Atlantic herring	*Clupea harengus*
Windowpane flounder	*Scophthalmus aquosus*
Smooth flounder	*Pleuronectes putnami*
Threespine stickleback	*Gasterosteus aculeatus*
Fourspine stickleback	*Apeltes quadracus*
Striped killifish	*Fundulus majalis*
Atlantic silverside	*Menidia menidia*
Common killifish	*Fundulus heteroclitus*
Grubby	*Myoxocephalus aenaeus*
Northern pipefish	*Syngnathus fuscus*
Rainbow smelt	*Osmerus mordax*
Cunner	*Tautogolabrus adspersus*
White hake	*Urophycis tenuis*
Atlantic tomcod	*Microgadus tomcod*
Silver hake	*Merluccius bilinearis*
Atlantic cod	*Gadus morhua*
Pollock	*Pollachius virens*
Red hake	*Urophycis chuss*
American sand lance	*Ammodytes americanus*
Rock gunnel	*Pholis gunnellus*
American plaice	*Hippoglossoides platessoides*
Haddock	*Melanogrammus aeglefinus*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Northern searobin	*Prionotus carolinus*
Ocean pout	*Macrozoarces americanus*
Shorthorn sculpin	*Myoxocephalus scorpius*
Yellowtail flounder	*Pleuronectes ferrugineus*
Skates	-
Atlantic mackerel	*Scomber scombrus*
Butterfish	*Peprilus triacanthus*
HABITAT	
SAV	
Eelgrass	*Zostera marina*
INVERTEBRATE	
BIVALVE	
Blue mussel	*Mytilus edulis*
Softshell clam	*Mya arenaria*
Sea scallop	*Placopecten magellanicus*
Northern quahog (hard clam)	*Mercenaria mercenaria*
Eastern oyster	*Crassostrea virginica*
Atlantic jackknife clam	*Ensis directus*
Atlantic surfclam	*Spisula solidissima*
European flat oyster	*Ostrea edulis*
CRAB	
Horseshoe crab	*Limulus polyphemus*
Atlantic rock crab	*Cancer irroratus*
Jonah crab	*Cancer borealis*
LOBSTER	
American lobster	*Homarus americanus*
SHRIMP	
Northern shrimp	*Pandalus borealis*
Sevenspine bay shrimp	*Crangon septemspinosa*
Daggerblade grass shrimp	*Palaemonetes pugio*
MARINE MAMMAL	
DOLPHIN	
Harbor porpoise	*Phocoena phocoena*
PINNIPED	
Gray seal	*Halichoerus grypus*
Harbor seal	*Phoca vitulina*
WHALE	
Long-finned pilot whale	*Globicephala melaena*
Northern right whale	*Eubalaena glacialis*
Minke whale	*Balaenoptera acutorostrata*
TERRESTRIAL MAMMAL	
SMALL MAMMAL	
Beaver	*Castor canadensis*
Northern river otter	*Lutra canadensis*
Muskrat	*Ondatra zibethicus*
REPTILE	
TURTLE	
Blanding's turtle	*Emydoidea blandingii*
Spotted turtle	*Clemmys guttata*
Wood turtle	*Glyptemys insculpta*

* Threatened and endangered species and species of special concern are designated by underlining

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 remove the debris that has slumped from the eroding cliffs
- There is strong vertical zonation of intertidal biological communities
- This shoreline type is regularly exposed to wave action and strong currents
- Wave reflection is a common phenomena along these shorelines
- Attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure
- Species density and diversity vary greatly depending on exposure and salinity, but barnacles, snails, mussels, amphipods, and macroalgae can be abundant
- Offshore islands are important for marine mammal haulouts
- Occasionally present along the outer coast, primarily in association with rock platforms in the Portsmouth area and the Isles of Shoals

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-tide 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

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

DESCRIPTION

- These structures are solid, man-made structures such as seawalls, 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 thus are exposed to rapid natural removal processes
- Attached animals and plants are sparse to moderate
- They are common along commercial zones and waterways

PREDICTED OIL BEHAVIOR

- Oil can be held offshore by waves reflecting off the vertical, hard surface in exposed settings
- Oil readily adheres to the dry, rough surfaces at the high-tide line, but it does not adhere to wet substrates
- The most resistant oil would remain as a patchy 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, improve aesthetics, and prevent direct contact with oiled surfaces

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

DESCRIPTION

- They are characterized by a flat or gently sloping shelf or platform that is exposed to regular waves or currents
- Although the platform is composed of bedrock, portions of the platform may be covered by a thin patches of sediments
- The surface of the platform is irregular with numerous crevices; tidal pools are common
- Species density and diversity varies greatly, but barnacles, snails, mussels, amphipods, and macroalgae are often very abundant
- Offshore islands are important for marine mammal haulouts
- Common on the outer coast as isolated rocky headlands, particularly abundant in the Portsmouth area

PREDICTED OIL BEHAVIOR

- Oil will not adhere to the wet rock surface, but could penetrate crevices or patches of sediments
- 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

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

DESCRIPTION

- These beaches are flat to moderately sloping and relatively hard packed
- There can be heavy accumulations of wrack present
- They are important habitats for migratory and summer nesting birds
- Common on the outer coast south of Portsmouth; Willis Sands State Park is a good example

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 both oiled and dune areas should be severely limited, to prevent contamination of clean areas
- Manual cleanup is advised to minimize the volume of sand removed from the shore and requiring disposal

- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic
- Mechanical reworking of lightly oiled sediments from the high-tide line to the middle intertidal zone may be effective along outer beaches

MIXED SAND AND GRAVEL BEACHES ESI = 5

DESCRIPTION

- Moderately sloping beach composed of a mixture of sand and gravel (gravel component should comprise between 20 to 80 percent of total sediments)
- Because of the mixed sediment sizes, there may be zones of pure sand, pebbles, or cobbles
- There can be large-scale changes in the sediment distribution patterns depending upon season, because of the transport of the sand fraction offshore during storms
- Because of sediment desiccation and mobility on exposed beaches, there are low densities of attached animals and plants
- Present along the outer shore as transition zones between sand beaches and rocky platforms

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 reworking by waves
- In sheltered pockets on the beach, pavements of asphalted sediments can form if there is no removal of heavy oil accumulations
- Once formed, asphalt pavements can persist for many years

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beachface
- All oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing may be used to float 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 zone to the upper intertidal zone may 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 in the middle zone on exposed beaches

GRAVEL BEACHES — ESI = 6A

DESCRIPTION

- Gravel beaches can be steep, with multiple wave-built berms forming the upper beach. 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
- Present as boulder and cobble berms perched atop rock platforms on the outer coast; also very common along the shores of Great Bay

PREDICTED OIL BEHAVIOR

- Deep penetration of stranded oil is likely on gravel beaches because of their high permeability
- Long-term persistence will be controlled by the depth of routine reworking by the waves
- Along sheltered portions of the shorelines, chronic sheening and the formation of asphalt pavements is likely where accumulations are heavy

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beachface
- All oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing can be used to float oil away from the sediments for recovery by skimmers or sorbents

- Mechanical reworking of oiled sediments from the high-tide zone to the upper intertidal zone may 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 in the middle zone on exposed beaches

RIPRAP — ESI = 6B

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of rock or concrete
- Riprap structures are used for shoreline protection and as jetties in harbors
- Attached biota are sparse on exposed riprap
- They are common in populated areas such as Portsmouth and Dover

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 liberated oil
- Heavy and weathered oils are more difficult to remove, requiring scraping and/or hot-water spraying

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 and gravel indicates that tidal currents and waves are strong enough to mobilize the sediments
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and use by foraging fish
- They are usually associated with sand beaches; also, they are commonly associated with tidal inlets

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 heavy machinery should be restricted to prevent mixing of oil into the sediments

SHELTERED ROCKY SHORES — ESI = 8A

DESCRIPTION

- The substrate is solid and composed of bedrock
- This shoreline type is sheltered from large waves and strong currents
- Sediments 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
- Sheltered rocky shores are common within Great Bay where they can be fronted by a narrow stand of marsh

PREDICTED OIL BEHAVIOR

- Heavy oils tend to coat the dry, irregular surface
- 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

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 structures are constructed of concrete, wood, or metal
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present
- Attached animal and plant life can be high
- They are common in highly developed commercial and residential waterfront areas such as around Portsmouth

PREDICTED OIL BEHAVIOR

- Oil will adhere readily to rough surfaces, particularly along the high-tide line, forming a distinct oil band
- 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 leaching of oil
- Low- to high-pressure spraying at ambient water temperatures is most effective when the oil is fresh

SHELTERED RIPRAP — ESI = 8C

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of rock or concrete
- These structures are found inside harbors and bays in highly developed areas, sheltered from direct exposure to waves
- Attached animal and plant life can be present
- They are common in highly developed commercial and residential waterfront areas such as around Portsmouth

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the boulders is likely
- Oil adheres readily to the rough surfaces
- 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

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 major wave activity, and frequently backed by marshes
- The sediments are very soft and cannot support even light foot traffic in many areas
- 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
- They are heavily utilized by birds for feeding
- Large sheltered muddy flats are common in Portsmouth Harbor and Great Bay

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 and desiccation cracks 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 and deployment of sorbents from shallow-draft boats may be helpful

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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
- Sediments are composed of organic mud except on the margins of islands where sand is abundant
- Exposed areas are located along bays with wide fetches and along heavily trafficked waterways
- Sheltered areas are not exposed to significant wave or boat wake activity
- Resident flora and fauna are abundant with numerous species with high utilization by birds, fish, and shellfish
- They are common in both the smaller estuaries of the outer coast and Great Bay

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 in burrows
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to one 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
- 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

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FRESHWATER MARSHES — ESI = 10B

DESCRIPTION

- These are grassy wetlands composed of emergent herbaceous vegetation in freshwater impoundments
- They occur in upland habitats only
- The substrate is seldom exposed since daily water-level changes are low; greater changes occur during floods
- Resident flora and fauna are abundant

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

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 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

SWAMPS **ESI = 10C**

DESCRIPTION

- Swamps consist of shrubs and hardwood forested wetlands. Vegetation is taller, on average, than 6 meters
- Sediments are silty clay with large amounts of organic debris
- They are seasonally flooded, though there are areas that are permanently flooded
- Flora and fauna are abundant with numerous species
- They occur in inland areas, often along stream floodplains and as isolated wetlands

PREDICTED OIL BEHAVIOR

- They are not a risk of oiling from marine spills because of their position above normal high tides
- They could become oiled during spills on land or that flow into streams
- Woody vegetation is less sensitive than grasses to oil

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. Cleanup is usually difficult and intrusive
- 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

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

DESCRIPTION

- Scrub-shrub wetlands consist of woody vegetation less than 6 meters 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 grow above normal spring high tides, thus they are seldom inundated by salt water
- Resident flora and fauna are abundant
- They occur as narrow bands of woody vegetation behind salt marshes in Great Bay

PREDICTED OIL BEHAVIOR

- They are generally not a risk of oiling from marine spills because of their position above normal high tides
- They could become oiled during very high water levels, from land-based spills, or during cleanup of adjacent areas
- Woody vegetation is less sensitive than grasses to oil

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
- 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