Exxon Valdez Oil Spill
Restoration Project Final Report

Alaska Coastal Habitat Web Site

Restoration Project 040721
Final Report

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for:

NOAA – Fisheries
Program manager
11305 Glacier Highway
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Study History: **Project** 040721 originated from the need to provide easy access to coastal habitat data collected during ShoreZone surveys and mapping efforts in a way that is accessible to a variety of users. Several components of a Gulf of Alaska coastal habitat mapping effort had been completed through various funding agencies and along various shoreline segments within the oil spill region and there was an identified need to provide this information in one place. This recommendation came about from an EVOS Trustee Council-sponsored workshop in spring 2003, where various researchers, agency personnel, and other organizations discussed their data-user needs.

Abstract: This project developed an Alaska Coastal Habitat Web Site based on several products that were produced using ShoreZone Mapping techniques. The final product ties together several components in a user-friendly, web-accessible format. The website (a) makes recently collected ShoreZone data immediately web-accessible, (b) combines ShoreZone mapping data with the existing Gulf of Alaska Coastal Imagery web site, and (c) combines ShoreZone mapping data with detailed site-specific data for various habitats and descriptions of biological assemblages and species. The project was coordinated by the Cook Inlet Regional Citizens Advisory Council through a subcontract to Coastal and Ocean Resources, Inc. (CORI) who developed the ShoreZone techniques and who is currently conducting various ShoreZone mapping projects in the GEM area.

Key Words: Coastal Habitat Mapping ShoreZone Intertidal Algae Invertebrates

Project Data: The primary data product of the proposed ShoreZone mapping project is a georeferenced database of biophysical shore-zone data. The shoreline is segmented into *alongshore units* or segments and into *across-shore components* (Fig. 1). A database contains attributes on each unit and component (Tables 3 & 4); units may be either polygons, lines or points and are referenced through GIS. The shoreline features are classified by geomorphologists and by biologists according to the Alaska ShoreZone Mapping Protocol (Harper and Morris 2003).

The ShoreZone mapping products are tied to individual AVI surveys for costing purposes. That is, each 6-day AVI survey is assumed to result in approximately 1,800 km of imagery for mapping. The cost associated with mapping is estimated at $ 86,400/survey or a total of $ 172,800 for the remainder of Kodiak.

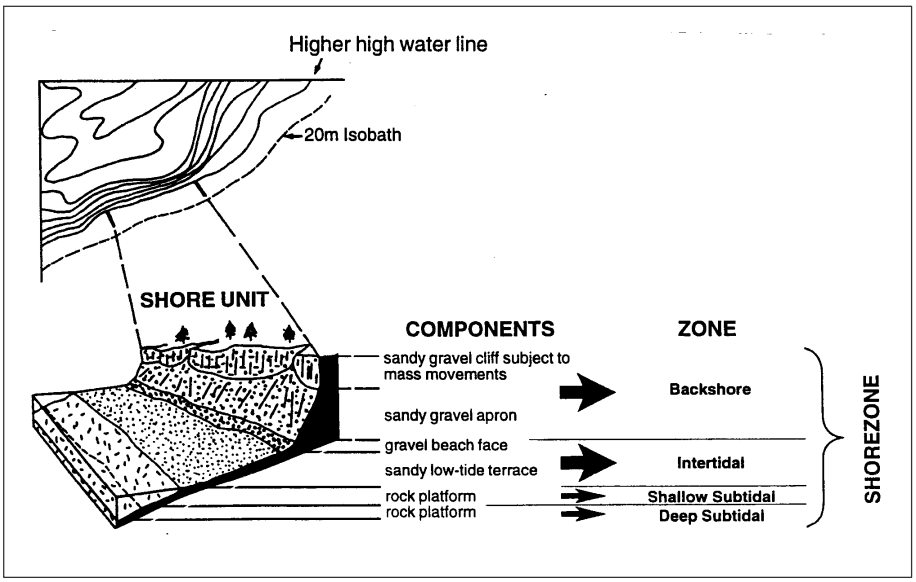

Figure 1. Schematic of the subdivision of the shoreline in *alongshore units* and *across-shore components*.

Table 1. Summary of Data Attributes Recorded for Each Shore Unit.

Category	Attribute	Description
General	Unit ID	unique identifier used to link database to maps
	Type	polygon, line or point features
	Length	alongshore length of unit
	Area	area of polygon
	Source	sources of imagery
	Mapper	name of mapper
	Map Date	date of mapping
	Editor	name of editor
	Edit Date	date of editing
Exposure	Exposure Calculated	exposure class calculated by GIS model (6 classes)
	Exposure Observed	exposure class observed by mapper (6 classes)
	Exposure Biological	exposure class determined by observed biota within unit
	Effective Fetch	fetch window
	maximum fetch length	maximum measured fetch
	max fetch direction	direction of maximum fetch
	orientation	shore normal direction to shoreline orientation
Shore Character	Shore Type	substrate/morphology summary (34 classes)
	Habitat Type	biological summary based on exposure and substrate (10 classes)
Sediment	Abundance	index of sediment (3 classes)
	Source	source of sediment in unit (3 classes)
	Transport Direction	direction of alongshore transport

Category	Attribute	Description
Shore Modification	Mod1 type	type of primary shore modification
	Mod1 %	% of shore modification in unit
	Mod1 length	length of shore modification
	Mod2 type	type of secondary shore modification
	Mod2 %	% of shore modification in unit
	Mod2 length	length of shore modification
	Mod3 type	type of tertiary shore modification
	Mod3 %	% of shore modification in unit
	Mod3 length	length of shore modification
Other	Riparian %	% of riparian vegetation in unit
	Riparian Length	length of riparian
	Oil Residence Index	derived estimate of potential oil residence based sediment type and exposure

Table 2. Data Attributes Recorded for Each Across-Shore Component within a Shore Unit.

Category	Attribute	Description
General	Component ID	unique identifier linked component to a unit
	Zone	the elevation of the component in the shore zone (3 classes)
	Sequence	the sequence of the component in the zone
Geologic	Component Morphology	a descriptor of the morphology (22 classes)
	Component Sediment	a descriptor of the sediment (22 classes)
	Component Width	width of component
	Component Slope	slope of component
	Process	dominant process (5 classes)
Biologic (Biobands)	VER	'Verrucaria'
	PUC	salt-tolerant grasses
	GRA	Grasses
	BAR	upper barnacle
	FUC	'Fucus'
	BLGR	Blue-green
	ULV	'Ulva'
	HAL6	'Halosaccion'
	BMU	blue mussel
	RED6	mixed filamentous & blade reds
	ALA1	Intertidal *Alaria* spp. with *Semibalanus cariosus*
	SBR6	Soft browns
	CHB6	Chocolate browns
	RED7	Bright red zone
	ZOS	'Zostera'
	ALA2	Dragon kelp
	NER	Nereocystis

INTRODUCTION

At the time of this web site development, ShoreZone Mapping had been implemented on about 7,000 km of coastline in the Gulf of Alaska between 2001 and 2004 (Fig. 1), with a variety of agencies having funded the mapping efforts (Table 3). The ShoreZone mapping approach is based on the same protocol used throughout Washington and British Columbia (WaDNR 2000; Harper and Berry 2001; Howes 2001). Aerial video imagery is collected during the lowest tides of the year and this imagery provides the primary data for the mapping.

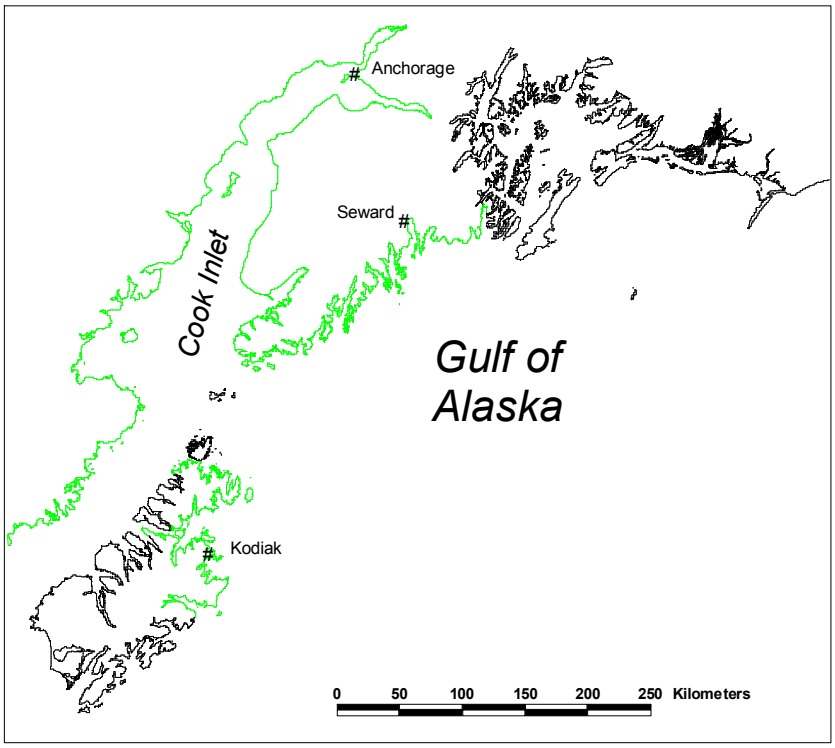

Figure 1. ShoreZone mapping ocverage (green) for 2001-2004 ShoreZone surveys in oil spill impact region.

The ShoreZone Mapping Products appeal to users at a number of levels, ranging from individuals to communities and to regional planners. The ShoreZone products offer a *significant planning tool for oil spill response* as well as for a spatial framework for potential GEM monitoring program. The ShoreZone dataset provides a single, region-wide dataset for the entire oil spill impact region with data collected to a single mapping standard (Harper and Morris 2003).

This web-site development project provides access to the imagery and biophysical habitat data in a number of formats; web-accessible sampled video, access to DVD or VHS of streaming video, pre-queried thematic maps of biophysical information, and access to the database for more detailed queries of the unit and cross-shore data.

Table 3. Summary of ShoreZone Projects, Gulf of Alaska (2001 to early 2004).

Year	Location	Project Activity	Funding
2001	lower Cook Inlet	Aerial imaging; pilot mapping; web-posting of imagery	CIRCAC
2002	outer Kenai, western Cook Inlet	aerial imaging; mapping,; web-posting of imagery	CIRCAC
	outer Kenai	aerial imaging; mapping; web-posting of imagery	EVOS/NPS
	outer Kenai	shore stations – ground-truthing	CIRCAC
	Kodiak	aerial imaging; web-posting	EVOS
2003	Upper Cook Inlet	aerial imaging; mapping; public awareness	USFW/CIRCAC
	Katmai National Park	aerial imaging, mapping; web-posting; ground station survey	NPS
	Aniakchak National park	aerial imaging; mapping; web-posting	NPS
	Kodiak	mapping 2002 imagery; workshop in Kodiak	CIAP/CIRCAC
	Gulf of Alaska	coastal users workshop; development of a ShoreZone mapping protocol	EVOS
	Gulf of Alaska	development of shore station database; pilot project for web-posting of imagery and thematic maps	CIRCAC
2004	Gulf of Alaska	(This project) Development of a 1-stop website for access to ShoreZone imagery and data	EVOS

Objective

The overall goal of the project was to develop a prototype Alaskan Coastal Habitat Web Site that will use and integrate the various components of ShoreZone mapping projects. The initial web site development will focus on data collected from the Kachemak Bay and outer Kenai Peninsula regions and incorporate the various levels and types of data that have been collected to date; ShoreZone mapping data from the aerial surveys, digital coastal images, on-the-ground survey data, and detailed descriptions of invertebrate and algal assemblages and species. The ShoreZone Mapping Workgroup will work in an advisory capacity to help guide this project and to provide input by user-groups. Project coordination will be provided by Cook Inlet RCAC as an in-kind match.

The proposed project will:

- post completed thematic ShoreZone map data on the web in a format that will allow use at regional and at local scales (*i.e.*, scalable map data),
- post completed ArcView map files and Access data files in a format suitable for downloading for use by more sophisticated users,

- combine the mapping data with the Coastal Imagery player that allows users to "fly the coast" while looking at the map data,
- provide an aerial videotape index map that allows users to identify VHS or digital tapes that they may wish to purchase for specific areas,
- provide an avenue for posting field inventory data and associated photos.
- allow expansion to accommodate other electronic mapping data.

Methods

Aerial video imagery (AVI) had been collected along approximately 7,000 km of GEM shoreline from 2001 through summer 2003. This oblique, color imagery is collected during the lowest daylight tides of the year, while tides are below "zero feet". The imagery includes a continuous geomorphological description of the shore zone on one sound track and a continuous biological description of the shore zone on the other sound track. A three-chip video camera is used for imaging, GPS location is burned onto each frame. GPS trackline data is electronically recorded and all imagery is recorded on digital tapes. Helicopters are used as the primary flying platform on most surveys but fixed-wing aircraft can be used on "straight" coastlines (e.g., western Cook Inlet).

Standard data products from the AVI surveys are: (a) a flightline manual documenting the flightline tracks and the electronic data files, (b) videotape copies and (c) web-posted 1 second image captures that allow web-users to fly the coastline through an ArcIMS site.

The primary data product of ShoreZone is a georeferenced database of biophysical shore-zone data. The shoreline is segmented into *alongshore units* or segments and into *across-shore components*. A database contains attributes on each unit and component; units may be either polygons, lines or points and are referenced through GIS. The shoreline features are classified by geomorphologists and by biologists according to the Alaska ShoreZone Mapping Protocol (Harper and Morris 2003).

Experience of Washington Department of Natural Resources (WaDNR) researchers has shown that a few parts of the ShoreZone dataset are *widely used* (e.g., shore type, eelgrass and kelp distributions and shore-modification data account for approximately 90% of the use in Washington). A few users (~10%) require more detailed info within the dataset and *need the full functionality* of database searches and GIS. The following components address these two ranges of users:

Table 4. Example thematic maps available on the coastalaska.net website.

Theme Category	Description
Physical	wave exposure
	major substrate
	gravel beaches
	sand & gravel beaches
	sand beaches
	mud flats
	organics/wetlands
	man made, impermeable
	man-made permeable
	oil residence index
Biological	habitat types
	Biobands
	lichen (*Verrucaria*/splash zone)
	wetland (*Puccinellia* type)
	grasses
	barnacles
	Fucus
	Ulva type
	bleached red algae type
	blue mussels
	mixed red algae type
	Alaria
	mixed soft-brown algae type
	chocolate brown algae type
	dragon kelp (*Alaria fistulosa*)
	eelgrass (*Zostera*)
	Nereocystis
	Macrocystis

- An ArcIMS mapping engine is used to display a variety of thematic map products. Example thematic maps are listed in Table 4. The ArcIMS system provides a system where regional scale maps of 1:1,000,000 can be produced or where maps as detailed as 1:500 can be produced of the various map themes. The ArcIMS data system is relatively easy to use and is likely to satisfy most users.

- A download portion of the site permits Arc users to access the complete spatial map data and the associated database files and meta data. The download portion of the site includes PDF versions of the Alaska ShoreZone Mapping protocol and other relevant summary documents. The full functionality of the Arc-compatible files should satisfy the most sophisticated users.

Additional site information provides improved functionality and access to imagery:

Results

The final result of this project is a website that provides access to various ShoreZone mapping products. Users can "Fly the Alaska Coastline" for areas surveyed within the oil spill region; they can "view thematic maps" of specific types of physical and biological information; they can view the available "Field Inventory System"; and "Download" associated information and protocols.

Thematic Data

A series of figures below illustrate some of the website features and how users can access the information. Figure 2 shows the home page where the various components of the ShoreZone information can be accessed. The home page provides links to the web-based imagery, pre-queried "thematic maps," downloadable pdf files and databases, the prototype field inventory system for the shore-station data, and can contact the web-host to purchase videotapes or DVDs of the streaming survey imagery. If the user wanted to view thematic maps of the biophysical data, they would click on "View thematic maps" and the thematic map page comes up (Figure 3). From this page, the viewer would "launch geocortex," the viewing software that allows users to select the coastline that they are interested in (Figure 4). From this page, the viewer can select which database or map layer they are interested. For the examples following, we have selected the Outer Kenai Enviornmental Data (ShoreZoen biophysical themes). If the user were to select "Dominant Morphology" as the data layer for a selection of the Kenai coastline, they would see a thematic map as in Figure 5. To turn on the legend that associates the mapped data to a color key, the legend layer must be turned on as shown for the sediment type data layer in Figure 6 and for Oil Residence Index in **Error! Reference source not found.**.
Error! Reference source not found. and Figure 9 illustrate the eelgrass biological data layer at two different spatial scales.

Figure 2. Home page for the coastalaska.net website.

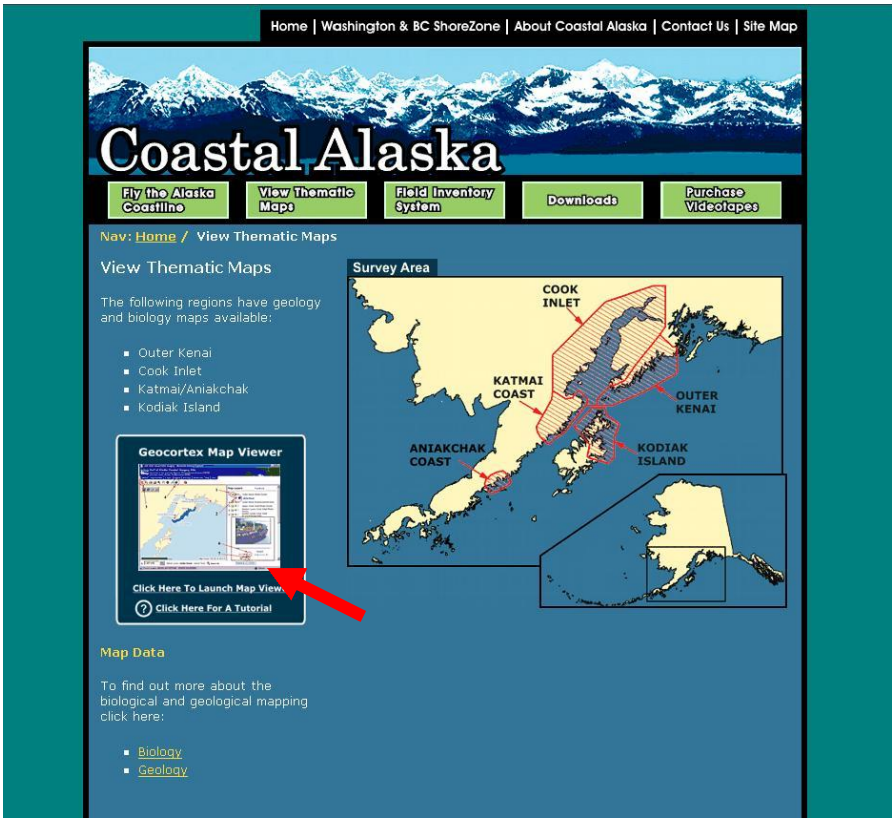

Figure 3. The thematic map page that will allow users to link to pre-queried data maps for their selected portion of the coastline. The red arrow points to the Geocortex Map Viewer link.

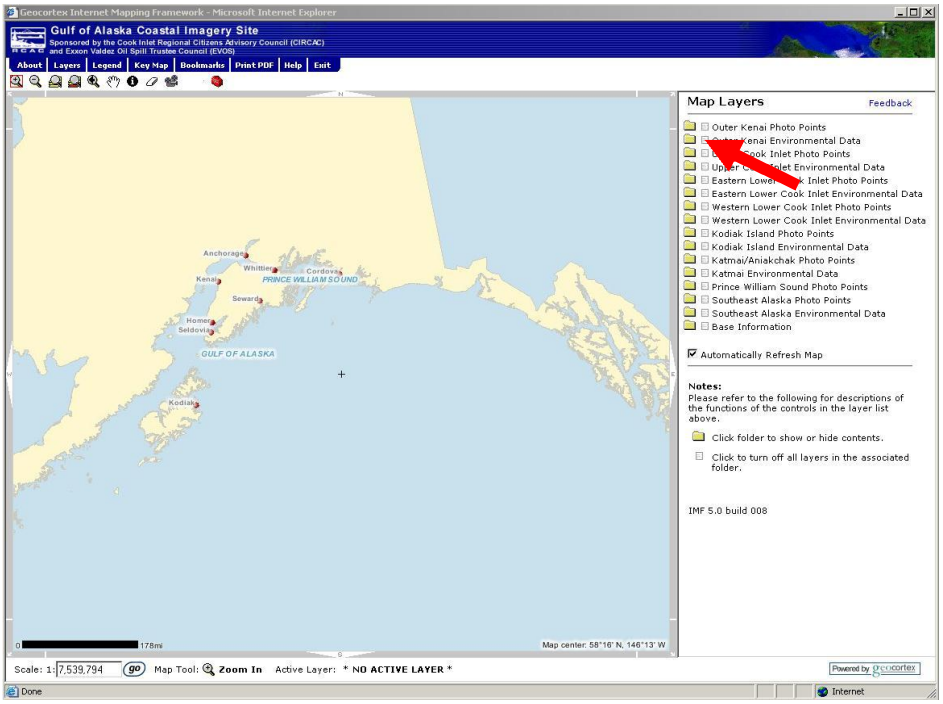

Figure 4. The Geocortex softward launched, showing the map layers available to the user. For this example, the red arrow shows that we will select "outer Kenai Environmental Data" which includes the biophysical data for the outer Kenai Peninsula Coast.

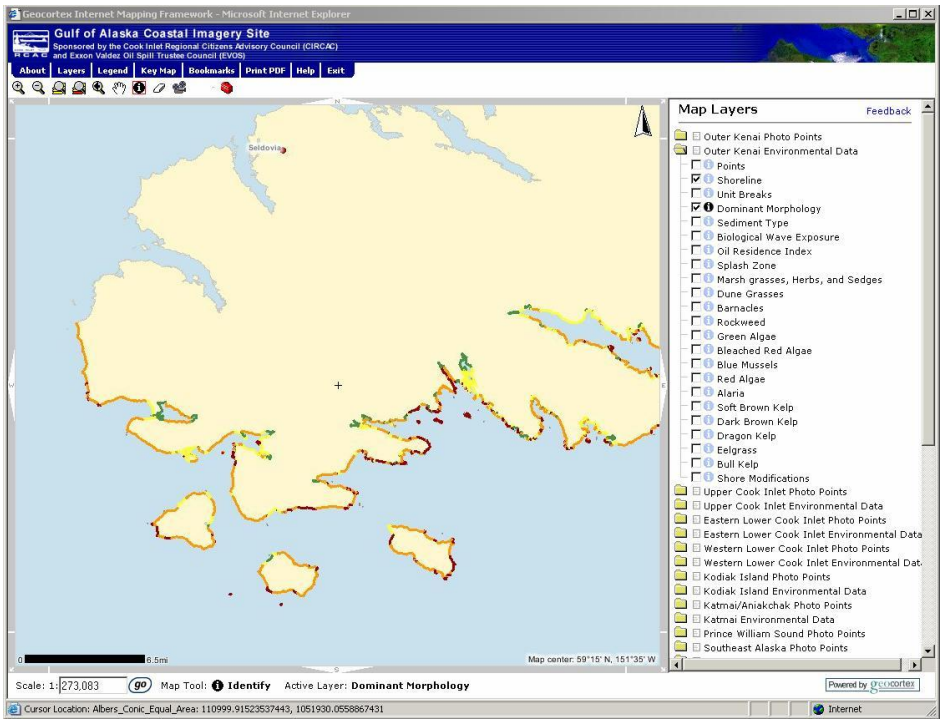

Figure 5. Example for a selection of the Kenai Peninsula coastline that shows the dominant morphology data layer. Note that the legend has not been turned on so that the segment colors are not defined in this view.

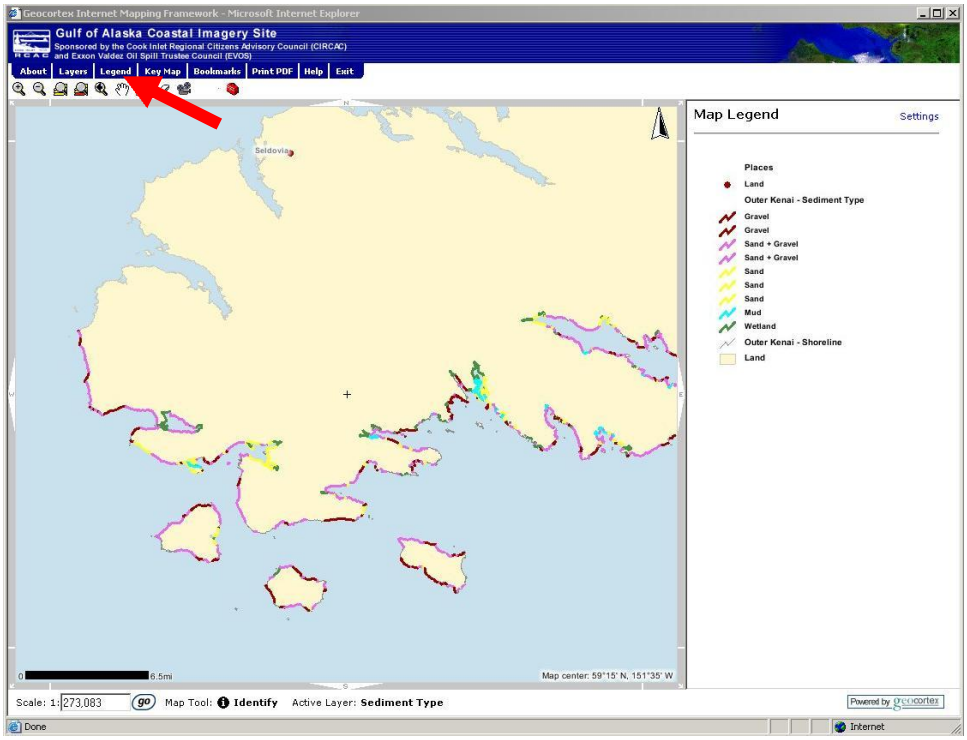

Figure 6. Turning on the legend layer (red arrow) shows the legend that associates the mapped data to the color key. Note that this example is for the sediment type data layer.

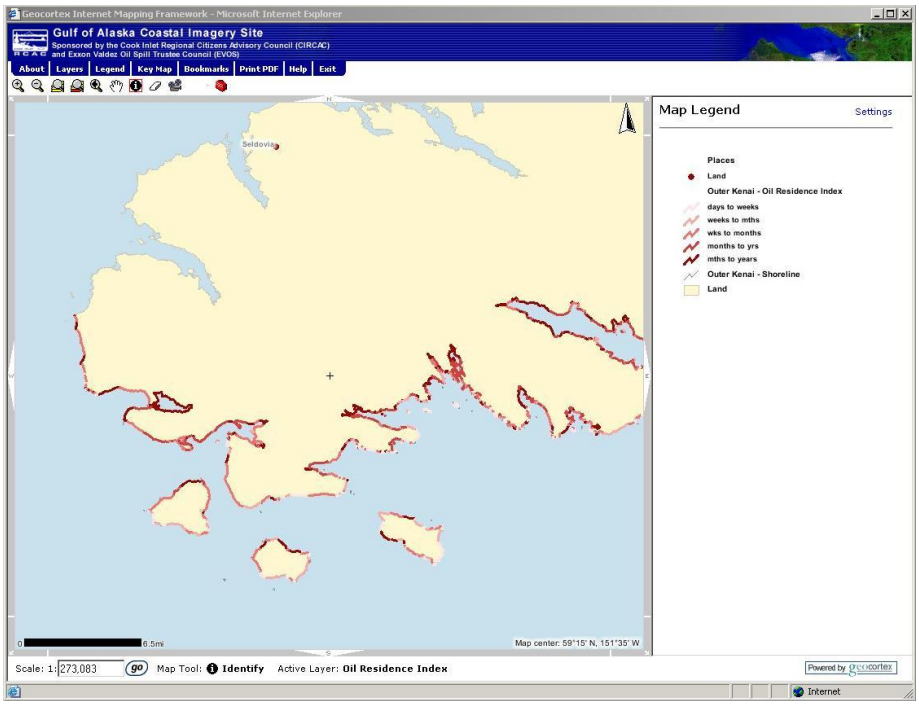

Figure 7. Example showing Oil Residence Index data for outer Kenai Peninsula coastline section. This Index is calculated through an algorithm

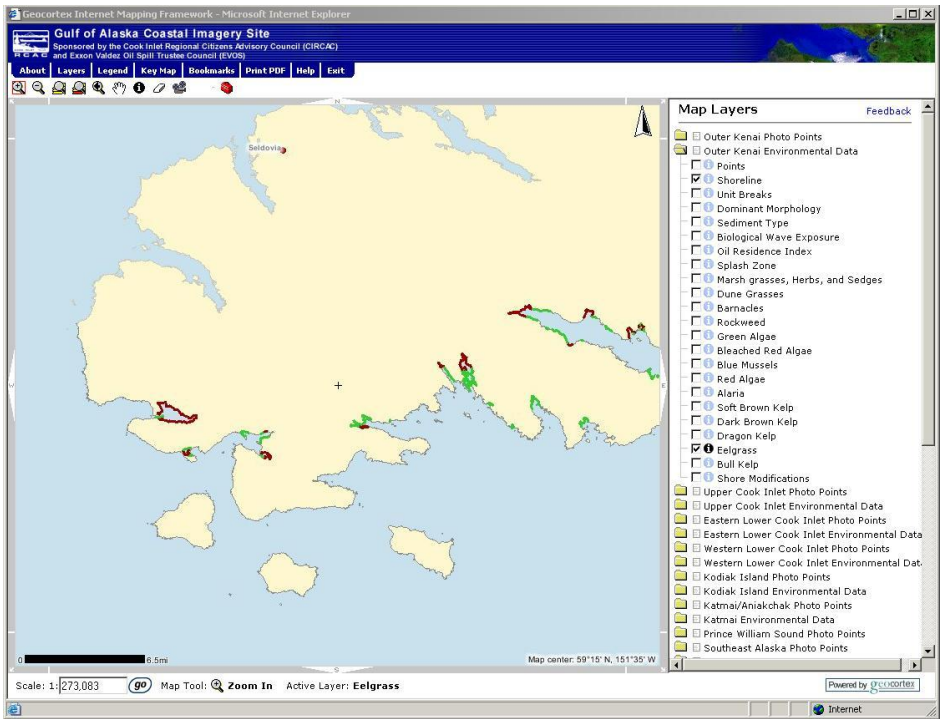

Figure 8. Figure 8. Example of eelgrass thematic map for a section of the outer Kenai Peninsula coastline.

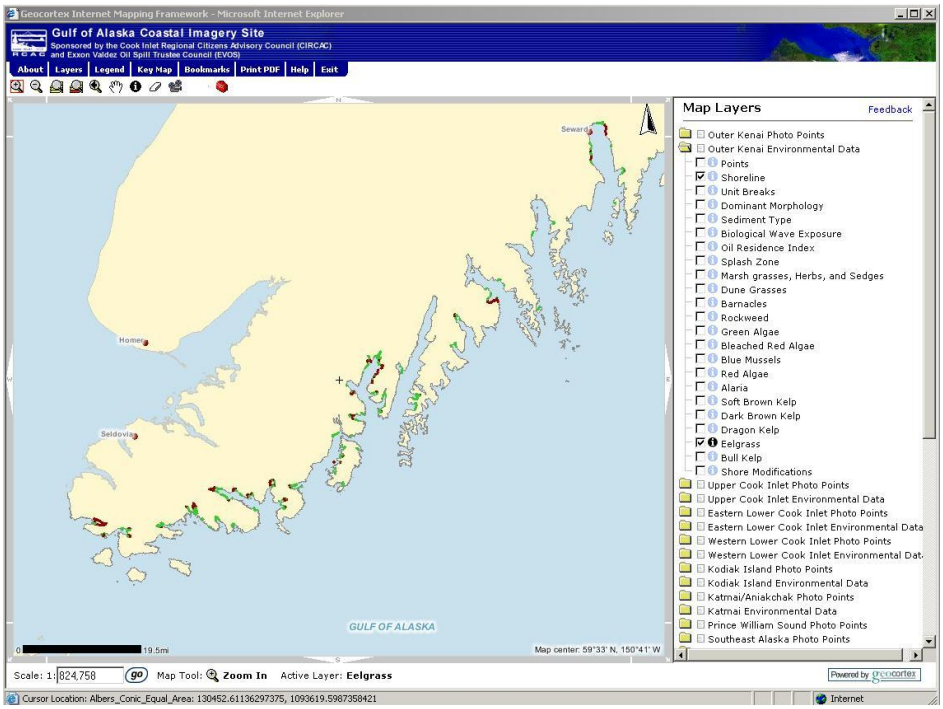

Figure 9. Example of eelgrass thematic map for a "zoomed out" section of the outer Kenai Peninsula coastline, illustrating the website's ability to include various scales. Not that if the query includes data outside of the original Outer Kenai map layer, that environmental data layer would also need to be turned on.

Coastal Imagery

The coastal video imagery has been sampled from the streaming video at one second intervals (every 28.6 frames) and posted to an ArcIMS web site for viewing. This web site has proven to be functional and appeals to a wide range of users. The imagery is also run via Geocortex through a link on the homepage (Figure 2). When the "Fly the Alaskan Coastline" link is clicked, the coastal imagery page appears (Figure 10). When connected to the Geocortex viewing tool, a section of coastline is selected (Figure 11) and the images are loaded and can be "flown" as shown in the upper right of the window. The video can be stopped and the background photograph can be viewed (Figure 12).

Figure 10. The Coastal Imagery page.

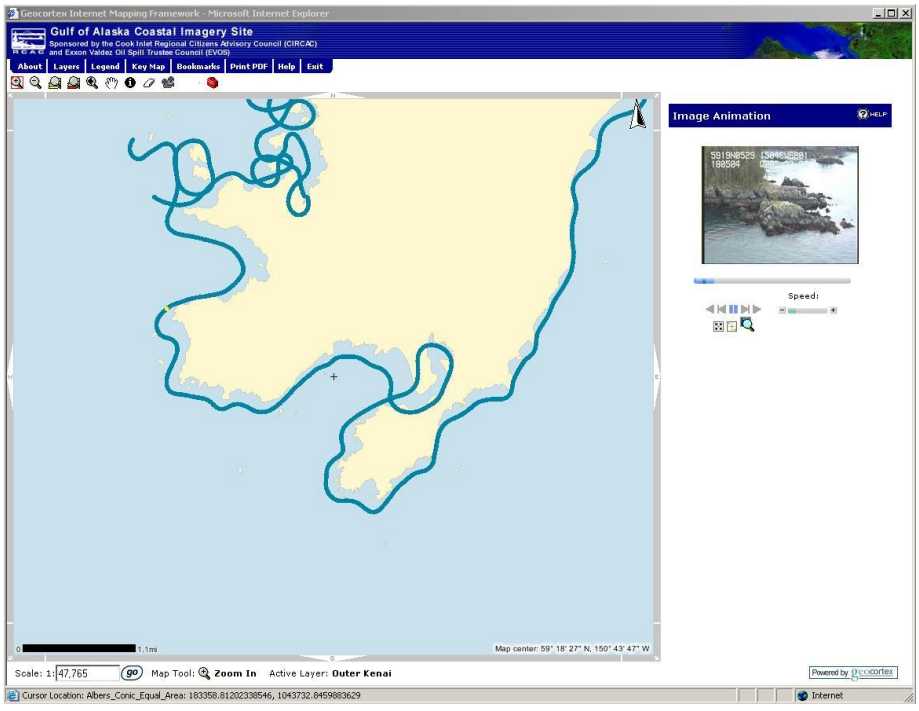

Figure 11. Selected coastline on the outer Kenai Peninsula with the Kenai Photopoints layer selected. The imagery appears in the upper right of the web page window.

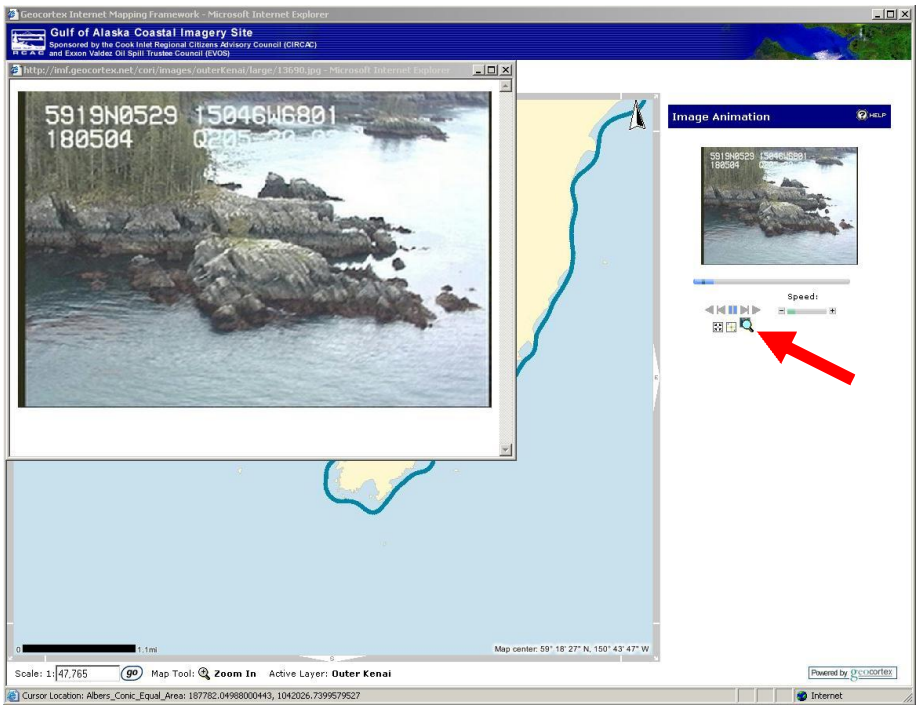

Figure 12. Web image of "background" photographs residing on coastalaska.net website. Red arrow shows tool to click to pull up background photo of video imagery from selected coastline. Note latitude and longitude burned onto image.

Field Data

In addition to the ShoreZone aerial survey and mapping information, on-the-ground stations were sampled where information about specific algal and invertebrate species were recorded. These data provide information about species assemblages associated with specific habitat types, such as morphology, sediment type, and wave exposure. A pilot web page has been developed where these data can be linked to the ShoreZone units identified from the aerial surveys and mapping. The link for this tool is "Field Inventory System" (Figure 13) at which details about biobands and associated species can be downloaded (Table 5).

Finally, there is a download section where ACCESS the Gulf of Alaska ShoreZone protocols can be downloaded. This web page also allows a "power" user to conduct more complex queries of the alongshore and cross-shore data.

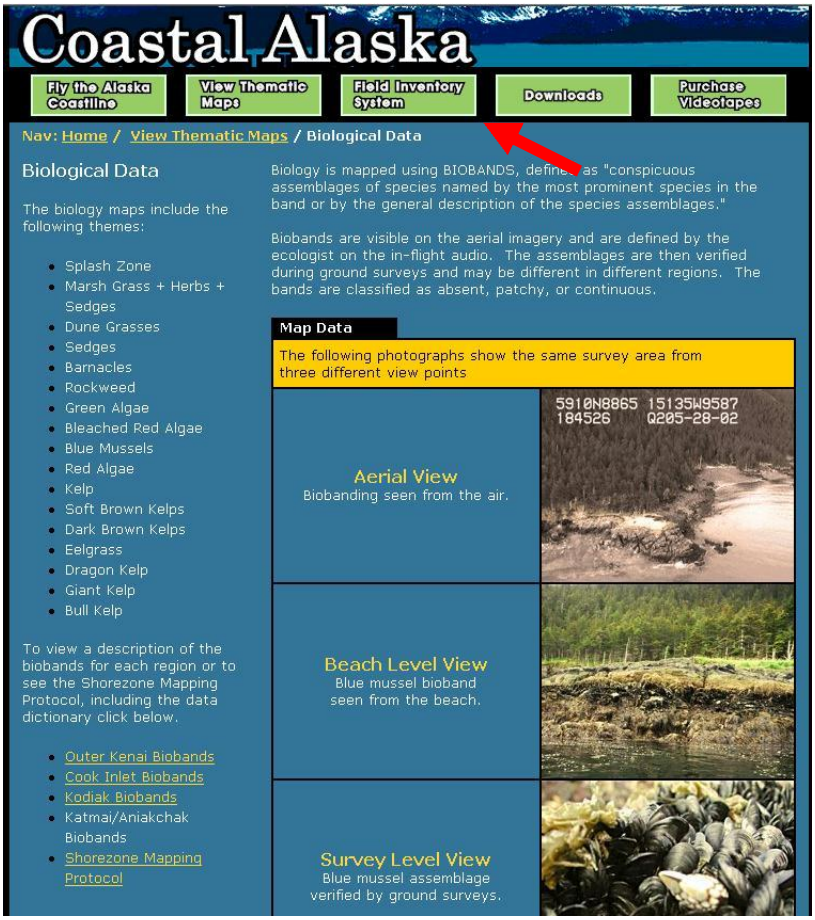

Figure 13. Field inventory system webpage. From this page, information about biobands can be downloaded (

Table 5. Example downloadable file describing biobands and associated species.

Table A - XX. Bioband Definitions: Outer Kenai Coast
The presence of a bio-band — except the Splash Zone — is always recorded as either Patchy (P) 25%-50% coverage, or Continuous (C) 50%-100% coverage.

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Description	Exposure	Associated Species
A	Splash Zone	VER	Black or bare rock	*Verrucaria sp.* Encrusting black lichens	Visible as a dark band on bare rock, marking the upper limit of the intertidal zone. Occurs on bedrock and on low energy boulder/cobble shorelines. **Note:** This band is recorded by width • Narrow (N) = less than 1m • Medium (M) = 1m to 5m • Wide (W) = more than 5m	Width varies with exposure N=VP-SP M=SP-SE W=SE-VE	*Littorina sp.*
A	Marsh grasses, herbs and sedges	PUC	Light, bright or dark green Red brown	*Puccinellia sp. Plantago maritima Triglochin sp. Carex sp. Honkenya peploides*	Appears in wetlands around lagoons, marshes, and estuaries. Can also appear on dunes, and can be distinguished from the dune grass band by its colour.	VP-SP	other grasses and sedges
A	Dune Grass	GRA	Pale blue-green	*Elymus mollis*	Found in the upper intertidal zone, on dunes or beach berms. Dune grass is often the only band present on high-energy beaches.	P-E	
upper B	Rockweed	FUC	Golden-brown to red-brown	*Fucus sp.*	Appears on bedrock cliffs and boulder, cobble or gravel beaches. Commonly occurs at the same elevation as the barnacle band.	P-SE	*Balanus sp. Semibalanus sp. Ulva sp. Pilayella sp.*
upper B	Barnacle	BAR	Grey-white to pale yellow	*Balanus sp. Semibalanus sp.*	Visible on bedrock or large boulders. Can form an extensive band in higher exposures where algae have been grazed away. In some areas there are two barnacles bands seen, one in upper intertidal, the other in the lower intertidal.	P-E	*Endocladia muricata Gloiopeltis furcata Porphyra sp. Fucus sp. Nucella sp.* Limpets

Conclusions

The web site developed through this project has been used by numerous user-groups over the past two years during its development. Since the initial plan, there has been significant work done by NOAA's Habitat Division to develop a web-based ShoreZone data and imagery site for work done in southeastern Alaska. There is interest in enveloping the website developed during this project, coastalaska.net, into their program. Given the significant monthly costs associated with hosting this website, we will be working the NOAA in the near future to either link or integrate this website into a larger Gulf of Alaska or Alaska coast web-site.

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