Gulf of Maine Council Habitat Conservation Subcommittee

Workshop Proceedings

Gulf of Maine Habitat Classification Workshop: Mapping for Decision Making

January 2009

Gulf of Maine
Council on the
Marine Environment

The Gulf of Maine Council on the Marine Environment was established in 1989 by the Governments of Nova Scotia, New Brunswick, Maine, New Hampshire, and Massachusetts to foster cooperative actions within the Gulf watershed. Its mission is to maintain and enhance environmental quality in the Gulf of Maine to allow for sustainable resource use by existing and future generations.

These workshop was made possible through the support of the Gulf of Maine Council on the Marine Environment and a grant from the National Oceanic and Atmospheric Administration (NOAA).

Workshop Background
The Gulf of Maine Council's Habitat Conservation Subcommittee was initiated to support the Council's interest in ecosystem-based management of regionally significant coastal habitats. Every two years, the Subcommittee develops a work plan with specific activities to advance progress towards its goal of protecting the Gulf's marine habitats. Over the past five years, the Subcommittee has facilitated the development and dissemination of background information that improves the region's knowledge and understanding of the Gulf of Maine's marine habitats, including:

- Published a Gulf of Maine Habitat Primer, which provides an overview of habitat characteristics, ecological functions, economic and recreational values, and management considerations. (2005)

- Convened experts to discuss and prioritize human impacts on a variety of habitats, and to discuss management strategies. (2005)

- Published a report to provide a basic understanding of marine habitat classification, including definitions, and explanation of why classification is important for conservation and management and an overview of some of the leading marine habitat classification schemes. (2007)

Based on feedback from the habitat classification report produced in 2007, the Subcommittee identified the need for continued dialogue around regional classification of the Gulf's marine habitats. Habitat classification enables organization of data and seafloor mapping information for key habitats in a manner that allows practitioners and researchers to speak more clearly about marine habitats. The Subcommittee organized a regional workshop to discuss regional classification needs in the Gulf of Maine. The two goals of the September 2008 workshop, *Gulf of Maine Habitat Classification Workshop: Mapping for Decision Making,* were:

(1) To facilitate communication on seafloor mapping and classification, and
(2) To understand management needs for information about marine habitats

The target audience for this workshop was a combination of federal, state, academic and non-governmental organization from throughout the Gulf of Maine region, with representatives from both Canada and the U.S. participating. A full list of participants is in Appendix A. The meeting was held at the offices of the New Hampshire Department of Environmental Services, located at the Pease International Tradeport, in Portsmouth, New Hampshire.

SUMMARY OF WORKSHOP

Habitat Classification Experience in the Gulf:

The workshop included presentations from habitat classification experts that addressed four questions in the context of their mapping and classification experience:

1. What characteristics should habitat maps of the northeast include?

2. How does your methodology/scheme address: (a) physical factors, (b) biological factors and (c) processes?
3. What are the innovative aspects of your methodology / scheme?
4. What is the most appropriate use or application of your methodology / scheme? Does your methodology / scheme fit in the Gulf of Maine scale?

Brian Todd, Geological Survey of Canada, offered the first presentation of the workshop, co-authored by **Page Valentine, United States Geological Survey**, and discussed *Habitat Classification, Characterization and Mapping*. The difference between habitat classification and mapping was outlined: classification- "produces a set of habitat types based on a suite of standard descriptors of topographical, geological, biological and natural and anthropogenic features and processes", whereas mapping is "the spatial representation of described and classified habitat units." The range of applications was also discussed, from the broad scale, with Australian marine reserve networks as an example, to the local scale, looking at harbor management in Santa Cruz.

Mark Finkbeiner, NOAA Coastal Services Center, followed with an overview of the *Coastal and Marine Ecological Classification Standard (CMECS)*, developed by the National Oceanic and Atmospheric Administration (NOAA) and NatureServe, via conference call from his office in Charleston, South Carolina. Finkbeiner emphasized that CMECS is a "flexible system for consistent reporting and does not require all fields to be completed." CMECS' four components were described as "pancakes of data", including Benthic Cover ,Water Column, Geoform, and Sub-benthic.

Vladimir Kostylev, Geological Survey of Canada, expanded the morning to include a discussion on Classification and Large Ocean Management Areas (LOMAs). Kostylev emphasized the importance of considering what habitats "do", rather than what they "are", and the value in looking at the status quo as well as the scope of variability in marine systems over time.

Application of Classification Schemes in the Gulf:

These presentations that described the state of classification methodologies were followed by two two case study applications of organizations that have used various classification methodologies and attempted to map them.

Anthony Wilbur, Massachusetts Office of Coastal Zone Management, provided an overview of seafloor mapping activities in Massachusetts to-date, and **Daniel Sampson, Massachusetts Office of Coastal Zone Management**, explained how they worked with consultants to test pilot an adaptation of Greene et al. to a swath area in Massachusetts Bay. One of the only states to have a comprehensive seafloor mapping program thanks to a partnership with the USGS and available mitigation funds, the northern portion of Massachusetts Bay was data-rich and provided a good opportunity for taking initial steps at habitat mapping. Wilbur and Sampson emphasized that while they were one of the only planning agencies to test Greene et al., that their products for the Massachusetts Bay swath area can only appropriately be called surficial sediment maps, and that true habitat mapping is years away. They also emphasized the need for a habitat classification scheme that includes human uses to account for impacts (i.e. dredging) that various uses have on habitats.

Jennifer Smith, WWF Canada, discussed Habitat Classification in Support of Conservation Planning , and explained how habitat classification methodologies can be paired with expert

opinion for representative marine protected areas planning on large regional scales, such as the Northwest Atlantic. The presentation featured two habitat classification products that span the entire region: the WWF-Canada/CLF Seascapes map, developed in 2004, which combines a number of different physical and chemical characteristics, and the more recent Northwest Atlantic Ecoregion Seabed Features classification, which is based on morphology and geology. The later has been used by DFO in their Scotian Shelf/Bay of Fundy MPA network plan.

A general question/answer and discussion period followed the morning presentations. Some highlights include:

Accuracy/Confidence

- How are we accounting for confidence in our mapping? Are large polygons a good use of classification schemes?

- U.S. National Park Service was cited as having a good primer on confidence assessment. It was suggested to look to the Massachusetts Habitat Mapping Strategic Plan for further information.

- It was stated that any line on a map is "fuzzy", therefore all maps are inaccurate to some degree. Therefore, users need to understand bias and error when using and interpreting maps. Determination of scale was included as a bias as well.

- We can obsess over spatial accuracy, but seafloor maps should convey why and how organisms are occurring. Acquiring an understanding of the system allows you to tolerate some spatial inaccuracy.

- Adjacency, heterogeneity, and density were deemed as leading toward understanding relationships and mapping systems.

- While understanding of marine ecological relationships was recognized, the need for accuracy was emphasized once again for specific situations like siting an underwater pipeline. Specificity is needed so that managers know what information they need from project applicants.

- We can't really accurately map habitats at this point. Similar sediment features may have different habitat features. Geological features that we can map now will be one layer of a future habitat map that will show the successional communities that take place there.

- Classification accuracy v. spatial accuracy are different.

- Spatial and thematic accuracy are both needed.

Scale

- The importance was noted of deciding on desired scale of a map up front. For example, are we mapping every boulder or every pile of boulders?

- A representative network of marine protected areas was offered as an example of large scale management need; with information supporting fisheries enforcement violations as an example of a small-scale management need. As similar agencies may have management needs at various scales, the need for multiple scale schemes was suggested.

Information and Data Management

- Organizing data and information and then managing that information so it can be applied to different scales is a first step that needs to happen prior to habitat mapping.

Other

- We need a classification scheme that can actually be mapped.

- May consider a "basic" habitat map and what data is required to produce a basemap. This basic map can inform more specific maps and can be used in compilation with other layers to produce derivative maps.

- It was questioned whether maps should note appropriate usage, but it was countered that there would be likely legal issues with government agencies responsible for publishing map products. In Canada, map authors have gone to user groups like fishermen to explain a map product as it's used in a management discussion.

Group Discussion Results:
The afternoon was reserved for breakout discussions that focused on a set of management and research related questions. Participants self-selected membership to one of three breakout groups and were encouraged to divide evenly between expertise (scientists, managers, etc.) Questions included:

Research Questions:

(1) What are the most appropriate – and feasible – data/mapping techniques for the needs described above?
(2) What proxies, work-arounds, or alternative data sources could help to overcome current limitations or gaps?
(3) How is the accuracy of habitat polygons determined?
(4) What techniques are available for mapping resiliency and disturbance?

Management Questions:

(1) What limitations do you face using currently-available seafloor mapping information?
(2) What are the attributes of a classification scheme that would help you achieve your management mandate?
(3) How do the attributes of an 'ideal' scheme differ for the needs and mandates of agencies around the Gulf (management, regulation, planning, etc.) ?
    -Offshore vs. nearshore environments?

Each of the three breakout groups provided a fifteen minute summary of their discussions. Highlights of these discussions are summarized below by question.

Research Question 1: What are the most appropriate and feasible data and mapping techniques for the management needs described above?

- Techniques should be scale-dependent (regional v. project scale/site-specific, such as laying a pipeline).

- Can supplement maps with hydrographic field sheets and other programs like OLEX (Norwegian fishing vessel sonar as proxy for multibeam).

- Piggyback on other data collection exercises to find economies of scale (e.g. military exercises).

- Should refer to polygons not as "habitat" polygons, but polygons of geological type.

- Accuracy is better defined by looking at physical attributes rather than biological distributions and increasing number of samples.

    - Need to indicate confidence levels throughout map.
    - Should places without data be left blank?

- Number of samples needed depends on variability and backscatter strength (sampling along transition lines and within backscatter).

- Consider raster aggregation techniques.

- Technique selection must match decision timeline (i.e. Mass Oceans Act, decisions need to be made quickly with existing data).

- While discussing habitat mapping, need to also maintain and improve data accessibility/transparency also important (Gulf of Maine Ocean Data Partnership cited as potential model).

- As a community we do not have collective access to our wealth of data from different sources (benthic substrate data, rugosity info, SST); we need to liberate the data to make it publically accessible.

- In addition to knowing what habitat or sediment is present, how can we also capture *vulnerability* and *functionality*?

- Even though we don't have high resolution data in all places, we need to work to develop protocols so we're ready when it is available or developed.

- A variety of data and mapping techniques were cited in order to meet regional needs. These include:

    - Data: Bathymetry, depth
      Technique: Acoustic data – like an aerial photo of the sea
    - Data: Ocean forcing factors – currents, velocity
      Technique: large scale modeling, satellite temperature data, sea surface color (as proxy for temperature), rays/ocean tracking
    - Data: temperature
      Technique: sea surface color, ocean rays, AZMP (temperature and depth), NOAA trawl surveys collect temperature
    - Data: Biological data, especially algae and plankton
      Technique: no silver bullet, video interpretation, continuous video transects (HabCam - originally developed to calibrate scallop surveys. Like side scan sonar except very

narrow swath. Infer biological data (organisms). Useful in nearshore and deepwater. Data processing consuming.); Sonar technology (DIDSON) for 3D images

- Need for common data storage, access, accessibility, usability across government agencies and beyond

- Education and crosstalk needed between managers and scientists in planning and using interpreted products. Ensure that the informal lines of communication are open. Workshops are an effective way to bring right people together. There should be a training component encouraged in state and federal agencies.

- Example: Department of Fisheries and Oceans uses both optical and grab samples; Natural Resources Canada can use only video and stills / optical methods and this ignores infauna

- Suggested to use general mapping template to create strategic map for Gulf of Maine. Identify the "hot spots" and then do more detailed work in those hot spots.

Research Question 2: What proxies, work-arounds, or alternative data sources could help to overcome current limitations or gaps?

- It was suggested that there is a lot of data already collected that could be mapped – surveys, etc. collected by various research groups scattered across the region. The Gulf of Maine Ocean Data Partnership promotes data discovery, accessibility, and management. There is a need for a regional commitment to these principles and to the GOMODP. Example: Deep sea coral database – Peter Auster – data existed, needed to really dig to get it and a lot of ground truthing,

- Lack of benthic data often cited, but there is data available that can be mapped. Existing data needs to be combined, shared, and mapped/processed.

- Obstacles to mapping existing data include not knowing data exists, no funding to process/change format, no metadata, proprietary data sources, need ground truthing, no funding for historical data.

- Spatial analysts need to know where the models work and where they don't work. Where do we have confidence in our models and where should we ignore the information because we don't think it's accurate?

- Use biological information as information to attach to seabed habitats, but not as a proxy for habitat. There are strong links between organisms and habitats, but the confidence you place in this connection depends on the management decision you need to make.

Research Question Three: How is the accuracy of habitat polygons determined?

- Need to know base accuracy of acoustic information to determine accuracy of polygons.

- Through robust groundtruthing.

- Through statistical validation. Look at where the points are – the more points, the better the data, resulting in better maps.

Research Question Four: What techniques are available for mapping resiliency and disturbance?

- Consider natural disturbances like storm events and their attributes.

- Consider the historic picture – what systems used to look like compared to now.

- Need to map habitat, not just geology. Consider this in terms of species richness. Need to know the community that was there to couple resilience with the disturbance in terms of how this affected the biological community. Kostylev argues "scope for growth" is a good indicator of resilience.

Discussion shifted into answering the question of "Where do we have current data?"

- Multi-beam:
  - Stellwagen Bank, Cashes Ledge, Georges' Bank (CA and some US), Brown's Bank, NE channel, 75% Bay of Fundy, 90% of Scotian Shelf, German Bank.
  - Missing Canadian data: George's Basin
  - 60% of CA side of GOM is mapped with multi-beam
  - 15% of US side is mapped.
  - Lacking 80% of needed multi-beam bathymetry

- Sediment samples: USGS, Natural Resources Canada, limited in state agencies. A great deal of unanalyzed video is available.

- Mineral Management Service has seismic tracks from 1960s, 1970s.

- ME Geologic Survey has conducted nearshore side scan sonar.

- US SEABED – USGS Woods Hole has point surface sample data of mineral resources information from marine aggregates program.

- We lack textual seabed interpretation (grain size) in Gulf of Maine.

- Need to learn more about indication of confidence/variability with data sets

- Data needed to assess natural disturbance includes:

  - bathymetry
  - sediment texture
  - nearbed currents (tidal, wave generated from models)
  - scope for growth
  - average temp over decadal scale, interannual and annual variability of temperature
  - concentration of Chl A (SeaWIFS during spring bloom)
  - Upper water column stratification 0-30m depth. ChlA + stratification made into one element: food availability
  - Oxygen at bottom

- Nutrients

Other research related comments:

- Terrestrial remote-sensing and landscape ecology has been working for years. There isa lot to be learned from that literature for marine landscape.

- Researchers don't want to make management decisions where they have low confidence in data – therefore, they recommend it is better to leave blank spaces to illustrate the need for better data.

Management Question 1: What limitations do you face using currently-available seafloor mapping information?

- *Linking biology*: Relevance of biological observations and data and how to link that information to surficial sediment maps. Difficult to convince stakeholders that life history data and expert knowledge is sufficient for knowing where species are and habitat needs.

- *Assumptions*: If you know enough about species you can make inferences/assumptions based on their life history/characteristics.

- *Uncertainty*: Difference of opinion on level of uncertainty managers are willing to accept – suggested that managers are willing to accept fairly high level of uncertainty while another suggested thatmanagers need exact locations (e.g., for siting purposes). Science community is not willing to accept uncertainty while managers are asking for products understanding and accepting that there is uncertainty.

- *Spatially explicit information*: Need to inform managers in a spatial explicit manner of *habitat* vulnerabilities and their locations. of habitats and where they are.

- *Presence/absence method*: Method will work in benthos but not water column. Also can't assume what will be there all the time because some benthos come and go. May also need map of potential habitat, actual habitat, and historical habitat. It may be more useful to understand the characteristics of an area so we can imply what it's suitable for (now and in future). Examples: eelgrass suitability parameters; suitable habitat for invasives like zebra mussels. Where will each of these be in the future? Where are they likely to go?

- *Outdated information*: Primary data source is from 60's ,70's with 1 mm sieve; need for new data; Spatial limitations of data.

- *Understanding of mapping applications*: There is a general misunderstanding of what mapping can and can not do, especially at different scales. A liaison staffer to translate between managers and mappers may be helpful. Not all maps/classification systems will serve all purposes. Interpretation of information limitations (high level of classification) must come with map.

- *Funding* (multibeam is costly but not a complete map minus groundtruthing)

- *Legally defensible*: Possibility of legal ramifications for inaccuracy of lines on a map in public eyes.

- *Seasonality of key parameters*: Need information on key parameters, such as temperature and salinity. These have advantage of being able to interpolate.

Management Question 2: What are the attributes of a classification scheme that would help you achieve your management mandate?

- Can make maps from classification schemes.
- Flexibility and scalability; linkages across scales. Ideal scheme is useful at multiple geo-nested scales and enables linkages across scales via a common set of descriptors.
- Scale independent- ability to easily crosswalk to different schemes.
- Compatibility is technology independent.
- Scientifically based as opposed to politically based.
- Can identify a tie between potential and current human uses.
- Information that is used in schemes should be stable and consistent and not change over time.
- Uses common descriptors.
- Defensibility and repeatability.
- Nearshore schemes need to be seamless to land side schemes (e.g. meshing Cowarden wetlands classification with marine scheme).
- Is easy to communicate to stakeholders.
- Ability to be precise and accurate (for licensing decisions and enforcement).
- Allows for fuzzy boundaries/mixing between classes that reflects complexity of environment. Scheme should have no strict boundaries. If can't draw a transitional area on a map, include that as another polygon. Fuzzy areas or "transition zones" are preferable to sharp lines because will allow to more readily zoom in/out of different scales, and more realistically reflect dynamic nature of habitat.

Management Question 3: How do the attributes of an 'ideal' scheme differ for:

- **The needs and mandates of agencies around the Gulf (management, regulation, planning, etc.)**
- **Offshore vs. nearshore environments?**

- Mandates differ between states and federal agencies in offshore and nearshore environments:
  -*Offshore* has fewer regulations, more stable environments;
  -*Nearshore* needs finer resolution, more regulations, more uses, several regulating bodies, more complex habitat, complex use conflicts, wave action, quick transitions between habitats, freshwater influence, more temporally variable.

- Discussion of need for scheme that can go from tidal influences, to marshes, to nearshore, to offshore abysses. This approach becomes unmanageable quickly. (primary issue with CMECS). On the other hand, one system may save challenges of combining classification schemes. Crosswalks are a lot of work.

- Some interpreted data layers (e.g., coastsal erosion, non-point, eutrophication) are needed for nearshore and not generally applicable to offshore.

- Existing human use layer provides useful information for managers whether used in classification or not.

- Classification involves a broad suite of ways to describe an area. Ecosystem services are the interpretation of that classification – it's not part of it. The "service" is the value we put on that place. We need to take this next step and ask the "so what" question of our habitats. What ecosystem service are they providing? This should be a separate analysis map.

CONCLUSIONS AND RECOMMENDATIONS

(1) Develop a "how-to" guide for seafloor mapping

Sections may include:

- Data – what base info available/accessible/does not exist; cost of data acquisition
- Protocols for addressing uncertainty and assessing confidence and accuracy
- Commonly-agreed upon attributes for basemaps and additional layers
- Established steps of habitat mapping and clarity on what each product is and what it is not (a- seabed characterization/surficial geology, b- habitat mapping, c- mapping processes, functionality and vulnerability)
- Methods to include human uses and cumulative impacts (as both are not accounted for in any current classification schemes)

(2) Promote outreach and education to end users

- Identify users of data and develop effective ways/key messages to share information with end users (fisheries habitat managers, high level managers, decision-makers, fisheries resources managers, politicians/secretaries).

- Promote an understanding of mapping images/concepts of what maps are/n't/limitations, establishing comfort with scale and uncertainty,

- Support GOMMI training workshops with managers to promote appropriate use of seafloor and habitat maps. These include:

    - Discussion of management implications of analysis of a Cashes Ledge multibeam study; exploring what types of inferences you can make (informs MPA and fish mgmt) (Winter 2008)

    - Discussion of management opportunities for the invasive tunicate, *Didendum*, (Spring 2009)

(3) Broaden expertise involved in mapping discussions

- Include trained benthic ecologists
- Include ocean planning experts to assess compatibility/suitability between human uses and habitats
- Involve communications experts to serve or to instruct others to serve in liaison role between researchers, mappers, managers and decision-makers.

(4) Coordinate and communicate as a region on on-going efforts

- National Fish Habitat Action Plan plans to develop marine classification scheme by 2010
- Track discussions surrounding CMECS as the FGDC standard in the US
- Share lessons-learned on pilot projects to inform discussion on need for regional unified classification scheme

Appendix A. Workshop Participants

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