Biological and Physical Mapping of the Shoreline In the Exxon Valdez Oil Spill Area, Alaska

Workshop Summary and Recommendations

March 20-21, 2003

Exxon Valdez Oil Spill Restoration Office Conference Room
441 W. 5th Ave. Suite 500
Anchorage, AK 99501

Executive Summary

The *Exxon Valdez* Oil Spill (EVOS) Trustee Council sponsored a workshop in Anchorage, Alaska on March 20-21, 2003, to discuss options and methodologies for mapping the biological and physical characteristics of the shoreline in the oil spill area. The focus on shoreline habitat mapping was one aspect that arose from a series of three previous workshops held during 2001 and 2002 to develop a long-term nearshore monitoring program for the Trustee Council's Gulf Ecosystem Monitoring and Research Program (GEM).

The objectives were to inventory existing mapping efforts, determine selection of the variables that should be included in the mapping products, identify and plan remedies for gaps or overlaps in existing efforts, and develop partnerships to enable complete mapping coverage of the area with an agreed-upon scale and list of attributes.

This workshop was designed to expand upon previous habitat mapping discussions and to focus on developing a plan for comprehensive habitat mapping coverage of the oil spill area shoreline. Workshop participants examined the possibilities of consensus for a standardized mapping protocol, adopting a particular methodology, accommodating a user-requested list of attributes, and partnering to afford mapping coverage of the entire oil spill area.

The workshop group met its objectives, and in addition, initiated the process of implementing a shoreline habitat mapping program by (1) forming a workgroup to take the lead in finding pragmatic ways to integrate current mapping projects and advance the ShoreZone methodology, and (2) suggesting the creation of a lead Shoreline Mapping Coordinator position to be sponsored by The Nature Conservancy, with first-year funds possibly available from both the GEM program and The Nature Conservancy.

Significant results of the workshop include consensus among participants to:

- Establish a region-wide standardized mapping protocol which shall include a tier of attributes from which selections can be made as funding allows

  A draft of this protocol (ShoreZone) for Alaska is currently being revised by John Harper, Coastal and Ocean Resources, Inc. in response to workshop review comments.

- Adopt the ShoreZone method as the standard for mapping biological and physical characteristics

  Target areas: Kenai Peninsula, Cook Inlet, Kodiak

- Develop a partnership with Alyeska (Rod Hoffman, Gail Colby) to optimize use of their Graphical Resource Database (GRD) survey data to produce mapping comparable to ShoreZone data. Adding biological shoreline attributes to existing and future GRD mapping needs to be addressed.

  Target area: Prince William Sound

- Establish a Shoreline Mapping Coordinator position that interacts with all agencies and concerned entities to oversee mapping efforts, maintain momentum, coordinate research and planning, address technical concerns, and ensure quality control

  Coordinator position to be housed at The Nature Conservancy. Agreement to pursue this role has been accepted subsequent to the workshop by Randy Hagenstein of the Nature Conservancy.

- Plan for data management, with a future goal of making all data web-accessible from an Internet browser. Some data and imagery are already available at http://imf.geocortex.net/mapping/demos/cori/launch.html

  Interim Data Manager, GIS format = recommend Joel Cusick, NPS
  Long term Data Repository needed = investigate possibilities of the new statewide GIS database being developed by DNR, or under the Coastal Alaska Observing System (CAOS)

- Maintain a ShoreZone Mapping Workgroup to further the goals and address technical issues raised in this workshop

  Current members include:
  Sue Saupe (Cook Inlet RCAC), Chair
  Amalie Couvillion (TNC), Joel Cusick (NPS), Dale Gardner (ADEC), John Harper (ShoreZone), Mary Morris (ShoreZone), Carl Schoch (KBNERR), Lewis Sharman (NPS), Dana Seagars

(FWS), Gail Colby (Alyeska), Rod Hoffman (Alyeska), and adjunct members Hally Hofmeyr (BC) and Helen Berry (WA)

- Pursue the option of expanding the ShoreZone mapping program statewide

Introduction

Shoreline mapping was identified as a top priority in recent nearshore workshops sponsored by the *Exxon Valdez* Oil Spill Trustee Council (Schoch et al, 2002; EVOS/GEM Nearshore Monitoring workshop, April 2002), because it provides a foundation for monitoring and research of the nearshore habitat under the GEM program (http://www.oilspill.state.ak.us). A recommendation was put forward at the April 2002 Nearshore workshop to expand the low resolution aerial video imaging program initiated by Cook Inlet Regional Citizens Advisory Council (RCAC) in Cook Inlet and the outer Kenai Peninsula to include areas in the Prince William Sound, Kodiak-Shelikof Straits and Kenai Fjords/Seward areas. This prompted the Trustee Council to fund ShoreZone mapping of one of those areas by John Harper during the summer of 2002. In November 2002, the Council funded Harper to develop standard protocols for the use of the ShoreZone system in Alaska (Development of an Alaska ShoreZone Mapping Protocol for GEM, EVOS Project 030641) based on the methods developed for the existing Cook Inlet and Kenai Peninsula mapping projects. This proposal included a users workshop as part of the protocol development.

Before recommending any further ShoreZone mapping in the GEM area, the EVOS Science and Technical Advisory Committee (STAC) requested a workshop be held to determine:

1. What shoreline mapping products are being developed, by whom, inclusive of what information, within what timeframes, on what spatial scale, and by what methodologies

2. What are the variables, geographic areas and scales that should be included in the mapping products to best serve the user groups

3. The location of any gaps and overlaps, and the potential to partner

This workshop was developed both to follow the objectives recommended by the STAC and to offer a chance for users to evaluate and modify the Draft Alaska Protocol being developed by John Harper. The workshop was co-chaired by Dr. Brenda Norcross and Sue Saupe, and was organized and reported on by Dede Bohn.

Workshop Discussion

The need for shoreline habitat mapping

Shoreline habitat mapping of the intertidal zone is desired by a wide user group that includes land and resource managers, recreational and community planners, oil spill responders, researchers, and citizen groups. The most common attributes requested from habitat mapping are the type of substrate (sand, gravel, mud, rock, wetlands, for example), major biological assemblages (such as wetlands, eelgrass, kelp, or other algae), and evidence of human impact or development.

The following uses were identified during the workshop:

Monitoring – determine locations to sample trends over time
Environmental assessment
Determining potential environmental impacts
Oil spill response, resource prioritization and planning
Planning by industries – oil, fishing, tourism, forestry
Resource management
Conservation planning
Recreational use planning
Habitat management
Subsistence species locations
Coastal community managing and planning
Private landowner – development and permitting
Public education

Presentations: Inventory of coastal mapping efforts

Workshop participants heard presentations from mappers, resource and land managers, planners, oil spill responders, and researchers about shoreline mapping projects and needs.

- Brenda Norcross, *University of Alaska-Fairbanks*

  Before selecting a coastal mapping approach, it is an imperative to determine how you will want to use the data, to identify what kinds of questions you hope to address. You must choose the technology carefully and know its limitations in order to ensure that it will collect the kinds of data you're seeking. Brandee Gerke's Masters Thesis in Fisheries at UAF underlines the need to be cautious about trying to apply data collected for one reason to another research question.

Gerke's thesis showed a drastic mis-match between vegetation and substrate data collected by acoustic sidescan sonar data for the EVOS Nearshore Vertebrate Predator project in 1995-1996 to that collected on visual dive surveys by the ADFG for estimating herring production in the late 1980's and early 1990's.

> Gerke, B.L. 2002. Spawning habitat characteristics of Pacific herring, *Clupea pallasi*, in Prince William Sound, Alaska, M.S. Thesis, University of Alaska Fairbanks, Juneau, Alaska.

- Lisa Ka'aihue, *Prince William Sound Regional Citizens Advisory Council (PWSRCAC)*

  The PWSRCAC supports development of the Geographic Response Strategies (GRS), which provides guidance for protecting specific areas to oil spill responders. To provide for environmental protection, the PWSRCAC supports inventory and monitoring efforts such as Alyeska's Geographic Response Database (GRD), Environmental Sensitivity Index (ESI) maps by NOAA, and Musselwatch projects by NOAA. PWSRCAC would like to see coastal mapping completed for northwestern Prince William Sound, and is interested in pursuing the potential to integrate ShoreZone technology.

- John Whitney, *NOAA ESI mapping*

  Environmental Sensitivity Index Maps (ESI) have been prepared as tools for oil spill and coastal zone management for all of Alaska. The maps provide information on the type of shoreline, its sensitivity to oil contamination, and the presence of human infrastructure and biological resources. This project mapped the coastal geomorphology and combined it with biological information provided by Federal and state agencies. Most of these maps are on a scale of 1:250,000, though some are 1:63,360, which is not usually adequate for biological purposes. Maps are available in hardcopy or in digital format requiring an ESI viewer.

- Alan Bennett, *National Park Service (NPS) inventory and mapping program*

  The Alaska Networks Long-term Monitoring Program is part of a national initiative being driven by interest in coastal issues. There are four networks in Alaska, each made up of clusters of National Parks. Approximately one-third of the program addresses coastline issues. An inventory of coastal mapping products currently available for the following parks shows: a series of high-resolution 1:24,000-scale aerial photos for Aniakchak; some discontinuous geomorphic coastline mapping within the 500-mile coastline of Katmai, also for Lake Clark and for Kenai Fjords. The NPS held a coastal scoping workshop in 2002. In 2003, the NPS is funding ShoreZone mapping of Katmai and Aniakchak parks. A

research and monitoring program for oceanic and nearshore areas under NPS purview in the northern Gulf of Alaska is being developed and is expected to be operational by 2006.

- Lewis Sharman, *Glacier Bay National Park*

  Sharman developed a protocol to provide baseline information on coastal resources, make information easily accessible, and create a mapping inventory for the NPS Alaska Coastal Resources Inventory and Mapping Program in Glacier Bay. In the six field seasons since 1997, a 2-person team has mapped 885 miles of coastline on the ground at low tide, and from high-resolution aerial photos. Attributes recorded include substrate, slope, intertidal biological inventory, vertical zonation transect, streams, and special features. The final products are a database, aerial photos, maps, and ground photos which are linked together into one interactive data-viewing form, accessible from any workstation within the Park's computer network. A future goal is to provide an interactive ArcIMS product on the Internet for public access to the data and the detailed field and data processing protocols.

- Gail Colby, *Alyeska Pipeline Service Company*

  The mapping that Alyeska has underway in Prince William Sound for oil spill response purposes is comprised of aerial video surveys, mapping and segmentation (by substrate and geomorphology) of coastline, and a Geographic Response Database (GRD). Aerial video surveys with narration are complete for the NE and East-South mapping regions, and almost complete for the SW/Central region. Photographs of shorelines are referenced by GPS. Biological characteristics are not recorded; biological information is later added to the database by Federal and State agencies. The GRD is a GIS database that contains information on the character of the shoreline, its protection and treatment categories, and operational considerations. Data are in MapInfo, and are not proprietary, but the GRD viewing platform is. The CD of the Graphical Resource Database sells for $350.

- Amalie Couvillion, *The Nature Conservancy*

  The Nature Conservancy is developing Ecoregions Conservation Unit maps as part of their mission to promote biodiversity. They are interested in developing a consistent, statewide classification scheme. In Washington and British Columbia, the Nature Conservancy relied on ShoreZone data for these maps. In Alaska, they've been using NOAA's ESI. Attributes of interest include substrate, biological resources, and anthropogenic modifications. Of the 11 units in Alaska, Cook Inlet and the Bering Sea have been completed.

- Sue Saupe, *Cook Inlet Regional Citizens Advisory Council (Cook Inlet RCAC)*

  The Cook Inlet RCAC initiated a ShoreZone mapping program in Cook Inlet with John Harper after noting a lack of existing shoreline habitat data available for their environmental monitoring program. They wanted to better assess the risk of oil impact to shorelines in Cook Inlet, and established a goal of getting longshore and cross-shore geomorphological and biological information. The 2001 pilot project incorporated central Cook Inlet and Kachemak Bay shorelines and as part of this project, the Cook Inlet RCAC requested that ShoreZone mapping begin incorporating digital imagery into the final product such that shorelines could be viewed along with the habitat data. The Cook Inlet RCAC expanded their project in 2002 to incorporate the outer Kenai Peninsula coastline and areas in lower Cook Inlet. Saupe emphasized how creating partnerships greatly increased the success and momentum that led to the expansion of shoreline habitat mapping. She also emphasized the value of on-the-ground surveys for revising the bioband tables for Alaska and developing protocols.

- John Harper, *Coastal and Ocean Resources, Inc.*
  Mary Morris, *Archipelago Marine Research Ltd.*

  Harper and Morris are contractors who use the ShoreZone technique (Harper, 2003) to provide coastal habitat mapping of the shoreline morphology and biota. Aerial video imagery of the intertidal zone is collected at low tide, and is interpreted and classified by geomorphologists and biologists, who record the features in a database that is geographically referenced to the digitally recorded shoreline. Biological resource information is recorded as a 'Bioband', which is an observed species assemblage with a characteristic color and along-shore elevation. The ShoreZone technique produces map and tabular data, both of which are geographically referenced and therefore linked. The map data display the distribution of physical and biological features along the shoreline, and the tabular data provide information about the map features. The data are provided in GIS format using ArcView data files. An Alaska ShoreZone Mapping Protocol is being developed with support from EVOS and the Cook Inlet RCAC to provide standardization for the technique in Alaska. The Protocol will describe the elements included in the core and also an enhanced ShoreZone system. (See http://www.coastalandoceans.com).

- Carl Schoch, *Kachemak Bay National Estuarine Research Reserve*

  At a much smaller scale than ShoreZone, Schoch is producing high-resolution maps of the intertidal and shallow subtidal shorelines of Kachemak Bay. The mapping uses quantitative techniques to record detailed physical and biological

attributes from on-the-ground surveys. This technique can be used to develop predictive models about longer stretches of similar shoreline, and can also detect and monitor change over time. ShoreZone mapping can be used as a first step in this process, as a screening tool to identify and locate shoreline segment types. Schoch's technique is a separate and parallel system that nests inside ShoreZone.

- Helen Berry, *Washington Dept. of Natural Resources*

  As a Nearshore Program Manager in the state of Washington, Berry has extensive experience using the ShoreZone technology, which was used to map the 3000 miles of Washington's saltwater coastline. Berry provided the pros and cons from her experience in working with this technology, which she values highly. On the positive side, ShoreZone was found to have multiple uses and was relatively easy to use by a variety of interested groups. On the negative side, there are some technical issues that still need resolving, e.g., polygon/line/point approach, need to improve substrate identification particularly between sand and mud, need for more ground-truthing to improve classifications, and the need to develop web-based imagery and data that don't require GIS technology. Overall, Berry heartily endorsed the ShoreZone methodology.

- Hally Hofmeyr *Ministry of Sustainable Resource Management, British Columbia*

  ShoreZone was used to map the approximately 22,000 miles of British Columbia coastline, and has proved successful for coastal management, environmental assessment and protection, research, and First Nation and coastal community needs (mapping traditional use sites). Hofmeyr stresses the need to publish standards, preferably on the web, for use of the technique in Alaska. An example for British Columbia is http://srmwww.gov.bc.ca/risc/standards.htm. Publication of standards will promote data collection and classification that is consistent with other regions using ShoreZone (Australia, Washington, and BC). Hofmeyr envisions a future opportunity for a Data Warehouse of ShoreZone data, with coverage linked from the Bering Sea south to Baja. He encourages collaboration and partnerships with Federal and provincial governments, industry, and others to produce a coastal information network that would transcend political boundaries.

Group Discussion

The need for a standardized approach

The advantage of adopting a standardized approach is to provide continuity that affords comparison among areas and to reduce overlap problems between mapped areas. The

disadvantage is possible incompatibility and even derailment of other mapping projects already underway.

Selecting ShoreZone as the standard

The workshop group selected the ShoreZone technology for a number of reasons. It is already being widely used for a substantial portion of the oil spill area, with aerial videography and mapping either underway, already completed or planned in the near-term for: Kenai Fjords/Seward (EVOS); middle and upper Cook Inlet, including Kachemak Bay, and the outer Kenai Peninsula coast (Cook Inlet RCAC); the northern Kodiak and Afognak Islands (EVOS and Cook Inlet RCAC); and Aniakchak and Katmai National Park coastlines (NPS). It is cost-effective, affordable, timely in generating data, and includes both biological and physical elements. It produces products with a wide range of applicability, such as a tightly geographically referenced aerial video with narration, photographs, and both an attribute and spatial GIS database. It is a flexible system that can be tailored to a user's needs by selecting and combining desired attributes. It has been successfully tested elsewhere (Washington State, British Columbia). It follows a protocol which can be shared with all users, and which is being adapted for Alaska. Its products can be posted on the Internet and made widely available.

Comparison of some of the biophysical methodologies

- ShoreZone: 32 classifications with hundreds of descriptors, costs $40-$50/mile to acquire imagery and post to the Web, $33 - $40/mile to produce database and associated maps; system can provide a spatial framework for environmental monitoring but not of suitable resolution to detect and monitor change
- ESI: 10 classifications, scales of 1:63,360 and 1:250,000
- NPS (Sharman's mapping in Glacier Bay): cost $500 to $700/mile, and is both time and labor-intensive, very-fine scale; appropriate base for detailed planning and environmental monitoring

What ShoreZone can and cannot do

- It's qualitative not quantitative; it isn't meant to monitor change, but instead is a record of conditions captured at a particular time
- Provides archival visual imagery
- Is accurately geographically referenced
- Is an open-ended GIS-based system that can be built upon or added to later
- Can incorporate previous mapping (such as ESI)
- Provides screening template for selection of monitoring sites
- Has multiple applications, with selections from Core or Enhanced program elements
- Is independent of scale
- Is currently limited in its ability to capture wide, flat homogenous areas or embayments

Lessons from other areas

- Spatially soft but attribute rich: numerous attributes will be recorded for one long segment of coastline, but how much of that segment corresponds to an individual attribute can't be determined
- To complete ShoreZone mapping for 3000 miles of coastline in Washington State took more than 7 years; for 22,000 miles of the British Columbia coastline, it took 20 years
- Most popular attributes from the Washington data, requested by 80% of all users: shoreline type, vegetation, and anthropogenic modification

Data Management

Workshop participants agreed that there is an imperative need for active and coordinated management of the data collected for the coastal mapping program. Standards are needed for collection, serving the data (targeted for web-accessibility), maintenance, storage (including metadata standards), and archival. Several of these issues are expected to be addressed in the revised Alaska Protocol for ShoreZone.

Data products created from the ShoreZone technology include aerial video imagery with two audio tracks, geographically referenced photographs, a database of attributes from imagery and from field verification, and GIS spatial data, all of which need to be stored in a relational manner. At present, the tabular data can be queried in ArcView, but a goal is to make them web accessible.

Workshop participants discussed the idea of a central repository. Sean Weems from Alaska DNR proposed incorporation into a new statewide GIS database that DNR envisions creating within the next year or two. The advantage to this system is in having one central location for many sets of data that could be complementary, and would afford "one-stop shopping". DNR hopes to leverage existing expertise such as using open standards that have been developed through a structured, open consensus process by the Federal Geographic Data Committee (FGDC). DNR plans to build a spatial lab that allows input of ArcInfo, ArcIMS, and MapInfo, and to build an online web-based application for non-GIS users. Scientists would have access to edit and update their own data as needed.

Another possible central repository option that was discussed is the CAOS (Coastal Alaska Observing System) program, which is undergoing development now. The concept of supporting a statewide shoreline mapping program should fit well within the CAOS mission. CAOS is the Alaska component of a nationwide program being developed for an integrated ocean observing system (IOOS). The goals of IOOS include providing data information required to improve predictions of climate change and its effects on coastal populations, mitigate the effects of natural hazards, improve marine operations, improve national security, reduce public health risks, protect and restore

healthy coastal marine ecosystems, and sustain living marine resources (Ocean.US, 2002).

Recommendations and next steps

1. Establish a ShoreZone Mapping Workgroup, which acts in an advisory capacity to coordinate and guide ongoing and future ShoreZone projects, and to advise a Mapping Program Coordinator
    a. Provide guidance for addressing technical issues
        i. For the ShoreZone technology, provide guidance to establish criteria for:
            1. When to collect polygonal, point or linear data
            2. Field verification (ground-truthing) of data
        ii. Establish a standardized coastline for Alaska
            1. For improving baseline topographic map quality, select high vs. low water lines
    b. Identify short-term (oil spill area) and long-term (statewide) goals
    c. Membership to include the following workshop participants:
        Sue Saupe (Cook Inlet RCAC), Chair
        Amalie Couvillion (TNC), Joel Cusick (NPS), Dale Gardner (ADEC), John Harper (ShoreZone), Mary Morris (ShoreZone), Carl Schoch (KBNERR), Lewis Sharman (NPS), Dana Seagars (FWS),, Gail Colby (Alyeska), Rod Hoffman (Alyeska), and adjunct members Hally Hofmeyr (BC) and Helen Berry (WA)

2. Create a Coordinator position that is responsible for the program
    a. Housed at The Nature Conservancy, possibly funded during the first year by both The Nature Conservancy and the GEM Program
    b. The coordinator will champion the program and maintain momentum, seek out information and resources to fulfill the needs to complete the mapping program.
    c. Duties will include coordinating research and planning, ensuring adherence to standards, working with the ShoreZone Mapping Workgroup, stakeholders and mappers, providing outreach, and linking Alaska's mapping with national and international efforts.
    d. The incumbent will work towards resolving technical issues, including those identified by the ShoreZone Mapping Workgroup.

3. Prepare a prototype product of ShoreZone mapping from a comprehensive geographic area, for example Cook Inlet or the Kenai Peninsula, and post it on the Internet

The Coordinator and the ShoreZone Mapping Workgroup shall address the following tasks:

4. Coordinate with the Alaska Geographic Data Coordinating Committee (AGDC) to pursue options for obtaining better topographic base maps, as current products are often drastically inaccurate at small scales

5. Publish the Alaska ShoreZone protocol on the web

6. Coordinate and partner with Alyeska to optimize use of their aerial videography and GRD data. Investigate the possibility of adding biological attributes (gleaned from their archived video imagery) to the GRD database of physical attributes for Prince William Sound. Determine whether it is feasible to add collecting biological attributes during future GRD mapping activities in Prince William Sound

7. Establish a comprehensive data management system that provides for:
    a. Database management and repository for all mapping components
        i. Allows users to edit and update their own data
        ii. Long-term maintenance plan
    b. Standards for database management, including:
        i. Metadata requirements
        ii. Quality control (QA/QC)
        iii. Integration with other data from separate projects
            1. Interface shoreline data with adjacent terrestrial data
    c. Accessibility and outreach
        i. Establish a user group when building the database
        ii. Provide outreach to inform potential users of availability and access
        iii. Internet accessible and user friendly
        iv. Provide training sessions for users, as needed
    d. A plan to upgrade as technology advances

8. Coordinate with the ongoing development of Nearshore monitoring for the GEM Program

Attachments

1. References
2. List of participants

REFERENCES

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