WORKSHOP SUMMARY

GIS Tools Supporting Ecosystem Approaches to Management

NOAA Fisheries
NOS/NCCOS Center for Coastal Monitoring and Assessment

NOAA National Ocean Service

NOAA Fisheries

Charleston, South Carolina   September 8-10, 2004

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Acknowledgments

For More Information…

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Executive Summary

The Workshop on GIS Tools Supporting Ecosystem Approaches to Management (EcoGIS Workshop) was held September 8-10 at the NOAA Coastal Services Center in Charleston, S.C. Forty-eight people attended representing a variety of organizations, including NOAA Fisheries (NMFS); NOAA National Ocean Service (NOS); NOAA National Coastal Data Development Center (NCDDC); the New England, Mid-Atlantic, South Atlantic, and Pacific Fishery Management Councils (FMCs); Duke University, and The Nature Conservancy.

The purpose of the workshop was to define the spatial analyses and decision support tools needed by the scientists and managers implementing the four Ecosystem Pilot Projects on the Atlantic Coast and Gulf of Mexico. Through presentations and discussion sessions, the input of all participants was used to define an initial conceptual view of the needs of scientists and managers, and in developing priorities for the EcoGIS project.

The requirements for Geographic Information System (GIS) tools compiled in the workshop ranged from simple map-based queries to complex ecosystem modeling. Examples of important questions were: Given changes in regulations or environmental conditions, what is the effect of displaced fishing activity on habitat, species, fishing communities, etc.? Where and under what circumstances is bycatch occurring, and what strategies might reduce it? How should ecosystem boundaries be delineated?

Data management coordination was also a major topic of the workshop. Because of the cross-cutting nature of ecosystem management, contributions of data will come from dozens of federal, state, private, and academic sources. To make these data more accessible and up-to-date, the workshop participants agreed to coordinate with existing data sharing efforts led by the NOAA GIS Committee, GeoSpatial One Stop, and observing system architectures.

The next step is the formation of a steering committee to guide development of the EcoGIS project. In conjunction with the steering committee and through face-to-face meetings with individual project partners, NMFS and NOS staff will define the scope of the project, develop a detailed project plan, flesh out the initial GIS tool requirements compiled in the workshop, assess data needs, and inventory and evaluate existing data sources.

Presentations and other materials from the workshop, including this summary, can be accessed online at http://www.st.nmfs.gov/EcoGIS. This web site will be expanded to include background information and the latest news about the EcoGIS project, project plans, and links to the developments of the Ecosystem Pilot projects.

Background and Rationale

A GIS is a key element in the development of "place-based" ecosystem approaches to fisheries management. In order to evaluate species interactions, habitat associations and bycatch issues, fishery managers rely on tools that can handle these multiple dimensions in a geographically explicit framework. Furthermore, GIS software allows for visual representation of important ecosystem attributes in map form, which is necessary for effective public communication and decision-making.

NOAA has launched a series of pilot projects to develop fishery ecosystem plans for each of four Fishery Management Councils on the East Coast. These pilots are being supported by a parallel-funded project with NOS to more fully develop GIS approaches for managing and researching marine fishery ecosystems.

To explore the state-of-the-art and future requirements for GIS tools supporting ecosystem approaches to fishery management, NMFS and NOS hosted the EcoGIS workshop at the NOAA Coastal Services Center in Charleston, South Carolina, on September 8-10, 2004.

The goals of this workshop were to:

• Increase awareness and demonstrate the capabilities of ecosystem-based fishery management and how spatial data and geoprocessing techniques can be used support these efforts.

• Understand the priority issues facing fishery managers and scientists in developing and implementing ecosystem-based fishery management plans.

• Develop requirements for GIS tools to support the needs of fishery managers and scientists, and ensure that these requirements are broad enough to serve all regions of the country.

• Provide clear guidance for the joint NMFS/NOS GIS tool development project.

Workshop contributors were invited from a broad range of functional areas, such as GIS and Information Technology experts, fishery scientists and managers, and ecosystem researchers; from a broad range of organizations such as Fishery Management Councils, non-federal agencies, and multiple line offices within NOAA; and from all regions of the country.

Summary of the Workshop Process

The workshop consisted of two components. The first was a series of formal demonstrations and presentations and an informal poster session from NMFS, NOS, and non-federal scientists and managers demonstrating GIS functionality and applications appropriate to ecosystem approaches to management. These presentations covered fishery-based GIS applications and novel approaches from allied fields. The second was a breakout session to identify fruitful extensions of current approaches and modeling and information needed to make GIS tools supporting ecosystem approaches more applicable for science and management.

Each session followed with discussions among all workshop participants. For Session 5, the participants broke out into four groups that engaged in focused discussions and prioritization of needs.

Session 1: Wednesday, Sep. 8 – Morning. Applications of GIS Supporting Ecosystem Approaches to Management.

Session 2: Wednesday, Sep. 8 – Afternoon. Management Needs.

Session 3: Thursday, Sep. 9 – Morning. Data Availability and Data Gaps.

Session 4: Thursday, Sep. 9 – Afternoon. Science Needs.

Session 5: Friday, Sep. 10 – Morning. Workshop Wrap-up and Feedback.

Please see the following sections for a summary of the Management Needs, Data Availability and Gaps, and Science Needs sessions.

Session 2: Management Needs

The objective of the Management Needs Session was to explore priority issues facing regional FMCs. Major tasks of all FMCs include the development and implementation of Fishery Management Plans (FMPs), the designation of Essential Fish Habitat (EFH), and coordination with other management entities. Representatives from four Fishery Management Councils (South Atlantic, New England, Mid-Atlantic, and Pacific) described FMPs under their management and the contrast between single-species and ecosystem management. Each council representative described the type of decision-making that is done with available information and what information is needed.

Representatives from the Fishery Management Councils were: **Gregg Waugh** and **Roger Pugliese** from the South Atlantic FMC, **Chad Demarest** from the New England FMC, **Tom Hoff** from the Mid-Atlantic FMC, and **Kit Dahl** from the Pacific FMC.

Major points that came out of the presentations and discussions in this session included:

GIS Tool and Data Needs Vary: Managers' needs ranged from basic GIS capabilities and spatial layers to more advanced needs such as tools for importing habitat data into ecosystem models. The variety of data needs reflect these differences.

Fishing Displacement: Managers expressed the need to predict the biological, socio-economic, and physical effects resulting from regulatory changes that cause fishing effort displacement. A related need is the ability to evaluate the effectiveness of a managed area.

Area Characterization: Managers have a need to define an area for regulatory or project consultation purposes and to characterize that area in terms of EFH, Habitat Areas of Particular Concern (HAPCs), critical habitat, gear impacts on habitat, and species life stage distribution.

Bycatch Analysis: Managers have the need to develop better methods for monitoring and reducing bycatch. This includes the ability to analyze fishing activity by gear type, amount of fishing effort, and bycatch species composition, as well as the ecology of targeted and non-targeted species.

Coordination: Because of the cross-cutting nature of ecosystem management, it is important to coordinate the GIS activities initiated by the numerous agencies and stakeholders involved in the EcoGIS project. An EcoGIS steering committee will be formed to foster this coordination.

Session 3: Data Availability and Gaps

The objective of the Data Availability and Gaps Session was to identify where richness of data may provide opportunities for developing GIS tools and, conversely, where sparseness of data might limit the ability to expand those tools to a wider geographic area and scope of problems solved.

Presenters listed and described spatial data collected and maintained by their agency or working group, including fishery-dependent and -independent data, socio-economic data, ecosystem observations, habitat maps, and physical and navigational features. Data gaps and data quality issues experienced by the Pacific Coast Groundfish EFH project were presented, and project collaboration tools, metadata tools, and data delivery services were discussed.

The following major issues were raised in the Data Availability and Gaps Session:

Coordination and Data Management Strategy: The South Atlantic FMC has developed a web site that contains over 90 thematic layers of historic and current information, incorporating data from federal, state, and private sources. Gathering these data layers for the other FMCs will likely involve a similar level of coordination and collaboration on a data management strategy.

Data Sharing, Availability, and Currentness: Workshop participants expressed the needs to have better access to well-documented and up-to-date spatial data. There was general agreement that data standards, protocols, and storage and delivery issues should be coordinated with existing efforts by the NOAA GIS Committee, Federal Geographic Data Committee (FGDC), Geospatial One Stop, and observing system architectures.

Geographic Focus Areas: Data rich areas allow models and analyses to be run using data with varying spatial resolutions. This information can be used to evaluate the robustness of these scaling methods and can provide justification for additional data collection support.

Data Scoping and Quality Assessment: Once the scope of the EcoGIS project is defined, the next key task will be to determine the spatial data required to meet science and management needs, to inventory existing data, and to evaluate the spatial extent, resolution, and quality of these data sets. This information will be important for assessing the applicability of existing data for ecosystem management. Table 1 provides a list of data sets mentioned by workshop participants during presentations and discussions. Not all of these data sets are currently available.

Table 1: Data sets mentioned in the Workshop. This list is intended to illustrate the breadth of information that may be needed as inputs for GIS tools.

Biological data	
Larval, juvenile, and adult life stages	Protected resources distribution and migration
Benthic composition	Protected species strandings
Spatial presence within water column	Age, weight, length, sex
Species & stock distribution data from scientific surveys (state and federal)	
Fishing activity	
Commercial catch and effort over time	Fishing vessel patterns
Recreational catch and effort over time	Vessel Monitoring System (VMS) tracks
Observer data	Vessel registration
Physical	
Shoreline	Acoustic Backscatter
Bathymetry	Surficial Geology
Oceanographic data	
Temperature, Dissolved Oxygen, Salinity	Larval transport
Upwelling	Current dynamics
Habitat	
Sediment type	Coral
HAPCs	EFH
Submerged Aquatic Vegetation (SAV) beds	MODIS satellite imagery for detection of Sargassum
Food web	
Geographic / seasonal information on predator-prey interactions	Secondary producers
Location of phyto- and zooplankton blooms (primary production)	
Designated areas	
Fishery management areas	Jurisdictional / political boundaries
Marine Sanctuaries	
Non-fishing activities	
All fluid discharge sites	Concentrations of non-point source discharges
All watersheds	Locations of other activities that affect the marine environment
Non-fluid disposal sites	Shipping lanes
Water transportation facilities and patterns	Valuable cultural sites
Survey of commercial "hangdowns"	Beach renourishment projects
Socioeconomic	
Location of fishing communities	Market distribution system
Economic dependence on fishing activities (including non-consumptive uses)	Areas where stakeholders reside
Location of major support infrastructure	Population areas
	Coastal development

Session 4: Science Needs

The objective of the Science Needs session was to address scientists' priority issues to provide clear guidance in developing requirements for GIS tools to support ecosystem-based management. This session surveyed the spatial tools and analyses that are needed by living marine resource scientists to understand the function of individual components within an ecosystem and to understand the interactions between components.

Topics of discussion included habitat characterization, species interactions, spatio-temporal models, frameworks for utilizing ecological models for management, and scientific data gaps. One overall conclusion of the Science Needs session was that the design of tools and spatial analyses should be as transparent as possible – methodologies used in processing data should be well documented. In addition, the discussion recognized that GIS training would be an important factor in successfully implementing the tools and analyses.

The major points that were developed at this session included:

Incorporate a wide variety of spatial data to make an ecosystem-based GIS: The development of an ecosystem GIS needs to include an assessment of the data that are currently available, the level of detail (*i.e.*, scale and resolution) of these data, and an understanding of how to deal with the uncertainty and patchiness of data.

Adapt traditional science and management-based models to a spatial framework: Ecosystem GIS should incorporate trophic web models, population dynamics (including life stages), movement patterns, migration rates and fisheries models.

Define ecologically relevant boundaries: Knowledge of the ecosystem (*i.e.*, benthic habitat, oceanographic processes, species interactions, and life history) should be applied to define ecologically relevant boundaries. Additionally, the relationship between ecologically relevant boundaries and jurisdictional boundaries needs to be defined. Because boundaries are rarely fixed in the ocean, shifts in ecological boundaries must be accommodated.

Use GIS to evaluate management plans and make predictions: The ecosystem GIS framework should include performance assessments and forecasting capabilities to compare alternative management strategies.

Expand the boundaries of traditional GIS: Ecosystem GIS users need to expand conventional GIS applications to include multiple dimensions (3D and time), dynamic behavior (movement), and temporal lags.

The Way Forward

Workshop participants identified a broad range of scientific and management questions that could be answered using GIS tools. This summary document has highlighted some of the more prominent questions posed, such as predicting fishing displacement, depiction of temporal data, and support for ecosystem models, but additional feedback and details on these capabilities are needed from project partners.

A steering committee will be formed to refine these requirements, to provide general guidance to the EcoGIS project, and to coordinate data management activities. In addition, NMFS and NOS staff will meet face-to-face with staff at the FMCs, NMFS, NOS, academic institutions, and other interested parties. These meetings will introduce the EcoGIS project to a wider audience, provide a focused opportunity to document the spatial analysis and GIS tool needs of each agency, and establish data sharing contacts.

Based on defined data needs, NMFS and NOS staff, in conjunction with project partners, will conduct an inventory of available data and evaluate the spatial coverage, resolution, and quality of these data. This process will provide information on geographic areas that will serve as test beds for the development of GIS tools. NOS staff will develop GIS tools and integrate primary data sets to address the priority questions. Training will be provided on use of the tools.

Regular communication between project partners will be important in relaying plans and progress and for facilitating the discussion of issues. This will be accomplished via a public web page and an email list or discussion forum.

With an eye toward the future, NMFS and NOS staff will write a plan for the development of advanced tools that are beyond the initial scope of the EcoGIS project. This plan will describe the questions to be addressed, data needs, and the costs for tool and data development.

Ecosystem approaches to management will be implemented in an evolutionary, not revolutionary, manner. As resource management agencies move incrementally from single-species management to more comprehensive approaches, GIS will no doubt be used increasingly as a tool for mapping and modeling ecosystems: the system of organisms (including humans), the environment, and the processes that control its dynamics.

The EcoGIS project will strive to establish the spatial data management infrastructure and develop the GIS tools needed to advance the evolution of ecosystem approaches to management.

APPENDIX A

PRESENTATION ABSTRACTS

Introduction & Overview:
The Challenges of Managing Marine Resources in 5 Dimensions

Steven Murawski
Project Manager, Ecosystem Pilot Projects
NOAA-Fisheries, Office of Science and Technology

Abstract

The traditional paradigm for managing living marine resources is to index a species or species group over time, and adjust management measures until the trajectory and or level of stock abundance achieves some societal benchmark of success. This paradigm operated well for any number of fisheries and protected species management issues, and was the operating model for diverse issues including pollution abatement, eutrophication and other challenges of resource management in the coastal zone. Increasingly, managers are employing zoning of coastal ecosystems, which limits certain activities by place and time. Thus, for example, fishery closed areas are used on a seasonal or annual basis to restrict certain or all fishing activities, to improve conservation of target species, limit bycatch or to protect vulnerable habitat types. Space is not only two-dimensional (e.g., bottom habitats) since important ecological processes and interactions among components occur in the water column. The incorporation of ecosystem-level considerations into the management of living resources implies that feedback interactions between components such as effects of marine mammal predation on prey species, competition among fish and invertebrates for food, and habitat-modifying effects of various human activities, have assumed a higher profile in decision making. Accounting for these five dimensions: time, three dimensional space, and interactions/feedbacks between components, is the primary challenge for ecosystem science to inform management. The design of quantitative tools for assessing the status of resources, their distributions and interactions is a necessary component supporting ecosystem-based management. Visualizing and providing benefit/cost assessments of management alternatives considering these five dimensions is a unique challenge that can be met by developing the next generation of GIS applications.

Session 1

Applications of GIS Supporting Ecosystem Approaches to Management

Biogeographic Assessments: The Integration of Ecology and GIS to Support Fishery Science and Management

Mark E. Monaco –   NOS Biogeography Program Manager (presenter)
John D. Christensen – NOS Marine Biologist
David M. Nelson –   NOS Marine Biologist

National Centers for Coastal Ocean Science-Center for Coastal Monitoring & Assessments

Abstract

The National Centers for Coastal Ocean Science/Center for Coastal Monitoring and Assessment's Biogeography Program develops information and analytical capabilities through research and assessments on the distribution and ecology of living marine resources and their associated habitats for improved ecosystem management. The foundation of the program is based upon a biogeographic assessment process that defines the distribution of habitats, species distributions, and the coupling of species to habitats. The presentation will provide case examples of GIS-based applications to define species habitat utilization patterns and define ecologically relevant management boundaries (e.g., MPAs). The work is underway in marine, coastal, estuarine, and coral reef ecosystems and digital map products are developed from the integration of ecology and GIS technology based on the principles of biogeography. Results from estuarine assessments to define essential fish habitat (EFH), marine analyses to evaluate existing MPA boundaries, and research to define reef fish habitat utilization patterns will be presented to demonstrate the use of GIS technology. Example outputs from GIS desktop applications will be shown and the success and challenges of developing ecological GIS tools will be discussed.

Assessing Risk to the Essential Fish Habitat of West Coast Groundfish

Stephen Copps (presenter)
Senior Policy Analyst
NMFS Northwest Region

Graeme Parkes
Marine Resources Assessment Group

Allison Bailey
Senior GIS Analyst
TerraLogic GIS

Mary Yoklavich
Habitat Ecology Team Lead
NMFS Southwest Fisheries Science Center, Santa Cruz Laboratory

Waldo Wakefield
Habitat Conservation and Engineering Team Lead
NMFS Northwest Fisheries Science Center, Fishery Resource Analysis and
Monitoring Division

Abstract

Assessment of essential fish habitat for groundfishes off the U.S. west coast has required a unique collaboration of experts from a variety of disciplines and presents an useful case study for migrating to an ecosystem-based approach. The assessment follows a decision-making framework that integrates detailed information on geologic and biologic substratum types, bathymetry, latitude, data quality, fish ecology, and anthropogenic risk factors together in an interpretive bayesian network model with GIS outputs. The assessment is designed to identify and profile the distribution and relative health of essential fish habitat and its associated risks from anthropogenic impacts to determine if policy intervention is desirable. While the scope of the assessment is limited to groundfish habitat and associated impacts, the decisionmaking framework lends itself to expansion for consideration of other ecosystem components. Due in large part to the scale of the study (the U.S. Exclusive Economic Zone from Canada to Mexico) and the broad range of relevant information, important challenges have arisen in stitching together and interpreting datasets of varying quality, content, and volume. The study has been guided by the Pacific Fishery Management Council (Council) under the mandate of the Magnuson-Stevens Fishery Conservation Act. This presentation will focus on the challenges of large-scale assessment and provide a brief overview of how the Council has applied the information in a policy setting.

Using an Interdisciplinary GIS Approach to Support Marine Ecosystem Management at the Fish and Wildlife Research Institute, Florida

Henry Norris
Program Administrator
Florida Fish and Wildlife Conservation Commission – Fish and Wildlife Research Institute

Abstract

The Fish and Wildlife Research Institute, formerly the Florida Marine Research Institute, employs GIS and mapping technologies to acquire, analyze, and serve spatially referenced information to support ecosystem management. FWRI is currently engaged in four management-relevant projects that illustrate the complexity and interdisciplinary nature of GIS work designed to support ecosystem management:

1) Broward County benthic habitat mapping; using LIDAR and acoustic sensors to capture accurate and detailed information showing the location, distribution, and condition of habitat for use in maps and models to better manage and protect these habitats

2) Human-use characterization across Tampa Bay; developing techniques to describe use patterns and preferences of the boating community to more effectively plan for growth in boating-associated coastal development while conserving our natural resources

3) Fish modeling in Charlotte Harbor; using fisheries-independent monitoring data, habitat layers, and landscape metrics to describe the distribution and relative abundance of both fish communities and individual species across an estuary to identify areas for possible conservation

4) Internet Map Service development; building Internet tools for the South Atlantic Fisheries Management Council to serve data and information products specific to Essential Fish Habitat.

These four projects call for the expertise of oceanographers, remote sensors, biostatisticians, benthic and landscape ecologists, fisheries and invertebrate biologists, geographers, economists, programmers, GIS analysts, and even Web designers. The complexities of ecosystem management require the involvement of many disciplines. To bring all this expertise to bear on the issue, FWRI is working to build in-house expertise and outside partnerships.

Ecosystem-based Regional Marine Conservation Planning: The Nature Conservancy's Approach to Ecoregional Assessments in the Marine Environment

Dan Dorfman (presenter)
Senior Marine Conservation Planner
The Nature Conservancy - Global Marine Initiative

Mike Beck
Senior Scientist
The Nature Conservancy - Global Marine Initiative

Abstract

The Nature Conservancy is working with government agencies, marine stakeholders, communities, and others to develop ecoregional assessments that support decisions and actions for marine conservation and management. The ecoregional assessment process encourages the participation and support of all local stakeholders, from governments to conservationists, communities and industry, to lay the foundation for a shared vision for regional ecosystem management. These assessments are based on a consistent process which is sufficiently robust for comparable purposes yet flexible enough to meet the needs of local partners and stakeholders. Each ecoregional assessment is based on establishing a specific list of conservation targets (species and ecosystems) and the creation of an information resource which integrates available data on the spatial distribution of each target, or in some cases modeled surrogates. Targets are then represented in a decision making platform which enables us to balance ecologically driven goals against threats, opportunities, and stakeholder input to enable an ecosystem-based management framework. TNC typically employs decision support software such as Marxan and a comprehensive spatial information resource such as a Marine Geodatabase to develop a vision for successful stewardship of natural resources. By building distributable information resources and providing an integrated view of ecological objectives and threats assessment, the ecoregional assessment process supports the adoption of an ecosystem-based management perspective by resource management agencies and stake-holders. The process can be used to identify a set of priority areas for focusing management attention such as a network of sites or it can be used to support individual decisions made within the context of a broader ecosystem.

GIS-based Visualizations In Support of Fisheries Research and Ecosystem Management

Christopher Moore (presenter)
Univ. of Washington/NOAA Pacific Marine Environmental Lab

Tiffany Vance
NOAA Fisheries Alaska Fisheries Science Center (AFSC)

Nazila Merati
NOAA Pacific Marine Environmental Lab

Abstract

A variety of visualization and analysis techniques can be used to enhance GIS contributions to fisheries research. VRML provides a simple way to create visualizations that the user can interact with. Tools in ArcGIS such as 3D Analyst and ArcScene can generate VRML views of ArcMap scenes. ArcGlobe can be use to create animations, but cannot produce VRML output. ArcIMS sites can be enhanced by the use of tools that allow Java-based intra and inter-layer calculations. These allow users to create new layers dynamically, based upon scenarios and criteria. Java3D and Java-wrapped VTK provide enhanced visualization capabilities. ArcGIS Engine can be used to integrate Java tools and Java3D with the core GIS functionality of ArcGIS. Demonstrations of the integration of advanced 3D stereo rendering and analysis within a GIS application will be shown on a low-cost stereo projection system known as a Geowall.

Session 3

Data Availability and Data Gaps

GIS Data for Research to Support Ecosystem-based Management - SEFSC

Steven Wong
Physical Scientist
NOAA Fisheries Southeast Fisheries Science Center (SEFSC)

Abstract

Research to support ecosystem-based management calls for availability of spatial data related to fisheries, protected species, and environmental variables. SEFSC staff has been collecting datasets in the southeast region that are both fisheries-dependent and fisheries-independent. Descriptions will be given on selected datasets, as well as GIS tools used by researchers. An attempt will be made to identify the gaps in GIS data and tools for effectively conducting research for the purpose of ecosystem-based management.

The Need For Improved GIS Capabilities and an Overview of NEFSC Data on Fish Distribution, Hydrography and Seabed Habitat

Dr. Thomas Noji, Division Chief (presenter)
Steven Fromm, IT Specialist
Suellen Fromm, IT Specialist
John Manderson, Fisheries Research Biologist

Northeast Fisheries Science Center, Howard Marine Lab, Sandy Hook, NJ.

Abstract

The Northeast Fisheries Science Center possesses extensive databases with data on seasonal fish distribution by life-history stage, seabed characteristics including surficial geology and benthic fauna, plankton and hydrography. In order to facilitate current research on habitat-dependent fish recruitment, as well as to address other habitat-related issues such as the protection of cold-water corals and the spread of invasive species, it is important to further develop (or replace) our current GIS to include hydrographic and seabed data, as well as information on relevant human activities such as current and planned trawl effort and petroleum activities.

GIS Activities within the National Ocean Service

Tony LaVoi
Acting Deputy Branch Chief, Coastal Information Services
NOAA Coastal Services Center

Abstract

This presentation will focus on selected geospatial activities within the National Ocean Service and specifically at the Coastal Services Center. We will highlight key spatial data sets created and maintained by NOS, along with applications, tutorials, and other resources available to users of this information.

Data Management at NCDDC

Sharon Mesick
Deputy Chief Scientist
National Coastal Data Development Center

Abstract

The National Coastal Data Development Center is NOAA's newest data center, providing Internet based discovery, display and delivery of coastal data from distributed sources. This presentation will focus on NCDDC's information technology infrastructure, which facilitates remote access to data collections maintained by a variety of Federal, State, Academic, and other organizations. Data collected and maintained by NCDDC for eco-system based management within the Gulf of Mexico, in collaboration with NMFS offices, will also be presented.

Data Gaps in the Risk Assessment for West Coast Groundfish EFH

W. Waldo Wakefield
Habitat Conservation and Engineering Team Lead
NMFS Northwest Fisheries Science Center, Fishery Resource Analysis and
Monitoring Division

Abstract

The process of developing the Essential Fish Habitat Environmental Impact
Statement has been constructive in identifying gaps in the information available
for a comprehensive risk assessment for West Coast groundfish EFH. This is
the first time a comprehensive, coast-wide assessment of EFH has been
undertaken, at the current level of detail, for the West Coast. The West Coast
assessment has required the compilation of new datasets, the use of existing
datasets for purposes other than those for which they were originally intended,
and the development of novel assessment techniques. As a result, the process
of developing a risk assessment has revealed many and sometimes substantial
gaps in our knowledge – gaps that in some cases are impossible to fill in the
required time frame. The identification and assessment of data gaps could be
considered an important product of the research effort to date, and is one that
should feed directly into the development of management alternatives. A
summary of data gaps will be presented along with a discussion of the
implications and ways in which at least some of the information could be
obtained.

Session 4

Science Needs

Spatial Analysis Needs for Marine Ecosystem Management: Habitat Characterization, Spatio-temporal Models and Connectivity Analysis Frameworks

Patrick N. Halpin
Director, Geospatial Analysis Program
Nicholas School of the Environment and Earth Sciences, Duke University

Abstract

Ecosystem management in the marine environment is an especially challenging endeavor due to the enormity of marine management areas, relative sparseness of marine observation data and the highly dynamic nature of the ocean environment. Strategic development of new spatial analysis tools is needed to provide a more robust framework for analysis in this challenging environment. In this overview, I present three areas of scientific needs and example tools now under development to meet these needs. The three general areas of interest are: habitat characterization, spatio-temporal models and connectivity analysis frameworks. To address issues of habitat characterization, I present examples of benthic complexity model development as a surrogate spatial data analysis when habitat observation data is unavailable. In the second example I provide examples of the development and tuning of spatio-temporal habitat models in dynamic marine environments. In the third example, I provide examples of connectivity models, using network analysis in marine planning applications. These example applications are provided to illustrate the range of different spatial analysis tools that will be required to meet future needs for marine ecosystem scientists and managers.

Beyond Maps: Using GIS to Identify Models and Evaluate Trade-offs in Fisheries Science

Paul Rago, Steven Murawski, Susan Wigley, and Charles Keith
NMFS Northeast Fisheries Science Center

Abstract

Much of fisheries science deals with the analysis of spatially-distributed resources harvested by mobile fleets. Seasonal movements of fishery resources and targeting of fishing effort on localized abundance concentrations are well-known features of fisheries. The spatial aspects of fisheries induce heterogeneity in the relationship between fishing effort and fishing mortality, and may have important biological implications for stock productivity. Yet these considerations infrequently enter models to estimate abundance or to evaluate the efficacy of alternative harvesting policies. GIS methods can be used to improve the realism of population models and also to evaluate trade-offs inherent in any fishery policy. One of the most difficult aspects is the identification of the appropriate level of spatial and temporal resolution. The appropriate resolution must not only address the salient features of the underlying process but also be supported by the available data. Deviations from this norm will result in either interesting dynamic models without data or biased models with overly aggregated data. GIS models can also be used to develop static models illustrating tradeoffs among competing objectives. Simultaneous maximization of yield, reduction of bycatch, and minimization of habitat impacts are not possible. Appropriate use of GIS methods can be used to evaluate the consequences of alternative spatial patterns of harvest that can be robust to alternative weightings of competing objectives. Example cases of model improvements and trade-offs, drawn from analysis of scallop and groundfish fisheries in the Northeast, will be used to illustrate potential improvements to existing methods.

Dolphinfish in the Western Atlantic—an Ecosystem Based Case Study

Kristin Kleisner (presenter)
University of Miami, RSMAS

Josh Sladek Nowlis
NOAA Fisheries Southeast Fisheries Science Center

Abstract

Dolphinfish (Coryphaena hippurus) are the basis of an important fishery in the western central Atlantic (the wider Caribbean basin). This fishery presents management challenges in that information about the population is uncertain and management needs span across national and international jurisdictions. Dolphinfish are believed to be highly migratory, seasonally abundant, and to exhibit more complex stock structure than larger oceanic epipelagic species, such as tunas and billfishes. Most of the information about dolphinfish in this region comes from studies in waters of the United States and the eastern Caribbean, yet there is a general paucity of information on which to base species-specific management. No Caribbean government undertakes regular assessments of dolphinfish or has put in place any species-specific management program.

The goal of this project is to identify and explore the implications of broad oceanographic and topographic features that may affect dolphinfish population dynamics. These findings in turn would be helpful in advising management needs for this species. We will pursue this goal by collecting and standardizing catch, landings, and abundance data for dolphinfish from the wider Caribbean basin and analyzing these data against physical and broad scale biological features. Fisheries dependent data will come from a variety of both commercial and recreational sources including US observer longline data (1992-present), the fishery logbook system, the accumulated landings system, carcass weight data, the Trip Interview Program (TIP), the Marine Recreational Fishing Statistical Survey (MRFSS), the For-Hire Survey, and the NOAA fisheries Southeast Headboat Survey (all primarily collected from US-based fleets). Fishery independent data is also available from an NSF sponsored larval billfish cruise. This project is using MOCNESS tows to collect larval trophodynamic data for billfish and other pelagic larvae, including dolphinfish, in the Florida Straits. In addition to the larval samples, CTD data is collected at most sites (temperature, currents, and salinity at various depths to the ocean bottom) as well as chlorophyll data. Dolphinfish are abundant in these samples, and it will be interesting to examine the competition/predator/prey relationship in the larval life history as a comparison to the adult and juvenile stages.

Kleisner and Nowlis, continued

Both fishery-dependent and fishery-independent data will be examined for correlations to corresponding geographic and temporal oceanographic and topographic information. Previous studies of long-term data (1962-1989) in Barbados indicated that such correlations may be important in shaping the timing of the dolphinfish season and possibly recruitment (Mahon, 1990). Oceanographic information that would be needed would include sea surface temperature (SST), currents, upwelling regions, and monthly probabilities of front occurrence. Topographic information includes regional bathymetry and bottom habitat types. With these information sources organized into a GIS framework, we will have the capacity to identify and explore the implications of spatially-explicit broad-scale for dolphinfish and the fisheries this species supports.

Session 5

Workshop Wrap-up and Feedback

EcoGIS: A Proposed GIS to Support Ecosystem Approaches to Fisheries Management in the Atlantic and Gulf of Mexico

David M. Nelson, NOS Marine Biologist (presenter) [1]
Mark E. Monaco, NOS Biogeography Program Manager [1]
Steven Murawski, Project Manager, Ecosystem Pilot Projects [2]
Tim Haverland, GIS Specialist [2]

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Abstract

NOAA is developing a Geographic Information System (EcoGIS) to support ecosystem approaches to fisheries management in the Atlantic and Gulf of Mexico. This project, a team effort of the National Marine Fisheries Service and National Ocean Service, seeks to more fully develop GIS decision support tools both for use by scientists and managers involved in ecosystem aspects of fishery management. Goals for this project include the development of two types of GIS decision support tools - a management level application geared to simple data visualization and summaries, and a scientific assessment tool to support ecosystem modeling. To launch the project, NOAA is hosting a workshop to demonstrate the application of GIS to ecosystem based fisheries management, describe the needs of fisheries management and science, and explore available data and modeling capabilities. The project team will set priorities based on the guidance provided by the results of workshop. In the coming year (FY'05), the team will compile data on marine and estuarine habitats, fishery-dependent and independent surveys, and managerial boundaries to incorporate into ArcGIS. Data will be analyzed and presented, and analytical models developed. Finally, the team will complete an interim report, and extend capabilities to user groups.

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APPENDIX B

AGENDA

Agenda Summary

Session 1: Wednesday, Sep. 8 – Morning
Applications of GIS Supporting Ecosystem Approaches to Management

This session will demonstrate the state of the art on applying GIS to ecosystem management in marine fisheries or in allied fields. Specific attention should be given to actual GIS tools, analyses, or procedures that are in use and the spatially related needs that have arisen through their application to real problems.

Session 2: Wednesday, Sep. 8 – Afternoon
Management Needs

Representatives from the Fishery Management Councils will describe interactions between fishery management plans and any limitations regarding, for example, EFH, trophic interactions, bycatch interactions etc. Each council will point out the type of decision-making that is done with available information, and what information is needed.

Session 3: Thursday, Sep. 9 – Morning
Data Availability and Data Gaps

The purpose of this session is to gauge the richness or sparseness of spatial data relating to the Atlantic Ocean and the Gulf of Mexico, and to learn from the experiences of our Pacific Coast colleagues. Each presenter should provide a description of the spatial data for which their organization has primary responsibility for collecting and maintaining or for which they have special experience in utilizing for ecosystem-based management. Also of interest in this session are notable gaps in spatial data that may hinder ecosystem-based approaches to management.

Session 4: Thursday, Sep. 9 – Afternoon
Science Needs

The Science Needs session will survey the spatial analyses or tools that living marine resource scientists need to understand individual components of an ecosystem and how those components interact. Topics of discussion may include but are not limited to delineation of ecosystem boundaries, characterizing species distribution and abundance, spatial variation in food webs, ecosystem model choice and spatial data or analysis requirements, analytical framework development, etc.

Session 5: Friday, Sep. 10 – Morning
Workshop Wrap-up and Feedback

A summary of the needs recorded during the workshop will be presented along with a plan for moving forward. The needs and plans will be discussed in breakout sessions. Feedback will be essential for guiding the joint NOAA Fisheries/NOS project to develop GIS tools supporting the Ecosystem Pilot Projects.

Session 1: Wednesday, Sep. 8 – Morning

8:00 am   **Coffee and continental breakfast**

8:30 am   **Welcome to Participants**
Margaret Davidson, Director, NOAA Coastal Services Center

8:40 am   **Introduction & Overview: The Challenges of Managing Marine Resources in 5 Dimensions**
Steve Murawski, Project Manager, Ecosystem Pilot Projects
NOAA-Fisheries, Office of Science and Technology

Applications of GIS Supporting Ecosystem Approaches to Management

9:00 am   **Biogeographic Assessments: The Integration of Ecology and GIS to Support Fishery Science and Management**
Mark E. Monaco, NOS Biogeography Program Manager (presenter)
John D. Christensen, NOS Marine Biologist
David M. Nelson, NOS Marine Biologist

National Centers for Coastal Ocean Science-Center for Coastal Monitoring & Assessments

9:30 am   **Assessing Risk to the Essential Fish Habitat of West Coast Groundfish**
Stephen Copps, Senior Policy Analyst (presenter)
NMFS Northwest Region

Graeme Parkes
Marine Resources Assessment Group

Allison Bailey, Senior GIS Analyst
TerraLogic GIS

Mary Yoklavich, Habitat Ecology Team Lead
NMFS Southwest Fisheries Science Center, Santa Cruz Laboratory

Waldo Wakefield, Habitat Conservation and Engineering Team
*   Lead*
NMFS Northwest Fisheries Science Center, Fishery Resource Analysis and Monitoring Division

10:00 am   Break

10:15 am   **Using an Interdisciplinary GIS Approach to Support Marine Ecosystem Management at the Fish and Wildlife Research Institute, Florida (Cancelled due to Hurricane Frances)**
Henry Norris, Program Administrator, Florida Fish and Wildlife Conservation Commission – Fish and Wildlife Research Institute

10:45 am   **Ecosystem-based Regional Marine Conservation Planning: The Nature Conservancy's Approach to Ecoregional Assessments in the Marine Environment**
Dan Dorfman, Senior Marine Conservation Planner (presenter)
Mike Beck, Senior Scientist
The Nature Conservancy - Global Marine Initiative

11:15 am   **GIS-based Visualizations In Support of Fisheries Research and Ecosystem Management (Cancelled due to Hurricane Frances)**
Christopher Moore (presenter)[1], Tiffany Vance[2], and Nazila Merati[3]

[1]Univ. of Washington/NOAA Pacific Marine Environmental Lab
[2]NOAA Fisheries Alaska Fisheries Science Center (AFSC)
[3]NOAA Pacific Marine Environmental Lab

12:00 pm   **Lunch, poster session, and interactive computer demonstrations**

Session 2: Wednesday, Sep. 8 – Afternoon

Management Needs

2:00 pm   **Presentations from Fishery Management Councils**

Gregg Waugh and Roger Pugliese, South Atlantic Fishery
      Management Council
Chad Demarest, New England Fishery Management Council
Dr. Tom Hoff, Mid-Atlantic Fishery Management Council

3:00 pm   **Questions for panelists and discussion of management needs**

Questions to spark spatial thinking:

- What spatial data, analyses, and mapping capabilities do FMCs need in order to manage fisheries from an ecosystem perspective?

- If you could design the ultimate map to communicate your management decisions or fishery ecosystem plans to stakeholders, what would the map contain?

- How do council staff and your stakeholders use maps (hang them on walls, carry them to meetings, draw on them, email them, interact with them online)?

- How would you evaluate the performance of a fishery ecosystem plan?

- What issues does your Council have regarding EFH, trophic interactions, bycatch interactions etc? What spatial tools do you need to resolve these issues?

- What are the top 10 requests you get for spatial data or analyses?

4:30 pm   **Wrap-up and summary of management needs**

5:00 pm   Adjourn

Session 3: Thursday, Sep. 9 – Morning

8:00 am   **Coffee and continental breakfast**

Available Data and Data Gaps

8:30 am   **GIS Data for Research to Support Ecosystem-based Management - SEFSC**
Steve Wong, NOAA Fisheries Southeast Fishery Science Center

9:00 am   **The Need For Improved GIS Capabilities and an Overview of NEFSC Data on Fish Distribution, Hydrography and Seabed Habitat**
Dr. Thomas Noji, Division Chief (presenter)
Steven Fromm, IT Specialist
Suellen Fromm, IT Specialist
John Manderson, Fisheries Research Biologist

Northeast Fisheries Science Center, Howard Marine Lab, Sandy Hook, NJ

9:30 am   **GIS Activities within the National Ocean Service**
Tony LaVoi, Acting Deputy Branch Chief
Coastal Information Services

10:00 am   Break

10:15 am   **Data Management at NCDDC**
Sharon Mesick, Deputy Chief Scientist
NOAA National Coastal Data Development Center

10:45 am   **Data Gaps in the Risk Assessment for West Coast Groundfish EFH**
Waldo Wakefield, Habitat Conservation and Engineering Team Lead
NOAA Fisheries Northwest Fisheries Science Center

11:15 am   **Discussion of Data Presentations**

11:45 am   Lunch

Session 4: Thursday, Sep. 9 – Afternoon

Science Needs

1:00 pm **Spatial Analysis Needs for Marine Ecosystem Management: Habitat Characterization, Spatio-temporal Models and Connectivity Analysis Frameworks**
Pat Halpin, Director, Geospatial Analysis Program
Nicholas School of the Environment and Earth Sciences, Duke University

1:30 pm **Beyond Maps: Using GIS to Identify Models and Evaluate Trade-offs in Fisheries Science**
Paul Rago (presenter), Steven Murawski, Susan Wigley, and Charles Keith
NMFS Northeast Fisheries Science Center

2:00 pm **Dolphinfish in the Western Atlantic—an Ecosystem Based Case Study**
Kristen Kleisner[1] (presenter) and Joshua Sladek Nowlis[2]

[1]University of Miami, RSMAS
[2]NOAA Fisheries Southeast Fisheries Science Center

2:30 pm **Break**

2:45 pm **Questions for scientists and discussion of science needs**

4:30 pm **Wrap-up and summary of science needs**

5:00 pm **Adjourn**

6:30 pm **Evening dinner/social – "Low Country Boil" at James Island County Park. Caravan leaves the Double Tree Guest Suites at 6:15 pm.**

Session 5: Friday, Sep. 10 – Morning

8:00 am   **Coffee and continental breakfast**

8:30 am   **Presentation on "straw man" GIS framework proposed and developed to date, and a summary of workshop recommendations**

9:00 am   **Breakout group discussions to get feedback on compiled needs and proposed project**

10:30 am   Break

10:45 am   **Presentation of feedback to larger group**

11:15 am   **Summary, wrap-up, the way forward**

Noon   Adjourn

APPENDIX C

PARTICIPANT LIST

Workshop on GIS Tools Supporting Ecosystem Approaches to Management

Participant List

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