

MAINE ENVIRONMENTAL VULNERABILITY INDEX MAPS

INTRODUCTION

This four volume set of Environmental Vulnerability Index Maps depicts environmental resources along the coast of Maine most at risk from oil spilled into the marine or estuarine environment. The maps show biological, geological and human use resources. It is important to note that these maps are not an exhaustive inventory of marine and estuarine species, but are a survey meant to give first responders a tool for prioritizing and targeting protection strategies.

The first maps of environmental resources sensitive to oil spills were prepared for Maine in 1985 in conjunction with the National Oceanic and Atmospheric Administration's Office of Response and Restoration. The 1989 Exxon Valdez oil spill in Alaska's Prince William Sound led to the federal Oil Pollution Control Act of 1990, which required that regional Area Contingency Plans be developed for oil spill preparation and response. Also in 1990, the state of Maine formed the Commission to Study Maine's Oil Spill Clean-Up Preparedness, out of which came funds from the legislature for identification of sensitive environmental resources. Several new data sets showing coastal marine geologic environments, coastal wildlife resources and marine resources and habitats were compiled, and Maine's first set of Environmental Vulnerability Index (EVI) maps, a 78 map series in 24 x 36 inch format, was published in 1999. This Version 2 series of EVI maps supercedes and expands upon the original 1999 maps.

The Environmental Vulnerability Index maps, now in 11 x 17 inch format, draw heavily upon standards published in NOAA Technical Memorandum NOS OR&R 11, "Environmental Sensitivity Index Guidelines"¹ in an effort to conform more closely with NOAA's Environmental Sensitivity Index mapping program. In particular, the map and data format, color scheme and symbology of the EVI maps mirror those of the national ESI program. The major difference with the EVI maps is that each data set is shown separately rather than in combination, and several data sets unique to Maine (such as essential habitat areas) are utilized as outlined in the sections below. Each map has an accompanying data sheet that gives specific information on species occurrence and life history.

Map Symbology: Data shown on the maps consist of polygon or point coverages and an accompanying label as shown on the description of each data set below and in the map legend. The symbol and polygon fill colors help to indicate what type of resource is being depicted. Threatened and endangered species are symbolized and outlined in red for ease of identification. Bird habitats shown as polygons are in green, as are bird symbols for those species that are not threatened or endangered. Rafting bird areas are outlined with colors that help to indicate which season they were present (red for fall, gray for winter, green for spring and yellow for summer). Fish symbols are blue, and shellfish areas are shown in yellow-orange. Eelgrass beds and marine worm areas are shown in purple and maroon, respectively. Human resources (aquaculture sites, herring weir sites, boat launches, etc.) are shown in black and white. The coastal marine geologic environments are also shown in colors to help indicate what is depicted: marshes are green, mudflats brown, beaches yellow, etc.

Bird Vulnerability Rankings: Unless otherwise indicated, bird habitat sites are ranked according to their importance for protection in the event of an oil spill in accordance with the Maine Department of Inland Fisheries and Wildlife's "Index of Vulnerability of Marine Birds to Oil Spills in Maine".² The method is a modification of the bird oil index developed by Speich, et al in 1991.³ Season-specific index values were developed based on 5 seasons: nesting, post-nesting, fall migration, winter, and spring migration. The rankings incorporate the vulnerability of particular species as determined by behavior (roosting, escape behavior, flocking, nesting concentration and feeding specialization), as well as vulnerability as determined by population characteristics (population size, reproductive potential, and seasonal distribution). The rankings also incorporate the significance of the Maine coast population to the coastal New England / Maritime Canada population.

DATA SETS

THREATENED AND ENDANGERED SPECIES

Threatened and endangered species information is shown on the maps as a combination of essential habitat areas and areas where species are known to be located through occurrence records. Although many of these species will not be affected directly by an oil spill, they may be adversely affected by the response effort (e.g. staging areas). The appropriate state or federal designation is shown on the accompanying data sheets. For plants, and for species identified through occurrence records, threatened or endangered species are shown that are within 500 feet of a coastal marine geologic environment. No federally threatened or endangered plant species are found in coastal areas in Maine.

Maine's Endangered Species Act requires that both threatened and endangered species and their habitats be protected. Essential habitats are those that have been determined to be essential to the conservation of a species by the Maine Department of Inland Fisheries and Wildlife. Essential habitats have been identified for piping plovers, least terns, bald eagles and roseate terns.

Piping Plover / Least Tern Essential Habitat (PP/LT)

This coverage consists of 12 piping plover / least tern essential habitats. These areas should be a priority for protection between April and August, and include nesting, feeding and brood-rearing areas. Piping plovers are listed as endangered in Maine, and federally as threatened. Least terns are listed as endangered in Maine. The coverage was last revised in 2002.

Roseate Tern Essential Habitat (RT)

There are 22 identified roseate tern essential habitats. They are a priority for protection between June and September. Roseate terns are listed as endangered both federally and in Maine. The layer was last revised in 2002.

Bald Eagle Essential Habitat (BE)

There are 296 bald eagle essential habitats within the coastal townships. They are a priority for protection between February and September. Sites must be within a nesting area occupied in at least one of the three most recent years of the survey, and have either a nest that has existed for two consecutive years, or the only existing nest in that nesting area. Bald eagles are currently listed as threatened federally and in Maine. The data set was last updated in 2005.

Harlequin Duck Wintering Habitat (HD)

This coverage consists of 118 harlequin duck habitats. The vulnerability of the areas is ranked as Vulnerable, Moderately Vulnerable or Highly Vulnerable. Vulnerability is based on the maximum number of harlequin ducks observed at each site during the fall migration, winter, or spring migration seasons (November through March), in combination with the bird vulnerability rankings described in the last section. The highest rank was considered the overall site rank. The data was updated in 2005.

Atlantic Salmon Habitat

This data set was prepared by the U.S. Fish and Wildlife Service Gulf of Maine Project Office and the Maine Atlantic Salmon Commission. The original data set contains information on habitat categories and areal extent, as well as an indication of spawning and rearing potential of Atlantic Salmon habitats. The coverage was developed from field surveys. On November 13, 2000, the National Marine Fisheries Service and the U. S. Fish and Wildlife Service announced that Atlantic salmon populations in 8 Maine rivers (Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap and Sheepscot rivers and Cove Brook) were officially declared endangered. The data shown on the EVI are meant to be indicative only of the possible presence of Atlantic salmon in those rivers. Portions of the original data set showing selected tributaries of the Kennebec and Penobscot rivers have been removed.



Other Threatened or Endangered Species
(SA: sensitive animal or SP: sensitive plant)

This data layer includes zoological data maintained by the Maine Department of Inland Fisheries and Wildlife as part of "Biotics of NatureServe", an information management component of the Natural Heritage Program created by the Nature Conservancy (<http://www.natureserve.org/prodServices/biotics.jsp>). The data are mapped as points, and represent occurrence records for rare wildlife species in Maine. The EVI layer combines this zoological information with the locations of rare plants and rare and exemplary natural communities in Maine as mapped by the Maine Natural Areas Program, also as part of the Natural Heritage Program. Threatened and endangered animals and plants occurring within 500 feet of a coastal marine geologic environment are shown on the EVI maps. Species already identified in conjunction with essential habitat areas have been removed from the layer. The plant areas are polygons, and are shown, where appropriate, with both the "pushpin" symbol and a pattern outlining the extent of the area (📌). Both data sets were published in 2003.



Species of Special Concern
(SA: sensitive animal or SP: sensitive plant)

Species of Special Concern information is compiled from the same sources as the Threatened or Endangered Species above. Species of Special Concern are denoted with a yellow-orange pushpin and, where appropriate, with an associated fill symbol (📌).

SEABIRDS, SHOREBIRDS AND RAFTING BIRDS



Seabird Nesting Islands (##-###)

This data layer is a subset of the statewide coverage of seabird nesting islands (island, ledge or portion thereof) maintained by the Maine Department of Inland Fisheries and Wildlife. Data are representative of annual survey efforts. All islands are not surveyed annually but have been periodically surveyed since 1976. Each seabird nesting island (487) was ranked as Not Vulnerable, Vulnerable, Moderately Vulnerable or Highly Vulnerable for the nesting and post-nesting seasons. Seabird nesting islands that were ranked as "Not Vulnerable" during the 2004 season are not shown. The data include islands with a record of nesting seabird pairs, including but not limited to islands regulated under the Maine Department of Environmental Protection's Natural Resources Protection Act. Any island that has documentation of one or more nests of a seabird that is a Maine endangered or threatened species in any year during or since 1976 is outlined in red, as is its symbol. The data set was last revised in 2005.



Shorebird Areas (SB)

Shorebird staging habitat consists of coastal areas that provide both tidal mud flats rich in invertebrates for feeding and areas such as gravel bars and sand spits for roosting. Use of areas (feeding, roosting or both) was determined through surveys. Each of the 570 shorebird areas was ranked as Not Vulnerable, Vulnerable, Moderately Vulnerable or Highly Vulnerable for each of the following seasons: post nesting, fall, and winter, based on the number of each species observed at the site. The highest site rank was considered the overall site rank. Sites ranked as "Not Vulnerable" are not shown on the map. Due to the large number of shorebird areas and the repetition of species names, the accompanying data sheet combines all shorebirds on each map extent for the species list. A species list for each polygon is available. Unidentified species were removed from the site-specific species list under some conditions. The data set is from the Maine Department of Inland Fisheries and Wildlife, last updated in 2005.

Winter (W) **Spring (Spr)** **Summer (Su)** **Fall (F)** **Rafting Birds**
Rafting bird areas are based on data collected by Maine Department of Inland Fisheries and Wildlife staff in cooperation with the U.S. Fish and Wildlife Service. The data are from aerial surveys of coastal waterbirds conducted over several seasons from 2000 through 2004. Winter data were obtained from coastal mid-winter waterfowl surveys of 2004. Bird counts were combined with vulnerability rankings to calculate a density number in order to pinpoint the most important rafting bird habitat areas. Density contours were plotted, and areas with numbers indicating concentrations of 200 or more individuals are shown on the maps.

FISH



Diadromous Fish (DF)

Contains point locations of streams and rivers in Maine with runs and passages of anadromous and catadromous fish. Anadromous fish make wide use of coastal areas. During spawning periods adults pass into fresh water and spawn. Catadromous fish (eels) spawn in the ocean and return to fresh water as juveniles. The locations shown here represent the importance of a passage location as well as a larger area that is used seasonally by one or more fish species or life stages. Data for this coverage were screen digitized by the Maine Department of Marine Resources from the Coastal Marine Resources Inventory (1981 - 1984)⁴ and Ecological Characterization of Coastal Maine (1980)⁵, and were supplemented by U.S. Fish and Wildlife coverages provided by the Gulf of Maine Project Office based on Eipper, et al, 1982.⁶



Elver Runs (ER)

This layer from the Maine Department of Marine Resources shows point locations of major elver runs in Maine where commercial harvesting activities have taken place. Eels return in the spring from the Sargasso Sea as juveniles and large numbers pass into fresh water systems where they grow to adulthood. Others remain in coastal water, but all eventually return to the Sargasso Sea to spawn. Locations shown here are critical for those juvenile eels migrating into fresh water. The layer was last updated in 1996.



Herring Spawning Areas (HS)

These are point locations of important herring spawning areas in Maine⁷, prepared specifically for the original oil spill response maps by the Maine Department of Marine Resources. Atlantic herring spawn in coastal water and on Georges Bank. They generally deposit eggs on the bottom in relatively deep water but egg beds have been found in shallow water downeast⁸. The layer was last revised in 1996.

SHELLFISH



Shellfish Beds (SF)

This coverage is a generalized representation of molluscan shellfish areas in Maine, based on a 1977 Maine Department of Marine Resources coastwide survey. Original mapping was done as a cooperative effort between the U.S. Environmental Protection Agency and Maine Department of Marine Resources staff. The layer used in the EVIs was digitized from the original mapping and the U.S. Fish and Wildlife Ecological Characterization of Coastal Maine.⁵ The ECCM manuscripts were reviewed for accuracy against the original EPA/DMR maps. This layer was first published as a paper map layer by the Maine State Planning Office in 1977.



Mussel Seed Conservation Areas (MS)

This layer shows polygon locations of Maine mussel seed conservation areas as outlined in the Maine Department of Marine Resources' Rule 12.06. Mussel regulations were implemented in 1988 by the Department of Marine Resources in response to concerns within the industry and legislature that the intensity of the fishery that existed at that time was leading towards resource problems and conflicts between users. One of the major problems was the significant demand for seed mussels by the aquaculture industry. There was a fear that recruitment to the prime wild beds might be impaired if the seed was heavily harvested and transferred to lease sites. The solution was to find an alternate source of seed for the aquaculture industry. To this end, the mussel regulation established four "seed mussel conservation areas", from which only seed-size mussels may be removed for growout. A permit issued by the Department of Marine Resources is required to remove any mussels from the conservation areas.



Lobster Pounds (LP)

This layer shows coastal locations of lobster pounds, defined as intertidal/subtidal areas which have fixed structures for holding lobsters for a finite period of time. These structures may hold large numbers of lobsters and also trap oil, making them difficult to clean or replace. The name of the facility and contact information is

provided on the accompanying data sheet. This layer was updated in 2005.

HABITATS



Marine Worm Habitat

This layer is based on interviews with commercial marine bait worm harvesters and site visits carried out between October 2004 and May 2005. Information was compiled on a 1:24,000 base and screen digitized from original paper documents. Areas represented are known harvest locations and historically have sustained significant populations of the two annelid worm species, *Nereis virens* (sand worm) and *Glycera dibranchiata* (blood worm). The habitat delineated is primarily mixed and fine grained sediment which can be categorized as predominantly intertidal mud flats. Site specific studies associated with this mapping are documented in Atherton, Chen and Thayer, unpublished.⁹



Eelgrass Beds

This dataset depicts Maine's eelgrass meadows. Sections of the coast have been flown and photographed at a scale of 1:12,000 since 1992. The original 1992 Penobscot Bay flights were contracted by the Maine Department of Transportation, with photography interpreted by Dr. Fred Short of the University of New Hampshire. The remainder of the coast was originally flown in the July to October period between 1993 to 1997. Since that time updates have taken place in the 2002-2005 time period. These updates include the geographic area from Saco Bay to eastern Penobscot Bay. When possible throughout this study, photography has been acquired at the time of extreme low tides, low wind velocity, good water clarity, and maximum biomass of eelgrass. These factors aid in the detection of the subtidal portion of a bed. Verification has been carried out by boat, on foot, and by plane. Density categories have been eliminated from these maps to simplify display. Though dense patches of eelgrass approximately 6 meters in diameter and less can be identified under good conditions, a conservative estimate of the minimum mapping unit is 150 square meters. This represents a stand approximately 14 meters in diameter.



Seal Haul-Outs

Data for this layer were obtained from the "Digital Atlas of Seal Haul-out Sites in Maine: 1981-2001", authored by Dow, et al, December, 2005.¹⁰ The atlas covers the coastal waters of Maine, from the Isles of Shoals to Cobscook Bay. Aerial surveys were conducted between 1981 and 2001. Seals and pups were identified from the aircraft and then counted using photos taken during the flight. Gray seals started appearing during surveys in 1997, and the areas shown may be either gray or harbor seals or both, although the vast majority are harbor seals. Surveys were conducted during two hours on either side of low tide, when the highest number of seals is expected to be hauled out. The seal haul-outs shown on the EVI maps are 967 distinct sites taken from the 6,973 total observations over the 20 year study. The complete data set can be downloaded and viewed at the OBIS-SEAMAP web site: <http://seamap.env.duke.edu>.

HUMAN RESOURCES



LOBSTER DEALERS (LD)

Lobster dealers typically run the wharf in the harbor the lobstermen fish out of, and where they return to sell their catch.¹¹ These facilities may have subsurface intakes that supply water to holding tanks, and/or floating crates or "cars" holding lobsters. This is an inventory of licensed Maine lobster dealer locations and contact information for wharved sites that buy lobsters from five or more lobster boats. These locations serve as the basis for the Lobster Port Sampling Program (<http://www.maine.gov/dmr/rm/lobster/research.htm#P>) carried out by the Maine Department of Marine Resources. Locations were last updated in 2005.



HERRING WEIR SITES (HW)

This layer, from the Maine Department of Marine Resources, shows point locations of herring weirs in Maine based on a 1990 overflight by the Maine Department of Marine Resources Marine Patrol. Contact information for these resources is included. The layer was

published in 1991. For the most part, herring weirs have not been maintained in recent years. Those that have not been maintained may not be visible at high water and could pose a hazard to navigation.



AQUACULTURE SITES (AQ)

These are locations of Maine aquaculture leases issued by the Maine Department of Marine Resources. All aquaculture operations are marked with buoys and may have: (1) an extension mooring system for fish pens and suspended shellfish culture, (2) floating trays for juvenile shellfish, or (3) may be carried out on the bottom in the case of oysters and clams. The data show the primary species grown and the size of the aquaculture site, as well as contact information. The layer was updated in 2005. Additional information on the leasing program and new or changed lease locations can be found at <http://www.maine.gov/dmr/aquaculture/index.htm>.



CONSERVATION LANDS (CL)

The conservation lands layer is provided through the Maine Office of GIS and is based on data first compiled by the Maine State Planning Office in 1989. The layer shows conservation lands ownership for Maine land in federal, state and non-profit ownership with easements. The original data were compiled by contacting agencies and organizations to obtain locations of conservation and public lands. The data set was last updated in 1993, and should not be considered to be all-inclusive, but as an inventory only. The Maine State Planning Office is currently revising this data.



BOAT LAUNCHES (BL)

This coverage contains point data for 90 coastal state sponsored or assisted trailerable boat launches compiled by the Maine Department of Conservation, Bureau of Parks and Lands Boating Facilities Division. Division staff initially located points visually from experience and knowledge of sites in 1989. The locations were updated to greater precision by Maine Department of Environmental Protection GIS staff using aerial photos and maps. The data were last revised in 2003, and give an indication of what facilities are available at the launch. The user should be aware that there are many boat launches not included in this layer. The best reference for these is probably DeLorme's "Maine Atlas and Gazetteer", available in local outlets (www.delorme.com).



COASTAL BARRIER RESOURCE AREAS

Coastal barriers are unique land forms that provide protection for diverse aquatic habitats and serve as the mainland's first line of defense against the impacts of coastal storms and erosion. The Coastal Barrier Resource Act (CBRA) established the John H. Chafee Coastal Barrier Resources System, comprised of undeveloped coastal barriers along the Atlantic, Gulf and Great Lakes coasts. The law restricts federal expenditures that encourage development, such as federal flood insurance. The U.S. Fish and Wildlife Service advises federal agencies, landowners and Congress on whether properties are in or out of the CBRS, and what kind of federal expenditures are allowed.¹² The CBRS area boundaries were taken from the Federal Emergency Management Agency's Consolidated CBRA Q3 Flood Data, dated 1998. FEMA's Flood Insurance Rate Maps, or the U.S. Fish and Wildlife Service, should be consulted for more specific boundaries of the CBRS.

COASTAL MARINE GEOLOGIC ENVIRONMENTS

 Marshes	 Coarse Flats & Bars, Exposed	 Mixed & Low Energy Beaches	 Rocky Shores
 Mud Flats, Sheltered	 Coarse Beaches & Riprap	 Sand Beaches	 Sand Dunes

This coverage shows regional characteristics of the Maine coast, and was compiled by the Maine Geological Survey from a 1976 map series. The original map series identifies 55 coastal marine environments. These were condensed into 8 environments for the purposes of the original Environmental Vulnerability Index maps, based on the following criteria: (1) geologic environment, (2) persistence of stranded oil, (3) biological sensitivity, and (4) ease of cleanup. The coastal marine environments are shown in the legend from the most vulnerable (marshes) to least vulnerable (sand dunes - due to their location). Subtidal and altered coastline categories were dropped to help simplify the map.

ARCHAEOLOGICAL SITES

The Maine Historic Preservation Commission maintains a database of historic and archaeological resources. Because of the sensitivity of the data, these sites are not shown on the EVI maps, but are available for display through Maine's Mobile Oil Spill Information System, or mobile GIS, in the event of a spill. The GIS layer prepared for the EVI maps includes 2,500 "prehistoric" sites and 1,500 historic sites within 150 meters of the coast. The oldest of these are Native American "prehistoric" (or before recorded history) archaeological sites. These sites are mostly camping and village locations, including shell heaps along the coast, but they also include rock art, rock quarry and cemetery sites. The sites range in age from the time of European settlement back to the end of the last ice age, 12,000 years ago. Historic archaeological sites, such as farmstead, mill and tavern remains, record European settlement and native life in Maine after about 1600 A.D.¹³ These sites are shown in the GIS coverage as 0.5 kilometer squares, within which the archaeological resource is found.

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