Exxon Valdez **Oil Spill**
Gulf of Alaska Ecosystem Monitoring Project Final Report

ShoreZone Mapping Protocol for the Gulf of Alaska (v1.0)

Gulf of Alaska Ecosystem Monitoring Project 030641
Final Report

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SUMMARY

This report provides a coastal habitat mapping protocol for use in the Gulf of Alaska as part of ongoing ShoreZone mapping projects and for future use in other areas of Alaska. The report provides for a published, publicly accessible procedure that clearly specifies a set of standards for intertidal and nearshore mapping so that (a) users have a clear understanding of the assumptions and methods incorporated into the mapping data and (b) future mappers have guidelines to ensure mapping consistency among agencies and mappers.

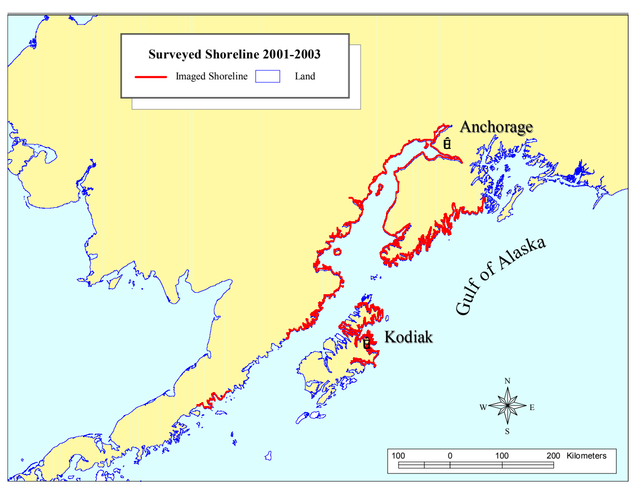
The ShoreZone mapping system is a "mature" system that has been in use since the early 1980s and has been applied to more than 40,000 km of shoreline in Washington and British Columbia (Berry *et al* 2004; Howes 2001). The system catalogs both geomorphic and biological shore-zone resources at effective mapping scales of better than 1:10,000. Approximately 5,000 km of Gulf of Alaska shoreline has been inventoried since 2001 using this system (inset, right & map).

Gulf of Alaska ShoreZone Projects

2001	Eastern Lower Cook Inlet (CIRCAC)
2002	Western Lower Cook Inlet (CIRCAC)
	Kodiak Island Imaging (EVOS)
	Outer Kenai Coast (EVOS)
2003	Katmai National Park (National Park Service)
	Upper Cook Inlet (US Fish & Wildlife; CIRCAC)
	Kodiak Is Mapping (CIAP)
2004	Coastal Habitat Website Development (EVOS)
	Illustrated ShoreZone Habitat Guide (CIRCAC)

CIRCAC = Cook Inlet Regional Citizens Advisory Council
EVOS = Exxon Valdez Oil Spill Trustee Council
CIAP = Coastal Impact Assistance Program

The ShoreZone protocol calls for information to be widely accessible. To this end, the low-tide-oblique aerial imagery has been web-posted, allowing any web-user to fly Gulf of Alaska shorelines that have been imaged. Selected thematic data is available on the web through an ArcIMS site; users can select themes of interest (e.g., eelgrass occurrence) to create region-wide or site specific maps. Complete GIS files and linked databases are available as downloads for 'power' users. Specific data products include: (1) imagery (both web-posted or videotapes/DVD), (2) spatial data (electronic maps), (3) linked attribute data that was interpreted from the aerial imagery and (4) ground station data collected in support of the aerial mapping program.



ShoreZone Mapping Coverage in the Gulf of Alaska (2003)

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1. BACKGROUND

1.1 Objective

The goal of the project is to provide a protocol for future coastal habitat mapping projects in the Gulf of Alaska as part of the EVOS Gulf of Alaska Ecosystem Monitoring Program (GEM). That is, there would be a published, publicly accessible procedure that would clearly specify a set of standards for intertidal and nearshore mapping so that (a) users would have a clear understanding of the assumptions and methods incorporated into the mapping data and (b) future mappers would have guidelines to ensure mapping consistency among agencies and mappers. The development of a coastal habitat mapping protocol represents a critical step in the creation of a region-wide, coastal habitat mapping system.

1.2 Other Programs

Coastal habitat mapping has been conducted in Alaska by a variety of groups and agencies. Most notable is the NOAA Environmental Sensitivity Index (ESI) that was originally developed in Alaska (Michel *et al* 1978) and has been applied to the entire coast of of the United States, including Alaska. The ESI system includes a set of mapping standards (Peterson *et al* 2002) and is essentially an environmental atlas that brings together a wide-range of physical, biological and cultural information in a standardized map format. Initial products were a very simplified map format (a 1 to 10 ranking system) but the system has evolved to include full GIS capability with spatial data linked to databases.

Other mapping systems that have been applied include a coastal sensitivity mapping system for the Chukchi Sea coast (Harper *et al* 1983), Kodiak Island (KIB 1985) and other specialized oil industry environmental atlases (Alaska Clean Seas; Alyeska 2003). Sears and Zimmerman (1977) conducted a Gulf-wide survey of kelp and eelgrass between 1975 and 1976.

The Kachemak Bay Estuarine Research Reserve (KBERR) has applied the SCALE system to Kachemak Bay (Schoch and Detheir 2001). This system involves very detailed inventory mapping (1:5,000 scale or better) where habitat units are delineated on low-tide aerial photos; both physical and biological data are inventoried. Previous application of this system in Washington has shown the system to be a useful spatial framework for environmental monitoring.

The ShoreZone Mapping system has been widely used in other areas of the Pacific Northwest. The system has been applied to 5,000 km of Washington shoreline (Columbia River to the Canadian border; see Berry *et al* 2004) and 35,000 km of the British Columbia shoreline (see Howes 2001).

The system is potentially compatible with the NOAA Environmental Sensitivity Index (ESI) system, which has been applied throughout Alaska; the ShoreZone mapping data provides greater detail of intertidal resources and could be directly imported to ESI.

1.3 Project Workshop

A workshop was held in March of 2003 at the Exxon Valdez Oil Spill Trustee Council (EVOS) to review existing mapping methods, select attributes that should be included in mapping products, identify overlaps and gaps in existing procedures and identify potential partnerships that would achieve at least a consistent, region-wide coverage of coastal habitat mapping. The workshop report is a available at:

http://www.oilspill.state.ak.us/pdf/shoreline_map_wrkshp_report_may21.pdf

Consensus of workshop participants was that the proposed ShoreZone Mapping system incorporated most of the desired elements for a Gulf-wide coastal habitat mapping system. The protocol being developed would be reviewed by a committee to ensure consistency with GEM program objectives and other potential partners.

As previously mentioned, the ShoreZone Mapping system has been applied to large portions of the Pacific Northwest coastline (>40,000 km) and has evolved over a period of 20 years; however, the basic technique has not changed.

2.1 Imagery

Low-tide, oblique aerial video imagery (Owens 1983) is acquired specifically for use with the ShoreZone Mapping system. Aerial overflights are scheduled for the low-tide window of the lowest daylight tides of the year, ensuring that virtually the entire intertidal is imaged. Each video frame is georeferenced by burning the GPS coordinates (Fig. 1). Individual features the size of boulders can be resolved on the imagery. Geological and biological mappers provide an in-flight, synchronous narration of shore-zone features to supplement the imagery (e.g., identification of eelgrass or kelp in the shallow, subtidal). The biologist also collects high-resolution photographs of features of interest.

Figure 1. Example of oblique aerial video imagery. Annotation on image is latitude/ longitude (top line) and time/quality/date (2nd line).

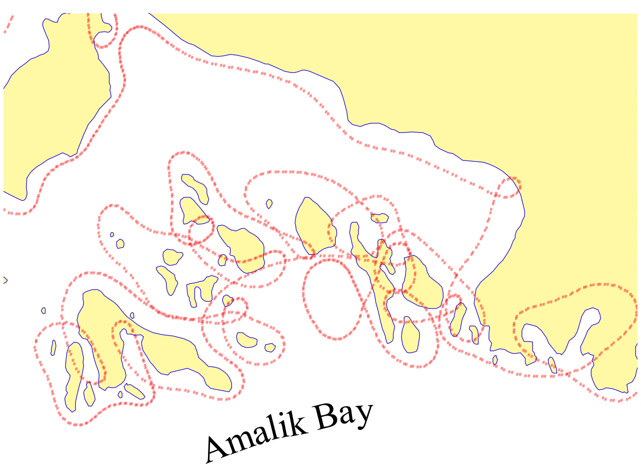

Figure 2. Example of flightline track over a complex series of islets on the Katmai coast. Each dot represents a one second fix mark.

The flightline track with one or two second fix marks (Fig. 2) is recorded using electronic navigation software. Navigation files are combined to produce a Navigation Database of all tracks and videotape numbers for each survey.

Digital video recording (miniDV) has been the standard recording format for surveys since 1998; each frame of the video imagery includes metadata, including a time stamp that can be directly linked to the navigation data. Not only is the recording format of high resolution but images are easily captured for use in web display. Since 2001, one second image captures have been accessible via the web using a specially designed image player that links flightline maps and imagery. A web-user can select an area of interest on a map, select a flightline starting point and then "fly" the coast.

The Gulf of Alaska Coastal Imagery is accessed at:

http://www.CoastAlaska.net

2.2 Mapping and Classification Rationale

The ShoreZone Mapping System is a procedure in which oblique aerial imagery is converted to repeatable units or classes of data; the data include both *spatial representation* that fixes the information on maps (i.e., a mapping system) and an *attribute representation* that classifies data into a discrete number of categories (i.e., a classification system). Both geological and biological attributes are mapped and classified.

The geomorphology mapper reviews the imagery, as well as other existing maps and airphotos, and marks the shore units onto an electronic shoreline (Fig. 3). We have used a variety of digital shorelines for data display including the USGS (1:63,000 scale) shoreline and the ESI shoreline.

Shore Units

A *shore unit* is the primary mapping unit which delineates locations of uniform sediment texture, geomorphology and wave exposure. *Shore units* may be represented as either line segments, points or polygons (Fig. 3); where a polygon is used to represent a *shore unit*, the high-waterline portion of the polygon is represented as one or more line segments so that alongshore length can be used as the standard dimension for region-wide summaries and comparisons.

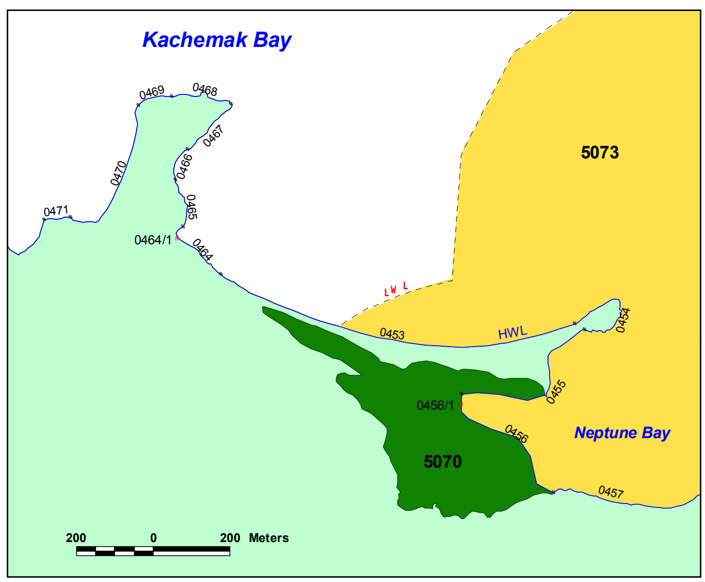

Fig. 3 Example of *Shore Units* represented as lines (segmented HWL), polygons (yellow polygon is a sandflat and green polygon is a supratidal marsh), and points (red dots).

Shore Components

Each shore unit is further characterized by the geologist in terms of a collection of *across-shore components*. The *across-shore components* are geomorphic features, such as cliffs, beach berms, tidal flats, with associated texture characteristics (Fig. 4); the *across-shore component attributes* are entered into the database but are not delineated on maps. The components are described in terms of (a) observed forms and substrates (e.g., a cobble berm), (b) a landward to seaward sequence and (c) the *tidal zone* in which they occur (i.e., supratidal, intertidal or subtidal). Within a unit, there may be primary, secondary or tertiary components.

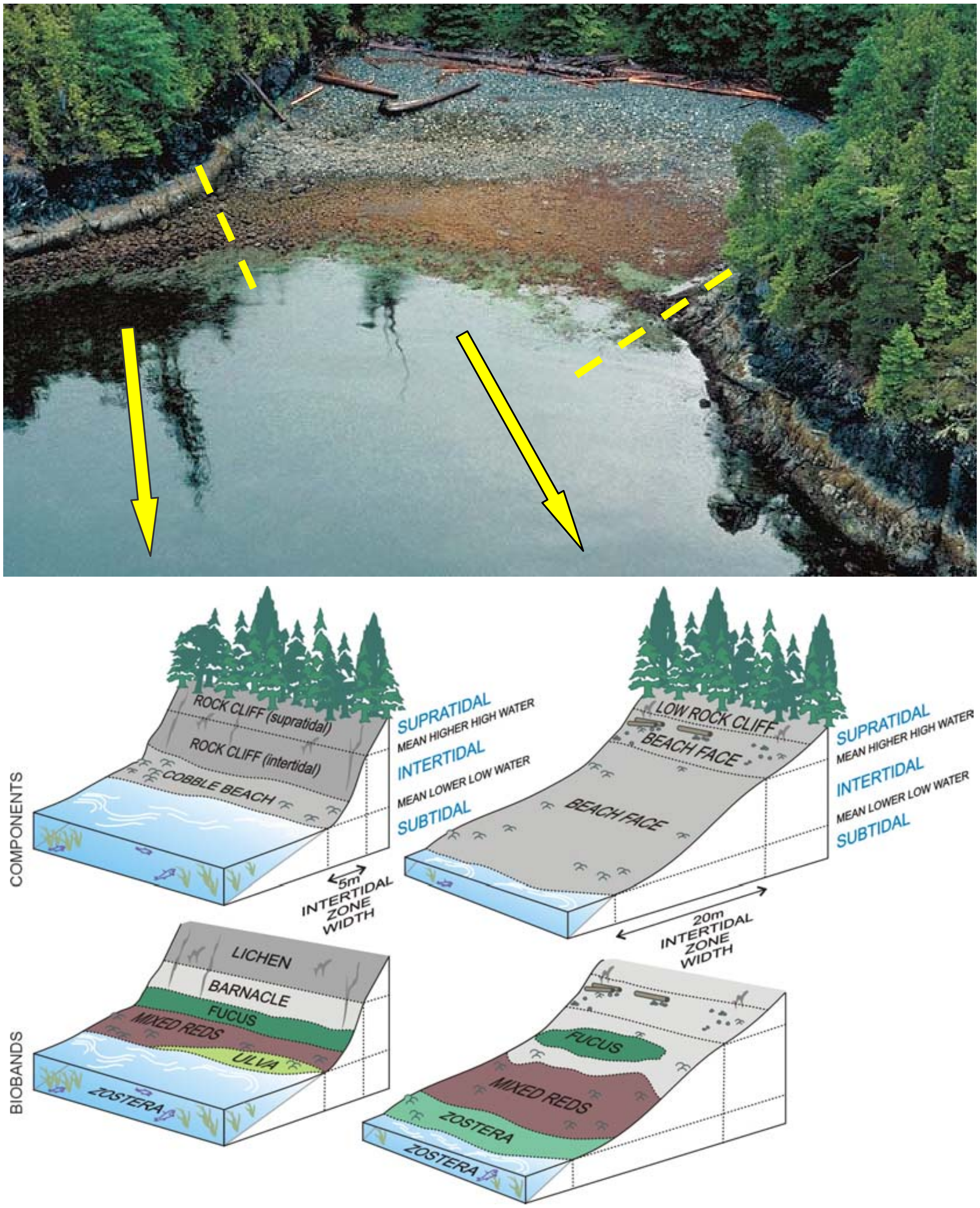

Figure 4 Oblique aerial photo (top) showing how the shoreline is sub-divided into *three shore units* and how each shore unit is further subdivided into *across-shore components* (e.g., rock cliff, cobble beach) and how *biobands* are nested within components.

The across-shore component data essentially paints an across-shore transect of each shore unit (Fig. 4). The Component data is searchable for particular features (e.g., dunes, pebble beach berms, intertidal structures, mudflats greater than 100m in width). The procedure provides the mapper with a high degree of coding flexibility. There are over 6,000 unique combinations of component attributes in the 45,000 components mapped in Alaska (to date).

Biobands

The intertidal and shallow subtidal macrobiota are visible on the imagery and are further described on the synchronous narrative. The biota are characterized by a biologist in terms of recognizable and repeatable biotic assemblages that we have called *biobands* (Fig. 4, Table 1). Biobands are attached, epibenthic species, both plants and animals, that are living in the intertidal zone, usually at characteristic across-shore elevations.

In most cases, the *biobands* are named by a single indicator species (e.g., 'Zostera' *bioband*) but in some cases a characteristic colour/texture descriptor is used for a combination of indicator species (e.g., the 'Dark-Brown Kelps' *bioband* that includes the lower intertidal, chocolate brown, stalked kelps); all of the biobands represent assemblages of biota and are not intended to indicate the occurrence of a single indicator species. Each *bioband* is classified as absent (not observed in the unit), patchy (occurs within less than 50% of the unit) or continuous (occurs within more than 50% of the unit); *biobands* are nested within *across-shore components*.

Some biobands are more recognizable than others, which leads to higher confidence in interpretations (e.g., surfgrass is usually a monoculture and if present appears as obvious patches whereas the mixed filamentous and blade red algal bioband is a mixture of species and often overlaps with other bands). The upper intertidal marsh/grass biobands often overlap making interpretations challenging. Low density coverages of some biobands result in under-reporting; however, given that the same methodology was used coast-wide, the error is at least consistent.

The bioband data are searchable and linked to both Unit and Component data. For example, a user can search for all patchy or continuous occurrences of the 'Zostera' Bioband (eelgrass) for the mapped area (Fig. 5) or could search for just intertidal occurrences of the 'Zostera' Bioband. Such searches are useful for examining spatial occurrence of various biobands.

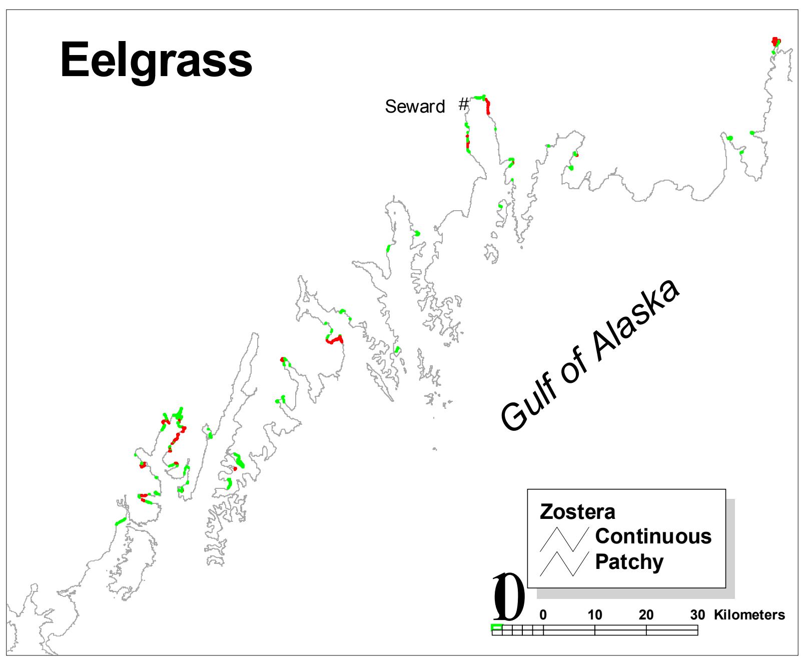

Figure 5. Occurrence of eelgrass (the Zostera bioband) along the Outer Kenai coast.

Table 1. Example of Biobands used on the Outer Kenai Coast[1]

Zone	Bio-band Name	Colour	Description	Wave Exposure[2]
Supratidal	**Splash Zone Lichen *Verrucaria***	Black or bare rock	Visible as a dark band on bare rock, marking the upper limit of the intertidal zone.	Width varies with exposure
	Marsh grasses, herbs and sedges.	Light, bright or dark green Red brown	Appears in wetlands around lagoons, marshes, and estuaries. Includes *Puccinellia, Plantago, Triglochin, Carex* and other salt-tolerent herbs, sedges and grasses.	Very-Protected to Semi-Protected
	Dune Grass	Pale blue-green	*Elymus mollis,* the dune grass found in the upper intertidal zone, on dunes or beach berms.	Protected to Exposed
Intertidal	**Rockweed**	Golden-brown	Dominated by *Fucus sp*. Commonly occurs at the same elevation as the barnacle band.	Protected to Semi-Exposed
	Barnacle	Grey-white to pale yellow	Continuous frosting of *B. glandula* and/or *S. balanoides*. Can form an extensive band in higher exposures where algae have been grazed away. Associated species include *Endocladia, Gloipeltis,*and *Porphyra.*	Protected to Exposed
	Green Algae	Green	Can consist of foliose green algae: *Ulva/Monostroma* or filamentous species: *Acrosiphonia* and *Cladophora.* Foliose greens are commonly mixed with red algae and indicate higher exposures.	Protected to Semi-Exposed
	Blue Mussels	Black or blue-black	Appears in dense clusters that form distinct black patches or bands, either above or below the barnacle band. Often associated with scattered *Fucus,* barnacles, or tufts of filamentous red algae.	Protected to Very Exposed
	Bleached Red Algae	Olive, golden or yellow-brown	A mixture of filamentous and foliose red algae, including bleached *Odonthalia, Palmaria.* Distinguished from the Red Algae band by colour. The bleached colour usually indicates a lower wave exposure than where the RED bioband is seen.	Protected to Semi-Protected
	Red Algae	brick red or bright red or pink/white of corallines	A diverse mix of species of unbleached Red algae includes *Neoptilota, Odonthalia, Neorhodomela,* and *Palmaria.* Lush foliose coralline algae indicate high exposures.	Semi-Proteced to Very Exposed or current affected
	Alaria	Dark brown or red-brown	dense cover of *Alaria marginata* morph. The band has distinct iridescent colour, and ribbon-like texture. Occurs above lower intertidal stalked kelps, and also is part of mixed Dark-brown kelp band.	Semi-Proteced to Exposed or current affected
	Soft brown Kelps	Yellow-olive brown or brown.	Can form dense lush bands in semi-protected areas, defined by ruffled fronds of *Laminaria saccharina* morph and feathery *Cystoseira.* Can also include *Alaria.*	Very Protected to Semi-Protected
	Dark-brown Kelps	Dark chocolate brown	stalked kelps in the lower intertidal, observed at higher wave exposures. Blades are leathery and shiny smooth dark brown. Includes a mixture of *L. bongardiana* morph, *Lessoniopsis, L. yezoensis,* and *L. setchellii*. Pure stands of *Lessoniopsis* occurs at the highest exposures.	Semi-Exposed to Very Exposed
Subtidal	**Eelgrass**	Bright to dark green	*Zostera marina* is the dominate species. Common in estuaries, lagoons and channels, in areas with fine sediments. Eelgrass can occur in sparse patches or in extensive dense meadows.	Very Protected to Semi-Protected
	Dragon Kelp	Golden-brown	*Alaria fistulosa* is a canopy-forming kelp with long blade and hollow midrib, found in nearshore habitats. Appears ribbon-like on water's surface.	Semi-Exposed
	Bull Kelp	Dark brown	A distinctive floating kelp with blades growing from a single floating bulb atop a long hollow stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa*.	Semi-Portected to Exposed or current-affected

1 A different bioband table is prepared for each coastal mapping region to reflect differences in the observed species assemblages (see Appendix A, Tables A-15, A-16, A-17).

2 Six Class Exposure Ranking: Very Exposed > Exposed > Semi-Exposed > Semi-Protected > Protected > Very Protected

2.3 Data Attributes

Data are stored in five separate tables within a relational databases as shown in Figure 6. The attribute data are linked to spatial units (see Fig. 3) through the Unit Table.

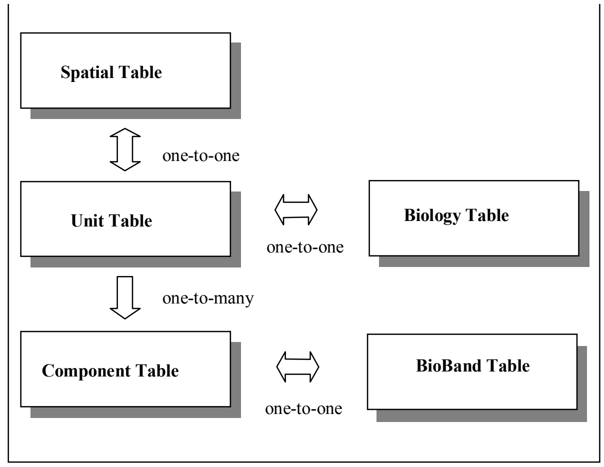

Figure 6. The five primary tables or databases and the data structure among those tables.

Physical Unit Table

The Unit Table includes information that is related to the entire unit. This includes various geomorphic attributes such as overall coastal morphology type, coastal stability, sediment sources to the unit, wave exposure level, orpotential oil residence. Administrative information such as the names of the mappers, editors, data mapped are also included within the unit table.

Biological Unit Table

There is a complementary Biology Unit Table that includes biological information related to the entire unit. Two of the most important attributes included in the Biology Table are: (a) the biological exposure and (b) the Habitat Class.

The *Biological Exposure* classification is based on the fact that many species have specific tolerances to wave exposure and substrate mobility. That is, species occurrence is largely determined by substrate type and wave exposure. Understanding the wave exposure requirements of certain species and associated assemblages is the foundation of the *biological exposure* categories and explains how presence/absence of intertidal species can be used as an index of the wave exposure at a site (Table 2). For example *Ulva* (the ULV bioband) occurs on lower energy shorelines (Semi-Protected or Protected) but is too fragile to survive in higher energy environments; as such, it is an indicator of lower exposures. On the other hand, the ‘dark-brown kelps’ bioband (CHB) contains *Laminaria yezoensis* and *Laminaria bongardiana* morph, which only occur in higher exposures (Table 2). The species assemblages provide a natural “bar-coding” of exposure levels within each shore unit. We regard the *biological exposure* as a better estimate of average wave-energy levels than the fetch-calculated exposure levels.

Habitat Class – the *habitat class* provides a summary indicator of the overall biotic assemblage. While not all species may be present at a specific site, the idea of typical biotic community as a function of exposure and substrate, is a useful concept, particularly for areas with no biotic mapping. For example, a semi-exposed, bedrock shore (immobile substrate) typically has the most diverse assemblage of intertidal epibenthic biota. But a semi-exposed, sand beach (mobile substrate) will not have any attached epibiota and is typically dominated by an infauna biotic community. A complete listing of Habitat Class is included in Appendix A, Table A-18.

Table 2 Example of Two Exposure Indicator Assemblages, Outer Kenai Coast[1]

Biological Exposure Category			
Semi-Exposed (SE)		Semi-Protected (SP)	
Associated Biobands[2]	**Indicator Species**	**Indicator Species**	**Associated Biobands**[2]
VER	medium width *Verrucaria*	narrow width *Verrucaria*	VER
BAR	*Balanus/Semibalanus*	*Balanus/Semibalanus*	BAR
FUC	*Fucus*	*Fucus*	FUC
		Ulva	ULV
BMU	*Mytilus trossulus*	*Mytilus trossulus*	BMU
RED	*Odonthalia*	*Odonthalia*	HAL
RED	*Palmaria*	*Palmaria*	HAL
RED	*Neoptilota*		
		Cystoseira	SBR
		Laminaria saccharina morph	SBR
CHB	*Cymathere*	*Cymathere*	SBR
CHB	*Laminaria yezoensis*		
CHB	*Laminaria bongardiana* morph		
CHB or ALA	*Alaria marginata* morph	*Alaria marginata* morph	ALA or SBR
ALF	*Alaria fistulosa*		
NER	*Nereocystis luetkeana*	*Nereocystis luetkeana*	NER

1 a complete table is presented in Appendix A, Table A-15 to A-17
2 codes for biobands are presented in Appendix A, Tables A-15 to A-17

The Biology Table also includes administrative information such as the biomapper and editor names, 35mm photos for the unit, ground station number and the sources of information used in the biological interpretations.

Component Table

The Component Table includes a record on each across-shore component (see Fig. 4) with attribute information on the morphology, sediment texture, width, slope, dominant modifying process and estimated oil residence index.

Bioband Table

The Bioband table includes a three level classification of the abundance for each bioband.

2.4 Products

One of the objectives of the Alaska ShoreZone Mapping System is to make regionally consistent products widely available. Based on previous experience with data dissemination in the State of Washington, information requests in Washington can be broadly classified into two categories:

general users who are primarily interested in maps of pre-selected thematic data such as coastal morphology type, wave exposure level, shore modifications or specific biota distributions (e.g. eelgrass). This data is widely distributed on a CD-ROM (see Washington Department of Natural Resources, Nearshore Habitat at www2.wadnr.gov/nearshore/), although users are required to have ArcView to view the thematic data.

"power users" who wish access to the entire data set, to conduct complex searches of the data and to display the spatial occurrence of searches. The complete dataset is also distributed on the same CD-ROM but "power users" would require knowledge of the database structures as well as having GIS tools for display of the data.

The Alaska ShoreZone data products are designed to facilitate user access through the internet and to address a variety of user needs.

1. web-posted imagery – users window an area of interested and using a VCR-like image player, fly the coast using one-second, video imagery captures (Fig. 7).

Figure 7 The web-based coastal imagery window, showing the flight track near Soldovia (green dots) and the image player (upper right). The image is of Port Graham and its location is shown by the yellow dot on the trackline. Access the coastal imagery at www.CoastAlaska.net.

2. thematic distributions of selected features in map format. The themes are pre-plotted from data that is known to be of interest to a wide range of users (e.g., Fig. 5). By placing the thematic data on an ArcIMS website, users can view the themes at different scales and tailor maps for their own use.

3. downloadable, full-function datasets. These datasets include all the mapping data in (a) spatial data in ArcView Shape Files and (b) Access97 database formats. These datasets appeal to "power users" who may be interested in analyzing the data or conducting complex, relational searches that can be displayed in a variety of map formats.

As part of a contract by EVOS, a website is being developed to access the ShoreZone data. Coastal imagery for a large part of the Gulf of Alaska coast is available and mapping data for the Outer Kenai coast has been posted to this site (www.CoastAlaska.net).

3.1 Imagery Acquisition and Handling

Image Acquisition

Acquisition of coastal imagery has remained remarkably consistent over the 25 years the aerial video imaging (AVI) surveys have been conducted (Owens 1983). The only major change that has occurred is to include a coastal ecologist in all aerial overflights (since 1991) so that there is an insightful description of intertidal and shallow, subtidal biota.

Guidelines used for imagery collection are summarized in Table 3. Survey results are typically compiled in flightline manual that includes: a summary table of tapes acquired during the survey, flight tracks that show the location of each videotape (Fig. 8), flight logs that summarize key locations, photos and time of each videotape; and a navigation data file.

Table 3 Guidelines for Oblique Imagery Acquisition

Category	Feature	Description
Aircraft	Aircraft Platform	where coastlines are highly crenulated (e.g., Prince William Sound, Afognak Is) a helicopter is required; for long, linear shorelines, especially those with wide intertidal zones, a fixed wing aircraft may be suitable
	Flight Altitude	200-300 ft normally but up to 600-700’ on very wide shorelines
	Flight Speed	60 knots in a helicopter; as slow as safely possible in a fixed wing aircraft
	Other	removal of door or window for the videographer is standard
Crew	Videographer/ Geomorphologist	images shoreline; provides synchronous narration of geomorphological features on one audio channel; directs pilot on altitude, distance offshore and flight speed; monitors video imagery quality
	Biologist	describes intertidal biota that is recorded on a second audio channel; shoots still photographs
	Navigator	monitors electronic navigation files; assists pilot in flight paths
Equipment	Navigation	DGPS positioning should be used where possible; record flightline fix marks at 1-2 sec intervals; use an electronic navigation system for flightline tracking during the survey (e.g., Nobeltec Navigator®)
	Video	“pro-sumer” video camera (e.g., Sony VX2000, minDV) with digital recording capability; GPS burn on device (Horita captioning system); separate digital recorder (e.g., Sony GVD1000); a gyro-stabilization system may be appropriate; audio commentary is recorded spearately on to the two audio soundtracks of the videotape
	Camera	high quality camera for still photos (Note: we recommend use of film camera and post-survey digitization of images; digital cameras have a delay in between the shutter and image recording and we have had up to 30% of our images blurred because of this delay); professional grade film is recommended
	Communications	the aircraft must have a communications system that links all of the flight crew; the communications system must have “push-to-talk” microphones to avoid interaction with recording system.

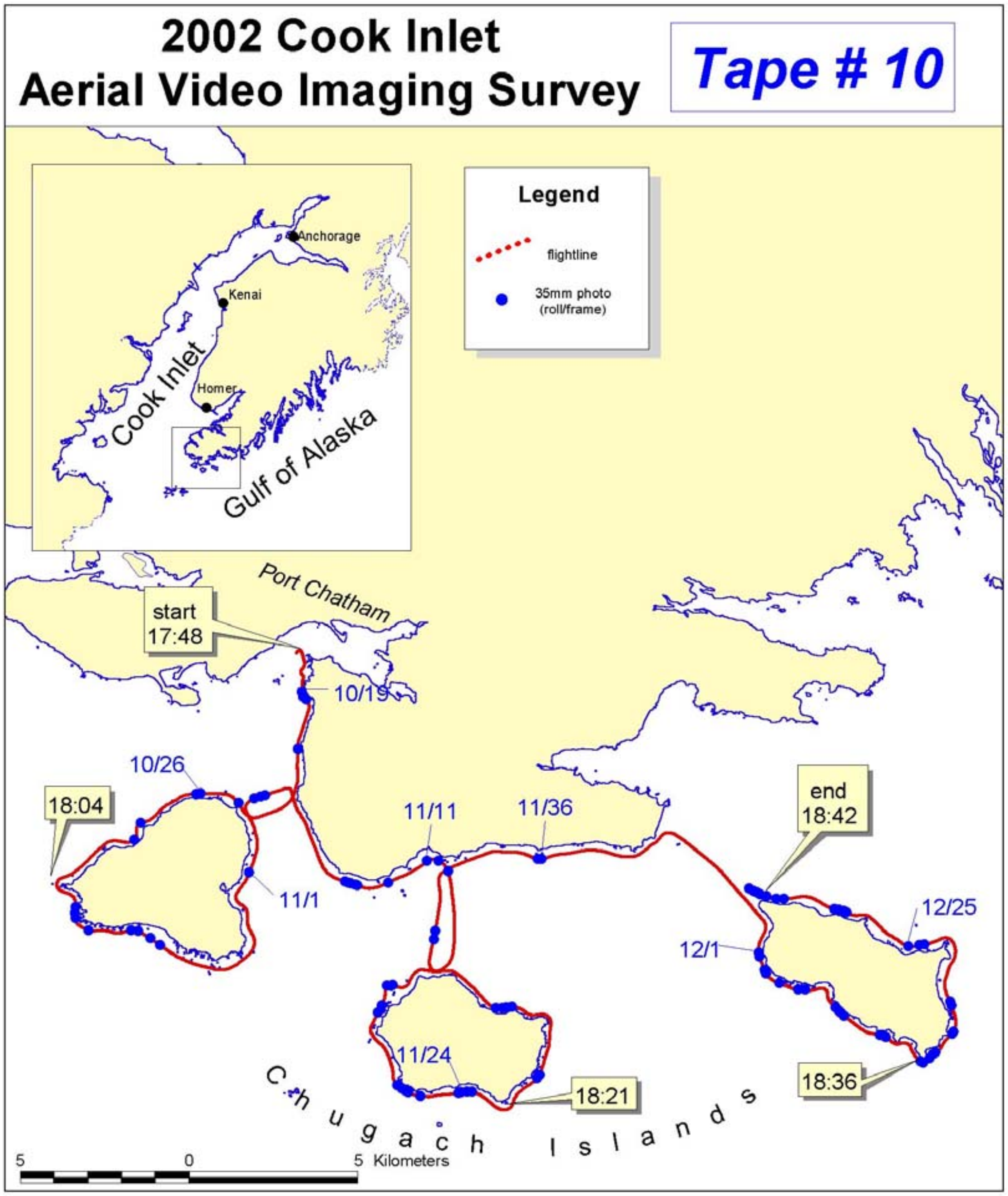

Figure 8. A flightline map showing the location of Tape 10 video imagery (red track) and still photo locations (blue dots) from the 2002 Outer Kenai aerial video imaging survey conducted for CIRCAC.

3.2 Aerial Survey Program

Planning for the aerial survey program must begin well in advance of the field program (typically months before) to secure the appropriate survey personnel, videographic equipment, aircraft and support base. Many of the base camps are at remote locations that require fuel to be placed prior to the survey, necessitating very long lead times.

The primary scheduling criteria for the aerial survey program is the selection of tide windows where tidal elevations will be lower than zero feet for all the imagery acquisition. There are typically three suitable tidal windows per summer season, each five to six days in duration.

Suitable low tides range from about 2.5 to 4 hours per day in duration and on the open coast, typically begin at first light.

While most fixed-wing aircraft have suitable ranges to fly for the duration of low tide (4 hours), helicopters are typically limited to 3 hours of flight time. Fuel placement is critical to optimize imagery acquisition during the low-tide window; we have used both helicopters and vessels to position fuel. Our absolute minimum refueling time has been 20 minutes, which is about 10% of the potential imaging window.

As imaging is conducted from the left side of the aircraft, the survey is usually planned to achieve a contiguous, sequential imaging of the shoreline. However, weather conditions may require alteration of the plan so primary, secondary and tertiary survey objectives should be part of each daily plan. We have often ended up surveying completely different areas as a result of patchy fog occurrence at the primary survey objective.

3.3 Ground-Survey Program

Most of the recent aerial survey programs have included shore or ground surveys to (a) improve mapping interpretations and (b) provide specific ground observations of substrate, morphology and biota. The ground stations can be linked very precisely to the aerial video imagery.

The ground surveys have been conducted for about ten years and the specific products of the field program are not as rigorously defined as they are for the ShoreZone mapping products. The following sections serve as general guidelines. However, the completion of the station survey database (Appendix C) is considered mandatory; use of this database will allow a Gulf-wide, standardized, ground-station intertidal database to be developed.

Ground-Survey Objectives

The primary objective of the ground survey is to obtain site information that improves the mapping interpretation and classification. Both geomorphologic and biological information is acquired. Across-shore profiles are surveyed for width, elevation, sediment composition and biota. The data are systematically recorded in databases. Field photos are systematically recorded and are linked to the survey notes.

Ground-Survey Scope

The geographic extent of the ground survey should reflect the geographic extent of the aerial survey (typically 1,500 – 2,000 km of shoreline; e.g., Outer Kenai coast) and should be planned for a similar tide window (lowest daylight tides of the year, usually a six-day window with tidal elevation below 1m for at least 3 hours per day). We have run some ground-survey programs at the same time as the aerial survey with a transfer of personnel between the two programs, and we have conducted ground surveys after the aerial survey program.

Most of the ground surveys have been vessel supported, using a larger support vessel with launches to support two shore teams. In some cases, a centrally-located base camp is used with either high speed launches or helicopter support to provide shore access. With two survey teams, approximately 50 stations per survey are inventoried.

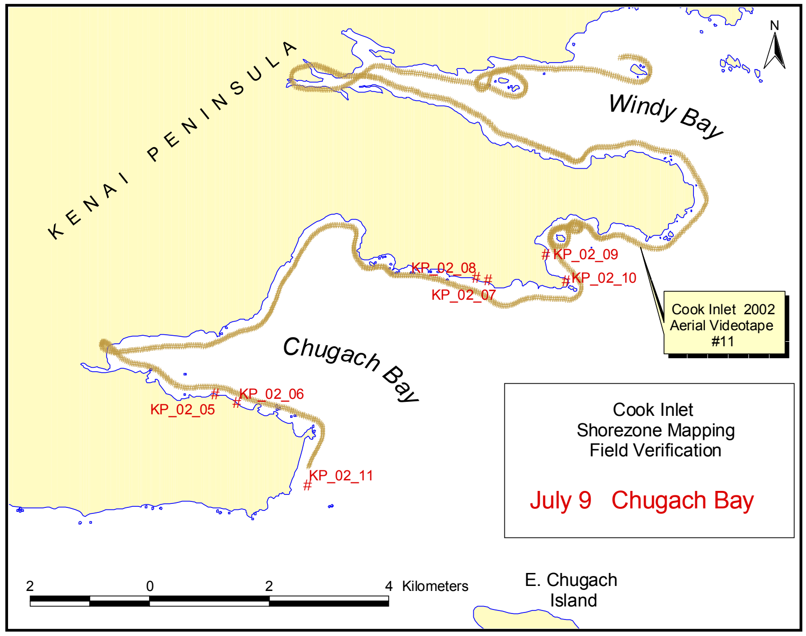

Figure 9. Example of shore station cluster (red dots) at Chugach Bay of the Outer Kenai coast. The beige line is the trackline from the aerial video imaging. An aerial view of Shore Station KP_02_05 is shown in Fig. 10.

<u>Ground Site Selection</u>

The ground survey is scheduled to provide a relatively uniform distribution of shore stations throughout the area of interest. Stations are typically clustered in a small area on a variety of shore types and exposures (Fig. 9) to minimize travel time during the low-tide window.

Figure 10. Aerial view of Station KP_02_05 (arrow), captured from video imagery. Note the GPS co-ordinates of the image are burned on the video. The site was selected because of representation of high wave exposures and because of suitable access by boat. See Fig. 11 for surveyed profile, Fig. 12 for a ground photo and Table 4 for bioband/species list.

The survey stations location can be precisely positioned on the aerial imagery (Fig. 10) and related directly to mapping data for the *shore unit*.

Field Data Collection

Location information, survey crew names, date and time of access are recorded on field forms and entered into a field station database (Appendix C).

1. *Surveyed Profile* – a profile is surveyed across the shoreline at each ground station (Fig. 11), using the water level, corrected to tidal datum, as a reference level. Key morphological features are identified and elevation of observed biobands (Fig. 12) and species are surveyed (Table 4).

Horizontal and vertical data are entered into a spreadsheet to graphically reconstruct the profile (Figure 11). Elevations of bands and of specific species are noted during the survey process.

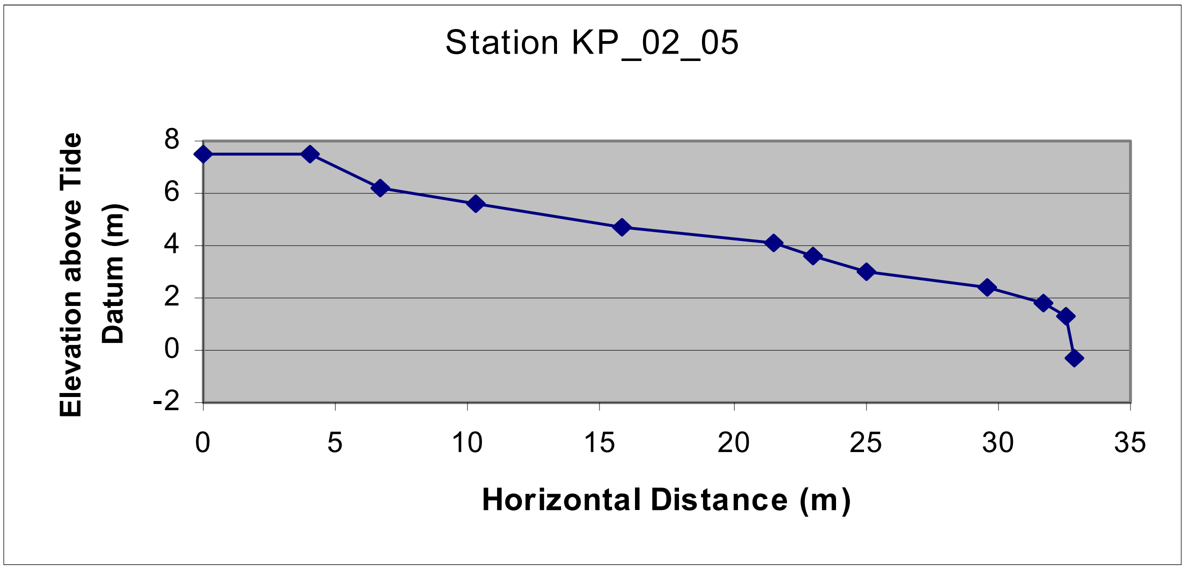

Figure 11. Across-shore profile at shore station KP_02_05. The “zero” elevation level is mean lower low water (MLLW) and the profile extended to 7.5 m above that level.

Bioband and Species Data

A shore-station biological database has been developed for recording the biological data (see Table 4 for example of bioband and species listing for shore station KP_02_05; see Appendix C for data dictionary). It is intended that the database will be web-posted, will be self contained with station data and data dictionary, and will be expanded as addition ground-station data are added.

Figure 12 A ground photo of field station KP_02_05 looking onshore. The dark band in the middle of the photo is the 'blue mussel' bioband (*Mytilus trossulus*) and the brown band below is the 'alaria' bioband (*Alaria marginata* [morph]). See Table 4 for inventory of species within each bioband.

3.4 Qualification of Mappers

Geomorphological mappers should have an appropriate degree in earth sciences and five years of experience in either mapping or in coastal inventories. Biological mappers should have an appropriate degree in biological sciences and five years of experience in either mapping or coastal habitat inventories. Mappers should have a one month apprenticeship or training of the ShoreZone system prior to conducting independent mapping.

3.5 Assembly of Materials

A variety of materials are required for the mapping process, where video-imagery is converted into digital data by professional classifiers (Table 5).

Table 4 Zones, Biobands and Species at Shore Station KP-02-05

Zone	Bioband	Species Name	Common Name
Supratidal	*'Grass' Bioband (GRA)*	*Elymus mollis*	dune grass
	'Verrucaria' Bioband (VER)	*Verrucaria*	splash -zone black lichen
Intertidal	*'Barnacle' Bioband (BAR)*	*Balanus glandula*	common pacific acorn barnacle
		Chthamalus dalli	small brown barnacle
		Endocladia muricata	thin dark spiny wires red alga
		Fucus sp	common brown rock weed
	'Blue Mussel' Bioband (BMU)	*Acrosiphonia sp*	green ropeweed
		Alaria marginata	short stipe alaria
		Anthopleura artemisia	burrowing anemone
		Anthopleura xanthogrammica	large solitary green anemone
		Bossiella sp	coralline red alga
		Callithamnion pikeanum	filamentous red alga
		Chthamalus dalli	small brown barnacle
		Desmarestia viridis	green acid kelp
		Endocladia muricata	thin dark spiny wires red alga
		Fucus sp	common brown rock weed
		Katharina tunicata	black katy chiton
		Limpet sp	limpet spp
		Lithothamnion/Lithophyllum	red calcareous crust
		Mytilus trossulus	blue mussel
		Nucella lima	rough purple dogwinkle
		Odonthalia floccosa	knob-tip branches filamentous red alga
		Polysiphonia sp	tier-celled fine tufts filamentous red alga
		Porphyra abbotae	Porphyra red alga
		Semibalanus cariosus	thatched barnacle
		Strongylocentrotus droebachiensis	green sea urchin
		Ulva_Ulvaria sp	sea lettuce
		Urticina crassicornis	white tubercle red anemone
	'Alaria' Bioband (ALA)	*Alaria marginata*	short stipe alaria
		Anthopleura artemisia	burrowing anemone
		Anthopleura xanthogrammica	large solitary green anemone
		Dermasterias imbricata	leather star
		Mikiamella ruprechtiann	filamentous red alga
		Neoptilota hypnoides	filamentous red alga
		Nucella lamellosa	frilled dogwinkle
		Pisaster ochraceous	purple/ochre star
		Pycnopodia helianthoides	sunflower star
		Semibalanus cariosus	thatched barnacle
		Urticina crassicornis	white tubercle red anemone

Table 5 Materials Required for ShoreZone Mapping

Material	Description
Aerial Video Imagery	in videotape or DVD format (avoid using third or fourth generation copies because of loss of resolution); it is essential that the imagery include a time code (normally the GPS satellite time that is burned on during the overflight) that is linked to the navigation file.
Flightline Manual	shows the general location of the tapes and flight path
detailed flight path maps	either digital flight maps or hard-copy flight paths that show times at 20 sec intervals and individual one-second fix points
Ground Survey Report	provides mappers with ground survey data and photographs to assist with interpretation
Access97 Database	mappers enter data directly into appropriate data fields
ShoreZone Data Dictionary	a data dictionary describes the contents of each data field (see Appendix A of this report)

3.5 Classification Procedures

The general procedure is for the physical scientist to map the shoreline first by delineating the shore units and recording the physical data. The physical mapper views the imagery, decides on the next appropriate shore unit, delineates the unit boundaries on the hard-copy map and enters the appropriate data into the database. The physical mapper then digitizes the unit breaks onto the electronic shoreline and adds unique identifiers so the spatial data can be linked to the attribute data. Mapped areas of the coast are then transferred to the biologist, who adds the biological data. Following completion of the biological data, a master database is created, reviewed by the database manager and submitted to the project client.

Physical Classification

The first challenge to the physical mapper is to delineate shore units. Within a *shore unit*, the geomorphology, sediment texture and wave exposure level are uniform in the alongshore direction but may accommodate across-shore variation in sediment texture and morphology. In some cases, shore units might contain repeatable sequences of morphologies and textures such as small pocket-beaches interspersed with rock headlands. Figure 13 illustrates a hard-copy map of Afognak Island that has been segmented for shore units.

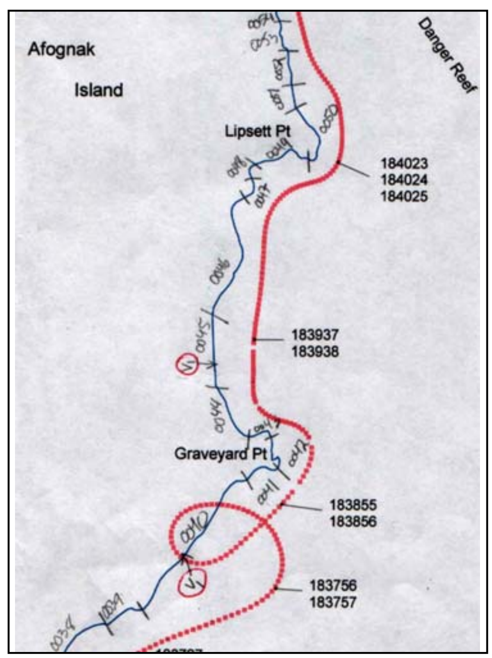

Figure 13 Example of a hand-annotated map with shore units delineated on the HWL and flight track (red dots are 1-sec fix marks) with annotated times.

Once the unit boundaries are delineated, the mapper begins filling the database with attribute data about the unit. Most mappers first fill in the across-shore component data; the sediment characteristics and across-shore width are important for classifying the overall unit type (Coastal Class) so it is easier to complete these data fields first. Next the Unit Table fields are completed. The mapping process requires concentrated attention to detail and try to limit our mappers to four hours per day of classification time. Remaining portions of a “mapping day” are dedicated to digitizing the unit breaks, reviewing other mappers classification and data management.

Polygon Protocol

Our preferred shore-unit spatial representation is a line segment as this is the standard format for comparison. In fact, even units represented as polygons are forced to have an associated linear length to facilitate data comparisons (e.g., there are 243 km of wetland in Western Cook Inlet or there are 47 km of highly permeable, cobble-boulder beaches on the Outer Kenai coast). However, there are locations where polygon representation is useful, such as the supratidal wetlands of Upper Cook Inlet. A "polygon protocol" was developed to provide consistency in implementation of polygon mapping (Table 6).

Table 6 Guidelines for Use of Polygons in ShoreZone Mapping

General: *polygons will be used where the existing linear mapping approach does not provide an adequate ecological picture of the shore zone.*

In general, polygons are used to describe wide shore zones, where the width of the unit would be close to the length of the unit and where our typical across-shore description of the shore zone, either as physical components or biological biobands does not adequately capture the ecological variation within the unit.

Examples include:
- complex offshore reefs
- wetlands with tidal channels
- tidal flats with complex tidal channels

Rules:
1. the across –shore width (supratidal zone + intertidal-zone) must be > 1,000m
2. the exception is that where there are adjacent polygon units, polygons can be used until shore zone widths are <100m) – polygonal mapping will **maintain ecological and spatial continuity**
3. the minimum polygon size (at a mapping scale of 1:20,000) is 1 cm^2 or $4,000m^2$.
4. polygons can be (a) an entire unit or (b) a collections of bands and components or (c) an individual band or component.
5. polygons nest within Units and there is a **line segment** for the *MHWL* representing each unit; there may be polygons above or below the line segment.
6. polygons will be recorded as variants within the unit field; that is, like our previously plotted **point** features, **polygons** represent a subset of features within the unit.
7. all component data that is recorded in the variant will also be recorded under the unit component data
8. the following lines should be used for polygon boundaries: (a) the marine limit, (b) the MHWL, (c) the MLWL and (d) other boundaries as required to *appropriately capture the ecological function of the mapping unit or subunit.*

Biological Classification

The biological mapper assembles the following information in preparation for classifying the intertidal epibiota: annotated hard-copy maps of shore units (Fig. 13), video imagery, flightline manual showing overall flight tracks, high resolution 35mm slides and ground-station data reports with band descriptions and species inventories. The biological mapper is heavily reliant on audio commentary of the videotape as many of the important species are not consistently visible on the imagery but *were* visible during the overflight and *were* systematically described.

The slide imagery is projected next to the video imagery to provide greater resolution of biobands. The mapper reviews the imagery within each unit, catalogs unit-wide information into the Biology Table (Fig. 6), and the appropriate bioband data into the Bioband Table (Fig. 6).

The biology mapper has all the physical mapping data available and provides a first order check on the physical spatial representation and coding; units requiring checks are noted in the database and the database manager is notified for review.

3.6 Quality Assurance and Quality Control (QAQC) Procedures

A formalized Quality Assurance and Quality Control (QAQC) procedure is recommended, to ensure that (a) data is consistent with the Data Dictionary, (b) the classifiers are inter-calibrated and consistent and (c) codes or definitions are modified where new features not previously encountered are identified.

Day-to-Day Reviews

Our mappers typically map in pairs for a given section of coast. Each mapper reviews 10 mapped units of the other mapper each day. In that mappers are typically completing 50-75 units per day, this represents about 15-20% review per day. A classification review code is entered for each unit by the reviewer (Table 7, 8). The original mapper is required to correct units with a QAQC code of 2 to 5.

This day-to-day review results in inter-calibration of mappers and also rapid identification of an systematic discrepancies of an individual mapper.

Table 7 Physical QAQC Severity Codes

QAQC Code	Type of Change Required
0 or blank	no changes required
1	change in Secondary, Tertiary Form or Material required; change in Sediment Supply or Shoreline Stability required; typographical error
2	change in Primary Form or Material required; minor line-work error
3	change in Coastal Class, ESI Class or Exposure required; significant line-work issue

Editor Reviews

A senior mapper reviews 10% of the overall mapping units each week. Sections of coastline to be reviewed will be distributed geographically throughout Region/Areas to provide geographically representative areas, tape qualities and shoreline types. The senior physical mapper uses the same coding system (Table 7) and the biological editor uses a slightly different classification for review (Table 8).

Table 8 Biological QA/QC Severity Code

QAQC Code	Description	Significance of Change?
0 or blank	**No changes required**	n/a
1	**Change band distribution code** – from patchy to continuous or vice versa. This revision was defined as the least significant type of revision and was considered as an example of variation of interpretation between observers.	least significant
2	**Add a bio-band** - Adding a band was the most common revision made in QA/QC and the frequency of this change decreased as junior mappers' experience with video interpretation increased. These changes are defined as an 'error of omission', not an error in interpretation	
3	**Delete a bio-band** – Deleting a band that had been mapped was considered an error in interpretation. Usually these changes were associated with an 'add band' change and were subject of discussion for assisting in clarifying bio-band descriptions.	
4	**change the habitat observed (HAB_OBS) classification** – The correct interpretation of the HAB_OBS also led to discussion of definitions of the classification on the species/wave exposure table (see Appendix A, Table A-18).	
5	**change the bio-exposure category (EXP_BIO)** – The correct interpretation of the Exposure category was considered the most significant QA/QC change type.	most significant

Database Overview

As each coastal mapping region/area is completed, the database manager performs a series of checks to ensure internal consistency of the database and consistency with the Data Dictionary. The checklist is summarized in Table 9.

Table 9 Database Manager's Final Review Checklist

1.0 General Review of Unit Database prior to Handoff to Biologists

1a. check all fields for blanks; fill in appropriate blanks.
1b. check out of range field data (can use a sort or query)
1c. fill in all tape numbers; (format is XXyyyy-nn where XX is the code for the tape series, yyyy is the code for the year and nn is the tape number.
1d. fill in the Region & Area fields (these are alphanumeric so use 03 for Region or Area 3); fill in the Phy_Ident field using the Region-Area-Unit-Subunit data.
1e. check to make sure there are no duplicate records (check on Phy_Ident)
1f. Print summary of Shore Problem fields
1g. check for units with missing X-shr

2.0 General Review of Xshr Database prior to Handoff to Biologists

2a. check for blanks and out of range data
2b. do a "Group By" query to lump components codes; also use Count in the Query and Sort-Descending on the Count Field to look at the combinations that only occur once or twice. Confirm that coding in all Form and Material fields is consistent with Data Dictionary.
2c. update Region and Area fields and then update the Cross-link field using Region-Area-Unit-Subunit-Zone and Component data. Note that fields are alpha numeric
2d. check for duplicate records using the Cross-link field.
2e. check for missing zones and zones out of sequence (i.e., A1, A2, B2, B3)

3.0 Link Between Spatial Data (ArcView shoreline) and Unit

3a. export the ArcView arc, point and polygon files to Access.
3b. using a "Group By" Make-Table query, summarize the shoreline length and shoreline area for each unit.
3c. using a "Find Unmatched" query, check the Arc Unit tables against the Unit database to locate unmatched records. Do the query in both directions.
3d. resolve any unmatched records.
3e. verify that there are the appropriate number of Arc, polygon and points in the Spatial and Mapping database.
3f. update the Length and Area fields in the Unit database.
3g. attach Unit field to the exported ArcView database and re-import to ArcView.
3h. review spatial distribution of Exposure for Units that are too long and lump several exposure categories and inconsistent exposure interpretation.

4.0 UPDATING and FEEDBACK

This report provides the first version of the protocol to guide ShoreZone mapping in the Gulf of Alaska. While it is important that a data standard provide backward compatibility to the original mapping (e.g., the 2001 surveys of Cook Inlet for CIRCAC), new attributes or techniques can be added to the system. For example, the State of Washington requested the addition of fields for shore modification inventory, as this amount of modified shoreline (e.g., seawalls and bulkheads) was an important issue for regulators. On specific projects, coastal riparian classifications of terrestrial vegetation types has been added to the classification. The system can accommodate the incorporation of specialized attributes.

Another example of flexibility of the ShoreZone system is the integration with ESI mapping. The ShoreZone mapping is potentially compatible with the NOAA ESI system, which has been applied throughout Alaska; the GIS ShoreZone mapping data provides greater detail of intertidal resources than does ESI. Data could be directly imported to ESI and treated as additional data layers for the ESI coverages.

As part of the March 2003 Coastal Mapping Workshop, it was recommended that a ShoreZone Mapping Workgroup be established to provide guidance on technical issues. The initial *ad hoc* Workgroup members are identified in the workshop report[1]; Ms. Susan Saupe of the Cook Inlet Citizens Advisory Council (CIRCAC) is the Acting Chair of the Workgroup. The workshop participants also recommended that a Coordinator position be established, possibly through The Nature Conservancy (TNC). Although the TNC offered to provide partial funding for the position, as of December 2003 the position has not been filled.

It is suggested the feedback on the protocol or products be provided through the ShoreZone Mapping Group Acting Chair (saupe@circac.org), until such time as a Coastal Mapping Coordinator is established. The CoastaAlaska.net website will provide a link(s) for additional comments.

[1] http://www.oilspill.state.ak.us/pdf/shoreline_map_wrkshp_report_may21.pdf

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Appendix A

Data Dictionary

Appendix A Table of Contents

Appendix A List of Tables

Table A-1 Summary of Data Fields in the Unit Database

Field Names	Type	Description
UnitRecID	I	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
REGION	T	coastal region number
AREAS	T	coastal area number
PHY_UNIT	T	physical unit number
SUBUNIT	T	sub unit number
TYPE	T	indicator of polygon, line or point unit type
BC_CLASS	I	shoreline type, BC classification system
ESI_CLASS	T	shoreline type, ESI classification system
LENGTH_M	N	alongshore length of unit in meteres
AREA_M2	N	area of unit in square meters
GEO_MAPPER	T0	last name of geology mapper
GEO_EDITOR	T0	last name of individual responsible for reviewing and editing
GEO_MAP_DATE	D/T	date of geological mapping
GEO_SOURCE	T	data sources for geological interpretation
SCALE	T	scale of base maps used to delineate units
VIDEOTAPE	T	the videotape id number
SCRN_TIME	T	the screen time burned onto the video image
QUAD_MAP	T	identifier number of orthophoto map
MAP_NO	I	page number from the DeLorme Alaska Atlas
CHART	T	NOAA chart number
EXP_IDENT	T	cross-reference to EXPOSURE database
EXP_CALC	T	exposure calculated from fetch info
EXP_OBSER	T	exposure observed by geomorphologist
EXP_CLASS	T	“best” estimate of exposure from calculated-, observed- and bio-exposure
ORI	I	oil residence index
SED_SOURCE	T	source of sediment within the unit
SED_ABUND	T	qualitative index of sediment in the unit
SED_DIR	T	estimate of sediment transport direction based on indicators within the unit
CHNG_TYPE	T	accretional, stable, erosional status
CHNG_RATE	N	rate of change
SHORENAME	T	local geographic name
OTHER	T	comment
SHORE_PROB	T	indicator of significant base map problem
SM1_TYPE	T	type of primary shore modification (e.g., type of seawall)
SM%	I	estimate % occurrence of SM1 in unit
SM1_M	I	calculated length of SM1 in unit
SM2_TYPE	T	type of secondary shore modification (e.g., type of seawall)
SM2%	I	estimate % occurrence of SM2 in unit
SM2_ M	I	calculated length of SM2 in unit
SM3_TYPE	T	type of tertiary shore modification (e.g., type of seawall)
SM3%	I	estimate % occurrence of SM3 in unit
SM3_ M	I	calculated length of SM3 in unit
SMOD_TOT	I	total % occurrence of shore modification in the unit
RAMPS	I	number of boat ramps in the unit
PIERS_DOCKS	I	number of docks or pier within the unit
REC_SLIPS	I	number of “recreational slips within the unit
DEEPSEA_SLIP	I	number of ship or “deepsea” slips within the unit
ITZ	N	intertidal width; sum of the width for across-shore components

Data Dictionary for UNIT Databases

(Adapted from methods and codes outlined in Harper *et al* 1999)

Field Name	Type	Description
Unit_RecId	N	space for unique id for each record
PHY_IDENT	T	unique Physical Ident number for the unit, a combination of region, area, unit, and sub-unit. (RR/AA/UUUU/SS)
REGION	T	coastal region number; see Appendix E
AREAS	T	coastal area number; see Appendix E
PHY_UNIT	T	physical shore unit number; the unit is the primary alongshore subdivision during the mapping
SUBUNIT	T	sub-unit number: “0” for main Unit and “1, 2, 3....” for variants or point features; the sub-units may be added at a latter date to reflect additional mapping detail (e.g., degree of oiling)
TYPE	T	a description of Unit type: a polygon-type with (**A**)rea, a combination unit with (**B**)oth area and length, a (**L**)ine-type unit, or a (**P**)oint variant (see Table D-2)
BC_CLASS	N	a number indicating the BC ‘coastal class’ or ‘shoreline type’ (see Table D-3)
ESI_CLASS	T	a number code for the ESI coastal classification system (see Table D-4)
LENGTH_M	N	the unit or sub-unit along-shore length in M, to be calculated by the GIS software
AREA_M2	N	the polygon area in sq m to be calculated by GIS software
GEO_MAPPER	T	last name of mapper.
GEO_EDITOR	T	last name of editor or reviewer
GEO_MAP_DATE	D	date of original mapping
GEO_SOURCE	T	the data source for the interpretations: (V)ideotape, (P)hoto-aerial, (T)opo maps, (C)harts, (O)ther.
SCALE	T	scale of the base map used to code and map original data
VIDEOTAPE	T	videotape identifier code(s)
SCRN_TIME	T	the “burned-in” tape time from the GPS that appears on the video image.
MAP_NO	T	the page number of the map in the DeLorme Alaska Atlas where the Unit is plotted
CHART	T	the NOAA chart number(s) for the Unit
EXP_IDENT	T	cross reference number to exposure database
EXP_CALC	T	The calculated exposure from fetch measurements (see D-5)
EXP_OBSER	T	an estimate of the wave exposure as observed by geomorphologist during mapping based on Table D-5.
EXP_CLASS	N	a numeric code for best exposure estimate where EXP_BIO better than EXP_OBS better than EXP_CALC and 1=VP, 2=P, 3=SP, 4=SE, 5=E, 6=VE (see Table D-5)
ORI	N	a code indicating the potential oil residence index, see Tables D-6 and D-7.
SED_SOURCE	T	a code indicating the estimated sediment source for the unit, (B)ackshore, (A)longshore, (F)luvial, (O)ffshore
SED_ABUND	T	code indicating the relative sediment abundance within the shore-unit, (A)bundant, (M)oderate, (S)carce
SED_DIR	T	one of the eight cardinal points of the compass indicating dominant sediment transport direction
CHNG_TYPE	T	a code indicating the stability of the shore unit, (A)ccretional, (E)rosional, (S)table

Data Dictionary for UNIT Databases (continued)

Field Name	Type	Description
CHNG_RATE	T	the rate of change of the shoreline within the unit in m/yr
SHORENAME	T	the name of a prominent geographic feature near the unit; used to facilitate searches
OTHER	T	a text field used for miscellaneous comments and notes during the mapping
SHORE_ PROB	T	comment on nature of the shore problem, usually the difference between electronic shoreline and observed shoreline
SM1_TYPE	T	the *primary* type of seawall occurring within the unit where:BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM1%	N	the estimated % occurrence of the *primary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM1_M	N	the calculated length in meters of the *Primary* seawall type
SM2_TYPE	T	the *secondary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP = sheet pile; RR = rip rap and WB = wooden bulkhead
SM2%	N	the estimated % occurrence of the *secondary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM2_M	N	the calculated length in meters of the *Secondary* seawall type

Field Name	Type	Description
SM3_TYPE	T	the *tertiary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; RR = rip rap and WB = wooden bulkhead
SM3%	N	the estimated % occurrence of the *tertiary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM3_M	N	the calculated length in meters of the *Tertiary* seawall type
SMOD_TOTAL	N	the total % occurrence of seawall in the unit, in tenths
RAMPS	N	the number of boat ramps that occur within the shore zone of the unit or subnunit. Ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate. Public boat ramps are shown as variants
PIERS/DOCKS	N	the number of piers or wharves that occur within the unit. Piers or docks must extend at least 10m into the shore zone. Category does not include anchored floats.
REC_SLIPS	N	the estimated number of recreational (or small) slips associated with the piers/docks of the unit based on small boat length (~<50’)
DEEPSEA_SLIPS	N	the estimated number of slips for ocean-going vessels (~>100’)
ITZ_WIDTH	N	the sum of the across-shore width of all the intertidal components (B-Zone) within the unit

Table A-2 Protocol for Unit Delineation

The primary goal of the mapping program is to catalog shore-zone features that may be of interest in resource management. As such the mapping should capture the key ecological features of the shore-zone. Units may be delineated as either *points*, *lines* or *polygons* within the spatial framework. This protocol provides criteria for assigning the most appropriate spatial characteristics to a unit.

1. the Alaska Shore-Zone mapping system is primarily a lineal system (length but not width) so that *a line segment representation is the preferred unit type*. These units are coded as **L** in the "Type" Field.

2. point and polygon features should be used in certain cases to *provide a clear characterization of the physical and biological characteristics of the unit as well as the processes that affect the unit*. These cases are outlined below.

3. ***points*** are used to identify features that are of interest to resource managers but are too small (in terms of alongshore length) to be represented by a line segment. The following features are represented by points: stream mouths, public boat ramps, and other small features within a unit with ecological or management significance such as wetlands. Stream mouths or marshes are normally identified from the aerial video imagery. These units are coded as **P** in the "Type" Field.

4. ***polygons*** are used when a feature has unique spatial characteristics that are not captured by a single line segment representation. Examples of possible polygons include: a wetland where the shape of the wetland does not allow a reasonable approximation of area by length and width estimates, an intertidal ebb-tidal delta where controlling processes (tidal currents) differ substantially from surrounding units or a very wide mudflat backed by a gravelly sand beach. The minimum area for a polygon is $1 cm^2$ at a 1:12,000 mapping scale or 15,000 ft^2.

   Two types of polygons are represented:

   a. a polygon that incorporates features that span the entire "shore-zone" from supratidal to subtidal, and therefore have an associated alongshore length on the electronic shoreline. A large wetland area with associated fringing mudflat is an example of this type of polygon. In that the polygon has both an area and an alongshore length (where it intersects the electronic), the feature type is coded as **both** and both area and length measurements are added to the database. This type of unit is coded as **B** in the "Type" field.

   b. a polygon that describes only a portion of the shore-zone (equivalent to an across-shore component) and that does not intersect the MHWL shoreline. An ebb-tidal delta or a large, intertidal mudflat are examples of this type of polygon. This type of unit is coded as **A** in the "Type" field.

Table A-3 Rationale for BC Shore Types[1]

SUBSTRATE	SEDIMENT	WIDTH	SLOPE	Shore Type Code & Description
ROCK	n/a	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(1) Rock Ramp, wide
			FLAT(<5°)	(2) Rock Platform, wide
		NARROW (<30m)	STEEP(>20°)	(3) Rock Cliff
			INCLINED(5-20°)	(4) Rock Ramp, narrow
			FLAT(<5°)	(5) Rock Platform, narrow
ROCK + SEDIMENT	GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(6) Ramp w gravel beach, wide
			FLAT(<5°)	(7) Platform w gravel beach, wide
		NARROW (<30m)	STEEP(>20°)	(8) Cliff w gravel beach
			INCLINED(5-20°)	(9) Ramp w gravel beach
			FLAT(<5°)	(10) Platform with gravel beach
	SAND & GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(11) Ramp w gravel & sand beach, wide
			FLAT(<5°)	(12) Platform w G&S beach, wide
		NARROW (<30m)	STEEP(>20°)	(13) Cliff w gravel/sand beach
			INCLINED(5-20°)	(14) Ramp w gravel/sand beach
			FLAT(<5°)	(15) Platform with gravel/sand beach
	SAND	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(16) Ramp w sand beach, wide
			FLAT(<5°)	(17) Platform w sand beach, wide
		NARROW (<30m)	STEEP(>20°)	(18) Cliff w sand beach
			INCLINED(5-20°)	(19) Ramp w sand beach, narrow
			FLAT(<5°)	(20) Platform w sand beach, narrow
SEDIMENT	GRAVEL	WIDE (>30m)	FLAT(<5°)	(21) Gravel flat, wide
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(22) Gravel beach, narrow
			FLAT(<5°)	(23) Gravel flat or fan
	SAND & GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	n/a
			FLAT(<5°)	(24) Sand & gravel flat or fan
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(25) Sand & gravel beach, narrow
			FLAT(<5°)	(26) Sand & gravel flat or fan
	SAND/MUD	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(27) Sand beach
			FLAT(<5°)	(28) Sand flat
				(29) Mudflat
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(30) Sand beach
			n/a	
	ORGANICS/FINES	n/a	n/a	(31) Organics/Fines
ANTHRO-POGENIC	MAN-MADE	n/a	n/a	(32) Man-made, permeable
				(33) Man-made, impermeable
CURRENT-DOMINATED				(34) Channel
ICE				(35) Glacial ice shoreline

[1]Shore Type code is used to provide a generalized summation of the detailed physical data complied for each shore unit (from Howes *et al*. 1994).

Table A-4 ESI Shore Type Classification (after Peterson *et al* 2002)

ESI No.	Description
1A	Exposed rocky shores; Exposed rocky banks
1B	1B Exposed, solid man-made structures
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave-cut platforms in bedrock, mud, or clay
2B	Exposed scarps and steep slopes in clay
3A	Fine- to medium-grained sand beaches
3B	Scarps and steep slopes in sand
3C	Tundra cliffs
4	Coarse-grained sand beaches
5	Mixed sand and gravel beaches
6A	Gravel beaches; Gravel Beaches (granules and pebbles
6B	Riprap; Gravel Beaches (cobbles and boulders)*
6C	Riprap
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud, or clay; Sheltered rocky shores (impermeable)
8B	Sheltered, solid man-made structures; Sheltered rocky shores (permeable)
8C	Sheltered riprap
8D	Sheltered rocky rubble shores
8E	Peat shorelines
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10A	Salt- and brackish-water marshes
10B	Freshwater marshes
10C	Swamps
10D	Scrub-shrub wetlands; Mangroves

Table A-5 Exposure Matrix Used for Estimating Calculated Exposure (EXP_CALC)

Maximum Fetch (km)	**Modified Effective Fetch (km)**				
	<1	**1 - 10**	**10 - 50**	**50 - 500**	**>500**
<1	very protected	n/a	n/a	n/a	n/a
<10	protected	protected	n/a	n/a	n/a
10 – 50	n/a	semi-protected	semi-protected	n/a	n/a
50 – 500	n/a	semi-exposed	semi-exposed	semi-exposed	n/a
>500	n/a	n/a	semi-exposed	exposed	exposed

[1] exposure definitions are the same categories listed in EXP_BIO - Table A - 18.

Codes for exposures:

very protected	**VP**
protected	**P**
semi-protected	**SP**
semi-exposed	**SE**
exposed	**E**
very exposed	**VE**

Table A-6 Oil Residence Index

Persistence	**Oil Residence Index**	**Estimated Persistence**
short	1	days to weeks
	2	**weeks** to months
↓	3	weeks to **months**
	4	**months** to years
long	5	months to **years**

Table A-7 Look-Up Table of Calculated ORI Classes Defined by Shore Type and Exposure

Shore Type	Calculated Exposure					
CLASS	VE	E	SE	SP	P	VP
1	1	1	1	2	3	3
2	1	1	1	2	3	3
3	1	1	1	2	3	3
4	1	1	1	2	3	3
5	1	1	1	2	3	3
6	2	3	5	4	4	4
7	2	3	5	4	4	4
8	2	3	5	4	4	4
9	2	3	5	4	4	4
10	2	3	5	4	4	4
11	1	2	3	4	5	5
12	1	2	3	4	5	5
13	1	2	3	4	5	5
14	1	2	3	4	5	5
15	1	2	3	4	5	5
16	1	2	3	3	4	4
17	1	2	3	3	4	4
18	1	2	3	3	4	4
19	1	2	3	3	4	4
20	1	2	3	3	4	4
21	2	3	5	4	4	4
22	2	3	5	4	4	4
23	2	3	5	4	4	4
24	1	2	3	4	5	5
25	1	2	3	4	5	5
26	1	2	3	4	5	5
27	2	2	3	3	4	4
28	2	2	3	3	4	4
29	999	999	999	3	3	3
30	2	2	3	3	4	4
31	5	5	5	5	5	5
32	2	2	3	3	5	5
33	1	1	1	2	2	2
34	999	999	999	4	4	4

Note: 999 combination should not occur; requires operator override

Table A-8 Summary of Data Fields in the BioUnit Database

Field Names	Type	Description
UnitRecID	I	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
EXP_BIO	T	exposure estimated from biota indicator species
HAB_OBS	I	observed habitat
HAB_CALC	I	predicted habitat based on BC_CLASS and EXP_CALC
BIO_SLIDE	T	roll number and frame number of 35 mm slide
BIO_SOURCE	T	data sources for biological interpretation
BIO_SITE	T	number of ground station
RIPARIAN%	I	% occurrence of coastal riparian (terrestrial vegetation overhang within the unit)
RIPARIAN_M	I	length of coastal riparian in meters
COMMENTS	T	comment field
BIO_MAPPER	T	last name of biology mapper
BIO_MAP_DATE	D/T	date of biological mapping
QAQC	Y/N	yes/no if unit reviewed in QAQC
QAQC_NAME	T	last name of QAQC reviewer
QAQC_CHANGE	T	QAQC change type code
%MOBILE	I	estimate of the % of unit with mobile substrate
HAB_OBS_OVERRIDE	Y/N	yes/no if HAB_OBS is over-ride of HAB_CALC lookup

Data Dictionary for BioUnit Databases

Field Name	Type	Description
UnitRecID	N	unique id for each record
PHY_IDENT	T	unique Physical Ident number for the unit, a combination of region, area, unit, and sub-unit. (RR/AA/UUUU/SS)
EXP_BIO	T	an estimate of the exposure based on observed indicator species.
HAB_OBS	N	the observed biotic assemblage from the imagery and classified according to Table A-18
HAB_CALC	N	the predicted biotic assemblage from the mapped BC_Class and the EXP_CALC (Table A-18)
BIO_SLIDE	T	oblique aerial slide-format image ident, film roll/ frame number
BIO_SOURCE	T	the source that was used to interpret shore-zone biota, (V)ideotape, (S)lide, (I)nferred
BIO_SITE	T	
BIO_SLIDE	T	oblique aerial slide-format image ident, film roll/ frame number

Field Name	Type	Description
BIO_SOURCE	T	the source that was used to interpret shore-zone biota, (V)ideotape, (S)lide, (I)nferred
BIO_SITE	T	the Station number of an ground surveys that were conducted in the unit
BIO_MAPPER	T	the last name of the biologist that provided the biological interpretation of the imagery.
BIO_EDITOR	T	last name of biologist that is responsible for reviewing and editing data
BIO_MAP_DATE	D	the date of the bio mapping
QAQC_NAME	T	last name of QAQC reviewer
QAQC_CHANGE	T	code (Table A-9) to indicate degree of discrepancy between original mapper and reviewer
%MOBILE	I	an estimate by the biological mapper of the percentage of the unit length that has mobile substrate (i.e., precludes development of epiflora or epifauna

Table A-9. Definitions of the Biology QA/QC Checks

Code for Change Type	Definitions & Discussion	Significance of change?
1	**Change band distribution code** – from patchy to continuous or vice versa. A revision of this type is defined as the least significant and is considered as an example of variation of interpretation between observers.	Least significant
2	**Add a bio-band** – Adding a band was the most common revision made in QA/QC review and the frequency of this change decreased as junior mappers' experience with video interpretation increased. These changes are defined as an 'error of omission', not an error in interpretation	
3	**Delete a bio-band** – Deleting a band that had been mapped was considered an error in interpretation. Usually these changes were associated with an 'add band' change and were subject of discussion for assisting in clarifying bio-band descriptions.	
4	**Change the HAB_OBS classification** – a discrepancy between the HAB_OBS and the HAB_CALC, which is computed as a function of the exposure (from biota) and the shore-type (BC_CLASS) *may* indicate that an error was made in the HAB_OBS classification. Only those QAQC'd units where a *change* was made in the HAB_OBS are flagged.	
5	**Change the EXP_BIO** – The correct interpretation of the Exposure category was considered the most significant QA/QC change type.	most significant

Table A-10 Summary of Data Fields in the Component Database (XSHR)

Field Names	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT
ZONE	T1	portion of shore-zone: supratidal, intertidal, subtidal
COMPONENT	Is	number of component
Form1	T20	descriptor of primary morphology of component
MatPrefix1	T1	descriptor holding "v" = veneer surface layer
Mat1	T20	descriptor of sediment of Form1
FormMat1Txt	T50	Translation sentence descriptor
Form2	T20	descriptor of primary morphology of component
MatPrefix2	T1	descriptor holding "v" = veneer surface layer
Mat2	T20	descriptor of sediment of Form2
FormMat2Txt	T50	Translation sentence descriptor
Form3	T20	descriptor of primary morphology of component
MatPrefix3	T1	descriptor holding "v" = veneer surface layer
Mat3	T20	descriptor of sediment of Form3
FormMat3Txt	T50	Translation sentence descriptor
Form4	T20	descriptor of primary morphology of component
MatPrefix4	T1	descriptor holding "v" = veneer surface layer
Mat4	T20	descriptor of sediment of Form4
FormMat4Txt	T50	Translation sentence descriptor
SUB_WIDTH	Is	average width of the primary component in metres
SUB_SLOPE	Is	estimated slope of primary component
PROCESS	T4	dominant coastal process modifying the primary component
COMPONENT _ORI	I	an estimate by the GeoMapper of the ORI of the primary component (see Table D7)

Data Dictionary for Across-Shore Component Databases (XSHR)

(Adapted from methods and codes outlined in Howes *et al* 1994)

Field Name	Type	Description
UnitRecId	N	the record number of the Unit to which the component is related
XshrRecID	N	a unique record number for each X-SHR record
PHYS_IDENT	T	unique id combining the region-area-unit-subunit fields (see UNIT Table data dictionary, above).
CROSS_LINK	T	a unique alphanumeric id combining the region-area- unit-subunit-zone-component fields
ZONE	T	a text code indicating the across-shore position of the component: (A) supratidal, (B) intertidal or (C) subtidal zone
COMPONENT	N	further subdivision of Zones, numbered from highest elevation in across-shore profile within Zone to lowest.
Form1	T	describes primary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix1	T	veneer indicator field; blank = no veneer; "v" = veneer
Mat1	T	describes substrate associated with primary form (see Table A-12 for codes)
FormMat1Txt	T	translation of Form and Material codes into a sentence descriptor
Form2	T	describes seconrdary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix2	T	veneer indicator field; blank = no veneer; "v" = veneer
Mat2	T	describes substrate associated with secondary form (see Table A-12 for codes)
FormMat2Txt	T	translation of Form and Material codes into a sentence descriptor
Form3	T	describes tertiary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix3	T	veneer indicator field; blank = no veneer; "v" = veneer
Mat3	T	describes substrate associated with tertiary form (see Table A-12 for codes)
FormMat3Txt	T	translation of Form and Material codes into a sentence descriptor
Form4	T	describes forth most common physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix4	T	veneer indicator field; blank = no veneer; "v" = veneer
Mat4	T	describes substrate associated with forth-order form (see Table A-12 for codes)
FormMat4Txt	T	translation of Form and Material codes into a sentence descriptor
SUB_WIDTH	N	the mean across-shore width of the component in meters.
SUB_SLOPE	N	the estimated across-shore slope of the component in degrees; not coded in Carr Inlet
PROCESS	T	the dominant coastal process affecting the morphology of the component (F)luvial, (M)asswasting, (W)aves, (C)currents, (O)ther, (E)olean
COMPONENT_ ORI	N	a numeric index between 1 and 5 that indiecates the potential oil residency based on Table A-13

Table A-11 'Form' Code Dictionary. (after Howes *et al* 1994).

A = Anthropogenic

a	dolphin
b	breakwater
c	log dump
d	derelict shipwreck
f	float
h	shell midden
I	cable/ pipeline
j	jetty
k	dyke
m	marina
n	ferry terminal
Ταβλε Α−□	log booms
p	port facility
q	aquaculture
r	boat ramp
s	seawall
t	landfill, tailings
w	wharf
x	outfall or intake
y	intake

B = Beach

b	berm
c	washover channel
f	face
I	inclined (no berm)
m	multiple bars&troughs
n	relic ridges, raised
p	plain
r	ridge (single intertidal bar)
s	storm ridge
t	low tide terrace
w	washover fan
v	veneer (modifier)

C = Cliff

a	eroding
p	passive
c	cave
f	fan,apron
g	surge channel
t	terraced
r	ramp
slope	
I	inclined (20to35°)
s	steep (>35°)

Cliff cont.

height	
l	low (<5m)
m	moderate (5-10m)
h	high (>10m)

D = Delta

b	bars
f	fan
l	levee
m	multiple channels
p	plain (no delta, <5°)
s	single channel

E = Dune

b	blowouts
I	irregular
n	relic
Ταβλε Α−□	ponds
r	ridge/swale
p	parabolic
v	veneer
w	vegetated

F = Reef

f	horizontal
I	irregular
r	ramp
s	smooth

I = Ice

g	glacier

L = Lagoon

Ταβλε Α−□	open
c	closed

M = Marsh

f	drowned forest
h	high
l	mid to low (discontinuous)
c	tidal creek
e	levee
Ταβλε Α−□	pond
s	brackish - supratidal

O = Offshore Island

b	barrier
c	chain of islets
t	table shaped
p	pillar/stack
w	whaleback
elevation	
l	low (<5m)
m	moderate (5-10m)
h	high (>10m)

P = Platform

f	horizontal
g	surge channel
h	high tide platform
I	irregular
l	low tide platform
r	ramp
t	terraced
s	smooth
p	tidepool

R = River Channel

a	perennial
t	intermittent
m	multiple channels
s	single channel

T = Tidal Flat

b	bar,ridge
c	tidal channel
e	ebb tidal delta
f	flood tidal delta
l	levee
s	multiple tidal channels
t	flats
p	tidepool

Table A-12 'Material' Code Dictionary. (after Howes *et al* 1994).

A = Anthropogenic

a	metal (structural)
c	concrete (loose blocks)
d	debris (man-made)
f	fill, undifferentiated mixed
Ταβλε Α−□	concrete (solid cement blocks)
r	rubble, riprap
t	logs (cut trees)
w	wood (structural)

B = Biogenic

c	coarse shell
f	fine shell hash
g	grass on dunes
l	trees, fallen not cut, dead
Ταβλε Α−□	organic litter
p	peat
t	trees (alive)

C = Clastic

a	blocks (angular,>25cm)
b	boulders (round, subround,>25cm)
c	cobbles
d	diamicton (poorly sorted sediment containing a range of particles in a mud matrix)
f	fines or mud (mix of silt, clay)
g	gravel (mix pebble, cobble, boulder >2mm)
k	clay
p	pebbles
r	rubble (boulders>1m)
s	sand
$	silt
x	angular fragments (mix block & rubble)
v	**sediment veneer**

R = Bedrock

rock type:

I	igneous
m	metamorphic
s	sedimentary
v	volcanic

rock structure:

1	bedding
2	jointing
3	massive

U = Undefined

DESCRIPTION OF SUBSTRATE
Simplified from Wentworth scale

GRAVELS

boulder	> 25cm
cobble	6 to 25 cm
pebble	0.5 to 6 cm
granule	0.2 to 0.5 cm

SAND
from very coarse to very fine:
all between .5mm to 2 mm

FINES (MUD)
from silt to clay:
smaller than .5mm

[The 'material' descriptor consists of one primary term code and associated modifiers (e.g. Cskb, Ad). Up to three descriptors may be written in order of importance to describe each layer. If only one descriptor is used, indicated material comprises 75% of the volume of the layer (e.g.Cs), if more than one descriptor, they are ranked in order of volume. A surface layer can be described by prefix 'v' for veneer (e.g. vCsk).

Table A-13 Component ORI Matrix

Component Substrate	VE	E	SE	SP	P	VP
rock	1	1	1	2	3	3
man-made, impermeable	1	1	1	2	2	2
boulder	2	3	5	4	4	4
cobble	2	3	5	4	4	4
pebble	2	3	5	4	4	4
sand	2	2	3	3	4	4
mud	999	999	999	3	3	3
organics/vegetation	999	999	999	5	5	5
man-made, permeable	2	2	3	3	5	5

Table A-14 Summary of Data Fields in the BioBand Database

Field Names	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT
VER	T1	occurrence of *Verrucaria* bioband
PUC	T1	occurrence of *Puccinella* and othersalt-tolerant herbaceous plants
GRA	T1	occurrence of dune grasses.
SED	T1	occurrence of the sedge bioband
BAR	T1	occurrence of barnacle bioband
FUC	T1	occurrence of *Fucus* bioband
ULV	T1	occurrence of *Ulva* bioband
HAL8	T1	occurrence of bleached red algae bioband
BMU	T1	occurrence of blue mussel bioband
RED8	T1	occurrence of red algae bioband
ALA	T1	occurrence of *Alaria* bioband
SBR8	T1	occurrence of soft brown algae band
CHB8	T1	occurrence of the chocolate brown bioband
SUR	T1	occurrence of the SURFgrass bioband
ZOS	T1	occurrence of the *Zostera* bioband
ALF	T1	occurrence of the giant *Alaria fistulosa* kelp band
NER	T1	occurrence of the *Nereocystis* bioband
COMMENTS	T50	misc. comments by the bio-mapper

Data Dictionary for BIO Databases

[Methodology described in Searing & Frith (1995)]

Field Name	Type	Description
UnitRecId	N	the record number of the Unit to which the component is related
XshrRecID	N	a unique record number for each X-SHR record
PHYS_IDENT	T	unique id combining the region-area-unit-subunit fields (see UNIT Table data dictionary, above).
CROSS_LINK	T	a unique alphanumeric id combining the region-area- unit-subunit-zone-component fields

Note: all Biobands are coded **P**atchy or **C**ontinuous (>50% cover) except the VER band, coded by width **N**arrow (<1m), **M**edium (1-5m) or **W**ide.(>5m) see Table A-15 for details.

Field Name	Type	Description
VER	T	bioband for 'VERrucaria' in supratidal splash zone
PUC	T	bioband for PUCcinellia and other salt tolerant grasses
GRA	T	bioband code for dune GRAsses of supra-tidal
SED	T	Bioband for mixed sedge of supratidal
BAR	T	bioband for continuous *Balanus glandula* BARnacle in upper intertidal
FUC	T	bioband for FUCus-/barnacle of upper intertidal
ULV	T	bioband for mixed ULVa-type green algae band, mid intertidal

Field Name	Type	Description
HAL8	T	Named for golden-yellow colour of *Halosaccion* which may not be present or dominate the bleached red algae band.
BMU	T	bioband for blue mussels (*Mytilus trossulus)* of mid-intertidal, protected areas
RED8	T	bioband for mixed RED algae of lower intertidal
ALA	T	pure stand of large or small morph of *Alaria spp*. Usually also includes mixed REDs with foliose and encrusting corallines.
SBR8	T	large bladed *Laminaria spp*. - the unstalked blade browns, which are seen in the lower intertidal and nearshore subtidal
CHB8	T	shiny, leathery dark browns, including *Alaria marginata* morph*, L. setchelli, L. bongardiana* morph*, Lessoniopsis , L. yezoensis, Cymathere*
SUR	T	bioband for green SURfgrass of lower intertidal
ZOS	T	bioband for *ZOStera* (eelgrass) of sheltered areas, lower intertidal and subtidal
ALF	T	giant *Alaria fistulosa* kelp band.
NER	T	bioband for nearshore subtidal *NEReocystis* bull kelp
COMMENT	T	a field for miscellaneous comments

Table A - 15. Bioband Definitions: Cook Inlet

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. Common on bedrock and on low energy boulder/cobble shorelines. **Note**: The splash zone 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.* *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	*Carex sp.*
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	
A	**Sedges**	**SED**	Bright green, yellow-green to red-brown. Often appears as a mosaic of greens.	*Carex ramenskii* *Carex lynbyei* *Carex sp.* *Eleocharis sp.* *Eriophorum sp.*	Appears in wetlands around lagoons and estuaries. Always associated with freshwater. This band tends to exist as a wide flat pure stand, commonly bordered by a PUC band. The multiple green tones are caused by winds that knock down patches of sedges.	VP-SP	* species referenced for this band from ground survey reports: Bennett, 1996 and Tande, 1996.
upper B	**Rockweed**	**FUC**	Golden-brown to red-brown	*Fucus sp.*	Appears on bedrock cliffs and boulder, cobble or gravel beaches. Commonly 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. Often appears as a "frosting" across less wave-exposed shores.	P-E	*Gloiopeltis furcata* *Bangia sp.* *Porphyra sp.* *Fucus sp.*

B	**Green Algae**	**ULV**	Green	*Ulva sp.* *Monostroma sp.* *Enteromorpha sp.* *Cladophora sp.* *Acrosiphonia sp.*	Found on a variety of substrates. This band can consist of filamentous and/or foliose green algae. Filamentous species often form a dark green haze associated with fresh water seeps. Foliose species are often mixed with red algae which indicates higher exposures. Can occur at higher elevations on wide mudflats or platforms in areas of greater wave exposure.	P-E	Filamentous and foliose red algae.
B	**Blue Mussels**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Appears in dense clusters that form distinct black patches or bands.	P-VE	*Fucus sp.* *Semibalanus sp.* *Balanus sp.* Filamentous red algae.
B	**Bleached Red Algae**	**HAL9**	Olive, golden or yellow-brown	Bleached foliose red algae *Palmaria sp.* *Odonthalia sp.*	Appears on most substrates except fine sediments. Distinguished from the RED9 band by colour. The bleached colour usually indicates lower wave exposure than where the RED9 band is observed., and may be caused by nutrient deficiency.	P-SP	*Halosaccion glandiforme* *Mazzaella sp* Filamentous and foliose green algae
B	**Red Algae**	**RED9**	Coralline: pink or white Foliose or filamentous: Dark red, bright red or red-brown.	*Corallina sp.* *Lithothamnion sp.* *Palmaria sp* *Odonthalia sp.* *Neorhodomela sp.*	Appears on most substrates except fine sediments. Lush coralline algae indicates high exposures; foliose red algae at the lower intertidal indicates medium exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures.	SP-VE	*Ulva sp.* *Pisaster sp.* *Nucella sp.*
B & C	**Alaria**	**ALA**	Dark brown or olive-brown	*Alaria marginata* morph	Common on bedrock cliffs and platforms, and on boulder/cobble beaches. This often single-species band has a distinct ribbon-like texture, and may appear iridescent in some imagery.	SP-E	Foliose red algae *Laminaria sp.*
B & C	**Soft brown Kelps**	**SBR9**	Olive-brown or brown	*Laminaria saccharina*	This band defined by non-floating large browns, can form lush bands in semi-protected areas. The kelp fronds have a ruffled appearance and can be encrusted with diatoms and bryozoans giving the blades a 'dusty' appearance.	VP-SP	*Alaria sp.*

B & C	**Dark brown Kelps**	**CHB9**	Dark chocolate brown	*Laminaria bongardiana* *Lessoniopsis littoralis*	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery and shiny smooth. A mixture of species occurs at the moderate wave exposures, while single-species stands of *Lessoniopsis.* occurs at high exposures. Limited distribution of this bioband in Cook Inlet.	SE-VE	*Alaria sp.*
B& C	**Eelgrass**	**ZOS**	Bright to dark green	*Zostera marina*	Common in estuaries, lagoons and channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or extensive dense meadows. In upper Cook Inlet, it is often seen in clumped in pools on mudflats.	VP-SP	*Pilayella sp*.
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with very long blade and hollow floating midrib, found in nearshore habitats. Appears ribbon-like on water's surface. Uncommon in Cook Inlet.	SE-E	*Alaria sp.* *Nereocystis luetkeana*
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	A distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa*. Often indicates current areas if observed at lower wave exposures.	SP-E	Understory assemblage of kelps, coralline and foliose red algae

Table A - 16. Bioband Definitions: Kodiak Island

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Splash Zone**	**VER**	Black or bare rock	*Verrucaria sp.* Encrusting black lichens	Visible as a dark stripe, on bare rock, marking the upper limit of the intertidal zone. This band is observed on bedrock, or 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	**Dune Grass**	**GRA**	Pale blue-green	*Elymus mollis*	Found in the upper intertidal zone, on dunes or beach berms. This band is often the only band present on high-energy beaches.	P-E	
A	**Marsh grasses, herbs and sedges**	**PUC**	Light, bright, or dark green, with red-brown	*Puccinellia sp.* *Plantago maritima* *Triglochin sp.* *Honkenya peploides*	Appears in wetlands around lagoons, marshes, and estuaries. Can also appear on dunes. This band is distinct from the dune grass band by its colour.	VP-SE	*Carex sp.*
A	**Sedges**	**SED**	Bright green, yellow-green to red-brown. Often appears as a mosaic of greens.	*Carex ramenskii* *Carex lynbyei* *Carex sp.* *Eleocharis sp.* *Eriophorum sp.*	Appears in wetlands around lagoons and estuaries. Always associated with freshwater. This band tends to exist as a wide flat pure stand, commonly bordered by a PUC band.	VP-SP	* species referenced for this band from Cook Inlet ground survey reports: Bennett, 1996 and Tande, 1996.
upper B	**Rockweed**	**FUC**	Golden-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.	P-E	*Endocladia muricata* *Gloiopeltis furcata* *Porphyra sp.* *Fucus sp.*
B	**Green Algae**	**ULV**	Green	*Ulva sp.* *Monostroma sp.* *Enteromorpha sp.* *Cladophora sp.* *Acrosiphonia sp.*	Found on a variety of substrates. This band can consist of filamentous and/or foliose green algae. Filamentous species often form a low turf of dark green.	P-E	Filamentous red algae.

B	**Blue Mussels**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Appears in dense clusters that form distinct black patches or bands, either above or below the barnacle band.	P-VE	*Fucus sp.* *Semibalanus sp.* *Balanus sp.* Filamentous red algae.
B	**Surfgrass**	**SUR**	Bright green	*Phyllospadix sp.*	Appears in tidepools on rock platforms, often forming extensive beds. This species has a clearly defined upper exposure limit of semi-exposed and its presence in units of Exposed wave energy indicates a wide across-shore profile, where wave energy is dissipated by wave run-up across the broad intertidal zone.	SP-SE	Foliose and coralline red algae
B	**Bleached Red Algae**	**HAL10**	Olive, golden or yellow-brown	Bleached foliose red algae *Palmaria sp.* *Odonthalia sp.*	Common on bedrock platforms, and cobble or gravel beaches. Distinguished from the RED10 band by colour. The bleached colour usually indicates lower wave exposure than where the RED10 band is observed., and may be caused by nutrient deficiency.	P-SE	*Halosaccion glandiforme* *Mazzaella sp.* Filamentous green algae
B	**Red Algae**	**RED10**	Corallines*:* pink or white Foliose or filamentous*:* Dark red, bright red, or red-brown.	*Corallina sp.* *Lithothamnion sp.* *Neoptilota sp.* *Odonthalia sp.* *Neorhodomela sp.* *Palmaria sp.* *Mazzaella sp.*	Appears on most substrates except fine sediments. Lush coralline algae indicates highest exposures; diversity of foliose red algae indicates medium to high exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures. In Kodiak, often mixed in lower B and upper C zone with lush large browns. *Neoptilota* is particularly abundant.	SP-VE	*Pisaster sp.* *Nucella sp.* *Katharina tunicata* mixed large browns of the CHB10 bioband
B & C	**Alaria**	**ALA**	Dark brown or red-brown	*Alaria marginata* *Alaria sp.*	Common on bedrock cliffs and platforms, and on boulder/cobble beaches. This often single-species band has a distinct ribbon-like texture, and may appear iridescent in some imagery.	SP-E	Foliose red algae *Laminaria sp.*
B & C	**Soft brown Kelps**	**SBR10**	Yellow-brown, olive brown or brown.	*Laminaria saccharina* *Cystoseira sp.*	This band defined by non-floating large browns, can form lush bands in semi-protected areas. The kelp fronds have a ruffled appearance and can be encrusted with diatoms and bryozoans giving the blades a 'dusty' appearance.	VP-SP	*Alaria sp.* *Cymathere sp.* *Hedophyllum sessile* (bullate)

B & C	**Dark brown Kelps**	**CHB10**	Dark chocolate brown	*Laminaria setchelli* *Laminaria bongardiana* *Laminaria yezoensis* *Lessoniopsis littoralis* *Hedophyllum sessile* (smooth)	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery and shiny smooth. A mixture of species occurs at the moderate wave exposures, while single-species stands of *Lessoniopsis.* occurs at high exposures.	SE-VE	*Cymathere sp.* *Pleurophycus sp.* *Costaria sp.* *Alaria sp.* *Neoptilota sp.*
B & C	**Eelgrass**	**ZOS**	Bright to dark green	*Zostera marina*	Commonly visible in estuaries, lagoons or channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or thick dense meadows.	VP-SP	*Pilayella sp.*
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with very long blade and hollow floating midrib, found in nearshore habitats. If associated with NER, it occurs inshore of the bull kelp.	SE-E	*Alaria sp.* *Nereocystis luetkeana*
C	**Bull Kelp**	**NER**	Dark brown.	*Nereocystis luetkeana*	A distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa*. Often indicates current areas if observed at lower wave exposures.	SP-VE	*Alaria fistulosa*

Table A - 17. Bioband Definitions: Outer Kenai Coast

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
B	**Green Algae**	**ULV**	Green	*Ulva sp.* *Monostroma sp.* *Enteromorpha sp.* *Cladophora sp.* *Acrosiphonia sp.*	Found on a variety of substrates. This band can consist of filamentous and/or foliose green algae. Filamentous species often form a low turf of dark green. Greens are commonly mixed with red algae which indicates higher exposures.	P-SE	Filamentous and foliose red algae

B	**Blue Mussels**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Appears in dense clusters that form distinct black patches or bands, either above or below the barnacle band. Predation by *Pisaster sp* or *Nucella sp* can cause this band to occur at a higher elevation.	P-VE	*Fucus sp.* *Semibalanus sp.* *Balanus sp.* Filamentous red algae
B	**Bleached Red Algae**	**HAL8**	Olive, golden or yellow-brown	Bleached foliose red algae *Palmaria sp.* *Odonthalia sp.*	Appears on most substrates except fine sediments. Distinguished from the RED8 band by colour. The bleached colour usually indicates lower wave exposure than where the RED8 band is observed., and may be caused by nutrient deficiency.	P-SP	*Mazzaella sp.* *Halosaccion glandiforme* Filamentous and foliose green algae
B	**Red Algae**	**RED8**	Coralline*:* pink or white Foliose or filamentous*:* Dark red, bright red or red-brown.	*Corallina sp.* *Lithothamnion sp.* *Neoptilota sp.* *Odonthalia sp.* *Neorhodomela sp.* *Palmaria sp.* *Mazzaella sp.*	Appears on most substrates except fine sediments. Lush coralline algae indicates high exposures; foliose red algae at the lower intertidal indicates medium exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures.	SP-VE	*Ulva sp.* *Pisaster sp.* *Nucella sp.* *Katharina tunicata* mixed large browns of the CHB8 bioband
B & C	**Alaria**	**ALA**	Dark brown or olive-brown	*Alaria marginata* morph	Common on bedrock cliffs and platforms, and on boulder/cobble beaches. This often single-species band has a distinct ribbon-like texture, and may appear iridescent in some imagery.	SP-E	Foliose red algae *Laminaria sp.*
B & C	**Soft brown Kelps**	**SBR8**	Olive-brown or brown	*Laminaria saccharina* *Cystoseira sp.*	This band defined by non-floating large browns, can form lush bands in semi-protected areas. The kelp fronds have a ruffled appearance and can be encrusted with diatoms and bryozoans giving the blades a 'dusty' appearance.	VP-SP	*Alaria sp.* *Cymathere sp.* *Hedophyllum sessile* (bullate)
B & C	**Dark brown Kelps**	**CHB8**	Dark chocolate brown	*Hedophyllum sessile* *Laminaria setchellii* *Laminaria bongardiana* *Laminaria yezoensis* *Lessoniopsis littoralis*	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery and shiny smooth. A mixture of species occurs at the moderate wave exposures, while single-species stands of *Lessoniopsis.* occurs at high exposures.	SE-VE	Coralline red algae *Cymathere sp.* *Alaria sp.* diverse invertebrate assemblage

B& C	**Eelgrass**	**ZOS**	Bright to dark green	*Zostera marina*	Common in estuaries, lagoons and channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or in extensive dense meadows.	VP-SP	*Pilayella sp.*
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with very long blade and hollow floating midrib, found in nearshore habitats. If associated with NER, it occurs inshore of the bull kelp.	SE-E	*Alaria sp.* *Nereocystis luetkeana*
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	A distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa*. Often indicates current areas if observed at lower wave exposures.	SP-VE	*Alaria fistulosa* Urchins. Understory assemblage of kelps, coralline and foliose red algae

Table A - 18. Definitions of Habitat Class, showing typical indicator biobands, with associated biological exposure and coastal classes.

Habitat Class	1	2	3	4	5	6	7	8	9
Biological Exposure	VE	E	SE	SP	P, VP	SP	P, VP	SP, P, VP	VE, E, SE, SP
Name	Very Exposed, Bedrock	Exposed, Bedrock	Semi-exposed, Bedrock	Semi-protected, Bedrock	Protected, Bedrock	Semi-protected, Sediment	Protected, Sediment	Estuary	Bare Beach
Major Substrate	Immobile Bedrock/ Boulder	Immobile Bedrock/ Boulder	Immobile Bedrock/ Boulder	Immobile Bedrock/ Boulder	Immobile Bedrock/ Boulder	Mobile Sand and Gravel	Mobile Sand and Gravel	Mobile Sand/Mud	Mobile Sand and Gravel
Coastal Class	1 - 20	1 - 20	1 - 20	1 - 20, 32, 33	1 - 20, 33	21 - 30, 32	21 - 30, 32	24 - 30, or 31	21 - 30
Biobands									
VER	WIDE	WIDE	WIDE - MEDIUM	MEDIUM - NARROW	NARROW	MEDIUM - NARROW	NARROW	NARROW	
PUC								X	
GRA						X	X	X	X
BAR	X	X	X	X					
FUC				X	X	X	X		
BMU		X	X						
ULV				X	X	X	X	X	
HAL8									
RED8	X	X	X	X		X			
ALA			X						
SBR8				X	X	X	X		
CHB8	X	X							
ZOS								X	
ALF			X						
NER			X						

Note: Habitat Class 10 and 11 described in table below.

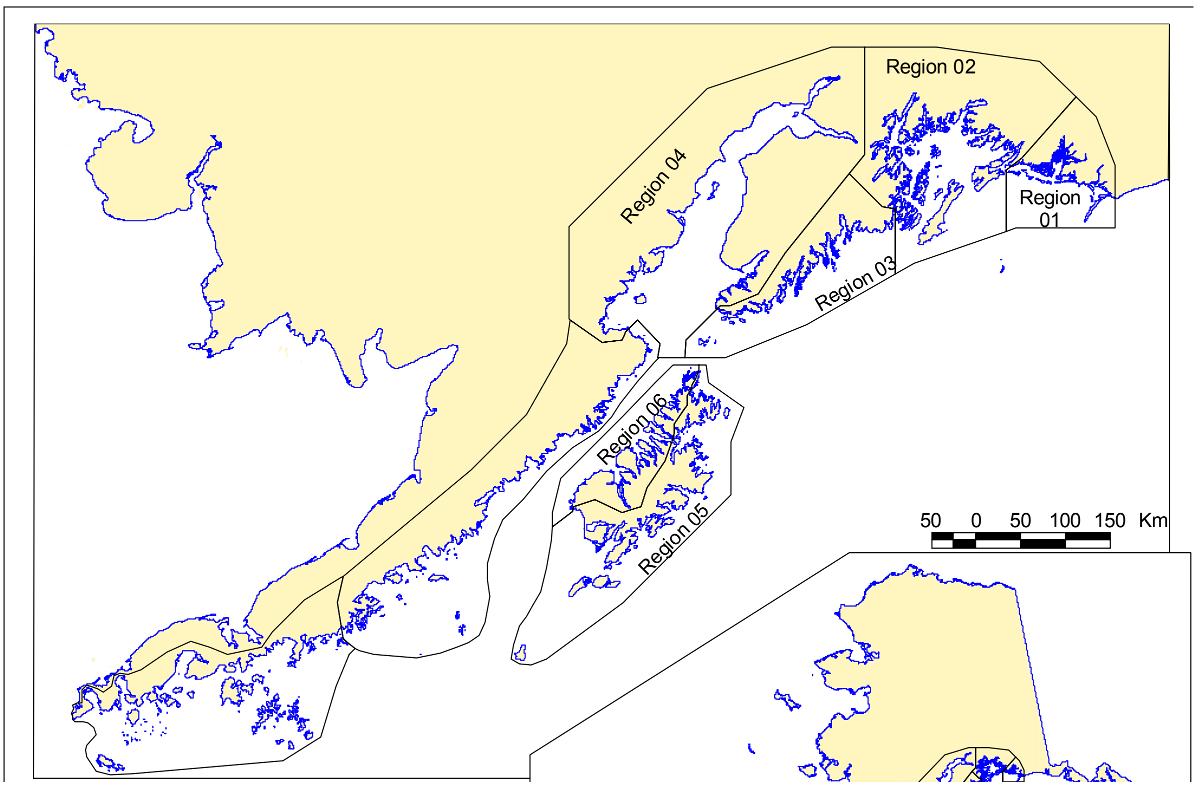
Table 18 - A (continued)

Two other Habitat Classes that are not strictly tied to Wave Exposure and Substrate.

Habitat Class	**10**	**11**
Biological Exposure	**n/a**	**n/a**
Name	**Current-dominated Passages**	**Glacier Ice**
Major Substrate	**usually Immobile Bedrock**	**Ice**
Coastal Class	**34**	**35**
Description	Units classified as current-dominated indicate a biotic assemblage that is anomolous with the wave exposure at the unit. That is, the energy in the unit is dominated by wave movement due to current, not wave exposure. Current-dominated passages are rare Habitat Classes, in that the total shoreline length with these biophysical characteristics is small.	A few units in the Kenai Fjords area have the unusual substrate category of Ice. Because this is a different substrate than all the other Habitat Classs, a new category was created specifically for glaciers.
Typical Biobands	ULV RED8 ALA ZOS	ULV

APPENDIX B – COASTAL MAPPING REGIONS OF THE GULF OF ALASKA

As part of the Gulf of Alaska ShoreZone Mapping Project, the Gulf of Alaska has been subdivided into a number of mapping regions. The mapping regions are delineated to assist with mapping discrete areas and are not intended to represent ecological regions.



A standardized database has been developed to record Shore Station data in a systematic manner. The Access97 database consists of five tables that are linked relationally (Fig. C-1). The system is designed to have Shore Station data continually added, building a bioband and species list that can be directly linked to the mapping as well as building a species collection.

To date there have been two Shore Station surveys conducted as part of the Gulf of Alaska mapping program: one on the Outer Kenai coast (sponsored by CIRCAC; 2002) and one on the Katmai National Park coast (sponsored by the National Park Service; 2003). It is intended that the Shore Station data from these two surveys will be web-posted on the CoastAlaska.net website in the near future.

Field descriptions of each of the five data tables are described in Tables C-1 to C-5.

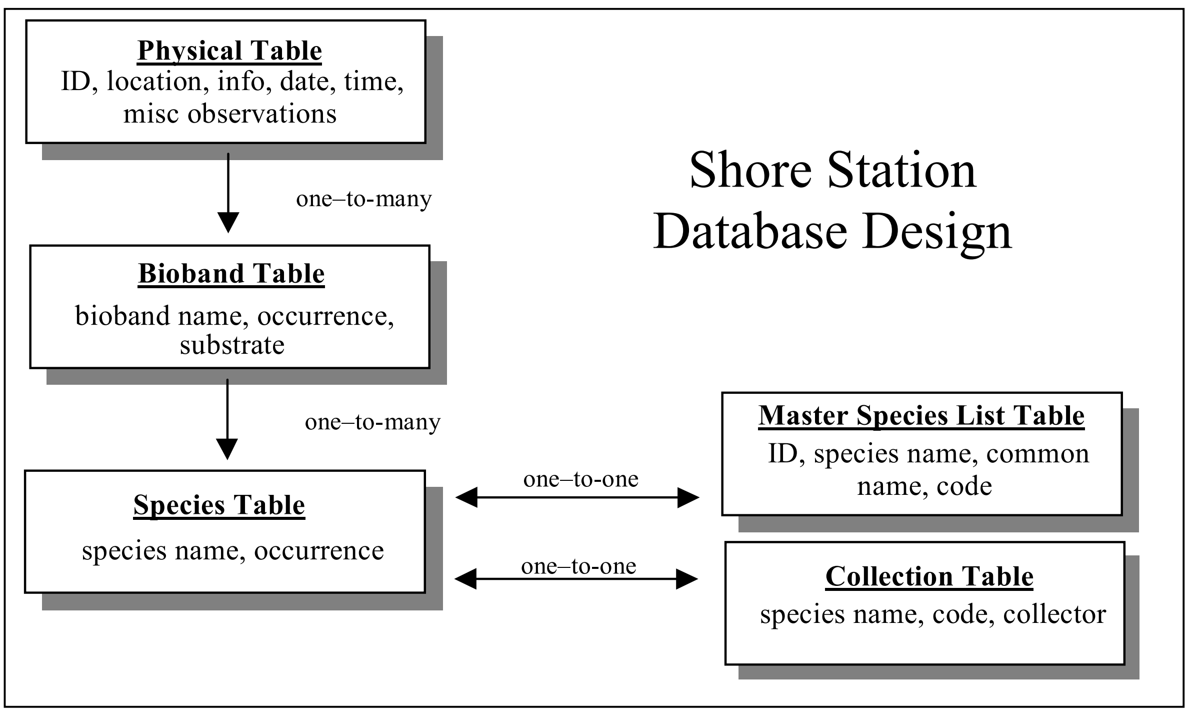


Figure C-1 Organisation of the Shore Station relational database

Table C-1 Data Fields and Descriptions for the Physical Tables (StationPhysical)

Field Name	Type	Description
STATION_ID	Autonumber	Unique record identification field, created automatically
STATION	Text	Number assigned to a specific field site. Used as this table's primary key.
LOCATION	Text	Description of the field site's physical location.
DATE	Date/time	The date that the field site was documented.
COASTAL CLASS	Number	Shoreline type, RIC standard code
REP SHORE TYPE	Number	Summary of shoreline type, RIC standard code
SUBSTRATE GENERAL	Number	Coded substrate summary: 1-bedrock, 2-mix of rock and sediment, 3-sediment dominated
MAX FETCH KM	Number	Maximum wave fetch distance from chart measurement
MAX FETCH NM	Number	Maximum wave fetch distance from chart measurement
FETCH EXPOSURE CATEGORY	Text	Fetch index: VP, P, SP, SE, E, Following the RIC standard
TIME OF STATION	Date/time	Time of site visit
TIDE LEVEL AT STN(M)	Number	Tide level, at time of site visit
LATITUDE-DEGREE	Text	Latitude degree, location of the station
LAT-DECML DEGREE	Text	Decimal degree, location of the station
LAT-MINUTES	Text	Minutes of latitude, location of the station
LONGITUDE-DEGREE	Text	Longitude degree, location of the station
LONG-DECML DEGREE	Text	Location of the station, decimal degree, location of the station
LONG-MINUTES	Text	Location of the station, minutes of longitude, location of the station
SITE DESCRIPTION	Memo	Physical description of the site
RECON OR PROFILE?	Text	Profile or 'recon' stations include a full species list. 'X-recon' stations include partial species list and useful for band and species macro-observations only
PROFILE BEARING	Number	The compass bearing of the transect. Measured offshore perpendicular to shore normal
UNIT ID	Number	The mapped shore unit key, from physical mapping, link to digital mapping, for spatial summaries
WEATHER	Text	Weather at the time of site visit
OBSERVERS	Text	Initials of the shore station crew
CURRENTS	Text	Note of obvious near shore current
SWELL	Text	Note of open ocean swell pres/abs
FRESHWATER INFLUENCE	Text	Note of influence of freshwater
EXPOSURE FROM BIOTA	Text	The field estimate of the EXP_BIO (the 'exposure bio'), same codes as fetch exposure category
NOTES RE BIO EXPOSURE	Text	Comments on interpretation of the bio exposure
DESCRIPTION OF BANDS	Memo	Biological description of the bio-bands observed at the site
FETCH BEARING	Text	Bearing of the maximum fetch

Table C-2 Data Fields and Descriptions for the Bioband Tables (StnBioBand)

Field Name	Type	Description
BAND_ID	Autonumber	Unique record identification field, created automatically. Table primary key
STATION	Text	Number assigned to a specific field site.
ZONE	Text	Across-shore zone: A-supratidal, B-intertidal, C-near shore subtidal
COMPONENT	Number	Across-shore zone subdivision. May not occur, uses RIC standard code definition
BAND	Text	Bio-band acronym and database label.
DISTRIB	Text	Distribution of an individual band. C-continuous (more than 50% in unit), P-patchy (25% - 50% in unit)
SUBSTRATE	Text	Physical substrate beneath the bio-band
ELEV TOP	Text	Highest vertical elevation of band
ELEV BTM	Text	Lowest vertical elevation of band
WIDTH	Text	Calculated width of band
TIDE POOL	Text	Comment on coverage of tide pool in the band, generally not used
CREVICE	Text	Comment on coverage of crevice in the band, generally not used
SLOPE	Number	Calculation of the band's slope, generally not used

Table C-3 Data Fields and Descriptions for the Species Tables (StnSpecies)

Field Name	Type	Description
SPECIES_ID	Autonumber	Unique record identification field, created automatically. Table primary key
BAND_ID	Number	Bio-band index number, links to table StnBioBand table
SPPTXTCODE	Text	Acronym for species name
ABUNDANCE	Text	Estimate of species abundance, A=Abundant; C=Common; F=Few; R=Rare
MICROHAB	Text	Microhabitat: UR-under cobble/boulder, TP-tide pool, CR-cracks & crevice
COMMENTS	Text	Comments about observation of the species

Table C-4 Data Fields and Descriptions for the Master Species List (SpeciesList)

Field Name	Type	Description
SPPLIST_ID	Autonumber	Unique record identification field, created automatically
SPP NAME	Text	Scientific name of species observed
COMMON NAME	Text	Common name of species observed
SPPTXTCODE	Text	Acronym for the species name, Table primary key
SPECIESNO	Number	Species number code from BC bio-map RIC standard list
INDICATOR OR RECURR SPP?	Text	Notes if the species is an 'indicator' or 'recurring' on the species list
CREATEDT	Date/Time	Date that species was added to the Master Species List.

Table: C-5 Data Fields and Descriptions for Sample Collections (FieldSampleCollections)

Field Name	Type	Description
SAMPLEID	Autonumber	Unique record identification field, created automatically. Table primary key
STATIONNUMBER	Text	Number assigned to a specific field site. Linked to table: Station Physical
SITENUMBER	Number	Sample site identifier, assigned
SITEDESCRIPTION	Text	Physical location
LATLONG	Text	Latitude and Longitude coordinates
SPECIESNUMBER	Number	Assigned sample number
SPECIESNAME	Text	Scientific species name
PHENOLOGY	Memo	Life history
HABITAT	Text	Physical substrate, and zone description of where the sample was found.
DATE	Date/Time	Sample collection date
NOTES	Text	Biological notes
COLLECTOR	Text	Initials and surname of sample collector
HERBARIUM	Text	Initials of the person who identified the sample