

APPENDIX P
DATA & INFORMATION NEEDS ASSESSMENT

**BAY MANAGEMENT STUDY
DATA AND INFORMATION NEEDS ASSESSMENT
DECEMBER 2006**

INTRODUCTION

Limitations in scientific data about the nearshore are often cited as a major constraint in moving forward with improved nearshore management. This data and information needs assessment was carried out to more fully examine this assertion. More specifically, the goals in carrying out this data and information needs assessment are to:

- 1) determine the range of nearshore data and information needed for bay management;
- 2) identify what data currently exists and where it is located;
- 3) identify limitations in data and information;
- 4) assess the current state of data availability and sharing; and
- 5) recommend steps to improving the availability of nearshore data and information.

We are interested in learning what nearshore data and information are available, where such data are located, how they are shared and exchanged and what limitations exist in the data and in information flow. To do this we looked at representative types of data and the most common locations for the data; we were not comprehensive and we did not attempt to provide a complete data inventory. This report is not meant to be a guide for someone who wants to find nearshore data. Rather, the information gathered in this report is intended to support solid recommendations about data needs for bay management.

The terms 'data' and 'information,' in this report, refer to both raw data and numbers and to analyzed or processed data that provide information and a greater understanding about a topic. Data and information can be in many forms including tables and charts, text reports, in-depth analyses and assessments, and Geographic Information System (GIS) layers to create maps.

Methods:

This assessment was carried out by two Department of Marine Resources and one State Planning Office staff. We reviewed major publications and websites regarding nearshore data to come up with a range of data needed for bay management (see references). To identify who creates and maintains data and the limitations of those data, we drew heavily upon staff knowledge, review of other agencies' and organizations' websites, and targeted phone calls. While we wanted to identify who maintains the relevant data, we did not attempt to carry out a complete nearshore data inventory for the State of Maine and likely neglected some organizations' data (especially those collected by academic researchers). The Findings and Recommendation sections are based on analysis of data availability, results of two bay management pilot projects, and reports from three GIS needs assessment studies including a 2006 Maine Marine GIS Needs Assessment.

Organization:

This report is organized into three major sections: Current Data Availability and Exchange; Findings (based on assessment of data availability and exchange); and Recommendations (optimal endpoints and how to get there). All acronyms are listed at the end of the report.

SECTION 1: CURRENT DATA AVAILABILITY AND EXCHANGE

Because ‘bay management’ actually refers to a suite of activities ranging from working on a specific issue in a bay (e.g. regional water access planning) to engaging bay communities (e.g. regional visioning process) to multi-resource area management, the type of data (and the resolution and scale of that data) needed for bay management will vary. While it is difficult to know every type of data that might be needed, it is, however, possible to list the types of data that would be useful for many kinds of bay management projects.

The following list of data could be used to characterize a bay. A comprehensive characterization would be a complex undertaking and would involve new data collection, synthesis or processing of existing data, and knowledgeable application. A smaller subset of the following data could be used to more generally describe an embayment and provide baseline data. This type of work requires compiling existing data and collecting priority new data, but, with some funding and expertise, could be a starting point for many bay management efforts. Finally, a given bay management project may only need one or two of these data types to inform an issue or problem at hand.

Nearshore Data and Information Relevant to Bay Management

This list of data has been divided into three categories: Physical/Chemical Information, Biological Information, and Social Information. The left hand column specifies the specific type of data, and the right hand column provides information about who primarily collects that data (not a comprehensive list), if it is available as a GIS layer, and what limitations exist (e.g., with scale, resolution, geographic extent, availability).

Physical/Chemical Information

<i>Data Type</i>	<i>Data Availability</i>
Bay specific circulation patterns and relation to GOM	<i>Who has data?</i> Researchers at UMO, USGS, and Texas A&M have each studied different bays
	<i>GIS layers available?</i> Yes, for some
	<i>Limitations?</i> Circulation data is only available for Cobscook, Casco and Penobscot bays. There is more limited flow/hydrographic data for other areas such as Stonington, Blue Hill Bay, Sheepscot, Damariscotta and lower Kennebec.
Tides	<i>Who has data?</i> NOAA NOS, GOMOOS, UMO
	<i>GIS layers available?</i> No
	<i>Limitations?</i> Tide predictions are often quite different than real time data. Locations for tide predictions and measurements are limited; local knowledge fills in where predictions lack.

Physical/Chemical Information, continued

<i>Data Type</i>	<i>Data Availability</i>	
Nutrients, Temp. and Salinity	<i>Who has data?</i>	GOMOOS; DMR; EPA National Coastal Assessment; Local groups such as Friends of Casco Bay
	<i>GIS layers available?</i>	Yes for some (e.g. GoMOOS has satellite data) but not for most.
	<i>Limitations?</i>	Local groups often collect this type of water quality data, but there is no one place where that data is stored or referenced, so it is not clear where there are gaps along the coast.
Bathymetry	<i>Who has data?</i>	MGS (10m contours); NOAA soundings
	<i>GIS layers available?</i>	Yes
	<i>Limitations?</i>	Nearshore data is variable in quality and all this data is below MLW.
Benthic substrate	<i>Who has data?</i>	MGS (primary source); UMO and DMR to lesser extent
	<i>GIS layers available?</i>	Yes
	<i>Limitations?</i>	Different levels of resolution depending on location. There is very little CMGE information below mean low tide. UMO data is mostly deep water and most of coast is extrapolated.
Geology	<i>Who has data?</i>	MGS has inner continental shelf surficial geology data, but bedrock geology has not been determined.
	<i>GIS layers available?</i>	No
	<i>Limitations?</i>	Very limited spatially
Coastal air quality/ atmospheric deposition	<i>Who has data?</i>	DEP (some stations on coast) National Atmospheric Deposition Program (2 coastal sites)
	<i>GIS layers available?</i>	Yes (location of monitoring sites)
	<i>Limitations?</i>	Limited locations
Weather	<i>Who has data?</i>	NOAA; GOMOOS (wind, temperature); DMR – Boothbay weather and sea conditions
	<i>GIS layers available?</i>	yes? (wind speed and direction for GOM)
	<i>Limitations?</i>	Limited locations
Climate Change	<i>Who has data?</i>	UMO and Bigelow
	<i>GIS layers available?</i>	Sea level rise for Wells (at MGS)
	<i>Limitations?</i>	Not bay specific

Biological Information

<i>Data Type</i>	<i>Data Availability</i>
<p>Species specific data: abundance, location, condition, requirements for all species of commercial, recreational, and ecological significance</p> <p>(phytoplankton, macrophytes, invertebrates, fish, birds, marine mammals)</p>	<p><i>Who has data?</i> DMR – commercial and noncommercial fish (e.g. inshore trawl survey); rockweed; eelgrass; horseshoe crabs IFW – Bald eagle nest sites; piping plover/least tern nest sites; seabird nesting islands USFWS – Atlantic salmon; seabird counts on islands in Maine Coastal Islands NWR; wintering waterfowl surveys; Darling Center/UMO – marine mammals, invertebrate taxonomy and ecology, deep sea biology, phytoplankton Allied Whale/COA – marine mammals Nat'l. Audubon – puffins, terns, black guillemot, laughing gull Bigelow – invertebrates including lobster, phytoplankton incl. red and brown tides DEP – contaminants in some marine tissues (e.g. mussels, lobsters and cormorants) GoMOOS – chlorophyll/sunlight data to estimate phytoplankton biomass GOM Ocean Data Partnership – fish abundance and distribution for GOM GMRI – Herring acoustic survey, shrimp survey, lobster diet study, cod-tagging</p>
	<p><i>GIS layers available?</i> Some</p>
	<p><i>Limitations?</i> Much of the information available about specific species is general; rarely is there data available about the distribution, condition and location of species in a specific area.</p>
<p>Habitat data: location and condition of coastal, intertidal, subtidal and open water habitats</p>	<p><i>Who has data?</i> MGS - CMGE maps show basic habitats for intertidal areas; beach profiles; bluffs, sand dune photos, inner continental shelf IFW – salt marsh habitat mapping in some areas; tidal waterfowl/wading bird habitats; Roseate tern essential habitat DMR – eelgrass; marine worm habitat USFWS – waterfowl coastal habitat; anadromous fish habitat Wells Reserve – Salt marsh habitats and communities; Reserve habitat values for fish, shellfish and birds; Salt marsh degradation and restoration GOM Ocean Data Partnership – benthic and pelagic seascapes Specific studies done by researchers. Gulf of Maine Council on the Marine Environment – salt marsh restoration, riparian buffers, seafloor mapping</p>
	<p><i>GIS layers available?</i> Some</p>
	<p><i>Limitations?</i> Limited habitat data exist for specific coastal regions. No central repository for the specific studies that have been done by researchers or local groups.</p>

Biological Information, continued

<i>Data Type</i>	<i>Data Availability</i>
Species interactions/ communities; Ecosystem components and functions	<i>Who has data?</i> DMR, NMFS, and Research institutes (e.g., Bigelow, Darling Center/UMO, UNH)
	<i>GIS layers available?</i> No
	<i>Limitations?</i> This research appears to be opportunistic and not usually location-specific. We generally lack good information about species interactions, communities and ecosystem functions, especially at a bay-scale.

Social and Human Use Information

<i>Data Type</i>	<i>Data Availability</i>
Human population	<i>Who has data?</i> US Census Bureau; SPO
	<i>GIS layers available?</i> Yes
	<i>Limitations?</i> Organized by town and county, not by ecoregions
Residential data (type & distribution; development trends)	<i>Who has data?</i> Bob Faunce (consultant) time series of development using USGS maps for 14 midcoast towns done for ME DOT; MEGIS – expansion of CMP utility lines since 1993
	<i>GIS layers available?</i> Yes: utility lines
	<i>Limitations?</i> Limited in geographic extent
Water access (commercial and recreational): location, conflicts	<i>Who has data?</i> Island Institute (in progress); DOT/DMR port inventory; DEP – dock permits
	<i>GIS layers available?</i> Yes
	<i>Limitations?</i> The Island Institute inventory is more detailed than anything done before, but the private access points will most likely be kept confidential and only the public access made available.
Fisheries – for each resource used: where, frequency and intensity, benefits, impacts, threats to the resource	<i>Who has data?</i> DMR (landings data for 32 species; research projects); shellfish growing area classifications; lobster zones, pounds and dealers NMFS Atlantic Salmon Commission DMR and GOMOOS – Northern shrimp catch
	<i>GIS layers available?</i> Yes: Drag areas; Lobster zones. Not much else
	<i>Limitations?</i> We don't have enough data about fisheries use. Landings data is not available at a bay level. Data is for the port of sale, not for where the resource is harvested. Confidentiality of some data limits its use.

Social and Human Use Information, continued

<i>Data Type</i>	<i>Data Availability</i>
Aquaculture – locations, impacts, benefits	<i>Who has data?</i> DMR and DEP (compliance data for finfish sites) DMR for shellfish sites
	<i>GIS layers available?</i> Yes
	<i>Limitations?</i> DEP's finfish data are not analyzed and may be difficult to interpret. DMR's finfish data are pre-2003. Confidentiality of some data limits its use.
Recreation – where, what, intensity, trends	<i>Who has data?</i> DMR – recreational fishing; MITA – island use; MASKGI; Sea Grant – kayaking; Maine Port Authority – dock/marina locations; Maine Marine Trade Association – clean marinas list
	<i>GIS layers available?</i> Unlikely
	<i>Limitations?</i> Scattered data; Data about many types of recreational uses and issues is lacking.
Marine transport	<i>Who has data?</i> Individual port records; Maine Port Authority website; DOT (Office of freight transport); Coast Guard
	<i>GIS layers available?</i> Yes: Ferry routes
	<i>Limitations?</i>
Dredging and spoils locations	<i>Who has data?</i> US Army Corps of Engineers; DEP
	<i>GIS layers available?</i> Some (limited sites)
	<i>Limitations?</i> Old data in paper files, making access difficult.
Energy projects (tidal, wind, hydro?)	<i>Who has data?</i> Private industry; SPO
	<i>GIS layers available?</i> No
	<i>Limitations?</i> Emerging use – limited information available
Water quality & Pollution (point and nonpoint) amounts and impacts	<i>Who has data?</i> DEP – point source, OBDS, Gulf Watch (mussel contaminants), hazardous and oil spills, water quality data for Atlantic salmon rivers, pumpout locations; DMR – human health impacts, mostly bacteria; EPA – Nat'l Coastal Assessment (toxics and nutrients); SPO/DMR – Healthy Beaches program; MGS – Landslide hazards; Wells Reserve – estuarine water quality; Gulf of Maine Council on the Marine Environment; Individual organizations (e.g. Friends of Casco Bay)
	<i>GIS layers available?</i> Yes for most this data

Social and Human Use Information, continued

<i>Data Type</i>	<i>Data Availability</i>
	<p><i>Limitations?</i> Data collection is not systematic; it occurs in areas where money, resources and interest emerge. Little to no analysis of how specific land uses/NPS pollution impacts coastal water quality, habitats and organisms.</p>
Economic benefits tied to use of nearshore environment	<p><i>Who has data?</i> DMR landings values; USM natural resource economist Charles Colgan (Ocean Economics Project?)</p>
	<p><i>GIS layers available?</i> No</p>
	<p><i>Limitations?</i> Very limited information and what exists is not bay specific</p>
Cumulative impacts of multiple uses	<p><i>Who has data?</i> No known studies</p>
	<p><i>GIS layers available?</i> No</p>
	<p><i>Limitations?</i> Virtually non-existent</p>
Conserved or protected areas (locations and types)	<p><i>Who has data?</i> MCHT (provides master database for individual land trusts); NPS, USFWS – federal protected lands; BPL, IFW – state protected lands (SPO has a conserved lands GIS layer that displays state and some federal and private lands) Municipalities – town lands; NOAA survey of marine managed areas (in progress - ME data not displayed yet); IFW - Beginning with Habitat</p>
	<p><i>GIS layers available?</i> Some. For example, MEGIS – conserved lands layer (state and national lands) and BwH data layers</p>
	<p><i>Limitations?</i> MCHT has a conserved lands registry for all coastal lands owned or protected by individual land trusts but this data is not available to others. Land trusts can access their own information through a website for the registry. Some conserved areas (i.e. some lands/easements owned by land trusts) may be confidential or proprietary and not available for others to use. BwH focus areas are not protected, but are presented to towns as valued areas</p>
Marine Archeology	<p><i>Who has data?</i> Darling Marine Center Maine Historic Preservation Commission</p>
	<p><i>GIS layers available?</i> Some at the National Register of Historic Places website</p>
	<p><i>Limitations?</i> MHPC compiles information about archaeological sites, but uncertain if includes marine areas</p>

Social and Human Use Information, continued

<i>Data Type</i>	<i>Data Availability</i>
Stewardship activities; Monitoring activities	<i>Who has data?</i> DMR/SPO/Cooperative Extension – Partners in Monitoring; GOMC; and Individual groups
	<i>GIS layers available?</i> Unlikely
	<i>Limitations?</i> Data collection is not systematic; it occurs in areas where money, resources and interest emerge. Some groups consistently collected data over time, while others fizzle out, which means data quality varies by place.
Shoreland zoning	<i>Who has data?</i> DEP and municipalities
	<i>GIS layers available?</i> No, except for that which is included in Island Institute working waterfront maps
	<i>Limitations?</i> Information on paper in DEP files or town offices.

Bay Specific Data

There have been efforts to compile existing data on a particular bay, collect new data, and analyze the data to provide more complete understanding of that area. A few examples are:

Cobscook Bay - The Cobscook Bay Resource Center conducts water quality data collection and community-based research (e.g., Cobscook Drifter study for circulation patterns), and they have published reports on the Cobscook Bay sea scallop fishery. TNC created a bibliography of studies in the area, directed a large ecosystem study of Cobscook Bay and published a special volume entitled: “Ecosystem Modeling in Cobscook Bay.”

Taunton Bay – The Friends of Taunton Bay and The Department of Marine Resources recently completed studies and analysis regarding a wide range of environmental and social factors.

Penobscot Bay –The Penobscot Bay Marine Resources Collaborative conducted research on phytoplankton communities, surficial mapping, intertidal habitat mapping, circulation patterns, intertidal lobsters, seafloor geology, and bathymetry (their website administered by Island Institute is obsolete). The East Penobscot Bay Research Center also collects data in this bay.

Muscongus Bay – The Quebec-Labrador Foundation compiled an annotated bibliography of studies completed in this region.

Damariscotta River Estuary - The Damariscotta River Association collects information about water quality and shellfish habitat. Much of the research done at the Darling Marine Center takes place in this region.

Casco Bay - More than 100 volunteers help the FOCB collect critical baseline data on salinity, dissolved oxygen, temperature, pH, and water clarity at more than 80 shore-based stations and ten profile stations. The FOCB recently published an analysis of their monitoring program that

synthesized over a decade of monitoring results. The Casco Bay Estuary Partnership also compiles information about relevant issues (e.g., stormwater, toxics, habitat conservation).

Publications that characterize the coast:

Two pre-GIS era publications provide comprehensive overviews and detailed summaries of available information for specific coastal regions. The Ecological Characterization of Coastal Maine (1980) presents a compendium of available information for certain bays. Though not all embayments are included in this publication and information on many of the areas covered was incomplete at the time, it provided a baseline for subsequent work. A second example, the Estuarine Profile Series (1991), provides descriptive information for 19 estuaries along the Maine coast. Unfortunately, these publications are out-of-print and can be difficult to obtain.

In addition to these location-specific publications there are a number of other reports that serve as a general resource for coastal areas. These include Maine's Coastal Wetlands by Alison E. Ward in which GIS was used to generate maps and summarize habitat information for coastal regions. Another example is the Distribution and Abundance of Fishes and Invertebrates in North Atlantic Estuaries by S. H. Jury and others (1994). For most embayments, these can serve as general guides to habitats and biota but do not provide embayment specific detail that often is required for good management decisions.

Current Status of Marine GIS in Maine

Three GIS needs assessments have been completed in Maine over the last 18 months. The Department of Marine Resources report, "Maine Marine GIS Needs Assessment" focused on the status of marine GIS at the State level. It asserts that marine-focused organizations have unique needs that are not being addressed by current land-focused GIS initiatives. More specifically, 12 of the 17 bottlenecks to better implementation of marine GIS in Maine are related to lack of data and metadata. Furthermore, there has been no coordinated, comprehensive effort among organizations that work in the marine environment to share data and many smaller organizations are not aware of what data are available. See the appendix for more detailed results and recommendations from the "Maine Marine GIS Needs Assessment."

The Maine Coast Protection Initiative (MCPI) report, "Geographic Information System Needs Assessment: Survey Results for Coastal Land Trusts in Maine," found that while most coastal land trusts collect geospatial data and make regular use of GIS for map production, a vast majority need capacity-building to make more effective use of GIS (more than 50% of those responding (26 organizations) had dial-up internet connections!). In addition, there are a number of important spatial data needs including digital parcel data, aerial and satellite imagery, priority habitat areas, and public access locations. As an outcome of this study, MCPI is funding three GIS resource centers for coastal land trusts: University of Maine at Machias (new center), Wells Reserve (existing), and Sheepscot Valley Conservation Association (existing). These centers will provide trainings to both seasoned and new GIS users, offer no- or low-fee mapping services, and provide a data bundle and ArcReader so all land trusts can access information via basic GIS. While the focus of these centers is to improve efforts of coastal land trusts and not necessarily to invest in marine GIS, these centers (especially Wells and Sheepscot) may be able to provide assistance to others (municipalities, conservation organizations) on nearshore projects.

The Maine Library of Geographic Information (Maine GeoLibrary) report, “GIS Needs Assessment & Requirements Analysis For Maine County Government” was based on a series of workshops with county, state, regional planning agency, and municipal officials from June 2005 until January 2006. They found that regionalization of data services is an important goal and that county offices could serve as regional GIS centers, although current staffing levels and technical knowledge would need to be increased to do so.

In addition to the information provided by these broad GIS needs assessments, two bay management pilot projects carried out GIS exercises that highlight the opportunities and limitations of GIS to assist with bay management initiatives. Both groups emphasized that GIS capabilities and the maps produced were essential for their efforts. Visualization of spatial information was pivotal to meaningful discussions during their respective studies. However, several specific major limitations arose:

- a. Several pivotal marine GIS layers are lacking (e.g. human use; habitat maps). Of the ecological and social data that do exist, much are not available at the bay level (i.e. it is at a very site specific scale or much larger coastal or Gulf of Maine scale). Local groups cannot possibly collect all the needed information.
- b. GIS maps were one of the most prized outcomes of the projects and yet took relatively more effort than any other component. Identifying and assembling the proper data layers takes considerable expertise, hardware and software that is beyond the capabilities of most local entities. Both pilot projects had GIS experts to help, but this help might not be available everywhere.

The Muscongus Bay pilot study by QLF provided eight recommendations highlighting the need for more and better data and documentation. An overriding need expressed by QLF was for centralized data storage and distribution on the part of State government. The following are QLF observations and recommendations:

- Paucity of readily available GIS data for the marine environment.
- Creating seamless data sets across the land/sea interface.
- Paucity of fine-scale, or bay-scale GIS data.
- Primary data gathering is essential for generating human use data, but it takes time.
- Absence of regional data on coastal development.
- Sensitivity of data sets.
- Lack of documentation for non-OGIS data sets.
- Aggregating data on the final maps.

Data Exchange: Storage, Sharing and Accessibility of Data and Information

Even without doing a complete data inventory (which would undoubtedly uncover additional locations of data), we identified 8 federal agencies, 8 state agencies, at least 6 university research centers (some of which are located out-of-state), 13 organizations (e.g. GOMOOS, GMRI, Island Institute, etc.), and at least 200 local groups and municipalities (a GOMC search came up with over 200 local research and monitoring organizations in Maine such as Friends of Casco Bay and Damariscotta River Association) that collect data about Maine’s nearshore and marine environment. At the same time, no entity attempts to catalogue where to find data about the nearshore. A few state agency websites have links to available data, but those links to data are

rarely all in one place and data can be very difficult to track down. It is even more difficult to learn about what data exist outside of federal and state government.

A recent NOAA study (Bricker et al 2006) that examined eutrophication of Maine's coastal waters also concluded that "Acquiring data was the most difficult part of this study and inadequate data was a limiting factor. Data were found in a number of places and had to be retrieved from a number of investigators; other forms of data collection proved unsatisfactory. Inadequate data was a limiting factor for both the eutrophication assessment and the development of the human-use indicator." Thus, even a well-funded study looking for limited data (only water quality) found it extremely difficult to locate and acquire needed data.

Information transfer can be accomplished in a variety of ways and for many purposes. There can be a physical place such as an office or library or a virtual space such as a website. The internet allows electronic access, searching, and delivery to meet a range of needs. Some examples include email listservs, websites and portals. The GOMOOS site is an example of a website geared to assist with information access and distribution. It provides regional (Gulf of Maine) near-real time data and a data archive that can be accessed for a range of parameters. On the national level, the NASA Global Change Master Directory, a comprehensive directory earth science data and applications, serves as an example of collaboratively maintained, data discovery portal that can function at any scale. The Maine Office of GIS provides a more traditional data catalogue that can be searched based on key words. However, at present, few if any formats provide adequate access to the range of information needed for even the simplest nearshore management applications.

SECTION 2: FINDINGS

Data Availability

- There are major gaps in basic nearshore data. There are many types of data about the nearshore that do not currently exist, as well as many existing data sources that are too outdated or at the wrong scale to be useful. A few of the major data acquisition priorities include: nearshore habitat mapping; human use mapping (what, where, when, how much); distribution of most species; cumulative impacts; species interactions/ecology; and land use impacts on nearshore water quality and habitats. For a list of the most needed marine GIS data sets, see the Marine GIS Needs Assessment recommendations in the appendix.

- Available nearshore data are scattered in topic and geographic area. Agencies and organizations that collect and manage marine data differ in that regulatory agencies collect different data than do management agencies, and government agencies in general are limited to collecting data related to their missions and funding sources, which may not be relevant to those outside of government. Agencies and organizations have wide ranging geographical foci and scales of interest, collecting data about very specific places, a bay, the entire coast, a particular watershed or even the Gulf of Maine. The different priorities for type and scale of data collected results in a compendium of unrelated or disconnected

data. For example, data about coastal land is often not compatible or analyzed in conjunction with data about nearshore waters. Furthermore, agencies and organizations involved in nearshore issues have different and sometimes contradictory research priorities. A more complete understanding of nearshore environments could be enhanced by working to develop a common list of priority data and research needs.

Data Exchange

- It is extremely difficult to find and gather existing data. State and Federal government websites are generally inadequate in making data available; not only is there no central place on their websites to access data, but their search engines are limited, often returning large numbers of unrelated hits to a query. Non-governmental organizations are scattered, and some do not have the capacity to make data easily available to others. Furthermore, all entities can be reluctant to share data for several reasons: desire for ownership or credit, fear that data might be misused or misinterpreted, belief that data is confidential or sensitive, or knowledge that the data collection or analysis is still in progress.
- It is helpful that so many types of organizations are collecting data, but this situation calls for careful documentation (i.e. creation of metadata or clear methods) and sharing of data. There is no designated group focused on compiling or creating data exchange agreements for nearshore data.
- While larger organizations (state agencies and large non-profits) in Maine are well set up for internet communications including data transfer, many local organizations still use dial-up connections or use older hardware and software. Efforts to improve data exchange need to consider such technological limitations.

Marine GIS

- Marine GIS in Maine is limited in its ability to assist with understanding nearshore environments and to assist with decision making. GIS data acquisition in Maine has been dominated by land-side data and issues. There has been no concerted effort on the part of marine-focused organizations to create a more integrated, coordinated, comprehensive, and targeted marine GIS.
- The Maine Marine GIS Needs Assessment found the following impediments to GIS data exchange and implementation, most of which are probably relevant to non-spatial data as well: data problems (inaccurate/out-of-date, inconsistent formats, no metadata), data exchange (hard to find data, assistance needed to view/analyze data), and priorities (tight funding, politics of data access/not sharing, lack of coordination).
- The MEGIS online data catalog and web viewer <http://apollo.ogis.state.me.us/catalog/> is the primary way that state agencies make their GIS data sets available to other organizations and the public. The Maine Marine GIS Needs Assessment found that while the most used web site is MEGIS, only about ½ of the organizations report using it. Furthermore, data not on MEGIS are very difficult to discover.

General

- Scientific inquiry will rarely produce definitive answers. For this reason, science is not likely to reduce debate and contention in nearshore management, especially when human values are at stake. Science can provide data and information to be used to help define a range of options, but must be paired with good decision-making processes and policies to be useful in any bay management endeavor. Furthermore, joint or cooperative data collection can be a constructive way to build trust and consensus.

SECTION 3: RECOMMENDATIONS

Recommendation 1: Create a Long-Term Coastal Marine Science Plan

The Department of Marine Resources should lead an initiative to bring together representatives from DEP, DMR, MGS, SPO, IFW, DOC, municipalities, universities and NGOs who work in the marine environment to develop a long-term plan for coastal marine science. The purpose of this science plan would be to identify common needs and priorities to support regional nearshore management and develop a strategy to address them. While some institutions, like DMR and Sea Grant have a set of research priorities, not all organizations that work in coastal waters have them nor were all plans developed to look at marine science in a regional coastal management context. This long-term coastal marine science plan would attempt to integrate related initiatives and priorities (e.g. Sea Grant aquaculture research plan, Gulf of Maine Council's Environmental Monitoring Plan, and EPA's National Coastal Assessment) when creating a coastal research plan. Tasks are listed in order of loose priority; however, it is not necessary that they be done in this order.

Task 1: Establish a science advisory committee

A multi-disciplinary committee with emphasis on nearshore management and science will be established to provide advice on tasks as outlined in this recommendation.

Task 2: Conduct sector-specific and cross-sector research needs assessments

The assessment will identify and prioritize top research and monitoring needs from various marine and nearshore entities (state and local governments, industry, non-profits). In addition, this assessment will determine research and monitoring needs of multi-sector issues such as cumulative impacts and carrying capacity. The research and monitoring needs assessment will put Maine in a positive position to seek funding through grants, programs, and partnerships. More importantly, it will guide agency policy makers and program managers by identifying priority needs in the context of Maine's coastal communities.

Timeline – 1 year startup, with ongoing review

Cost ~ 1 FTE equivalent or \$60,000 to start and \$10,000/year thereafter

Task 3: Develop a human use and resource atlas

Coastal and bay management suffers from lack of information on the location and condition of coastal resources and their uses. This GIS-based atlas will compile information from various sources and incorporate both quantitative and local knowledge. It will be used to set priorities and identify ecological relationships, especially between habitat and species requirements and

their vulnerability to human exploitation. Once the base atlas has been developed, it can be updated as new data from the larger coastal monitoring program is gathered.

Timeline – 5 year

Cost ~ 1 FTE - \$60,000/yr

Task 4 – Establish Long-term Monitoring Stations

Distinguishing natural variability from that caused by humans is important. Trying to manage natural events is futile and resources are better spent on managing those impacts that are truly manageable. Long-term monitoring, although not glamorous, is essential in creating long time series that documents the ebbs and flows of nature. A network of index stations would monitor changes in living resources and physical and chemical parameters of sediments and water.

Opportunities exist to integrate this long-term network into other ongoing and supported programs such as the Integrated Ocean Observing System, EPA's National Coastal Assessment, and NOAA's Status and Trends Program. However, to serve the needs of coastal management, the long-term network would place more emphasis on the very near shore coastal waters and their land-sea interface.

Timeline – Ongoing

Cost ~ \$200,000/yr. (multi-agency and NGO partnership)

Task 5: Compile information on historical baseline conditions

There is already much information that has been collected on the condition and quality of coastal resources. However, much of this is in the form of paper files, agency reports, and inaccessible archival material. Decision makers are unable to assess changing conditions in our coastal systems. For example, the Maine State Archives contains Critical Areas Program files that characterize intertidal benthic communities along the entire coast from the 1970s. Incorporating these data into Task 4, above, would extend the time series inexpensively. Older data need to be made available digitally to measure natural variability, identify sensitive habitats and biological communities, and enhance our ability to assess environmental impacts after human or natural events. Funding is needed to prioritize, catalogue and digitize earlier publications and data sets so that the information contained is accessible for use by resource managers and scientists.

Timeline – 1 year

Cost ~ 1 FTE - \$60,000

Recommendation 2: Enhance Information Exchange and Marine Geographic Information Systems in Maine

DMR should lead an initiative to identify information exchange needs and develop information management, delivery and exchange mechanisms that will provide wide access to coastal marine data. DMR should also take the leadership role in coordinating and advocating for better Marine Geographic Information Systems (GIS). Together with a coordinated coastal Maine science plan, information management and exchange is a powerful tool for regional management.

Task 1: Develop a nearshore management information portal

A portal similar to that used by Chesapeake Bay Program (<http://www.chesapeakebay.net/>) would be developed to provide access to available information and foster communication among

those interested in bay management. The portal should provide simple tools for data and information access, as well as background and updates on regional bay management initiatives. It should be integrated with InforME (<http://www.maine.gov/informe/>) and also take advantage of innovative regional and national information technology such as those being explored by the Gulf of Maine Ocean Data Partnership

Timeline – 3 yrs

Cost ~ \$100,000/yr

Task 2 – Engage in a focused effort to develop marine GIS data layers, standards and exchange

Only through a concerted and specific focus will Maine be able to develop marine GIS robust enough to aid in coastal understanding and decision making. There is currently not enough marine ecological or social GIS data at a bay level to manage efficiently. The Marine GIS Needs Assessment (see Appendix G), concluded that most GIS needs would benefit from better coordination and planning by DMR and that the Maine GeoLibrary and MEGIS could offer the organizational structure to fully integrate marine GIS with other GIS activities in the state.

The State can help by collecting and compiling marine GIS in a way that enables bay level organization of data. To make data exchange most useful, spatial and non-spatial data must be created with common standards and associated with good documentation or metadata. Data standards such as those developed by the Maine GeoLibrary for parcel data will need to be established for marine data sets and accompanied by FGDC compliant metadata. As data are developed according to established standards, the marine GIS could be integrated into the MEGIS and the GeoLibrary so that it is easily accessible. The State should develop Web Mapping Services such as ArcIMS applications or other OpenGIS services that can be used in support of marine GIS. Additional GIS staff based at DMR are needed to manage and coordinate this effort.

Timeline – 3 yrs

Cost ~ \$150,000/yr

Task 3 – Provide support to existing community GIS centers

Two GIS needs assessments and both bay management pilot projects pointed to the need to have regional GIS resource centers to support regional initiatives. Most local groups do not have the capacity and knowledge to find and analyze data on their own and state staff cannot dedicate the time needed to help individual groups. A community GIS center is one way to provide this link. The Maine Coast Protection Initiative has provided trial support to three such GIS centers, and the Applied Geographics County Needs Assessment suggested using county government offices for such centers (although no work has begun on this yet). The State should evaluate the effectiveness of and provide additional support (training, funding, and data) to those pre-existing GIS resource centers most able to assist regional bay management initiatives. If a gap exists along the coast (e.g., Frenchman's Bay area), the State could look to supporting an existing group to could become a resource center. Supporting resource centers will build local capacity and will equally benefit state resource managers as it does regional centers.

Timeline – Ongoing

Cost - \$150,000/yr

ACRONYMS

BPL - Maine Bureau of Parks and Lands (in Department of Conservation)
BwH - Beginning with Habitat (program of IFW)
CMGE – Coastal Marine Geologic Environment (data layer maintained by MGS)
COA – College of the Atlantic (in Bar Harbor, ME)
DEP – Maine Department of Environmental Protection
DMR – Maine Department of Marine Resources
DOT – Maine Department of Transportation
EPA – US Environmental Protection Agency
GIS – Geographic Information System
GMRI – Gulf of Maine Research Institute (in Portland, ME)
GOM – Gulf of Maine
GOMC – Gulf of Maine Council on the Marine Environment
GoMOOS – Gulf of Maine Ocean Observing System
IFW - Maine Department of Inland Fisheries and Wildlife
MASKGI – Maine Association of Sea Kayak Guides and Instructors
MCHT – Maine Coast Heritage Trust
MCPI – Maine Coast Protection Initiative (MCHT, SPO, NOAA and Land Trust Alliance)
MEGIS – Maine Office of GIS
MERI – Maine Environmental Research Institute (in Blue Hill)
MGS – Maine Geologic Survey
MITA – Maine Island Trail Association
NASA – National Aeronautics and Space Administration
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NOS – National Ocean Service (part of NOAA)
NPS – National Park Service
NWR – National Wildlife Reserve (administered by USFWS)
OBD – Overboard Discharge
QLF – Quebec-Labrador Foundation
SPO – Maine State Planning Office
SVCA – Sheepscot Valley Conservation Association
TNC – The Nature Conservancy
UMO – University of Maine
UNH – University of New Hampshire
USGS – US Geological Survey
USFWS – US Fish and Wildlife Service

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