



## **Preliminary Release: Seeking Comments on Habitat Change and Land Use Research Priorities**

Sound coastal decision-making depends on the sustained interaction between scientists and managers that produces the science needed by managers. Over time, the Regional Association for Research in the Gulf of Maine (RARGOM) and the Gulf of Maine Council on the Environment (Council) have played an instrumental role in supporting communication among and between scientists and managers in the region. The last research plan to incorporate the region's research needs was developed in 1992 by RARGOM for the Gulf of Maine Regional Marine Research Program. Much research has been completed since then and a new list of research priorities needs to be established.

The Council and RARGOM recognize that a priority-setting process is complex and needs to incorporate many mandates and perspectives. New research, both basic and applied, should focus along a continuum from the open Gulf, to various coastal embayments, and up into the Gulf's watershed. It needs to be conducted at scales appropriate to processes and environmental issues.

During 2004, both entities renewed efforts to sustain the dialogue between coastal scientists and resource managers about the kinds of policy-driven research needed to solve longstanding environmental and resource issues in the Gulf region. A web-based survey hosted by the Council and the Coastal States Organization was conducted to identify the research, information, and technology needs of resource managers from the Gulf of Maine states and provinces. The tabular results of the survey and a 12-page report providing an analysis and historical perspective of this feedback are both available for review on the Council's web site (see <http://www.gulfofmaine.org> under publications).

The Council and RARGOM then cooperated to bring the results of the survey to a wider Gulf audience for discussion. On September 20, 2004, over 40 scientists and resource managers met for a one-day meeting in South Portland, Maine. The purpose of the forum was to identify critical research activities that could lead to the improved management of habitat change and the effects of land development on coastal ecosystems, the region's top priority management concerns to emerge from the survey.

Attached are summaries of the draft research projects prepared at the workshop. Participants were asked to address the research, information, and technology needs for habitat change or land use, using a research statement template to help tease out and capture comparable levels of detail. Since the South Portland meeting was the start of an ongoing process to further refine these research priorities and entrain necessary funding, we need and welcome your comments on the proposed projects and your continued involvement in the priority setting process. Please provide comments to [Lorraine.Lessard@Maine.gov](mailto:Lorraine.Lessard@Maine.gov). Thank you.

## ***Potential Land Use Research Project Abstracts***

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### **Research Project #1 – land use analytical tool**

Create a land use analytical tool for the Gulf of Maine (GOM) watershed that complements measurements being collected through the GOM Ocean Observing System. Once developed, these regional land use change models and protocols would enable managers to understand changes in land use/land cover and accurately predict the corresponding effects of these changes on the GOM marine ecosystem. Mass loading models would be similarly of use to land and water managers. The project approach entails using consistently interpreted and ground-truthed satellite imagery to produce automated maps and time series of land use and habitat change patterns in the GOM that could be accessed using newly developed web-based assessment and communication tools. It also requires the integration of traditional environmental monitoring with long-term observations. The proposal takes advantage of existing federal expertise in land cover change analysis and could incorporate plans in Maine to produce 5-meter resolution land cover maps for the state in 2005. It would also reinvigorate an initiative proposed by the GOM Council during the mid 1990s to apply the Soil & Water Assessment Tool or SWAT, a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds. The effort was not pursued at that time due to insufficient funds. Ongoing activities that would relate to this proposal include the use of data on land-based sources of pollution by state water quality agencies to quantify Total Maximum Daily Load requirements for coastal waterbodies and nutrient modeling being undertaken in Massachusetts' estuaries.

### **Research Project #2 – indicator tools for identifying and tracking land use changes and ecosystem responses**

Develop a suite of indicator tools for identifying and tracking land use changes and ecosystem responses. This project is predicated on developing an improved understanding of the relationship between land use change and resulting impacts in natural systems. A multi-disciplinary team that included both scientists and users would determine appropriate segments to study within a continuum from the continental shelf to the headwaters of the GOM watershed and develop 3-4 indicators best suited for each segment. Ideally, these indicators (new or existing) would be capable of describing a gradient of potential environmental responses to a given land use decision, giving managers the capacity to make more informed decisions that minimize impacts. The proposed project would involve the collection, management, and integration of economic datasets with natural resource data sets on a GIS platform over a range of scales using spatial correlation techniques. A model framework for this research and a potential collaborator is the National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California at Santa Barbara. The proposed project builds on the Gulf of Maine Council's regional indicator initiative and would draw from environmental and socioeconomic indicator development activities being pursued across government and non-governmental organization sectors alike.

### **Research Project #3 – effect of concentrated versus dispersed development**

Assess the environmental effect of concentrated versus dispersed development. This project would develop a model using data derived from a series of paired coastal watersheds to improve the capacity of managers and policymakers to influence decisions on where new growth should be directed in order to minimize adverse impacts. The model runs would compare the outcomes of enacting various forms and patterns of development with corresponding watershed and water quality conditions. Such results would help guide alternative watershed sensitivity analyses necessary to determine whether directing development to already impacted watersheds would have a less negative impact than dispersing development over the broader landscape. The Nonpoint Education for Municipal Officials project, initiated at the University of Connecticut, has documented the quantifiable relationship between the percent of impervious surfaces in a watershed and coastal water quality. The proposed model could be used to verify the accuracy of the current estimates for the tipping point of 8-10 percent of impervious surfaces for the GOM watershed and further determine the relationship between the rate of change in impervious cover and the corresponding rate of change of degradation. Related studies, such as an analysis of the drivers of current patterns of sprawl that may serve as barriers to changes in policymaking, were suggested.

## ***Potential Habitat Change Research Project Abstracts***

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### **Research Project #1 – habitat change**

Link habitat change to local and regional circulation and watershed discharge models. The project would develop a series of linked models capable of predicting how habitat changes would cause changes in discharges in various hydrodynamic settings. These discharges, such as nutrient loading, stem from human alterations of the landscape and the atmosphere and can lead to subsequent impacts on habitats and changes to the structure and function of biological communities. It was recommended that the first step be to identify the types of estuaries that represent different circulation and ecosystem regimes and to focus the research initially on systems that represent different combinations of circulation patterns. The second step would be to identify the key forcing mechanisms for these models, assuming that although various models may already exist for depicting coastal and offshore circulation and watershed discharges, the following aspects will particularly require further investigation: the models may not be at a suitable broader scale; and the linkages need to be determined that allow model results to be exported between coupled models. The third step would entail linking circulation and discharge models to the corresponding changes in habitat. Additional spatial data would need to be acquired, in addition to field measurements, ranging from episodic event sampling to ecosystem responses occurring on annual to multi-year timeframes. It was agreed that modelers, whether they be operating in the private sector or in academia, would need to develop new levels of mutual understanding and interaction in order to work on a larger scale.

### **Research Project #2 – assess change**

Assess baseline and change in the ecological, economic and cultural value of specified habitats (individual or in combination) subjected to human activity. The working group envisions the outcome of this work to yield decision support tools enabling managers to assess the consequences of proposed individual and multiple land development decisions, so tradeoffs can be effectively weighed. The capacity to understand the value and significance of habitats and how anticipated changes will affect those values is an integral part of the environmental regulatory process, from the phase of meeting requirements for alternative and cost-benefit analyses under National Environmental Policy Act (NEPA) and state NEPA and resource protection statutes, to devising standards for habitat mitigation, to the science support required for oil spill planning and response and the Natural Resources Damage Assessment process. The scientific objectives for the proposed research were framed through the following series of questions. (1) How does habitat change translate into changes in structure and function of biological communities? (2) How do these changes translate into societal goods, services, and values? (3) What are the qualitative and quantitative biological uses of these habitats? (4) What are the physical services provided by habitat (e.g., shoreline protection from storm water)? A number of approaches were identified to accomplish this work, beginning with conducting baseline mapping of critical habitat through such means as the Council's GOM Mapping Initiative and in a process that incorporates the input of users. Information on the life history of living marine resources and on food web dynamics would need to be synthesized. Effort would have to be placed on developing better assessments of the economic (market/non-market) valuation of habitat goods and services and their intrinsic cultural value. Finally, the need was cited for monitoring habitat uses. The spatial scales envisioned for this project ranged from single or linked habitats or embayments located along a

continuum from the watershed to the nearshore to offshore areas; the working group suggested using a stratified approach for including representative systems.

### **Research Project #3 – thresholds and stressors**

Identify appropriate thresholds of various (physical, biological, chemical, hydrological) stressors on habitats. Sources of stressors include the direct and indirect effects from regulated or unregulated activities and projects (e.g., the impact of docks and piers on shellfish beds, dredging, atmospheric inputs of mercury). The types of end products from this study would be an improved understanding of thresholds for allowable impacts and stressor response models--information to support improved decision support models. These products would be of use to those charged with coastal resource permitting, land use and water resources planning, ocean zoning, shellfish/fisheries resource allocation decision making and remediation and restoration. The working group outlined a series of objectives and approaches that would need to be undertaken: establishing cause and effect relationships (e.g., dose response studies, multivariate analysis of physical, chemical, biological, socioeconomic components of a system, synergistic effects); determining assimilative capacity and organism/community resilience; conducting sensitivity assessments; and establishing thresholds for ecosystem change. Long-term mapped data would be needed for spatial analyses to identify large scale habitat patterns and to understand natural variability. The project could be conducted at a broad range of spatial scales and from lab-based or mesocosm studies to those performed in a single embayment.