

SEASCAPES: Getting to Know the Sea Around Us

A Guide to Characterizing Marine and Coastal Areas

**Appendix A:
Maine Information Sources**



QUEBEC-LABRADOR FOUNDATION
Atlantic Center for the Environment

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Note: This document incorporates Appendix A only.
Other sections are available for download.

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This Appendix lists some of the many useful Web sites, documents, maps, GIS layers, and other references. Not listed here are all the local, state, county, and federal agencies, universities, businesses, and non-profit organizations that are rich sources of information on these topics. More information sources may be found on their Web sites, along with contact information for individuals who may be able to help with specific questions.

Oceanographic and Physiographic Components

O1 Marine Area Boundaries, Major Geographic Features, and Habitats

Watersheds

Maine Office of GIS map layer for wetlands, lakes, rivers and streams (WTRSHD).

Go to: apollo.ogis.state.me.us/catalog/

Surf Your Watershed. Environmental Protection Agency.

Go to: cfpub.epa.gov/surf/state.cfm?statepostal=ME

Watershed Profiles, Maine Rivers.

Go to: www.mainerivers.org/water_profiles.html

Description: This site provides a map of Maine's watersheds. Click on the desired watershed to find out facts about the watershed, including the rivers it contains and the organizations that are working to protect that watershed.

Wetlands

Maine Office of GIS interactive wetlands mapping site.

Go to: megisims.state.me.us/Website/spowetc/viewer.htm

Description: "The Maine Wetlands Characterization is designed as a planning tool to use when looking at wetlands in a landscape context. The Characterization sorts wetlands based upon their capacity to provide six specific functions at a significant level. As you zoom in on this map, more data will become visible. Once the wetlands appear color coded for the characterization functions they provide, you can turn on the wetland label layer which will assign a number to each wetland. This number will also appear in the table that corresponds with the Wetlands Characterization."

Reports and references on Maine's wetlands, U.S. Fish and Wildlife Service.

Go to: northeast.fws.gov/wetlands/

Description: Click on Maine under the My State menu.

Wetland Mapper, National Wetlands Inventory.

Go to: wetlandsfws.er.usgs.gov/wtlnds/launch.html

Geologic Features

Online maps, digital data, and geological bibliography, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/mgs.htm

Description: Among the maps and data available are beach and dune geology (aerial photos), bedrock geology maps, bedrock groundwater resources maps, bluff maps, coastal landslide hazards maps, earthquakes, lakes, significant sand and gravel aquifers maps, surficial geology maps, surficial geology of the Maine inner continental shelf maps, and surficial materials maps.

O2 Substrate types (see also B2 Habitats)

Beach and dune geology aerial photographs, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/pubs/series/descrip-dunes.htm

Description: "These color photos provide detailed information about Maine's largest beaches and dune systems. The photos show frontal dunes, back dunes, and other geologic environments conforming to the Department of Environmental Protection's 2004 Coastal Sand Dune Rules."

Coastal bluff maps, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/pubs/online/bluffs/bluffs.htm

Description: "Coastal Bluffs Maps show the shoreline type and relative stability of bluffs along the Maine coast. The slope, shape, and amount of vegetation covering a coastal bluff and the adjacent shoreline are directly related to the susceptibility of the bluff face to ongoing erosion. These maps can help identify shorelines with increased risk of coastal erosion. Bluff erosion can result in a landward shift

of the top edge of the bluff. This shoreline change is a natural process that, by itself, is not a coastal hazard. Only when erosion threatens something of value, such as a building near the bluff edge, does bluff retreat become a hazard. Understanding local erosion rates can help determine the severity, and perhaps longevity, of coastal development along a bluff edge.”

Coastal marine geologic environments maps, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/pubs/series/descrip-cmge.htm

Description: “These maps show regional characteristics of the Maine coast. They illustrate which areas are rocky, muddy, sandy, etc. along the shoreline between the high- and low-tide lines. These maps include sand and gravel beaches and dunes in areas of the state where MGS has not published detailed Sand Dune Photos for use in the Department of Environmental Protection permitting process. These maps illustrate the location of salt marshes and other tidal wetlands for evaluation of coastal habitats, impact of dredging, and siting of coastal facilities.”

Dynamic Atlas of the Gulf of Maine, Census of Marine Life.

Go to: research.usm.maine.edu/gulfofmaine-census/data-mapping/

Description: Access to data used throughout the Census program, either directly from the Data and Mapping Portal, or from the list of data providers and links.

Maine Office of GIS coverage of intertidal habitat (BATHY30).

Go to: apollo.ogis.state.me.us/catalog/

Description: “BATHY30 is a raster data set of bathymetry and intertidal cover types for the Gulf of Maine developed by the U.S. Fish & Wildlife Service Gulf of Maine Program. Sounding data was used in deeper areas to generate a relatively coarse resolution bathymetry grid. Finer spatial resolution around in-shore features were achieved by use of tidal exposure classifications described from aerial photography (e.g., “regularly flooded, irregularly exposed, irregularly flooded”) in the USFWS National Wetland Inventory data sets, channels and tidal flats mapped from photography in Maine’s Coastal Marine Geologic Environments (CMGE) and Massachusetts

orthophoto wetlands maps. These classes were not translated into absolute elevations, but instead were coded as to position within the intertidal zone, and the general cover type (e.g., high marsh, lower intertidal flats, etc.), which may convey useful ecological information.”

Kelley, J.T. et al. 2005. *The Seafloor Revealed: The Geology of the Northwestern Gulf of Maine Inner Continental Shelf*. Augusta, ME: Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/marine/seafloor/contents.htm

Description: “During the past ten years we have conducted many exploratory surveys of the seafloor of the western Gulf of Maine. Recently we compiled that information, along with previously published data, using a geographic information system (GIS) to produce a series of maps of the seafloor of the inner continental shelf of the western Gulf of Maine. The data compiled for this map series were originally collected for a variety of research projects, contracts, and graduate student theses. For this reason there are varying degrees of geophysical data and bottom-sample coverage from place-to-place along the coast. More detailed information regarding specific locations and original field descriptions exists in Maine Geological Survey open-file reports. This report is written to accompany the map series and to explain the field techniques used to collect data. The nature of the seafloor, as well as the late Quaternary geologic history of the area, is also described.”

Surficial geology maps of the Maine Inner Continental Shelf, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/pubs/online/ics/ics.htm

Description: “The maps in this series provide a broad overview of the seafloor along the coast of Maine. They illustrate the complex characteristics of bathymetry and bottom types for a variety of marine uses. Information on these maps can be of value in identifying seabed habitats, sand for beach nourishment, dredged material disposal sites, unstable sites with subsurface biogenic gas deposits, shipwreck sites, potential cable or pipeline routes, and sites for offshore wind farms or aquaculture. The maps are not intended for navigational use, but they can supplement other information in selecting anchorages. This map series shows the surficial geology of the Maine inner continental shelf. Color map units showing seafloor type were determined using

side-scan sonar surveys, seismic reflection profiles, grab samples, cores, and video images. Bathymetry is shown with 10 meter (33 ft.) contour intervals from National Ocean Service provisional bathymetric and fishing maps. An explanatory text describes the regional geologic setting, scientific methods used, description of seafloor types, geologic history, summary of seafloor types, and sources of additional information.”

O3 Bathymetry

Dynamic Atlas of the Gulf of Maine, Census of Marine Life.

Go to: research.usm.maine.edu/gulfofmaine-census/data-mapping/

Kelley, J.T. et al. 2005. The Seafloor Revealed: The Geology of the Northwestern Gulf of Maine Inner Continental Shelf. Augusta, ME: Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/marine/seafloor/contents.htm

Maine Office of GIS map layer (BATHYM100).

Go to: megisims.state.me.us/metadata/bathym100.htm

Description: “BATHYM100 contains bathymetry lines for the Gulf of Maine at a scale of 1:100,000 showing depth in 10-meter intervals. This coverage was developed by the Maine Geological Survey using USGS 30 X 60 minute series topographic-bathymetric maps. Bathymetric contours are coded with depth in feet (10 meter interval -mean lower low water datum). Spatial topology varies from good to poor.”

Marine geology maps, NOAA National Geophysical Data Center.

Go to: www.ngdc.noaa.gov/mgg/mggd.html

Description: Among the maps available are bathymetric maps (topographic maps of the sea floor). “Through the use of detailed depth contours and full use of bathymetric data, the size, shape and distribution of underwater features are vividly portrayed. No other map or chart gives this descriptive picture of the ocean bottom terrain. The bathymetric map serves as the basic tool for performing scientific, engineering, marine geophysical and environmental studies, that are required in the development of energy and marine resources. Also, detailed multipurpose maps show both the NOS bathymetry (ocean

bottom topography) and the US Geological Survey (USGS) land topographic information. These maps are cooperatively produced by National Ocean Service and USGS to support the Coastal Zone Management and Energy Impact Programs and the offshore oil and gas program. They may also be used by land-use planners, conservationists, oceanographers, marine geologists, and other having an interest in the coastal zone and the Outer Continental Shelf’s (OCS) physical environment.”

Surficial geology maps of the Maine Inner Continental Shelf, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/pubs/online/ics/ics.htm

Description: See listing under O2 Substrate types

O4 Circulation and Currents

General

Gulf of Maine Ocean Observing System (GoMOOS).

Go to: www.gomoos.org

Description: GoMOOS brings hourly oceanographic data from the Gulf of Maine via buoys, radar, and satellites. Historical, “real-time,” and forecast data are available.

Introductory information about ocean circulation in the Gulf of Maine.

Go to: www.gomoos.org/datatypes/CURRENTS.html

Description: Provides an overview of Gulf of Maine circulation along with diagrams.

Xue, H., F. Chai, and N.R. Pettigrew. 2000. A model study of seasonal circulation in the Gulf of Maine. *Journal of Physical Oceanography* 30:1111-1135.

Go to: rocky.umeoce.maine.edu/publication.htm (publications page of the University of Maine’s Ocean Modeling Group). Scroll down to the year 2000 and click Download next to the listing of this publication.

Abstract: “The Princeton Ocean Model is used to study the circulation in the Gulf of Maine and its seasonal transition in response to wind, surface heat flux, river discharge, and the M_2 tide. The model has an orthogonal-curvature linear grid in the horizontal with variable spacing from 3 km nearshore to 7 km offshore and 19 levels in the vertical. It is initialized and forced at the open boundary with model results

from the East Coast Forecast System. The first experiment is forced by monthly climatological wind and heat flux from the Comprehensive Ocean Atmosphere Data Set; discharges from the Saint John, Penobscot, Kennebec, and Merrimack Rivers are added in the second experiment; the semidiurnal lunar tide (M_2) is included as part of the open boundary forcing in the third experiment. It is found that the surface heat flux plays an important role in regulating the annual cycle of the circulation in the Gulf of Maine. The spinup of the cyclonic circulation between April and June is likely caused by the differential heating between the interior gulf and the exterior shelf/slope region. From June to December, the cyclonic circulation continues to strengthen, but gradually shrinks in size. When winter cooling erodes the stratification, the cyclonic circulation penetrates deeper into the water column. The circulation quickly spins down from December to February as most of the energy is consumed by bottom friction. While inclusion of river discharge changes details of the circulation pattern, the annual evolution of the circulation is largely unaffected. On the other hand, inclusion of the tide results in not only the anticyclonic circulation on Georges Bank but also modifications to the seasonal circulation.”

Casco Bay

Janzen, C.D., J. Churchill, and N. Pettigrew. 2005. **Observations of exchange between eastern Casco Bay and the western Gulf of Maine.** *Deep Sea Research Part II* 52:2411-2429.

Abstract: “Exchange of water between eastern Casco Bay and the adjacent Gulf of Maine shelf is examined to assess the circulation processes that impact the distribution and occurrence of a toxic dinoflagellate, *Alexandrium fundyense*, in eastern Casco Bay. Over the inner shelf adjacent to the bay, tidal variance is weak, and the across-shelf current is highly coherent and in phase with the along-shelf wind stress. Although tidal current variance increases as one advances into the bay, non-tidal currents account for 30–40% of the across-shelf current variance at the bay entrance. Between the shelf and the bay interior is a transition region, where the circulation response to wind forcing changes as the wind adjusts to the changing orientation of the shoreline. Far from shore, the overall large-scale coastline orientation dominates the wind-driven response, but within a few internal Rossby radii, the local coastline clearly dominates

the flow patterns and across-shelf wind becomes locally shore-parallel inside the bay. Within the bay interior, the across-shelf wind is highly coherent and in phase with the near-surface subtidal across-shelf current. The Kennebec River north of the study area supplies freshwater to eastern Casco Bay in all seasons. A pool of low-density, relatively fresh water at the entrance to the bay sets up an across-shelf density gradient that is reversed from a typical estuary, and likely contributes to the mean surface on-shelf transport in this region. Surface-drifter trajectories observed over the course of the study suggest that both the across-shelf wind and the across-shelf density gradient are important in driving surface up-bay transport and in the retention of surface-dwelling organisms in eastern Casco Bay.”

Understanding Casco Bay: A Circulation Study, Casco Bay Estuary Partnership.

Go to: www.cascobay.usm.maine.edu/publications.html

Description: An eight-page illustrated pamphlet summarizing what is known about circulation in the bay.

Cobscook Bay

Brooks, D.A., M.W. Baca, and Y.-T. Lo. 1999. **Tidal circulation and residence time in a macrotidal estuary: Cobscook Bay, Maine.** *Estuarine, Coastal and Shelf Science* 49:647-665.

Abstract: “Cobscook Bay is a macrotidal estuary situated near the entrance to the Bay of Fundy, where the mean semi-diurnal tidal range is 5.7 m. Vigorous tidal currents in the bay maintain cold water temperatures year-round and effectively exchange nutrients and other dissolved matter with offshore waters. Partly because of the cold water and tidal exchange, a net-pen salmon aquaculture industry has rapidly expanded in the last decade, raising questions about sustainable levels of production in the environmentally pristine bay. The present study addresses the question of dispersion and flushing of materials in the bay, using a three-dimensional numerical model to simulate the circulation driven by the semi-diurnal tide and runoff from principal rivers. With initialization based on May 1995 cruise data, the results show that the tidal-mean flushing times for neutral surface particles vary from less than one day in the main channel near the entrance to more than a week in the extremities of the inner arms of the bay. A bay-wide average flushing time is about two days, or four tidal cycles, but the detailed distribution is strongly influenced by a pair

of counter-rotating eddies that forms in the central bay during each flooding tide. The eddy pattern preferentially directs the initial flood into a southern arm of the bay, where particles and dissolved materials are sequestered. The effective horizontal mixing coefficient in the main channel of the central bay is 300–400 m² s⁻¹, leading to rapid dispersal of particles and pollutants in the along-channel direction and into the shallow inner arms of the bay where they tend to accumulate. A map of tidal-mean residence time indicates that most current aquaculture sites are located in reasonably well flushed regions.”

Cobscook Bay Resource Center Drift Study.

Go to: www.cobscook.org/resourceCenter/student-DriftStudy.htm Scroll down and select a date to view a map of results from the drift study showing currents in Cobscook Bay.

Description: “Cobscook Bay is well known for its dramatic tidal range and strong currents. During the Nature Conservancy’s Cobscook Bay Ecosystem Study, a computer model was designed by David Brooks of Texas A&M University and others to simulate the three-dimensional circulation in the bay. The predictions made by this model have not been extensively confirmed in the field. The Drift Study was conceived and designed to allow for groundtruthing of the model while involving high school students in a meaningful scientific project. Students at Shead High School designed and built the drifters and continue to participate in all aspects of the study from data collection to data analysis. For each trial, drifters were dropped between Gove Point, Lubec and Birch Point, Perry at the start of flood tide and tracked for about six hours (one-half a tidal cycle) using skiffs and hand-held Global Positioning System (GPS) units. The data collected were brought into ArcView software and used to create maps. Click on the links to view maps of each drifter trial.”

Penobscot Bay

Pettigrew, N. 2000. **Circulation Patterns and Processes in Penobscot Bay: Preliminary Interpretation of Data. A Final Report for Year 4 of the Penobscot Bay Experiment.**

Go to: www.islandinstitute.org/penbay/pettigrew.htm Click on the pdf report from 1999 or from 2000.

Description: “The principal objectives of the third year of the circulation experiment were to expand the seasonal circulation study into the previously un-

measured inner Bay, to study the circulation linkages between the inner and outer Bays and the Eastern Maine Coastal Current (EMCC), and to monitor the here-to-fore unmeasured currents in the near-surface layer (2m). These objectives were achieved by deploying five buoys in the experiment (two in the inner Bay, two in the outer Bay, and one in the EMCC), adding acoustic current meters at 2 m depth on each of the four Bay buoys, and maintaining this coastal ocean observing system for a period of approximately 12 months.”

Xue, H. et al. 2000. **Modeling the Circulation in Penobscot Bay, Maine.** In: *Estuarine and Coastal Modeling Louisiana*, November 3-5, 1999.

Go to: rocky.umeoce.maine.edu/publication.htm Scroll down to the year 2000 and click Download next to the listing of this publication.

Abstract: “Penobscot Bay, with approximate dimensions 50 x 100 km, is the largest estuarine embayment along the Maine coast. It can be characterized by two deep channels on its eastern and western sides, which are separated by several islands and a shoal region in the middle of the Bay. Subtidal circulation in Penobscot Bay is influenced by winds, fresh water discharge from the Penobscot River, and the southwestward Maine Coastal Current flowing past the mouth of the Bay. The Princeton Ocean Model was adapted to Penobscot Bay to simulate the circulation for the spring and summer of 1998. Observed winds at nearby Matinicus Rock and realistic river discharge rates were used to force the model. Open boundary conditions were specified using the results from a Gulf of Maine climatological model. Simulations were somewhat sensitive to the mixing coefficient in the model. When a background viscosity of 5x10⁻⁶ m²/s was used, the model reproduced the observed three-layer structure in the outer western bay with outflows near the surface and the bottom and inflows in the middle of the water column. In contrast, a two-layer estuarine like circulation was found in the outer eastern bay with outflows in the upper water column and inflows in the lower water column.”

O5 Tides, Tidal Currents

Tidal Range

NOAA Tidal Predictions.

Go to: co-ops.nos.noaa.gov/tide_pred.html

Description: Tidal data for many locations in Maine.

Tidal Currents—General

NOAA Tidal Current Predictions.

Go to: co-ops.nos.noaa.gov/curr_pred.html

Description: “Unlike tide stations, which are normally located along the shoreline, most tidal current stations are located offshore in channels, rivers, and bays. Tidal current stations are often named for the channel, river, or bay in which they are located or for a nearby navigational reference point. A map or some personal knowledge of the area may be necessary to help identify stations in the area you are interested in.”

The Maine Coast Guide.

Go to: www.coastguides.com/intro/tides.html

Description: General narrative information about tidal currents in Maine.

Cobscook Bay

Brooks, D.A., M.W. Baca, and Y.-T. Lo. 1999. **Tidal circulation and residence time in a macrotidal estuary: Cobscook Bay, Maine.** *Estuarine, Coastal and Shelf Science* 49:647-665.

Brooks, D.A. 2004. **Modeling Tidal Circulation and Exchange in Cobscook Bay, Maine.** *Northeastern Naturalist* 11 (Spec. Issue 2):23-50.

Description: This paper summarizes a Cobscook Bay circulation study by Brooks et al. (1999) and presents some new results to improve understanding of the tidal circulation and potential exchange pathways linking the bays.

O6 Winds

Wind data from buoys and island stations, GoMOOS.

Go to: www.gomoos.org

Gulf of Maine Wind Vector Images.

Go to: wavy.umeoce.maine.edu/frames_qs.html

Description: The images are based on data collected by a satellite passing over the Gulf of Maine (one ascending and one descending orbit per day). Wind speed is reported in meters per second.

O7 Sea Level

Barnhardt, W.A., and J.T. Kelley. 1995. **Carbonate accumulation on the inner continental shelf of Maine: a modern consequence of late Quaternary glaciation and sea-level change.** *Journal of Sedimentary Research* A65:195-207.

Barnhardt, W.A., W.R. Gehrels, D.F. Belknap, and J.T. Kelley. 1995. **Late Quaternary relative sea-level change in the Western Gulf of Maine: evidence for a migrating glacial forebulge.** *Geology* 23: 317-320.

Kelley, J.T., S.M. Dickson, D.F. Belknap, and R. Stuckenrath. 1992. **Sea level change and the introduction of late Quaternary sediment to the southern Maine inner continental shelf, pp. 23-34 in *Quaternary Coasts of the United States* (J. Wehmiller and C. Fletcher, eds.) Special Paper 48, Society of Economic Paleontologists and Mineralogists.**

Maine’s history of sea-level changes, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/marine/facts/sealevel.htm

Description: Fact sheet on history, effects, and potential for future sea-level change.

Sea level trends for stations in Maine, NOAA.

Go to: co-ops.nos.noaa.gov/sltrends/sltrends_states.shtml?region=me

Description: Water-level records combine data on ocean fluctuations and vertical motion of the land at the station. The sea-level variations determined by these records include the linear trend, the average seasonal cycle, and the interannual variability at each station. Monthly data through the end of 1999 were used in the calculation, and all stations had data spanning a period of 25 years or more.

O8 Vertical Profiles of Temperature, Salinity, and Density

Temperature, salinity, and density measurements, GoMOOS buoys.

Go to: www.gomoos.org

Sea surface temperature from University of Maine Satellite Oceanography Data Lab.

Go to: wavy.umeoce.maine.edu/sat_ims.htm

Description: A Web site which presents the research activities carried out in the UMaine Satellite Oceanography Data Lab and makes available some of the data products they produce including real-time and archived satellite imagery for several geographic regions (special focus on the Gulf of Maine).

Biological Components

B1 Historical Perspective on Ecological Changes

Frequency of harmful algal blooms (red tide)

Biotoxin Monitoring Program, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/public_health/biotoxinmonitoring.htm

Description: Extensive history of red tide for some sites going back almost 30 years. Data available by request.

Eutrophication

Mayer, L., et al. 1996. *The Kennebec, Sheepscot, and Damariscotta River Estuaries: Seasonal Oceanographic Data*. Technical Report No. 9601, Department of Oceanography. Orono, ME: University of Maine.

Nutrient data from Marine Resources Volunteer Coordinator, Maine Department of Marine Resources.

Go to: www.umaine.edu/umext/ssteward

Description: Data collected by volunteers in the Shore Stewards water-quality monitoring program.

Changes in wetlands and eelgrass coverage

Effects of commercial fishing on eelgrass in New England: Characterization of impacts and measurements of regrowth, results of high altitude photography [Maquoit Bay]. Report from Maine Department of Marine Resources to USGS Eastern Regional Office State Partnership Project.

Go to: www.maine.gov/dmr/rm/ecologydivision.html

Description: "As part of a multi-agency USGS State Partnership Program funded study of eelgrass regrowth in Maquoit Bay, Brunswick, Maine, Maine Department of Marine Resources (MDMR) docu-

mented small (1:12,000) and medium (1:2,400) scale distribution of eelgrass throughout the bay. This work was initiated in response to reports of the destruction of eelgrass beds by commercial mussel harvesting activities in the bay... Maquoit Bay has offered an excellent opportunity to study re-growth of eelgrass after meadows had been disrupted by a number of commercial harvesting methods. It was apparent from aerial photography taken in 1999 and from field observations that in recent years fairly extensive portions of Maquoit Bay had been impacted by mussel harvesting activities. It was also clear that eelgrass beds in Maquoit Bay had expanded since they were mapped in 1993 and that there was evidence of marine worm and soft clam harvesting activities that continued to take place in eelgrass. In addition, other uses of the Bay such as boating may have had impacts on eelgrass."

Maine Office of GIS map layer of eelgrass beds (MEGRASS).

Go to: apollo.ogis.state.me.us/catalog/

Description: "MEGRASS is a REGIONS dataset of Maine's eelgrass meadows, which form an important aquatic habitat for the state. These meadows provide shelter for juvenile fish, and invertebrates. In certain locations they also help stabilize unconsolidated sediments and shorelines. As a continuing project, sections of the coast have been flown and photographed using Kodak 2448 film at a scale of 1:12000. This photography has been supplemented in the Penobscot Bay region by 1992 flights using Kodak 2445 film. The Penobscot Bay flights were contracted by the Maine Department of Transportation and interpreted by Dr. Fred Short of University of New Hampshire." Contact: GIS specialist, Maine Department of Marine Resources, (207) 633-9500.

Regional wetland status and trend reports, U.S. Fish and Wildlife Service.

Go to: northeast.fws.gov/wetlands/ and for ordering instructions go to northeast.fws.gov/wetlands/docs/publication.pdf

Description: In the mid-1970s, the National Wetlands Inventory program was established to inventory the nation's wetlands and report on their status. The program produces wetland maps and periodically updates these maps and accompanying digital data. The program also evaluates and reports on changes in wetland status (wetland trends) to inform the Ameri-

can public on how wetlands are changing in response to natural processes (e.g., sea level rise, fire, and mudslides) and to human development (e.g., agriculture, urban and suburban development, impoundment, dredging, channelization and ditching).

Habitat changes/degradation

Historical aerial photographs, USGS Earth Resources Observation Systems Data Center.

Go to: edc.usgs.gov/products/aerial.html

Description: Aerial photographs dating back to the 1940s can be ordered for a fee from this site. Search the site for availability of photographs from Maine.

Recent aerial photographs, Maine Department of Marine Resources.

Go to: www.state.me.us/dmr/aerialphotos/index.html

Description: “The photographs for Maine were from a coast-wide eelgrass mapping project and represent scanned images for the years 1992 to 1997. Photographs are organized by region.”

Maine Office of GIS map layer for impervious surfaces (IMPERV).

Go to: apollo.ogis.state.me.us/catalog/

Description: “IMPERV is a raster data set of impervious areas, derived from 5 meter SPOT imagery collected in the summer of 2004 over the State of Maine. Areas of imperviousness are characterized by anthropogenic features such as buildings, roads, parking lots, etc. Pixel values of 0 (zero) indicate an impervious land cover, while pixel values of 1 (one) indicate pervious land cover features.”

Maine Office of GIS map layer for land cover (MELCD).

Go to: apollo.ogis.state.me.us/catalog/

Description: “MELCD is a land cover map for Maine primarily derived from Landsat Thematic Mapper 5 and 7 imagery, from the years 1999-2001. This imagery constitutes the basis for the National Land Cover Dataset (NLCD 2001) and the NOAA Coastal Change Analysis Program (C-CAP). This land cover map was refined to the State of Maine requirements using SPOT 5 panchromatic imagery from 2004. The Landsat imagery used was for three seasons: early spring (leaf-off), summer, and early fall (senescence) and was collected with a spatial resolution of 30 m. The SPOT 5 panchromatic imagery was collected at a

spatial resolution of 5 m during the spring and summer months of 2004. The map was developed in two distinct stages, the first stage was the development of a state wide land cover data set consistent with the NOAA-CAP land cover map. The second stage was: a) the update to 2004 conditions, b) a refinement of the classification system to Maine specific classes and, c) a refinement of the spatial boundaries to create a polygon map based on 5 m imagery.”

Maine Office of GIS high-resolution coastal photographs.

Go to: apollo.ogis.state.me.us/ *Note: These can also be found in Google Earth along with some other industry sources, earth.google.com/*

Maine Land Cover Change Reports, NOAA Coastal Services Center.

Go to: www.csc.noaa.gov/crs/lca/maine.html

Description: “This project studied the estuarine drainage areas of the Gulf of Maine, including the surrounding areas of Great Bay in New Hampshire and the St. Croix Estuary at the Maine/Canada border. This project mapped terrestrial land cover in coastal watershed environments and identified changes in these areas that occurred between 1985 and 1995. The project relied on satellite multispectral imagery as the primary information source. These data were used to distinguish major land cover classes, and previous images were studied to locate areas that changed over time. For this project, the data were acquired according to the Center’s Coastal Change Analysis Program (C-CAP) methods.”

Invasive species

Berman, J., L. Harris, W. Lambert, M. Buttrick, and M. Dufresne. 1992. **Recent invasions of the Gulf of Maine: three contrasting ecological histories.** *Conservation Biology* 6:435-441.

Abstract: “Introduced species are common members of estuarine communities where their role as competitors and predators is of concern. This paper examines the invasion of Gulf of Maine benthic habitats by the ecologically similar alien invertebrates *Styela clava*, *Botrylloides diegensis*, and *Membranipora membranacea*. *Styela clava* increased slowly in abundance at study sites in Beverly, Massachusetts and Portsmouth, New Hampshire. We found no evidence of competitive dominance by *S. clava*, even though it is the competitive dominant in similar habitats elsewhere. *Botrylloides diegensis* rapidly became a dominant species after its arrival in the Great Bay Es-

tuary, but this dominance was short-lived. *B. diegensis* persists in the estuary as an early colonist of primary space and as an epibiont on secondary substrates in established communities. *Membranipora membranacea* became the dominant epiphyte on laminarian kelps within two years. Although *M. membranacea* overgrew the native epiphytes *Obelia geniculata* and *Electra pilosa* in the overwhelming majority of encounters these native species are more common on other algal hosts. Therefore, competitive dominance is not likely a factor in the successful invasion of the Gulf of Maine by *M. membranacea*. These species provide evidence for opposing views of the role of competition in mediating community invasion. We show that ecological similarity among species is not an accurate criterion to predict either the mechanism of invasion or the means of persistence. In addition, these data indicate that biological invasions must be examined on broad spatial and temporal scales; short-term or narrowly focused studies can lead to incorrect conclusions.

Carlton, J.T. 2004 (unpublished). **A Preliminary Checklist of the Introduced Marine and Estuarine Organisms on the Coast of Maine, U.S.A.** Mystic, CT: Williams College-Mystic Seaport.

Go to: www.seagrant.umaine.edu/documents/pdf/invchk.pdf

Description: “This regional list for the coast of Maine is derived from a larger work (commenced in 1975) monographing the introduced and cryptogenic marine organisms from Nova Scotia to Long Island Sound. Many colleagues and students have been involved in this work over the past 29 years. August 2003 surveys of selected sites along the Maine coast (led by Dr. Judith Pederson and colleagues; personal communications) added several new taxa to this working list. These sites included South Portland (Port Harbor Marine floats and retaining walls), Portland (Portland Yacht Services floats), and South Freeport (Brewer South Freeport floats).”

Maine’s Marine Invasion: A Forum on the Impact of Non-native and Other Invasive Species on Maine’s Coastal Ecosystems. Presentation and documents from a workshop on May 5, 2004.

Go to: www.cascobay.usm.maine.edu/oldsite/invasforum.html

Description: “At this forum, scientists and managers working on marine invasive species issues through-

out New England addressed questions related to the issue of marine invasions in Maine. Presentations included the results of an August 2003 survey for marine invasive species in Casco Bay and ports south of Casco Bay in New England; information about specific bio-invaders; potential pathways for their introduction; and a case study from Massachusetts on how to manage what’s here and keep potential new invasions out.”

Maine’s Marine Invasion, Maine Sea Grant.

Go to: www.seagrant.umaine.edu/documents/pdf/MMI05.pdf

Description: Provides general information and resources on marine invasions in Maine.

Marine Invaders in the Northeast: Rapid assessment survey of non-native and native marine species on floating dock communities.

Go to: www.mass.gov/envir/massbays/pdf/ras2003.pdf

Description: “A rapid assessment survey (RAS) approach was used to identify native, introduced, and cryptogenic species present as fouling communities on floating docks and associated structures (ropes, buoys, chains, hulls, and other floating materials) for selected coastal locations along the northeastern U.S. coast from Portland, Maine through New York City and Staten Island, New York. The Northeast RAS was similar to surveys conducted in Puget Sound, Washington, San Francisco Bay, California, and Southern California (Cohen et al. 1998; Cohen et al. 2001; H. Berry pers. comm.; C. Mills pers. comm.) and in Massachusetts and Rhode Island (Cute 2001; Pederson et al. 2001) and relies on taxonomic experts who are familiar with native, introduced, and cryptogenic species for taxonomic identifications.”

B2 Habitats

Mapping and image data documenting coastal marine habitats

Aerial photography index of the Maine coast, Maine Department of Marine Resources.

Go to: www.state.me.us/dmr/aerialphotos/index.html

Description: See Habitat Change listings under B1 Historical Perspective on Ecological Changes.

Beginning with Habitat maps and GIS data.

Go to: www.beginningwithhabitat.org/the_maps/index.html

Description: “Three primary maps, Water Resources & Riparian Habitats, High Value Plant & Animal Habitats, and Undeveloped Habitat Blocks, form the core of the Beginning with Habitat information.”

Brown, B. 1993. A Classification System of Marine and Estuarine Habitats in Maine: An Ecosystem Approach to Habitats. Part 1: Benthic Habitats, Maine Natural Areas Program.

Go to: www.mainenaturalareas.org/docs/publications/

Description: This document describes a preliminary classification system for Maine’s benthic marine and estuarine habitats. It uses an ecosystem approach and classifies habitats based on both biotic and abiotic features.

GIS maps of eelgrass beds, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/eelgrass/index.htm

Description: “In the period 1992-1997, eelgrass bed locations were compiled on stable-base manuscripts containing the coastline and other basemap features from the 1:24,000 scale USGS topographic maps. Polygons delineating stands of eelgrass were digitized and coded using a four category scale of percent cover. In the 2001 to 2005 time period polygons were screen digitized. Verification has been carried out by boat, on foot, and by plane. Though dense patches of eelgrass approximately 6 meters in diameter and less can be identified under good conditions and in some cases were mapped, a conservative estimate of the minimum mapping unit is 150 square meters. This represents a stand of approximately 14 meters in diameter.” Digital eelgrass data are also available from Maine Office of GIS.

GIS data for Essential Wildlife Habitats and Significant Wildlife Habitats as well as habitat of endangered, threatened or special concern species, Maine Department of Inland Fisheries and Wildlife.

Go to: www.maine.gov/ifw/wildlife/habitat_data/index.htm

Description: “MDIFW provides digital copies of its wildlife habitat data upon written request. All data are provided as Geographic Information System (GIS) shapefiles.” Habitat for some species are also available as statewide datasets from Maine Office of GIS.

Maine Office of GIS map layer of commercially harvested worm habitat (WORM).

Go to: apollo.ogis.state.me.us/catalog/

Description: “WORM provides a generalized representation at 1:24,000 scale of commercially harvested marine worm habitat in Maine, based on Maine Department of Marine Resources data from 1970s. Original maps were created by MDMR and published by USF&WS as part of the Ecological Characteristics of Coastal Maine. According to a MDMR staff member in 2007, there is new information available that has been incorporated into DEP EVI maps but not yet published by the Maine Office of GIS.”

GIS identification of important habitats in the lower Casco Bay (Maine) watershed.

Go to: gulfofmaine.org/library/casco/casco.htm

Description: “The U.S. Fish and Wildlife Service Gulf of Maine Project has identified important habitats for a variety of plants, invertebrates, fishes and birds, in the lower Casco Bay watershed of Southern Maine. Habitat identification was based on species occurrences and also was projected from environmental parameters favorable to those species, such as suitable vegetation, water depth, or presence of food resources. Numerical scores were assigned to each habitat, reflecting level of use and apparent environmental quality for the evaluation species. Scores were adjusted according to the relative abundance of each habitat within the study area, and the relative ranking of the evaluation species on the Gulf of Maine Council regional listing. Habitat maps for the individual species were aggregated into a final map highlighting areas important to one or several species. This information is being used in an analysis of threats to important habitats from development activities, performed in cooperation with the Casco Bay Estuary Project. The digital data described in this report are available as geo-referenced compressed binary raster files. These files may be downloaded for use in a number of GIS programs and viewers by accessing the documentation page from several places in this report.”

Maine Office of GIS map layer of saltwater and estuarine habitat value (SALINE91).

Go to: apollo.ogis.state.me.us/catalog/

Description: “SALINE91 represents the overall habitat values, within saltwater and estuarine cover types for 91

priority trust species of the U.S. Fish Wildlife Service, in the U.S. portion of the Gulf of Maine watershed. Habitats for each species were mapped and ranked from actual sightings or by developing habitat suitability models reflecting environmental requirements for each species. Scores for each species were then added to derive the sum of scores for all species combined. The value for each cell reflects both the number of species using each cell and the relative habitat suitability for those species.” For more information about the US-FWS Gulf of Maine Coastal Program’s Gulf of Maine Habitat Analysis, Go to: www.fws.gov/northeast/gulfofmaine/projects/habitat_analysis.htm

Maine Office of GIS map layer of shellfish habitat (SHELL).

Go to: apollo.ogis.state.me.us/catalog/

Description: “SHELL offers a generalized representation of molluscan shellfish habitat 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 (USEPA) and Maine Department of Marine Resources (MDMR) staff. The coverage represents a composite of the 1:24000 scale coastline with polygons digitized from paper maps produced for the US Fish and Wildlife Service (USF&WS) Ecological Characteristics of Coastal Maine.”

Gulf of Maine Watershed Habitat Analysis Important Habitat Internet Map Viewer, U.S. Fish and Wildlife Service Gulf of Maine Coastal Program.

Go to: www.fws.gov/northeast/gulfofmaine/maps_data/map_viewer.htm

Description: “This online mapping tool displays the results from the Gulf of Maine Watershed Habitat Analysis. It allows you to view important habitat for 91 priority trust species of the U.S. Fish and Wildlife Service as determined by analysis of field data and modeling efforts. The study area includes Maine, and the eastern portion of New Hampshire and Massachusetts that drain into the Gulf of Maine. The habitat data in the map viewer are intended to be used for proactive, voluntary habitat protection projects. This may include use in comprehensive and open space planning. It may also be used to prioritize habitat protection efforts and to support grant applications. The data are not meant to be used in a regulatory fashion and are not meant to portray U.S. Fish and Wildlife Service Critical Habitat.”

Reports documenting coastal marine habitats

Beginning with Habitat Focus Areas of Ecological Significance, Maine Natural Areas Program and Maine Department of Inland Fisheries and Wildlife.

Go to: www.mainenaturalareas.org In the left-hand menu click on Focus Areas of Natural Significance. Click on the desired county, or scroll down to see an alphabetical listing by county of reports on profiled areas.

Description: This site includes a description of each area and its unique habitat characteristics, a table of rare species and exemplary natural communities, conservation considerations and protection status. An explanation of the ranking system can be found under Natural Communities in the main menu on the home page.

Doggett, L.F., et al. 1978. Intertidal bedrock areas of high species diversity in Maine, and their relevance to the Critical Areas Program, Maine Critical Areas Program Planning Report No. 55. Augusta, ME: Critical Areas Program, Natural Resource Planning Division, Maine State Planning Office. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Description: “Intertidal bedrock areas have a high species diversity when specific conditions are met. A relatively high energy level due to wave action and a heterogeneous substrate which contains tidepools and crevices in the lower intertidal zone are among the most important conditions determining the level of species diversity. A number of the species present in these high diversity areas are unusual and noteworthy. Brittlestars, sponges, sea spiders, and nudibranchs (shell-less gastropods) are examples of the fauna present. This report documents and describes areas of high species diversity at 18 intertidal bedrock sites. Also included (for the 12 sites which were field checked) are species lists which state the zone in which the species was found and the relative abundance of the species. General information on marine invertebrates is provided. Abiotic and biotic factors as they pertain to the species in this habitat are discussed. Descriptions of the intertidal zones and the species which were present at the sites which were checked are included. Criteria for determining significant sites are stated. It is recommended that additional sites be considered and that they be evaluated based on the criteria presented in this report.

Intertidal bedrock areas of high species diversity can be disturbed and/or destroyed by over-collecting and excessive foot traffic. Therefore, this report recommends that the 18 sites described here be evaluated for inclusion in the Register of Critical Areas.”

Fefer, S.I., L.L. Thornton, P. Schettig, and R. Brami. 1978. **An Ecological Characterization of Maine's Coast North and East of Cape Elizabeth.** Boston, MA: U.S. Fish and Wildlife Service. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Description: This study consists of six volumes devoted to the detailed study of the ecological characteristics of Maine's coast.

Natural Resource Inventories of coastal watersheds produced by local land trusts. The Maine Land Trust Network lists most of the organizations and provides links to their Web sites.

Go to: www.mltm.org

The Ecology of Maine's Intertidal Habitats: A Report Prepared for the Maine State Planning Office. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Ward, A. 1999. **Maine's Coastal Wetlands (Vol. I and II).** Augusta, ME: Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/blwq/doceducation/general.htm

Description: Part I serves as a reference providing biological and geological information on Maine's coastal habitats and summarizing coastal development activities during the later half of the 1990s. Part II provides functional assessment guidelines to enable consultants to meet permit application requirements in Maine's Natural Resources Protection Act.

B3 Plants and Animals

Sources about multiple types of plants and animals

Census of Marine Life Gulf of Maine Area Program.

Go to: research.usm.maine.edu/gulfofmaine-census/biodiversity

Description: Interactive maps and narrative descriptions about changes in fish populations and many other aspects of sea life in the Gulf of Maine.

Dynamic Atlas of the Gulf of Maine, Census of Marine Life.

Go to: research.usm.maine.edu/gulfofmaine-census/data-mapping/

Description: Access to data used throughout the Census program, either directly from the Data and Mapping Portal, or from the list of data providers and links.

Maine marine resource information by species, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/speciesinformation.htm

Description: Information about many kinds of fish and invertebrates.

Maine-New Hampshire Inshore Trawl Survey, Maine Department of Marine Resources and New Hampshire Department of Fish and Game.

Go to: www.maine.gov/dmr/rm/rawl/index.htm

Description: “The Inshore Groundfish Trawl Survey is a fisheries independent assessment of living resources inside the coastal waters of Maine and New Hampshire. Its purpose is to fill a significant information gap that hampers efficient management of Maine's fishing industry. In fact, until this survey, Maine and New Hampshire were the only states on the east coast not conducting a near shore assessment. Quotas, closures, and other management measures are based on assessments done outside Maine waters where fishing pressure and conditions are entirely different. As a result, Maine's and New Hampshire's resources are being managed without benefit of adequate information. While the funding comes from money Congress set aside to provide some economic relief to the groundfish industry, the assessment is more than a groundfish survey. Lobsters, recreational finfish species, and non-commercial species of ecological interest are also assessed. This is truly a multispecies survey that should benefit all decision makers confronted with issues such as fish stock recovery, fishery management measures, Essential Fish Habitat designations, climate change, Marine Protected Areas and more. The coast has been broken into 5 areas based on geologic, oceanographic, geographic and biologic factors and in addition, each area has been divided into four depth layers; 5-20, 21-35, 36-55, and 55+ fathoms. Stations are located randomly to reflect representative conditions within each of the strata. We attempt

to complete 115 tows during each survey. Gear consists of a modified shrimp net with a 2 inch mesh in wings and 1/2 inch mesh liner in the cod end. Foot rope and head ropes are 57' and 70' respectively, with 6 inch rubber cookies. The gear was designed to be very light on the bottom to minimize habitat disruption. Video work conducted in February and August 2002 has confirmed that this is so."

Rare plant fact sheets, Maine Natural Areas Program.

Go to: www.mainenaturalareas.org and click on Rare Plants in the column on the left hand side.

Description: Fact sheets provide information on the identification, distribution, and population status of rare plants, including those found in coastal habitats.

Resource information by species, Maine Department of Inland Fisheries and Wildlife.

Go to: www.maine.gov/ifw/wildlife/species/index.htm

Description: Information about many kinds of game, nongame, and endangered and threatened animals including waterfowl and shorebirds. Sport fish also described at: www.maine.gov/ifw/fishing/species/identification/index.htm

Sears Island Dry Cargo Terminal Marine Resources Baseline Report. 1995. Prepared for Maine Department of Transportation by Normandeau Associates.

Description: "This report presents results of investigations of various marine resources in the vicinity of Sears Island, Maine in upper Penobscot Bay during 1992. These investigations were undertaken to supplement baseline information on intertidal and nearshore habitat conditions and utilization of fisheries resources as a basis for evaluating impacts of the Maine Department of Transportation's (MDOT) proposed Sears Island Dry Cargo Terminal. These investigations included studies of eelgrass (*Zostera marina*), soft-shell clams (*Mya arenaria*), marine worms (primarily baitworms *Glycera dibranchiata* and *Nereis virens*), lobsters (*Homarus americanus*), sea scallops (*Placopecten magellanicus*) and sea urchins (*Strongylocentrotus droebachiensis*). The northwest shoreline, in the area covered by the High Intensity Wildlife Survey, was encompassed in these investigations because this entire area was being reviewed for alternative port locations at the time. Information on other marine resources is recapitulated from the EIS."

The Taunton Bay Assessment, A Report to the Maine Legislature Marine Resources Committee for Consideration of the 2000-2005 Dragging Prohibition. January 30, 2004. Augusta, ME: Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/baystudy/baystudy.htm to contact the Ecology Division of the Maine Department of Marine Resources.

Description: Seabed mapping (Maine DMR/local fishermen); Characterization of the Bay's dragging history (Maine DMR/local fishermen); Eelgrass distributional changes (Maine DMR); Intertidal community characterizations (Maine Maritime Academy); Horseshoe crab seasonal movements (Maine DMR/Friends of Taunton Bay); Shallow subtidal fish communities (Maine DMR); Mussel dragging experiment (Maine DMR/Univ. of Maine/local fishermen).

B3.1 Phytoplankton

General

Bigelow, H.B. 1926. Plankton of the Offshore Waters of the Gulf of Maine. Washington, DC: Government Printing Office. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Chlorophyll concentration data, Gulf of Maine Ocean Observing System (GoMOOS).

Go to: www.gomooos.org/oceanbiology/

Description: "GoMOOS measures microscopic plant life. Direct measurements include chlorophyll and sunlight. These measurements are utilized to estimate phytoplankton biomass, the occurrence of phytoplankton blooms, and primary productivity."

Field Guide to the Phytoplankton in the Gulf of Maine. University of Maine Cooperative Extension and the Maine Sea Grant Program.

Go to: www.umaine.edu/umext/ssteward/phyto.htm

Description: "This field guide was created for the citizen volunteers who provide a first-alert system to the Maine Department of Marine Resources by watching for the presence of potentially toxic phytoplankton along Maine's coast."

Marine Planktonic Diatoms of the Northeast U.S. Coast.

Go to: thalassa.gso.uri.edu/flora/NElist.html

Description: This Web site consists of a list of diatom genera. The site user can click on one of the genera to see which diatom species of that genus are found on the northeast U.S. coast.

Cobscook Bay

Cobscook Bay Phytoplankton Reports.

Go to: www.cobscook.org/reference/publications/phytoReports.htm

Description: “The Cobscook Bay Resource Center has monitored phytoplankton presence and abundance in the Cobscook Bay region since 1998. Data are shared with and analyzed by the Maine Department of Marine Resources (DMR). Samples are collected using two methods: net tows and “at-depth” cell counts. We sample six shore-side sites and two fish farm sites regularly. Other sites are sampled by special arrangement. We have recently completed development of a database which allows us to track changes in the phytoplankton community as they occur. In response to blooms of multiple species which occurred in 2003, the Resource Center developed an email notification system to inform fish farmers and other interested parties of phytoplankton conditions. Our partner in these efforts is the Pleasant Point Passamaquoddy Environmental Department.”

Kennebec River Estuary

Wong, M.W. and D.W. Townsend. 1999. **Phytoplankton and hydrography of the Kennebec estuary, Maine (USA).** *Marine Ecology Progress Series* 178:133-144.

Abstract: “The biomass, abundance and species composition of phytoplankton in the Kennebec estuary, Maine, USA, were investigated in relation to hydrography and light regime during 7 seasonal survey cruises. The salinity distribution ranged from 32 at the mouth to between 0 and 5 at the head, depending on the magnitude of freshwater discharge at the time of each survey. Maximum vertical salinity and temperature gradients were observed at the mouth, while local tidal mixing, combined with the freshwater flow, produced a well-mixed water column at the head of the estuary. The middle portion of the estuary was stratified on flooding and ebbing tides, but was vertically well mixed at high and low tides. Phytoplankton biomass was lowest in winter (chlorophyll *a* ~ 1 µg l⁻¹) and highest in summer (up to 10 µg l⁻¹). The

phytoplankton species assemblages at the seaward and the riverine ends of the estuary were made up of taxa with corresponding salinity preferences. Both cell numbers and biomass (chlorophyll *a*) exhibited a bimodal distribution along the length of the estuary in the warmer months, with the middle portions of the estuary having depressed phytoplankton standing stocks compared with the seaward and landward ends. This bimodal distribution was related to light limitation and nutrient regeneration in the middle portion of the estuary and to the production of and advective contributions of phytoplankton from both the freshwater and seaward ends.”

Penobscot Bay

Reports on the characterization of phytoplankton communities, primary production, and detrital components in Penobscot Bay.

Go to: www.islandinstitute.org/penbay/phytoplankton.htm

Description: “Maureen Keller and Andrew Thomas studied several aspects of primary productivity, the base of the food web, in the bay. Their research sought to identify patterns of temperature, salinity, chlorophyll, light transmission, primary productivity, and dissolved and particulate organic matter in the surface waters of the Bay. In addition, the researchers identified the distribution of dominant phytoplankton species.”

B3.2 Macrophytes

Lamb, M. et al. 1977. *Artificial Key to the Common Marine Algae of New England North of Cape Cod.* Cambridge, MA: Farlow Herbarium, Harvard University.

Description: “The purpose of this field guide is to provide the reader with a convenient means to the identification of selected marine algae of the New England Coast, north of Cape Cod to adjacent Canadian waters....The majority of plants contained in the key are identifiable macroscopically or by the use of a hand lens....The majority of species descriptions are accompanied by line drawings or [black-and-white] photographs. These illustrations were prepared almost exclusively from living specimens.”

GIS maps of eelgrass beds.

Go to: www.maine.gov/dmr/rm/eelgrass/index.htm

Description: See listing under B2 Habitats Mapping data.

South, G. R., and I. Tittley. 1986. ***A Checklist and Distributional Index of the Benthic Marine Algae of the North Atlantic Ocean***. St. Andrews, New Brunswick: Huntsman Marine Laboratory.

Go to: www.huntsmanmarine.ca/publications1985-1989.shtml

Villalard-Bohnsack, M. 1995. ***Illustrated Key to the Seaweeds of New England***. Rhode Island Natural History Survey.

Description: Black and white photos and line drawings.

Watling, L., J. Fegley, and J. Moring. 2003. ***Life Between the Tides, Marine Plants and Animals of the Northeast***. Gardiner, ME: Tilbury House.

Go to: www.tilburyhouse.com/Maine%20Frames/me_tide_fr.html

Description: Includes drawings and descriptions of vascular marine plants and seaweeds.

Wippelhauser, G. 1996. ***Ecology and Management of Maine's Eelgrass, Rockweeds and Kelps***. Augusta, ME: Maine Natural Areas Program.

Go to: www.mainenaturalareas.org/docs/publications/

B3.3 Invertebrates

General

Bousfield, E.L. and D.R. Laubitz. 1972. **Station lists and new distributional records of littoral marine invertebrates of the Canadian Atlantic and New England regions. Biological Oceanography Publication No. 5, Canadian National Museum of Natural Sciences. Available from the University of Maine Library System.**

Go to: www.library.umaine.edu

Description: “Station data and locality maps are provided for field investigations on the distribution and ecology of littoral marine invertebrates, mainly molluscs and crustaceans, in the following regions: St. Lawrence estuary and Gaspé coast, 1953, 1969; the southwestern Gulf of St. Lawrence, 1960, the Atlantic coast of eastern Nova Scotia, 1962; and the Gulf of Maine coast of western Nova Scotia and New England, 1963. Locality records are provided for a number of invertebrate species that are believed to set new distributional limits, or are of particular interest, zoogeographically or ecologically.”

Brinkhurst, R.O., L.E. Linkletter, et al. 1976. **A preliminary guide to the littoral and sublittoral marine invertebrates of Passamaquoddy Bay**. St. Andrews, New Brunswick: Fisheries and Marine Service Biological Station. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Description: “This is a general, easy-to-use key to the common intertidal and subtidal invertebrates of the Passamaquoddy region.”

Doggett, L. (unpublished.) ***Species Checklist for the Gulf of Maine***.

Description: This 241-page document lists a variety of species that have been sighted in Maine and gives the location in which they were found.

Gosner, K.L. 1978. ***Atlantic Seashore: A Peterson Field Guide***. Boston, MA: Houghton Mifflin.

Go to: Available at most bookstores and libraries.

Description: A guide and identification key to intertidal marine invertebrates.

Marine Flora and Fauna of the Northeastern United States, NOAA Technical Report, NMFS Circular Series.

Go to: To check for the availability of a circular on a particular group of organisms, and to order copies, call the Sales Office at the National Technical Information Service at (703) 605-6900 or email info@ntis.gov. Ask for titles in NOAA's Marine Flora and Fauna Series. Also available from the University of Maine Library System, www.library.umaine.edu

Description: Each of these circulars contains information, drawings and identification keys about a different group of marine organisms.

Pollock, L.W. 1998. ***A Practical Guide to the Marine Animals of Northeastern North America***. New Brunswick, NJ: Rutgers University Press. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Description: Species identification key.

Watling, L., J. Fegley, and J. Moring. 2003. *Life Between the Tides, Marine Plants and Animals of the Northeast*. Gardiner, ME: Tilbury House.

Go to: www.tilburyhouse.com/Maine%20Frames/me_tide_fr.html

Description: See listing under B3.2 Macrophytes.

Crustaceans

Conkling, P. and A. Hayden. 2002. *Lobsters Great and Small*. Camden, ME: Down East Books.

Go to: www.islandinstitute.org/programs.asp?section=publications

Description: A description of the basis, activities and outcomes of the Penobscot Bay Marine Resources Collaborative Project. Between 1996 and 2001 lobstermen and scientists investigated the health and future of the bay's lobster resource.

New England Lobster Settlement Index.

Go to: www.bigelow.org/srs/lobsterset.html

Description: "The New England lobster settlement index is a sampling program supported by Maine, Rhode Island, and Massachusetts. The goal of the program is to evaluate the strength of lobster year classes as they first arrive by larval settlement in shallow, nearshore nurseries. The information obtained from the research can then be used in stock assessment, and in forecasting trends in the fishery."

Palma, A.T., R.S. Steneck, and C. Wilson. 1999. *Settlement-driven, multiscale demographic patterns of large benthic decapods in the Gulf of Maine*. *Journal of Experimental Marine Biology and Ecology* 241:107-136. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Abstract: "Three decapod species in the Gulf of Maine (American lobster *Homarus americanus* Milne Edwards, 1837, rock crab *Cancer irroratus* Say, 1817, and Jonah crab *Cancer borealis* Stimpson, 1859) were investigated to determine how their patterns of settlement and post-settlement abundance varied at different spatial and temporal scales. Spatial scales ranged from centimeters to hundreds of kilometers. Abundances of newly settled and older (sum of several cohorts) individuals were measured at different substrata, depths, sites within and among widely spaced regions, and along estuarine

gradients. Temporal scales ranged from weekly censuses of new settlers within a season to inter-annual comparisons of settlement strengths. Over the scales considered here, only lobsters and rock crabs were consistently abundant in their early post-settlement stages. Compared to rock crabs, lobsters settled at lower densities but in specific habitats and over a narrower range of conditions. The abundance and distribution of older individuals of both species were, however, similar at all scales. This is consistent with previous observations that, by virtue of high fecundity, rock crabs have high rates of settlement, but do not discriminate among habitats, and suffer high levels of post-settlement mortality relative to lobsters. At settlement, large, habitat-scale differences exist for lobsters but not for rock crabs; these are probably the result of larval settling behavior. In contrast, patterns at the largest, inter-regional, spatial scales suggest oceanographic control of larval delivery. Increased mobility and vagility with greater body size for both species reduces demographic differences among older individuals over a range of spatial scales."

Reports from Volunteer-based Juvenile Lobster Monitoring Program, Lobster Conservancy.

Go to: www.lobsters.org Click on Volunteers in left-hand menu. Scroll down to see reports on juvenile lobsters in Maine's intertidal zone.

Description: "The Juvenile Lobster Monitoring Program measures the health and productivity of lobster nursery habitats over space and time by measuring the abundance and distribution of juvenile lobsters and using mark/recapture techniques to investigate growth rates and survival. TLC scientists have developed a set of rigorous training tools to teach volunteers how to become 'citizen scientists' by censusing lobsters at nursery grounds in the lower intertidal zone. Harboring 'baby' lobsters under rocks, these nursery sites are accessible once a month during the lowest low tides. The census data collected by volunteers are extremely valuable as indicators of lobster fishery health because the juvenile lobsters of today represent the catches of tomorrow."

Williams, A.B. 1984. *Shrimps, Lobsters and Crabs of the Atlantic Coast*. Washington, D.C.: Smithsonian Institution. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Mollusks

Abbott, R.T. and P.A. Morris. 1995. *Shells of the Atlantic and Gulf Coasts and the West Indies: A Peterson Field Guide*. Boston, MA: Houghton Mifflin.

GIS map layer for shellfish growing areas.

Go to: Maine Department of Marine Resources Public Health Division for current GIS data.

Description: The status of shellfish growing areas is monitored for the protection of public health.

Polychaete Worms

Appy, T.D., L.E. Linkletter, and M.J. Dadswell. 1980. *A Guide to the Marine Flora and Fauna of the Bay of Fundy: Annelida: Polychaeta*. Technical Report No. 920. St. Andrews, New Brunswick: Fisheries and Marine Service Biological Station. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Description: “42 families and 188 species of polychaetes known from the Bay of Fundy are distinguished in an illustrated dichotomous key. A description and the biology and distribution records are given for each species.”

Pettibone, M.H. 1983. *Marine Polychaete Worms of the New England Region*. Smithsonian Institute. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Description: Includes species description, drawings, and key to identification.

Sea Urchins

Green Sea Urchins in Maine: Fishery, Monitoring, and Research Information, Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/seaurchin/research.htm

Description: Includes reports on distribution and abundance of urchins along the Maine coast based on the sea urchin survey initiated in 2001. “DMR, with the cooperation of industry, the SUZC, and scientists and students at the University of Maine, began an annual spring sea urchin dive survey, funded by the industry. It is probably the most thorough urchin survey in the world. DMR and industry divers counted and measured urchins at 135 shal-

low sites, working from industry vessels. A remotely deployed video camera was used to view the bottom at 90 deeper sites. Crabs, starfish, and algal (seaweed) cover were evaluated. The survey has been repeated each year since 2001. 72 of the sites visited in 2001 were recommended by harvesters to be revisited each year. The rest are picked randomly from suitable bottom types and depths.”

Taylor, P.H. 2004. *Green Gold: Scientific Findings for Management of Maine’s Sea Urchin Fishery*. Boothbay Harbor, ME: Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/seaurchin/greengold.pdf

Description: This document provides an overview of the ecology and life history of sea urchins in Maine, as well as discussion of the management and future of the sea urchin fishery.

Tunicates

Plough, H.H. 1978. *Sea Squirts of the Atlantic Continental Shelf from Maine to Texas*. Baltimore, MD: Johns Hopkins University Press. Available from the University of Maine library system.

Go to: www.library.umaine.edu

B3.4 Fish

Ames, E.P. 2004. *Atlantic Cod Stock Structure in the Gulf of Maine*. *Fisheries* 29:10-28.

Go to: www.penobscoteast.org/ames_research.asp

Abstract: “Atlantic cod (*Gadus morhua*) in the Gulf of Maine provide an important but depleted fishery that needs to be made sustainable. However, restoring and maintaining robust population components to achieve sustainability is made difficult when their distribution and character is unknown. This study clarifies the structure of the Gulf of Maine cod grouping by deriving the distribution, movements, and behavior of population components from 1920s data and surveys of retired fishermen. These derivations are consistent with current cod populations and with the existence of localized spawning components. Nearly half the coastal spawning grounds of 50 to 70 years ago are abandoned today and their spawning components have disappeared, suggesting depletion, undetected by system-wide assessments, may have been well advanced by the 1980s.”

Collette, B. and Klein-McPhee, G., eds. 2002. ***Bigelow and Schroeder's Fishes of the Gulf of Maine***. Washington, D.C.: Smithsonian Institution Press.

Go to: www.gma.org/fogm

Description: This large volume contains drawings and descriptions of the fish species found in the Gulf of Maine.

Ecology of Groundfish Along the Maine Coast, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/groundfish.html

Description: This Web page contains information about the life history of certain groundfish species, stock decline, and enhancement. Information about whom to contact with questions is also provided.

Fish Species of the Wells National Estuarine Reserve.

Go to: www.wellsreserve.org/research/fish-brochure.pdf

Description: "This brochure lists the 55 fish species found during surveys done between 1989 and 2001 in the Merrilland River, Branch Brook, the Little River, the Webhannet River, and Wells Bay. Biologists used fish weirs, fyke nets, seine nets, minnow traps, and electrofishing to sample adults and juveniles, and ichthyoplankton nets to sample larvae." The brochure indicates whether adults and/or larvae were found, and where the fish were found (e.g., channel, marsh, salt panne). An indication of relative abundance is also provided.

GIS map layer for anadromous and catadromous fish, U.S. Fish and Wildlife Service Gulf of Maine Program.

Go to: www.fws.gov/northeast/gulfofmaine/maps_data/index.htm

Maine Office of GIS map layer for Atlantic salmon habitat (ASHAB3).

Go to: apollo.ogis.state.me.us

Description: "This dataset is designed to be used in a variety of management and planning activities including fry stocking, developing production estimates and habitat protection efforts. ASHAB3 contains arcs representing important Atlantic salmon habitat in Maine, suitable for mapping at 1:12,000 or smaller scale. This coverage was developed from field surveys conducted on the main stem and/or selected tributaries of the Aroostook, Dennys, Ducktrap, East Machias, Kennebec, Machias, Passagassawakeag, Penobscot, Pleasant, Presumpscot, Sheepscot, St. George, Tunk and Union

Rivers in Maine by staff of the Maine Atlantic Salmon Commission and U.S. Fish and Wildlife Service. These surveys were conducted to identify important Atlantic salmon habitat including spawning and rearing areas. The majority of the survey data was collected using Trimble Pro, Pro-XL and GeoExplorer3 receivers and survey files were differentially corrected to provide 2-5 meter accuracy. Surveys for some reaches were collected with minimal or no GPS control points and the attributes were overlaid on a stream centerline created using either a GPS-acquired line, a line derived from MEGIS/USGS 1:24,000 hydrography data, or a line drawn as a centerline based on MEGIS 1-meter Digital Orthophotography. The dataset includes information on habitat categories and areas, and an indication of spawning and rearing potential, as well as detailed attribute information concerning stream dimensions, substrates, vegetation, and other stream characteristics."

GIS map of historic spawning grounds for Atlantic cod and haddock based on work of Ted Ames, available on request from the Island Institute, Rockland, ME.

Go to: www.islandinstitute.org/resources.asp?section=maps and for information on the mapping project that developed the data go to www.penobscoteast.org/documents/commercialfisheries.pdf

Description: Map layers of spawning grounds carefully developed through interviews with fishermen and supplementary research.

Jury, S.H., J.D. Field, et al. 1994. Distribution and abundance of fishes and invertebrates in North Atlantic estuaries. NOAA NOS Strategic Environmental Assessments Division, ELMR (No. 13). Available from the University of Maine library system.

Go to: www.library.umaine.edu

Description: This report presents information on the spatial and temporal distribution, relative abundance, and life history characteristics of 58 species of fishes and invertebrates in 17 estuaries between Cape Cod and the Canadian border.

List of fish species targeted by recreational fishermen in the Gulf of Maine, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/rm/speciesinformation.htm

Description: This Web page contains general information on these fish species and indicates whether each is found inshore, offshore, or both.

Matthiessen, G.C. 2007. *Forage Fish and the Industrialized Fishery*. Ipswich, MA: Quebec-Labrador Foundation, Inc.

Go to: www.qjf.org

Description: Drawings and descriptions of principal forage fish species in the U.S. Gulf of Maine and their population status.

Watling, L., J. Fegley, and J. Moring. 2003. *Life Between the Tides, Marine Plants and Animals of the Northeast*. Gardiner, ME: Tilbury House.

Go to: www.tilburyhouse.com/Maine%20Frames/me_tide_fr.html

Description: See listing under B3.2 Macrophytes.

B3.5 Marine Birds

Birds of the Wells National Estuarine Research Reserve.

Go to: www.wellsreserve.org/research/bird-list.pdf

Description: “These 235 species have occurred at the Wells Reserve since recordkeeping began in the 1980s. The list follows the AOU Check-list of North American Birds.” It indicates which season(s) each species is present.

Christmas Bird Count, National Audubon Society.

Go to: www.audubon.org/bird/cbc/ Click on Current Year’s Results. On the next page, fill in the query to find data by species and location. Or click on Historical Results in the menu for data from past years.

Description: “More than 50,000 observers participate each year in this all-day census of early-winter bird populations. The results of their efforts are compiled into the longest running database in ornithology, representing over a century of unbroken data on trends of early-winter bird populations across the Americas. Simply put, the Christmas Bird Count, or CBC, is citizen science in action.”

Checklist of Maine’s birds, Maine Audubon.

Go to: www.maineaudubon.org/nature/checklist.shtml

Description: This Web site presents a list of all bird species observed in Maine, including seabirds. The site also indicates whether the species is declining.

Distribution maps for marine mammals, seabirds, and sea turtles, Ocean Biogeographic Information System and Duke University.

Go to: obis.env.duke.edu/map/main/viewer.pmap
Click on Select Animals to choose a species to view. You need to know the scientific name of the species.

Description: “As part of the Ocean Biogeographic Information System (OBIS), a group of investigators, led by Andrew Read of Duke University, will create a digital database of marine mammal, seabird, and sea turtle distribution and abundance. Partners with Duke include UC San Diego, University of Washington, College of the Atlantic, St. Andrews University, British Antarctic Survey, SAHFOS, NMFS Southeast Fisheries Center, and several industries. The Web-based system will allow the interactive display, query, and analysis of Digital Archive in conjunction with environmental data.” This site is a work in progress but there is a large amount of data available currently on seals, sea turtles, whales, dolphins, and seabirds.

eBird Mapping Site, National Audubon Society and Cornell Ornithology Lab.

Go to: www.ebird.org/content/ Click on View and Explore Data in the menu. Then click on Create Maps and Graphs to generate results on sightings of a species by date and location.

Description: “eBird, a project developed by the Cornell Lab of Ornithology and the National Audubon Society, provides a simple way for you to keep track of the birds you see anywhere in North America. You can retrieve information on your bird observations, from your backyard to your neighborhood to your favorite bird-watching locations, at any time for your personal use. You can also access the entire historical database to find out what other eBirders are reporting from across North America. In addition, the cumulative eBird database is used by birdwatchers, scientists, and conservationists who want to know more about the distributions and movement patterns of birds across the continent.”

Essential habitat maps for bald eagles, piping plovers, least and roseate terns.

Go to: megisims.state.me.us/Website/mdifweb/viewer.htm or www.state.me.us/ifw Click on Essential Habitat in the left hand menu. Click on Introduction to Essential Habitat. Click on Essential Wildlife Habitat Maps. Then click on Essential Wildlife Habitat Internet Mapping Service. Use the zoom tool to focus on the desired area.

Description: This is an interactive mapping site by the Maine Department of Inland Fisheries and Wildlife that presents information on essential habitat in Maine for bald eagles, piping plovers, least terns, and roseate terns.

Maine Office of GIS map layer of Piping Plover and Least Tern Essential Habitat (EHPVTRN).

Go to: apollo.ogis.state.me.us/catalog/

Description: “EHPLVTRN contains piping plover and least tern nesting, feeding, and brood-rearing areas identified and mapped as Essential Habitat by the Maine Department of Inland Fisheries and Wildlife (MDIFW). This dataset contains both LINE and POLYGON topology, and both are needed to accurately depict Piping Plover/Least Tern Essential Habitats.”

Great Backyard Bird Count, National Audubon Society and Cornell Lab of Ornithology.

Go to: www.birdsource.org/gbbc/ Click on View Results. Click on State Tallies and then select Maine. Scroll down and select “see list of localities in Maine with reports.” Click on a locality to see the information broken down by species.

Description: This Web site provides access to data taken by citizens during the Great Backyard Bird Count. Data include the number of individuals of a species that observed during the count by state, by year, and by participating towns. These data are most helpful in obtaining a list of species that occur in a given area.

List of Birds Found on the Petit Manan Wildlife Refuge (now known as Maine Coastal Islands National Wildlife Refuge).

Go to: library.fws.gov/refuges/Petit_Manana_Birds.pdf

Description: “This document provides a list of the over 300 bird species that have been identified on the islands of the refuge. The list also identifies whether the birds nest in the refuge, whether they are threatened or endangered, and which season(s) they are observed in the refuge. The Maine Coastal Islands National Wildlife Refuge contains 47 offshore islands and three coastal parcels, totaling more than 7,400 acres. The complex spans more than 150 miles of Maine coastline and includes five national wildlife refuges: Petit Manan, Cross Island, Franklin Island, Seal Island, and Pond Island.”

Pierson, E.C., J.E. Pierson, and P.D. Vickery. 1996. *Bird-er's Guide to Maine*. Camden, ME: Down East Books.

Description: “A guide to where and when to see Maine’s inland and coastal birds. There are maps, directions, background information about an area, and hints for observing the birds.”

Project Puffin, National Audubon Society.

Go to: www.audubon.org/bird/puffin/ Click on Seabird Research News. Scroll down on the next page to see reports from islands in the Gulf of Maine that serve as seabird habitat.

Description: The reports deal mostly with terns and puffins.

B3.6 Marine Mammals and B3.7 Sea Turtles

Clapham, P., J. Barlow, M. Bessinger, T. Cole, D.D. Mattila, R. Pace, D. Polka., J. Robbins, and R. Seton. 2003. **Abundance and demographic parameters of humpback whales from the Gulf of Maine, and stock definition relative to the Scotian Shelf.** *Journal of Cetacean Research and Management* 5:13-22.

Distribution maps for marine mammals, seabirds and sea turtles, Ocean Biogeographic Information System and Duke University.

Go to: www.iobis.org/

Description: See listing under B3.5 Marine Birds.

Sea Turtle Program, National Marine Fisheries Service’s Northeast Regional Office.

Go to: www.nero.noaa.gov/prot_res/seaturtles/

Description: General information page with internet links.

Katona, S.K., V. Rough, and D.T. Richardson. 1993. *A Field Guide to Whales, Porpoises and Seals From Cape Cod to Newfoundland*. Washington, D.C.: Smithsonian Institution Press.

Recent Whale Sightings Interactive Map, Maine Department of Marine Resources Large Whale Take Reduction Program.

Go to: megisims.state.me.us/WhaleSightings/

Description: This interactive mapping page allows the user to view locations of sightings of large whale species within the Gulf of Maine. Data are categorized by species and by the time frame of the sighting (ranging from the past day to the past year). Histori-

cal data are also available. “The Voluntary Sightings Network is comprised of members of the Maine commercial fishing industry, Maine Marine Patrol (MMP), whale watch vessels, and other mariners (ship pilots, ferry captains, tugboat pilots, recreational boaters, sailors). All large whale sightings can be reported to the Maine Whale Plan Coordinator using the upgraded state-wide toll free Maine Marine Animal Reporting Hotline. Once verified, whale sightings are fed into the Web-based GIS application by staff at the Department of Marine Resources (DMR) in West Boothbay Harbor and are immediately viewable to the public on the Maine Whale sightings page.”

U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. NOAA Technical Memorandum NMFS-NE-162. U.S. Department of Commerce.

Go to: www.nefsc.noaa.gov/nefsc/publications/tm/tm169/

Description: “Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) were required to generate stock assessment reports (SAR) for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone (EEZ)... The current (2002) report contains updated assessments for Atlantic strategic stocks and for any additional stocks which had significant new information available.”

Human Dimensions

General

These general resources can be used to develop a story of change for an area, a harbor, a town, or a watershed. For example, some of the resources indicate locations and types of industries that historically were located in the area.

Podmaniczky, C., and E. Shettleworth. 1981. *Through a Bird's Eye: Nineteenth Century Views of Maine*. Rockland, ME: Farnsworth Museum.

Description: Available at local historical societies. Some maps have been reproduced and are available commercially (e.g., Portland, Bangor). Detailed views of cities and towns created mainly in the 1870s and 1880s that show industries, waterfronts, residential areas, and sometimes farmland and streams.

Atlas of the State of Maine 1894-1895, 9th ed. West Paris, ME: Stuart.

Description: This atlas and other county maps and state atlases are available through historical societies, county commissioners offices, and local libraries. Several of the state atlases are at the State Library in Augusta and the Fogler Archive in the library of the University of Maine. Large wall maps of many Maine counties were published in the 1850s and 1860s. State of Maine atlases were printed in the 1880s and 1890s by various publishers. Maps typically show towns or portions of towns with roads, streams, rivers, and farmhouses, and are useful to understand development in a watershed.

Cronon, W. Jr. 1983. *Changes in the Land: Indians, Colonists and the Ecology of New England*. New York, NY: Hill and Wang.

Historical resources, State of Maine.

Go to: www.maine.gov/portal/facts_history/

List of local historical societies for Maine towns.

Go to: www.maine.gov/portal/facts_history/historicalsoc.html

Description: Municipal history, books, artifacts, reports, images.

Maine Historic Preservation Commission.

Go to: www.maine.gov/mhpc/archaeology/index.html

Description: Extensive information related to Native Americans, European colonization, and prehistoric and historic archaeology.

Maine Historical Society.

Go to: www.mainehistory.com/

Maine Memory Network.

Go to: www.mainememory.net/bin/Browse

Description: Historical photographs, maps, documents, and other information resources related to fishing, agriculture, maritime activities, and other human dimensions of Maine's coast. “Developed and managed by the Maine Historical Society, the Maine Memory Network enables historical societies, libraries, and other cultural institutions across the state to upload, catalog, and manage digital copies of historic items from their collections into one centralized, Web-accessible database. Through online exhibits, outreach, interactive tools, lesson

plans, in-school demonstrations, and other resources, the Maine Memory Network strives to help communities and schools learn about, celebrate, and share their local history. Visitors to the Web site can search, browse, sort, and easily access these historic items. With a free account, you can create your own collections of albums, add your own text, collaborate with friends and colleagues, and even create online exhibits. There are currently over 12,000 historic items from over 180 Contributing Partners in the database. Examples include:

- Letters, journals, notes, manuscripts, and other hand-written materials.
- Photographs, albumen prints, glass plate negatives, paintings, and other images.
- Sketches, woodcuts, broadsides, business cards, and other graphic items.
- Architectural and mechanical drawings, maps, and other oversized documents.
- Clothing, tools, household goods, archaeological artifacts, and other museum objects.
- Audio and video files.”

Managing Maine’s Nearshore Coastal Resources, Final Report of Bay Management Study.

Go to: www.maine.gov/dmr/baystudy/baystudy.htm

Description: Appendices are useful for various specific categories below.

Muscongus Bay Atlas. 2007. Quebec-Labrador Foundation, Inc.

Go to: www.qlf.org or www.community-gis.org

Description: Maps of land cover, commercial and recreation fishing grounds, kayaking and sailing areas, educational use areas, important wildlife, transportation and navigation and other characteristics of the bay, its estuaries, nine mainland towns and one year-round island community.

Sanborn Insurance Co. maps.

Go to: A Library of Congress publication lists all that have been published nationally: Fire Insurance Maps in the Library of Congress (Washington, 1981). Bowdoin College Library and the State Library have the microfilm edition in eight reels. However, it is in black and white only and loses the color-coding for building material, height, roof form, and other features. Volumes for individual towns and

cities can sometimes be found at a County Recorder of Deeds office, a town planning department, or a local historical society. The History Room at the Bangor Public Library has access in its basement storage to cataloged, bound Sanborn Insurance Co. maps for some towns.

Description: Published periodically between the 1800s and 1960s for Maine towns and cities. Color-coded footprint maps showing streets, commercial and industrial buildings, watercourses, and sometimes sewer outflows (e.g., Portland) and gasoline tanks (e.g., Bath).

Sewer maps.

Go to: Maps may be available at public works department (e.g. Portland) or engineering office (e.g., Bangor).

Description: Available for some areas (e.g., Portland) showing not only locations of sewer lines but also direction of flows. The latter reveals historic watersheds because early sewers typically were built in streams and went downhill to a body of flowing water.

State of the Bay 2005 Report maps, Casco Bay Estuary Partnership.

Go to: www.cascobay.usm.maine.edu/maps.html

Description: Maps of population changes, impervious surface, conserved lands, eelgrass distribution, and other characteristics of towns around Casco Bay.

Year-by-year descriptions of harbors, rivers, estuaries, and bays.

Go to: Army Corps of Engineers Annual Reports. Reports from the twentieth century were published by the U.S. Department of War and then the U.S. Department of Defense. Nineteenth-century reports were released, as were most government documents of the period, as House or Senate publications. The 1883 report is in Senate Exec. Doc. No. 44, 48th Congress, 1st Session. The 1887-88 report appeared in House Exec. Doc. No. 133, 50th Congress, 1st Session. Some nineteenth-century reports have useful charts of the rivers and harbors. Available at libraries of Bowdoin College and University of Maine.

Description: The Corps reported on every river and bay where they worked, e.g., where dredging would be done, the locations of shoals, what features were subject to blasting, and the actual work carried out. Reports are voluminous until the 1980s because

projects had to be described every year until completed and for some time after completion. By comparing reports, it is possible to determine the evolution of a harbor with its industrial and commercial uses. The lengthy reports stopped in the 1980s.

H1 Human Population

Maine Census Data Program.

Go to: www.maine.gov/spo/economics/census/

Description: This site is intended to facilitate public access to the services of the Maine Census Data Center Program by providing information about and electronic links to participating organizations. It also provides information about and electronic links to numerous sources of data likely to be of interest to users of Census data. In addition, the site provides answers to common information requests.

Maine census interactive Web site, University of Maine.

Go to: www.library.umaine.edu/census/

Description: This site allows the user to search census data from 1790 to 2000. Searches can be conducted in terms of trends or thresholds and by area (municipality, locality, etc.).

Maine state census through time, Maine Historical Society.

Go to: www.mainehistory.com/library_search.shtml
In the library search engine type "Maine" and "census" to see a listing of census results by date (from 1790 to 1920).

Thorndale, W., and W.D. Bountiful. 1987. *Map guide to U.S. federal censuses: Maine 1790-1920*. Utah: American Genealogical Lending Library. Available from the Maine Historical Society library.

H2 Community Economic Profile

Directory of local chambers of commerce.

Go to: www.mainechamber.org/local_chambers.asp

Description: Local chambers of commerce usually have a list of many of the businesses and industries in an area.

Maine Census Data Program.

Go to: www.maine.gov/spo/economics/census/

Description: This site is intended to facilitate public access to the services of the Maine Census Data Center Program by providing information about and electronic links to participating organizations. It also provides information about and electronic links to numerous sources of data likely to be of interest to users of Census data. In addition, the site provides answers to common information requests.

New England Fishing Communities, MIT Sea Grant.

Go to: web.mit.edu/seagrant/aqua/cmss/marfin/index.html

Description: Sections 5.8-5.11 profile 14 Maine fishing communities and eight fishing counties. "This report takes several approaches to identifying New England's fishing communities and ranking their dependency. One approach is based on a regional consideration of fisheries-related employment compared to alternative employment. Another approach focuses on fishing structure complexity and degrees of individual communities' gentrification, and finally, the third approach offers community profiles that detail individual ports' characteristics with some attention to stakeholders' views on their community, way of life, institutions, and fisheries management."

MIT Sea Grant report from Community Panels project.

Go to: web.mit.edu/seagrant/aqua/cmss/comm%20mtgs/commmtgs.html

Description: Two Maine communities are profiled in this study, Beals Island/Jonesport and Portland, Maine. "The Massachusetts Fishermen's Partnership's Community Panels Project, funded by the Northeast Consortium and Saltonstall-Kennedy grants, is focusing on 6 communities: Beals Island/Jonesport and Portland, Maine; Gloucester, Scituate and New Bedford, Massachusetts; and Point Judith, Rhode Island. MIT Sea Grant College Program's anthropologist, Dr. Madeleine Hall-Arber, is the project leader with Dr. Bonnie McCay of Rutgers University and David Bergeron of the MFP as co-principal investigators. The six communities in the study represent the variety of characteristics found in New England's fishing industry including inshore/off-shore, large/small vessels; urban/rural communities; fish/shellfish products; mobile/fixed gear; auction/entrepreneur-dealer."

H3 Land Ownership

County Registry of Deeds.

Go to: www.mainelandrecords.com/melr_me005/MelrApp/index.jsp or conduct an internet search for the registry in a particular county.

Description: Research on past ownership of any particular property or special conditions of current ownership, such as a right of way, can also be found through a title search.

Local land trust listing, Maine Land Trust Network.

Go to: www.mltln.org

Description: Some land trusts have worked with towns to create GIS data layers of town tax maps. They might be willing to share this digital data.

Municipal tax maps.

Go to: Your local town office to view land parcel maps.

Description: Some may be in print form only while others may be available as a GIS data layer. Ownership of individual parcels may be listed on the maps or in the most recent town report. Also available are which parcels are under special tax reduction programs.

H4 Land Use and Land Cover

Maine Office of GIS map layer for land cover (MELCD).

Go to: apollo.ogis.state.me.us/catalog/

Description: “MELCD is a land cover map for Maine primarily derived from Landsat Thematic Mapper 5 and 7 imagery, from the years 1999-2001. This imagery constitutes the basis for the National Land Cover Dataset (NLCD 2001) and the NOAA Coastal Change Analysis Program (C-CAP). This land cover map was refined to the State of Maine requirements using SPOT 5 panchromatic imagery from 2004. The Landsat imagery used was for three seasons: early spring (leaf-off), summer, and early fall (senescence) and was collected with a spatial resolution of 30 m. The SPOT 5 panchromatic imagery was collected at a spatial resolution of 5 m during the spring and summer months of 2004. The map was developed in two distinct stages, the first stage was the development of a state wide land cover data set consistent with the NOAA-CAP land cover map. The second stage was: a) the update to 2004 conditions, b) a refinement of the classification system to Maine specific classes and,

c) a refinement of the spatial boundaries to create a polygon map based on 5 m imagery.”

Land Cover Analysis, NOAA Coastal Services Center.

Go to: www.csc.noaa.gov/crs/lca/

Description: This Web site provides land cover mapping data, tools, and assistance to the coastal management community. The NOAA Coastal Services Center works with resource managers and mapping professionals to promote the use of land cover mapping to address coastal management issues.

H5 Fisheries and Fishing Industries

Fishing grounds by gear, MIT Sea Grant.

Go to: web.mit.edu/seagrant/aqua/cfer/index.html or web.mit.edu/seagrant/aqua/cfer/GearMapping/GearMapping.html

Description: MIT Sea Grant has been mapping the types of gear used on different fishing grounds.

Fishing grounds by port.

Go to: geography.rutgers.edu/people/faculty/stmartin/research.html

Description: Faculty in the Department of Geography at Rutgers University have mapped the relationship between fishing grounds and fishing ports to show which offshore grounds are predominantly fished by which ports.

Maine Office of GIS layer of commercially harvested worm habitat (WORM).

Go to: apollo.ogis.state.me.us

Description: “WORM provides a generalized representation at 1:24,000 scale of commercially harvested marine worm habitat in Maine, based on Maine Department of Marine Resources data from 1970s. Original maps were created by MDMR and published by USF&WS as part of the Ecological Characteristics of Coastal Maine.”

Maine Office of GIS map layer of herring weirs (WEIR90).

Go to: apollo.ogis.state.me.us

Description: “WEIR90 shows point locations of herring weirs in Maine based on 1990 overflight by MDMR Marine Patrol, mapped at an approximate scale of 1:100,000. Data were screen digitized from paper maps used during the overflight.”

Good, G.B. 1884. **Fisheries and Fishery Industries of the U.S. Washington, D.C.: Government Printing Office.** Available from the State Library, Bowdoin College library, and University of Maine Library System.

Go to: www.library.umaine.edu

Description: This publication contains a chapter on “The Coast of Maine and Its Fisheries” by R. Edward Earll.

Landings Data, National Marine Fisheries Service Fisheries Statistics Division.

Go to: www.st.nmfs.gov/st1/index.html Click on Commercial Fisheries or Recreational Fisheries.

Description: This Web site allows users “to query our commercial fishery data bases and summarize United States domestic commercial landings in several formats. Domestic fishery landings are those fish and shellfish that are landed and sold in the 50 states by U.S. fishermen and do not include landings made in U.S. territories or by foreign fishermen. You can summarize the pounds and dollar value of commercial landings by your choice of years, months, states and species for the years 1990 onwards. The volume and value of 1950 onwards landings can be summarized by: years, states and species; by years, states, species and fishing gears; or years, states, species, finfish or shellfish groups, and price per pound.”

Lotze, H.K. and I. Milewski. 2004. **Two successive centuries of multiple human impacts and successive changes in a North Atlantic food web.** *Ecological Applications* 14(5):1428-1447.

Go to: conservationcouncil.ca/marine/marine_quoddy_publications.html

Abstract: “European colonization of North America severely altered terrestrial and aquatic ecosystems alike. Here, we integrate archaeological, historical, and recent data to derive the ecological history of the Quoddy Region, Bay of Fundy, Canada, an upwelling region rich in marine diversity and productivity. We document successive changes on all trophic levels from primary producers to top predators over the last centuries. Our objectives were to (1) construct a baseline of what was natural in the coastal ocean, and (2) analyze the sequence and potential interaction of multiple human impacts. Archaeological records highlight the abundance and diversity of marine species used by indigenous people over the last 2000–3000 years. Europeans colonized the

area in the late 1700s and rapidly transformed the environment by multiple ‘top-down’ (exploitation), ‘bottom-up’ (nutrient loading), and ‘side-in’ (habitat destruction, pollution) impacts. Most large vertebrates were severely overexploited by 1900, leading to the extinction of three mammal and six bird species. Diadromous fish dramatically declined after river damming in the early 1800s, and recovery was prevented by subsequent river pollution. Over-fishing of groundfish stocks started in the late 1800s, gradually leading to a final collapse in the 1970s. In the 20th century, decline of traditional fisheries induced a shift to low trophic level harvesting and aquaculture, which increased exponentially over the past 20 years. Eutrophication caused shifts in seaweed and phytoplankton communities: Some long-lived rockweeds were replaced by annual bloom-forming algae, and diatoms were replaced by dinoflagellates. Today, the once unique Quoddy Region shows the most common signs of degradation found in highly impacted coastal areas worldwide. Multiple human influences have altered abundance and composition of every trophic level in the food web and reduced upper trophic levels by at least one order of magnitude. We highlight cumulative and indirect effects that impair the ability to predict and manage highly impacted coastal ecosystems. On the other hand, simple protection and restoration measures in the 20th century led to the recovery of some species. It is these successes that provide guidance for a more sustainable interaction of humans with their marine environment.”

NOAA Fisheries Northeast Regional Office landings reports.

Go to: www.nero.noaa.gov/fso/ Click on *Weekly Quota-Landing Reports*. On the next page, select the desired species.

Description: The data are divided by state.

Rich, W. 1929. **Fishing Grounds of the Gulf of Maine** (reprint). Augusta, ME: Maine Department of Marine Resources.

Description: Hand-drawn maps and brief descriptions of areas fished (principally outside of bays and beyond) and the species caught in the early 1900s in the Gulf of Maine and Bay of Fundy. Originally published by the U.S. Dept. of Commerce, Bureau of Fisheries.

Status of Fishery Resources off the Northeastern United States, NOAA Northeast Fisheries Science Center.

Go to: www.nefsc.noaa.gov/sos/spsyn/ Click on “42 species” in the text of this page to see a list of species, then navigate to the desired data.

Description: “The synopses of information on the status of the stocks of the 42 species or groups of species presented in this section are based on commercial and recreational fishery data and on research survey data, as described in the Introduction to this report. Each synopsis briefly reviews the biology of the animals and the general nature of the fishery, summarizes recent catch statistics and stock assessment results and indicates the general status of the stock. For each stock or species a summary table of recent catches is presented, along with graphs depicting trends in landings, stock abundance, fishing mortality, age structure and other pertinent results from the most recent stock assessment. The measures of stock abundance include research vessel survey catch per tow indices and estimated stock size from age structured or biomass dynamics models.”

Steneck, R.S. 1997. Fisheries-induced biological changes to the structure and function of the Gulf of Maine Ecosystem, pp. 151-165 in *Proceedings of the Gulf of Maine Ecosystem Dynamics Scientific Symposium and Workshop* (G.T. Wallace and E.F. Braasch, eds.) RARGOM Report 91-1. Hanover, NH: Regional Association for Research on the Gulf of Maine. Available from the University of Maine library system.

Go to: www.library.umaine.edu

Abstract: “Atlantic cod and other large predatory groundfish were important components of near shore marine habitats in the Gulf of Maine for over four thousand years. They were harvested over most of that time by hook and line through the 1920s. In the 1930s otter trawls and other technological improvements allowed for the efficient harvesting of spawning stocks and by the end of the 1940s groundfish stocks in coastal zones were said to be depleted. Studies conducted over the past 109 years document this rapid decline of coastal fishing grounds and changes in average body size of cod. Several decades later, harvesting caused the decline of the offshore groundfish on Georges Bank. Dominant fish predators were replaced by commercially less important species, such as sculpins, in coastal zones and dogfish and skate on Georges Bank. Today large predatory finfish are functionally

absent from vast regions of the Gulf of Maine. This loss of the top trophic level for benthic systems may have fundamentally altered food webs, with lobsters, crabs and sea urchins increasing in abundance in coastal zones. Fisheries-induced changes there have continued with the sequential targeting of species at lower trophic levels. The recently developed industry for herbivorous sea urchins has resulted in increases in kelp and other macroalgae. This may increase productivity, habitat and the recruitment potential for some species in coastal zones. If true, such cascading changes to both the structure and function of the Gulf of Maine ecosystem may make predictions difficult or impossible.”

H6 Maritime Transport and Commerce

Baker, W.A. 1974. *Maine Shipbuilding, A Bibliographical Guide*. Portland, ME: *Maine Historical Society*. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Dredged areas, U.S. Army Corps of Engineers, New England section.

Go to: www.nae.usace.army.mil/ Digital mapping information can be found at <http://www.usace.army.mil/howdoi/where.html#Maps>

Description: For more details and help in finding the most recent information as well as historical data, the Army Corps of Engineers local office is located in Manchester, Maine.

Maine Maritime Museum Library in Bath, Maine.

Go to: www.bathmaine.com/research/library.cfm

Description: The Library contains information on every aspect of Maine maritime history and coastal life. There is a concentration of material related to shipbuilding, the maritime history of the Kennebec River region, and Bath history.

Maritime Maine Heritage Trail Bibliography of Resources.

Go to: www.maritimemaine.org/biographysources.aspx

Description: “[A] bibliography of sources on Maine maritime history. This is by no means an exhaustive work, and additions, corrections and other suggestions are welcome. For help in locating these works, contact your maritime history museum, historical society or local library.”

Navigational aids, lighthouses, and deep draft vessel routes, NOAA.

Go to: chartmaker.ncd.noaa.gov/mcd/enc/download.htm for electronic navigational charts.

Description: “The NOAA Electronic Navigational Charts are a geo-referenced database(s) of NOAA nautical chart features and their attributes, published by NOAA in the format of the International Hydrographic Organization S-57 Standard, IHO Transfer Standard for Digital Hydrographic Data. NOAA updates the ENC’s for Notice to Mariners on a weekly basis (timing of their availability is not guaranteed).”

Go to: chartmaker.ncd.noaa.gov/mcd/Raster/Index.htm for raster navigational charts.

Description: In the United States, all official nautical paper charts produced by NOAA’s Office of Coast Survey (OCS) are available in raster format. A fundamental tool of marine navigation, NOAA’s Raster Navigational Charts (NOAA RNCs™) are produced by scanning at high resolution the original color separates, which are used to print the paper charts. NOAA adds to the digital raster file such features as data describing the chart, its datum, projection, and its geo-reference. Geo-referencing enables a computer-based navigation system that is connected to a GPS to locate and display on the chart image on screen the vessel’s exact position.

Stephen Phillips Memorial Library at the Penobscot Marine Museum, Searsport, Maine.

Go to: www.penobscotmarinemuseum.org/libraryresearch.html

Description: “The library serves as the museum’s research center, providing access to books, manuscripts, photographs, nautical charts, maps, and boat plans. In addition to our strong collections in maritime history, with an emphasis on mid-coast Maine, we also have very important collections in Maine history and genealogy.”

H7 Marine research and monitoring sites and facilities

Fisheries and aquaculture, aquatic habitat, climate change, coastal development, contaminants, eutrophication, Ecosystem Indicator Partnership (ESIP) Monitoring Map.

Go to: www.gulfofmaine.org/esip/map

Description: The Ecosystem Indicator Partnership (ESIP) is a committee of the Gulf of Maine Council on the Marine Environment. ESIP is developing indicators for the Gulf of Maine and integrating regional data for a new Web-based reporting system for marine ecosystem monitoring. Activities of ESIP initially center on convening regional practitioners in six indicator areas: coastal development, contaminants and pathogens, eutrophication, aquatic habitat, fisheries and aquaculture, and climate change.

GIS data illustrating the locations of long term monitoring or survey work can be also be obtained directly from the researchers. For example:

- **Marine biotoxin monitoring, water quality monitoring, rain gauge, and phytoplankton monitoring stations, Public Health Division of the Department of Marine Resources.**
Go to: www.maine.gov/dmr/healthsafety.htm
- **Maine-New Hampshire Inshore Trawl Survey, Ecology Division at the Department of Marine Resources.**
Go to: www.maine.gov/dmr/rm/rawl/index.htm
- **Green urchin survey, Biological Assessment and Monitoring Division at the Department of Marine Resources.**
Go to: www.maine.gov/dmr/rm/seaurchin/research.htm
- **Recreational island usage data, Maine Island Trail Association.**
Go to: www.mita.org
- **Location of juvenile lobster survey stations, The Lobster Conservancy, Friendship, ME.**
Go to: www.lobsters.org
- **Seabird surveys, Maine Coastal Islands National Wildlife Refuge (formerly named Petit Manan National Wildlife Refuge) U.S. Fish & Wildlife Service.**
Go to: www.fws.gov/northeast/mainecoastal/
- **Ocean observing buoys, GoMOOS.**
Go to: www.gomoos.org/
- **Long-term hydrographic surveys, University of Maine School of Marine Sciences.**
Go to: www.umaine.edu/marine/

National Buoy Data Center

Go to: www.ndbc.noaa.gov/maps/Northeast.shtml

Marine research facilities. Some of the marine laboratories, field and research stations in Maine include:

- Bigelow Laboratory for Ocean Sciences, Sheepscot River
- Center for Cooperative Aquaculture Research, Taunton Bay
- Downeast Institute for Applied Research & Education, Great Wass Island
- Gulf of Maine Research Institute, Casco Bay
- Marine Environmental Research Institute, Blue Hill Bay
- Mount Desert Island Biological Laboratory, Frenchman Bay
- Suffolk University R.S. Friedman Field Station, Cobscook Bay
- University of Maine Darling Marine Center, Damariscotta River
- University of New England, Marine Science Center, Saco Bay
- University of Southern Maine, Casco Bay
- West Quoddy Biological Research Station, Cobscook Bay

H8 Transportation infrastructure

Maine Office of GIS map layer for airports, air strips, seaplane bases (MEAIR).

Go to: megisims.state.me.us/metadata/meair.htm

Description: “MEAIR includes point locations of airports in Maine from USGS 1:100,000 scale DLG files. Data for this coverage were compiled by MEGIS staff in 1999. Seaplane base locations were generated from lat-long coordinates. The coverage was updated in August 1995 by MEGIS staff using the latest NOAA Airport/Facility Directory and NOAA Sectional Aeronautical Charts, and has been renamed from MEAIR100 to MEAIR. Codes were added at this time for a number of attributes including length of longest runway, runway surface, and fuel available.”

Maine Office of GIS map layer for bridges (BRDGS).

Go to: megisims.state.me.us/metadata/brdgs.htm

Description: “BRDGS was created by Maine Department of Transportation to show locations of public bridges at 1:24,000 scale. This dataset was designed for use in applications within MEDOT. Only attribute is bridge number.”

GIS map layer for culverts and catch basins, Maine Department of Transportation’s Office of Transportation Reporting, Inventory and Mapping.

Go to: www.maine.gov/mdot/systems_management/trim.php

Maine Office of GIS map layers for railways (MERAIL24).

Go to: megisims.state.me.us/metadata/merail24.htm

Description: “MERAIL24 is a statewide railroad coverage for Maine at 1:24,000 scale. The data were extracted from USGS 1:24,000 DLG files by MEGIS staff in 1997, built the attribute tables and edge-matched the coverage across quadrangle boundaries. Arc attributes include railroad name, operator, track type (mainline, branch, siding, yard), status (active, inactive, abandoned) and remarks.”

Maine Office of GIS layer of other transportation features (OTRANS, TRANS).

Go to: megisims.state.me.us/metadata/otrans.htm or megisims.state.me.us/metadata/trans.htm

Description: “OTRANS represents other transportation features - electric, pipeline, railroad, and telephone lines at 1:24,000 scale. Some New Hampshire and New Brunswick features are also included. Data for this coverage were digitized from USGS 1:24,000 scale quadrangle maps by various contractors. TRANS represents roads, trails, railroads, transmission lines, and pipelines in Maine at 1:100,000 scale. Data for this coverage were compiled from U.S. Geological Survey (USGS) 1:100,000 scale digital line graph files by J.W. Sewall Co., for the Maine Low-Level Radioactive Waste Authority in 1989.”

Maine Office of GIS map layers for roads, ferry routes (E911RDS).

Go to: megisims.state.me.us/metadata/e911rds_01062006.htm

Description: “E911RDS contains updated road centerline and road name data for Maine at 1:24,000 scale. E911RDS digital roads were developed, and are maintained, to serve the Enhanced 911 project in Maine.”

H9 Manufacturing sites

Facility compliance and enforcement records, Environmental Protection Agency.

Go to: www.epa-echo.gov/echo/

Description: EPA's searchable database called ECHO is where users can locate and learn about the compliance and enforcement status of facilities with state and/or federal permits.

Local records

Local comprehensive plans available at town offices (and/or on town Web sites) often list manufacturers in the municipality. Sometimes information on historical facilities is also included.

Sites with NPDES permits (industrial wastewater discharge sites), Bureau of Land and Water Quality, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/blwq/docstand/municipal_industrial/index.htm or cfpub.epa.gov/npdes/

Sites with air emission discharge licenses (industrial air emission sites), Bureau of Air Quality, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/air/licensing/index.htm

H10 Natural resource use

Managing Maine's Nearshore Coastal Resources, Maine Coastal Program.

Go to: www.maine.gov/spo/mcp/baymanagementreport.php

Description: Appendix B has information on current uses and anticipated trends.

Local comprehensive plans available at town offices (and/or on town Web sites) usually have a section on natural resources of the municipality.

Agriculture

Agricultural fact sheets by county, Maine Department of Agriculture.

Go to: www.maine.gov/agriculture/mpd/farmland/mainecountymap.html

Description: County fact sheets give information on the acreage devoted to farming along with the economic value of various crops by county.

Census of Agriculture, U.S. Department of Agriculture National Agriculture Statistics Service.

Go to: www.nass.usda.gov/census/

Description: These comprehensive databases and documents contain recent and historical information on the economics and demographics of farming in Maine. Data are available at the state or county level.

Day, C.A. 1954. *A History of Maine Agriculture, 1604-1860.* Orono, ME: University of Maine Press.

Day, C.A. 1963. *Farming in Maine, 1860-1940.* Orono, ME: University of Maine Press.

Maine Association of Soil and Water Conservation Districts.

Go to: www.maineswcds.org/index.htm

Maine Department of Agriculture.

Go to: www.maine.gov/agriculture/index.shtml

Natural Resources Conservation Service, U.S. Department of Agriculture.

Go to: www.me.nrcs.usda.gov/

Logging

Coolidge, P.T. 1963. *History of the Maine Woods.* Bangor, ME: Furbush-Roberts.

Maine Office of GIS map layer on woodlots (MEOWN250).

Go to: apollo.ogis.state.me.us/catalog/

Description: "MEOWN250 describes industrial, non-industrial, and public woodlot ownership in Maine at 1:250,000 scale. Industrial owners are those having at least one primary wood processing facility. Non-industrial owners are those with no primary wood processing facility. Public ownership includes property which is owned by either a local, state, or federal entity. Individual owners are NOT identified in this coverage. State, town, and coastline arcs in this coverage most closely match those of the 1:250,000 scale coverage METWP250. Data for this map were provided by the J.W. Sewall Co. to the Northern Forest Land Survey in 1993. Information in this coverage is NO LONGER CURRENT and should be used with caution. The dataset MECNSLND contains information on conservation lands ownership boundaries for Maine land in federal, state, and non-profit own-

ership with easements. MEOWN250 was created to identify major industrial, non-industrial, and public woodlot ownership.”

Judd, R.C. 1989. *Aroostook: A Century of Logging in Northern Maine*. Orono, ME: University of Maine Press.

Maine Forest Service.

Go to: www.maine.gov/doc/mfs/index.shtml

Description: Links to publications and resources on the status of Maine’s forests.

Patten Lumbermen’s Museum.

Go to: www.lumbermensmuseum.org

Smith, D.C. 1961. *A History of Lumbering in Maine, 1861-1960*. Orono, ME: University of Maine Press.

The Forests of Maine, 2003, USDA Forest Service.

Go to: www.fs.fed.us/ne/fia/states/me/ME5yr.html

Description: “In 1999, the Maine Forest Service (MFS) and the USDA Forest Service’s Forest Inventory and Analysis (FIA) program implemented a new system for inventorying and monitoring Maine’s forest resources. The following is a summary of resource conditions, a prospective future outlook, and policy implications related to the principal findings of this report.”

Wood, R.G. 1935. *A History of Lumbering in Maine, 1820-1861*. Orono, ME: University of Maine Press.

Mining/Quarrying

History of Quarrying in Maine, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/mining/quarry.htm

Mining in Maine: Past, Present, and Future, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/mining/minemaine.htm.

Virtual Tour of Maine’s Mines and Quarries, Maine Geological Survey.

Go to: www.maine.gov/doc/nrimc/mgs/explore/mining/virtual/slides.htm

Geological publications, Maine Geological Survey.

Go to: megisims.state.me.us/DOC_IMS/viewer.jsp?MODE=mgs_pubs

Description: This interactive map enables searches by geography and keyword for publications on Maine mining history, maps of mineral resources, and mining reports.

King, V. 1994. *The Mineralogy of Maine, Vol. 1 and 2*. Augusta, ME: Maine Geological Survey.

Description: “This book is a collection of articles with emphasis on the state’s rich mining history, gem production, and geology. It was edited by Vardall King, who is an authority on Maine minerals. He has collected a tremendous amount of information on mining history, including gem mining operations and the 1880s silver boom in eastern Maine. Much of this information has never appeared in print, and there are many rare photographs of people and places connected with Maine mining. Related topics include the development of the science of mineralogy in Maine, and the history of the Maine Geological Survey. Another useful chapter is a collection of maps showing precise locations of all known significant mineral localities in Maine. These maps are cross-referenced to lists giving both the preferred and alternate names of the localities.”

Hydropower

A Citizen’s Guide to Dams, Hydropower and River Restoration in Maine, Natural Resources Council of Maine.

Go to: www.nrcm.org/publication_rivers.asp

Description: Information on the history, location, and environmental effects of dams in Maine. It also discusses dam removal and river restoration.

Maine Development Commission. 1929. **Report on Water Power Resources of the State of Maine**. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

Wells, W. 1868. *Provisional Report Upon the Water-Power of Maine*. Augusta: Stevens and Sayward. Available from the University of Maine Library System.

Go to: www.library.umaine.edu

H11 Residential Development

Maine census data from the Maine State Planning Office.

Go to: www.maine.gov/spo/economics/census/

Click on the downloadable Excel file to see data from the year 2000.

Description: Within this Excel file are worksheets containing information on housing by town, including the year of construction.

Regional data, Maine State Planning Office.

Go to: www.maine.gov/spo/landuse/

Description: The Land Use Planning Team is working with data provided by Bangor Hydro and Central Maine Power that shows the addition of new service areas between 1990 and 2005. This data can be used to create GIS maps that illustrate where new service has been added in a given region.

Town data.

Research property and building permit records in town offices.

H12 Recreation (Individual, Commercial)

Organizations devoted to particular recreational pursuits and commercial recreational service companies often can be found through the Internet or local town offices. Individuals within these groups or companies can be a great source of information about specific activities or interests in a particular marine area.

Information on kayaking routes and launches, Maine Association of Sea Kayak Guides.

Go to: www.maineaseakayakguides.com

Description: A listing of local guides. Information on kayaking activities may also be available through staff and volunteers of the Maine Island Trail Association, www.mita.org.

Members of yacht and boat clubs in your area may provide information about sailing use.

Go to: www.yachtclub.com/usycs/maineyc.html

Description: A listing of Maine's yacht clubs.

Outdoor sports clothing and equipment shops often have guidebooks and other sources that describe where certain activities take place in regions of Maine (e.g., kayaking, sailing, canoe, biking, and hiking guides).

Published cruising guides, such as Howard and Jan Taft's *A Cruising Guide to the Coast of Maine*, often provide helpful descriptions and maps of sailing activities in an area.

Gather information on sport fishing and hunting directly from licensed guides working in your area.

Go to: maineguides.com

The Maine Atlas and Gazetteer. 2007. Freeport, ME: Delorme Mapping.

Go to: shop.delorme.com/

Description: The atlas contains a section with information about beaches, parks, public access areas, and other recreational sites.

H13 Public and Private Waterfront Access

Coastal Water Access Priority Areas for Boating and Fishing, Maine Coastal Program and Maine Department of Marine Resources.

Go to: www.maine.gov/spo/mcp/downloads/coastal_access_report/coastal_water_access.doc

Description: "This report on water access needs was developed for the Land for Maine's Future Board and state agencies with water access-related programs... The *Strategic Plan for Providing Public Access to Maine Waters for Boating and Fishing* guides the LMF Board's decisions on acquiring land for water access. Developed by the Departments of Conservation (DOC) and Inland Fisheries and Wildlife (IF&W) in 1995, the *Strategic Plan* contains a comprehensive, prioritized list of freshwater lakes, ponds, and rivers in need of public access. A comparable list did not exist for coastal waters. The LMF Board requested that SPO and DMR develop a prioritized list of coastal water access needs."

Maine Office of GIS map layer showing locations of boat launches (BOATLNCH).

Go to: apollo.ogis.state.me.us

Description: "BOATLNCH provides digital mapping of Maine boating facilities on both coastal and inland waters, and shows the locations of state-managed and state-assisted boat launches in Maine. BOATLNCH depicts locations throughout Maine at 1:24,000 scale or better... Sites may have gravel or hard-surfaced ramps and may include boarding floats, rest rooms and picnic tables. A few sites have canoe or carry-in access only. Some ramps on tidal waters may be use-

able only at high tides and are designated “part-tide” facilities. A brochure listing all the boat launches is available by calling (207) 287-4952.”

Maine ports and marine facilities, Maine Port Authority.

Go to: www.maineports.com

Public Shoreline Access in Maine: A Citizen’s Guide to Ocean and Coastal Law. Marine Law Institute, University of Maine School of Law, Maine Sea Grant College Program, and University of Maine Cooperative Extension, 2004.

Go to: www.seagrant.umaine.edu/documents/pdf/pubacc04.pdf

Description: This document addresses the legal issues including previous cases dealing with public access to the coast in Maine. Also discussed are ways to improve public access to the beach.

Saving Working Waterfront: Mapping the Maine Coast’s Economic Future. 2005. Island Institute, Rockland, Maine.

Go to: www.islandinstitute.org/programs.asp?section=planningGIS

State-sponsored and assisted public boat access sites, Maine Department of Conservation.

Go to: www.maine.gov/doc/parks/programs/boating/sitelist.html

GIS layers of working waterfront and public access points for coastal towns, Island Institute.

Go to: www.islandinstitute.org/programs.asp?section=planningGIS

H14 Protected/Conserved/High-Value Natural Areas

Land

Maine Office of GIS map layer for conserved lands (MECNLSND).

Go to: apollo.ogis.state.me.us

Description: “MECNLSND contains conservation lands ownership boundaries at 1:24,000 scale for Maine land in federal, state, and non-profit ownership with easements. State, county, town, and coast boundary data were obtained from MEGIS town boundary dataset METWP24. 1:24,000 US Geological Survey (USGS) digital line graph data was used for hydrography and transportation features. Where state, county,

and town boundaries were coincident with property boundaries, the coincident features were taken from METWP24. Where hydrography, roads, railroads and power-lines were coincident with property boundaries, the coincident features were taken from 1:24,000 digital line graph data. The ownership lines do not represent legal boundaries nor are the ownership lines a survey. MECNLSND is an inventory. Original mapping and text on this theme, produced in 1989 and updated in 1993 by R.D. Kelly Jr., Maine State Planning Office (MESPO). MESPO contacted agencies and organizations to obtain locations of conservation and public lands, and prepared hard copy maps. Mapping was based on USGS 1:250,000 quadrangles and was originally published in digital form by the Maine Office of GIS as MEPUB250. The Maine Cooperative Fish and Wildlife Research Unit, University of Maine at Orono, digitized the maps, built the attribute database and subsequently, compiled the data at 1:100,000 scale with standard USGS quadrangles as a base to produce MEPUB100. MEPUB100 was used as a basemap for the development of MECNLSND. MECNLSND was created to provide GIS coverage for the conservation lands database. The ownership lines do not represent legal boundaries nor are the ownership lines a survey. The data contained in MECNLSND is an inventory only. Users must assume responsibility in determining the usability of these data for their purposes. Data at this scale are suitable for local and regional planning.”

Protected lands, Land for Maine’s Future.

Go to: www.maine.gov/spo/lmf/

List and map of protected lands, Maine Chapter of The Nature Conservancy.

Go to: nature.org/wherewework/northamerica/states/maine/preserves/

Listing of Maine’s parks, Bureau of Parks and Lands, Maine Department of Conservation.

Go to: www.maine.gov/doc/parks/index.html

Description: This interactive site allows you to find parks in Maine by county or by desired activity.

Local land trusts listing, Maine Land Trust Network.

Go to: www.mltn.org/

Description: Contact your local land trust for GIS data on the properties they protect and for more information about other organizations which own or manage conservation lands.

Sea

Atkinson, J., et al. 2000. *The Wild Sea*. Boston, MA: Conservation Law Foundation.

Go to: www.clf.org

Description: Describes marine protected areas in New England and the federal, state, and local authorities under which they were established.

Recchia, C., et. al. 2001. *Marine and Coastal Protected Areas in the United States Gulf of Maine Region*. Washington, D.C.: Ocean Conservancy.

Go to: www.oceanconservancy.org/site/PageServer?pagename=issues_mpa

Description: Information and maps of marine and coastal protected areas in the U.S. and Gulf of Maine.

H16 Tidal Restrictions and Barriers to Fish Passage

Interactive map of tidal restriction sites, Gulf of Maine Council on the Marine Environment.

Go to: www.gulfofmaine.org/maps/hrp/htdocs/index.html?map=tr

Description: Symbols on map show location and type of tidal restriction. Click on symbols for detailed information.

H18 Habitat Restoration Project Sites

Interactive map of habitat restoration sites, Gulf of Maine Council on the Marine Environment.

Go to: www.gulfofmaine.org/maps/hrp/htdocs/index.html?map=proj

Description: Symbols on map show restoration project locations. Click on symbols for detailed information.

H19 Significant Cultural Sites (Prehistoric, Historical, Current)

National Historic Sites or Districts, National Park Service or the Maine Historic Preservation Commission.

Go to: www.nps.gov/history/nr/about.htm or www.maine.gov/mhpc/

For information about local and regional historical organizations, contact town offices or libraries. Many of these groups cannot be easily found on the Internet. They often have very helpful information about the area's sites and resources.

State Historic Sites, Maine Bureau of Parks and Lands.

Go to: www.maine.gov/doc/parks/index.html

National Register of Historic Places.

Go to: www.nationalregisterofhistoricplaces.com/ME/state.html

Sites of local, state and/or national significance may be described in municipal comprehensive plans.

H20 Point Source Pollution (Known or Potential)

General

Brownfields Guide for Maine Municipalities, Volume I and II. 1998. Augusta, ME: Maine State Planning Office.

Go to: www.maine.gov/spo/landuse/pubs/bfguidevol1.php

Description: “This is the first of two volumes about brownfield redevelopment in Maine. Brownfields are areas where there once existed industrial or commercial uses which may have left pollutants in the area. The redevelopment of such sites into productive and safe uses is a major issue for older Maine communities. In this first volume general questions are answered such as: What makes a property a ‘brownfield?’ How can polluted property become a valuable tool for economic development? Who are the people and what are the skills which are needed to successfully redevelop a contaminated property? The second volume in the series provides case studies of potential brownfields areas in six Maine communities: Lewiston, Auburn, Rockland, Lubec, Houlton, and Skowhegan. It also lists historic industrial uses and typical contaminants which are associated with those uses.”

GIS layer of air and water discharge sites, Bureau of Land and Water Quality or Bureau of Air Quality, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/air/ or www.maine.gov/blwq

GIS layer of toxic spills, underground tanks, and other sites, Bureau of Remediation and Waste Management, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/rwm

Maine Environmental and Groundwater Analysis Database (EGAD).

Go to: www.maine.gov/dep/rwm/egad

Description: EGAD is “designed to store site and water quality information. It currently includes spatially located data for 37 different types of potential and actual sources of contamination to groundwater in Maine.

Access to comprehensive up-to-date analytical data allows DEP to assess trends in regional ground water quality and quantity. It also improves automated analysis and map-making capability including rapid access to information for emergency response to hazardous materials spills. Detailed well and analytical information in the database is used by staff to design remedial action at hazardous spill sites. It is also used by staff to evaluate potential for cumulative impacts of real estate development on ground water quality.” Site data managers in DEP’s Bureau of Land & Water Quality can use this data to provide digital maps of specific locations in the database, for any area in the state.

Casco Bay

2007 Toxic Pollution in Casco Bay: Sources and Impacts, Casco Bay Estuary Partnership.

Go to: www.cascobay.usm.maine.edu/toxicsreport07.html

Assessment of Sediment Contamination in Casco Bay, 2005. Casco Bay Estuary Partnership.

Go to: www.cascobay.usm.maine.edu/publications.html

Historic Sources of Pollution in Portland Harbor, 1840-1970. 1993. Casco Bay Estuary Partnership.

The Dirty History of Portland Harbor. 2005 (reprinted from a 1994 publication). Casco Bay Estuary Partnership.

Go to: www.cascobay.usm.maine.edu/publications.html

Twelve-Year Water Quality Data Analysis: 1993–2004 Report. Friends of Casco Bay.

Go to: www.cascobay.usm.maine.edu/publications.html

H21 and H22 Management and Regulatory Framework for Shore and Water

Managing Maine’s Nearshore Coastal Resources, Final Report of Bay Management Study.

Go to: www.maine.gov/dmr/baystudy/baystudy.htm

Management plans for lobster, striped bass, herring, and 19 other interstate coastal fish species or groups, Atlantic States Marine Fisheries Commission

Go to: www.asmf.org/

Federal Fisheries Management Plans, New England Fisheries Management Council.

Go to: www.nefmc.org/nemulti/index.html

GIS map layer of lobster zone districts, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/council/lobsterzonecouncils/index.htm

Maine Office of GIS layer of seafood safety restrictions on mollusk harvesting.

Go to: megisims.state.me.us/metadata/class03w.htm

Maine/New Hampshire Sea Grant. 1998. **The Maine Clam Handbook: A Community Guide for Improving Shellfish Management**. Orono, ME: Maine Sea Grant.

Go to: www.seagrant.umaine.edu/pub/pubalphadir.htm

Description: Contains information on history of the soft-shell clam fishery, clam biology, aquaculture, and related legal issues.

Marine Law Institute. 1993. **Maine Citizens’ Handbook on Coastal Water Quality Enforcement**. Orono, ME: Maine Sea Grant.

Description: An introduction to the legal standards and penalties established by state and federal coastal water quality laws.

Natural Resources Protection Act, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/blwq/docstand/nrpapage.htm

Description: The Natural Resources Protection Act contains regulations or restrictions on building in the shoreland zone, sand dune rules, and rules for protection significant wildlife habitat.

Recreational fishing regulations, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/

Marine harvesting laws and regulations, Maine Department of Marine Resources.

Go to: www.maine.gov/dmr/lawsandregs.htm

Waterbody classifications, Maine Department of Environmental Protection.

Go to: www.maine.gov/dep/blwq/monitoring.htm

Description: General information about the water quality classification system that regulates discharge into receiving waters.



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