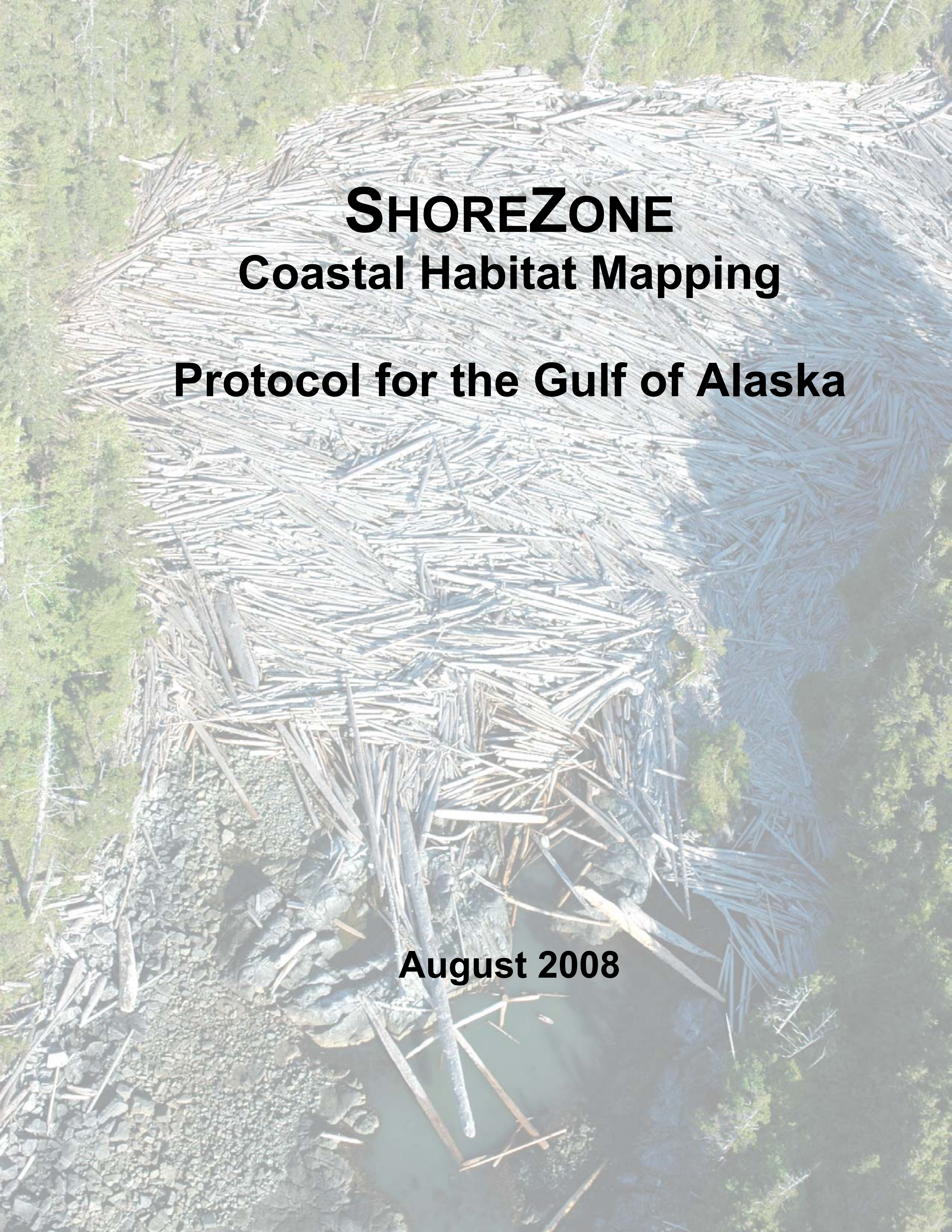

SHOREZONE
Coastal Habitat Mapping

Protocol for the Gulf of Alaska

August 2008

On the cover:
Log debris collected in a supratidal storm berm, Hidden Bay, Clarence Strait (east Prince of Wales Island). Photo: SE06_MM_10733.

CORI Project: 08-01 August 2008

ShoreZone Coastal Habitat Mapping Protocol for the Gulf of Alaska 2008

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SUMMARY

The land-sea interface is a crucial realm for terrestrial and marine organisms, human activities, and dynamic processes. ShoreZone is a coastal habitat mapping and classification system that specializes in the collection and interpretation of spatially-referenced aerial imagery of the intertidal zone and nearshore environment. Its objective is to produce an integrated, searchable inventory of geomorphic and biological features which can be used as a tool for science, education, management, and environmental hazard mitigation.

This report provides documentation of the ShoreZone Coastal Habitat Mapping Program in the State of Alaska. The objectives of this protocol are to:

- Provide a record of the ShoreZone program, its partners, and its procedures.
- Specify standards for image collection and intertidal/nearshore habitat mapping to improve users' understanding of the methodology and to ensure inter-agency and inter-annual consistency for the program.
- Document the status of the Alaska ShoreZone program as of August 2008.
- Provide illustrated examples of mapped features from the Kodiak Archipelago and Southeast Alaska.
- Summarize the principal findings of two assessment studies of ShoreZone (mapping repeatability and field verification in Victoria, BC).

The ShoreZone system utilizes spatially referenced, oblique aerial video and digital still imagery of the coastal zone collected during the lowest daylight tides of the year. Image interpretation and mapping is accomplished by a team of physical and biological scientists. The mapping system (housed in ArcGIS and MS Access databases) catalogs both geomorphic and biological coastal resources at effective mapping scales of better than 1:10,000 and provides a spatial framework for coastal habitat assessment on local and regional scales. Specific data products include:

- imagery (web-posted, video, DVD, libraries on external drives)
- linked geomorphic and biological attribute data interpreted from aerial imagery
- ground station data collected in support of the aerial mapping program
- research applications
- data summary reports
- technical data and flight reports.

The ShoreZone system was employed in the 1980s and 1990s to map coastal features in British Columbia and Washington state (Howes 2001; Berry et al. 2004). Between 2001 and 2003, ShoreZone imaging and mapping was initiated in the Gulf of Alaska, beginning with Cook Inlet, Outer Kenai, Katmai, and

portions of the Kodiak Archipelago (Harper and Morris 2004). The program in Alaska has continued to grow through the efforts of a network of partners, including federal, state, local, private, and non-profit agencies. This protocol serves as an update to Harper and Morris (2004) and to Harney et al. (2007).

The ShoreZone program mandates that the information be widely accessible. Aerial imagery exists for nearly 45,000 km of shoreline in Alaska and can be viewed online at www.alaskafisheries.noaa.gov/maps/szintro.htm. Mapped data (such as eelgrass, canopy kelps, sediment type, and other features) can also be viewed on these web sites for more than 28,000 km of mapped shoreline, including parts of Southeast Alaska and the Northern Gulf of Alaska. Mapped regions also include nearly 45,000 km of coastline in British Columbia and Washington state (Figures 1.1 and 1.2).

ShoreZone imagery provides a useful baseline, while mapped resources (such as shoreline sediments, eelgrass occurrence, and wetland distribution) are an important tool for scientists and managers. ShoreZone coastal mapping data is used for oil spill contingency planning, conservation planning, habitat research, development evaluation, mariculture site review, and recreation opportunities.

The ShoreZone program is a partnership of scientists, GIS specialists, web specialists, nonprofit organizations, and governmental agencies. The multi-agency program offers the opportunity to build a contiguous, integrated coastal resource database for the Pacific Northwest and Alaska.

Organizations working in partnership for the Alaska ShoreZone effort to date include: Alaska Department of Fish and Game, Alaska Department of Natural Resources, Archipelago Marine Research Ltd., Coastal and Ocean Resources Inc., Cook Inlet Regional Citizens' Advisory Council, Exxon Valdez Oil Spill Trustee Council, National Park Service, NOAA National Marine Fisheries Service, Prince William Sound Regional Citizens' Advisory Council, National Park Service, The Nature Conservancy, US Forest Service, and US Fish and Wildlife Service.

This and other ShoreZone reports are available for download from the Coastal & Ocean Resources website (www.coastalandoceans.com).

TABLE OF CONTENTS

LIST OF TABLES

List of Figures

1.0 OVERVIEW OF THE SHOREZONE MAPPING SYSTEM

The land-sea interface is a crucial realm for terrestrial and marine organisms, human activities, and dynamic processes. ShoreZone is a mapping and classification system that specializes in the collection and interpretation of aerial imagery of the coastal environment. Its objective is to produce an integrated, searchable inventory of geomorphic and biological features of the intertidal and nearshore zones which can be used as a tool for science, education, management, and environmental hazard planning.

ShoreZone imagery provides a useful baseline, while mapped resources (such as shoreline sediments, eelgrass and wetland distributions) are an important tool for scientists and managers. The ShoreZone system was employed in the 1980s and 1990s to map coastal features in British Columbia and Washington state (Howes 2001; Berry et al. 2004). Between 2001 and 2003, ShoreZone imaging and mapping was initiated in the Gulf of Alaska, beginning with Cook Inlet, Outer Kenai, Katmai, and portions of the Kodiak Archipelago (Harper and Morris 2004).

The ShoreZone program in Alaska continues to grow through the efforts of a network of partners, including scientists, managers, GIS specialists, and web specialists in federal, state, and local government agencies and in private and nonprofit organizations. The coastal mapping data and imagery are used for oil spill contingency planning, conservation planning, habitat research, development evaluation, mariculture site review, and recreation opportunities. Protocols and standards are updated through technological advancements (e.g. Harney et al. 2007), and applications are developed that use ShoreZone data to examine modern questions regarding the coastal environment and nearshore habitats (Harney 2007, 2008). As of June 2008, mapped regions include more than 26,000 km of coastline in the Gulf of Alaska and 45,000 km of coastline in British Columbia and Washington state (Figures 1.1 and 1.2).

Oblique low-altitude aerial video and digital still imagery of the coastal zone is collected during the lowest tides of the year, usually from a helicopter flying at or below 100 m altitude. During image collection, the aircraft's GPS position is recorded at 1-second intervals using electronic navigation software and is continuously monitored in-flight to ensure all shorelines have been imaged (Figure 1.3). Video and still imagery are spatially-referenced and time-synchronized using a 6-digit UTC time code (Figures 1.4 and 1.5). Video imagery is accompanied by continuous, simultaneous commentary by a geologist and a biologist aboard the aircraft.

Image interpretation and mapping is accomplished by a team of physical and biological scientists, who use the imagery and commentary to delineate along-shore coastal habitat **units** and to "map" their observations of physical, geomorphic, sedimentary, and biological across-shore **components** within those units (Figure 1.6). Units are digitized as shoreline segments in ArcView or ArcGIS, then integrated with the geological and biological data housed in a relational Microsoft Access database. Mapped habitat features include degree of wave exposure, substrate type, sediment texture, intertidal biota, and some nearshore subtidal biota.

Mapped data is in the form of **line** segments and **point** features. Line segments are the principal spatial features, representing along-shore units, each with a unique physical identifier (PHY_IDENT) that links the data to the digital shoreline in GIS. Point features (also called "variants") are small features such as streams that are better represented as a point rather than a line. Such point features are also mapped as "forms" within the unit that contains them.

The ShoreZone program mandates that the information be widely accessible. Imagery and mapped data are specially formatted for posting on regional websites (www.alaskafisheries.noaa.gov/maps/szintro.htm for Alaska and www.shim.bc.ca/gulfislands/atlas.htm for the Gulf Islands in British Columbia, Canada).

Thematic data (such as the distribution of eelgrass, canopy kelps, sediment type, and other features) can also be viewed on the NOAA web site for many mapped regions, including parts of Southeast Alaska, Prince William Sound, and the Northern Gulf of Alaska.

The ShoreZone mapping system provides a spatial framework for coastal habitat assessment on local and regional scales. Research and practical applications of ShoreZone data and imagery include:

- natural resource planning and environmental hazard mitigation
- linking habitat use and life-history strategy of nearshore fish and other intertidal organisms;
- habitat suitability modeling (for example, to predict the spread of invasive species or the distribution of beaches appropriate for spawning fish;
- development evaluation and mariculture site review;
- ground-truthing of aerial data on smaller spatial scales; and
- public use for recreation, education, outreach, and conservation.

Details concerning mapping methodology and the definition of 2008 standards are available in the ShoreZone Coastal Habitat Mapping Protocol for the Gulf of Alaska (Harney et al. 2008). This and other ShoreZone reports are available for download from the Coastal & Ocean Resources website (www.coastalandoceans.com).

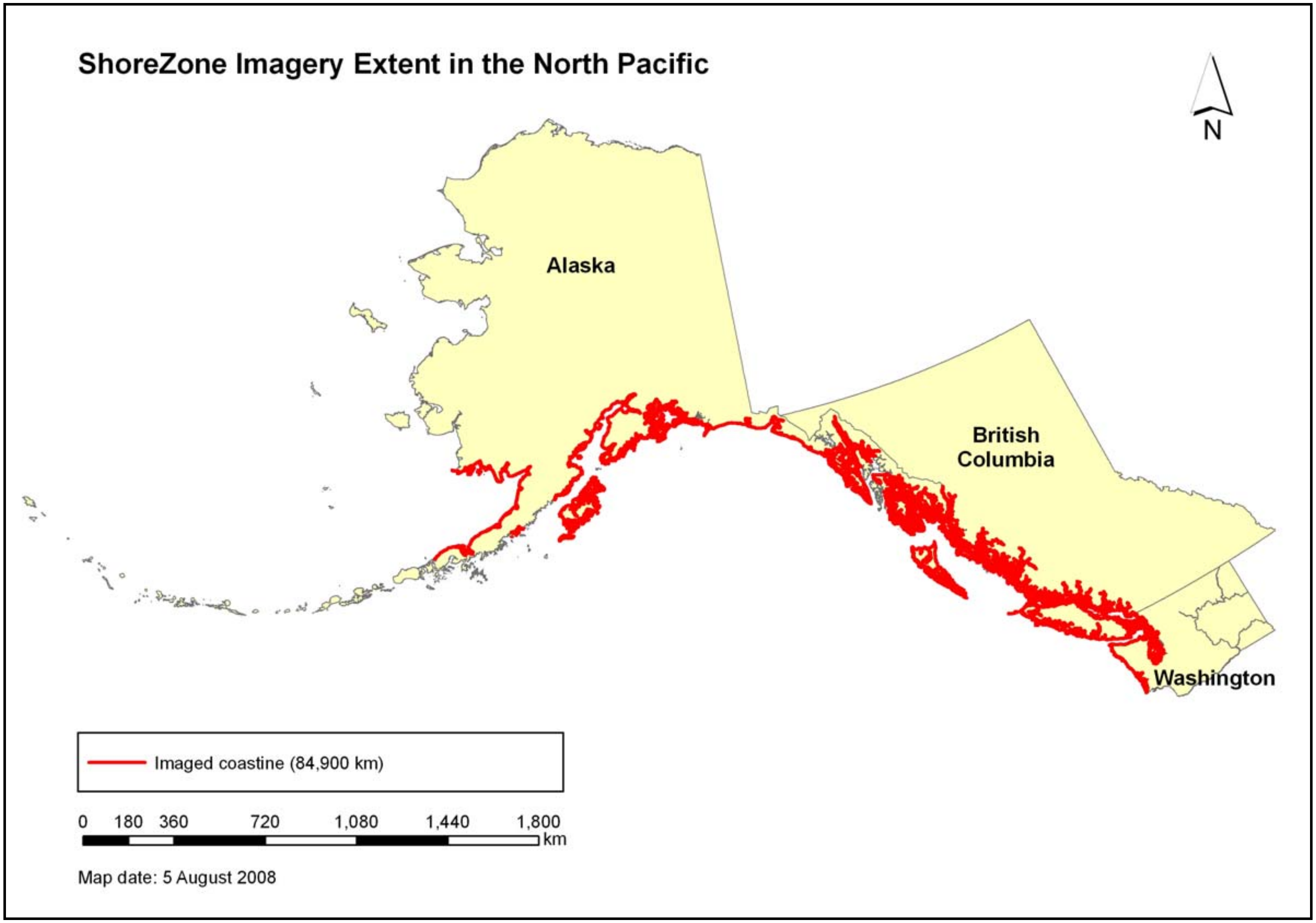


Figure 1.1. Extent of ShoreZone imagery in Alaska, British Columbia, and Washington State: 84,900 km as of August 2008).

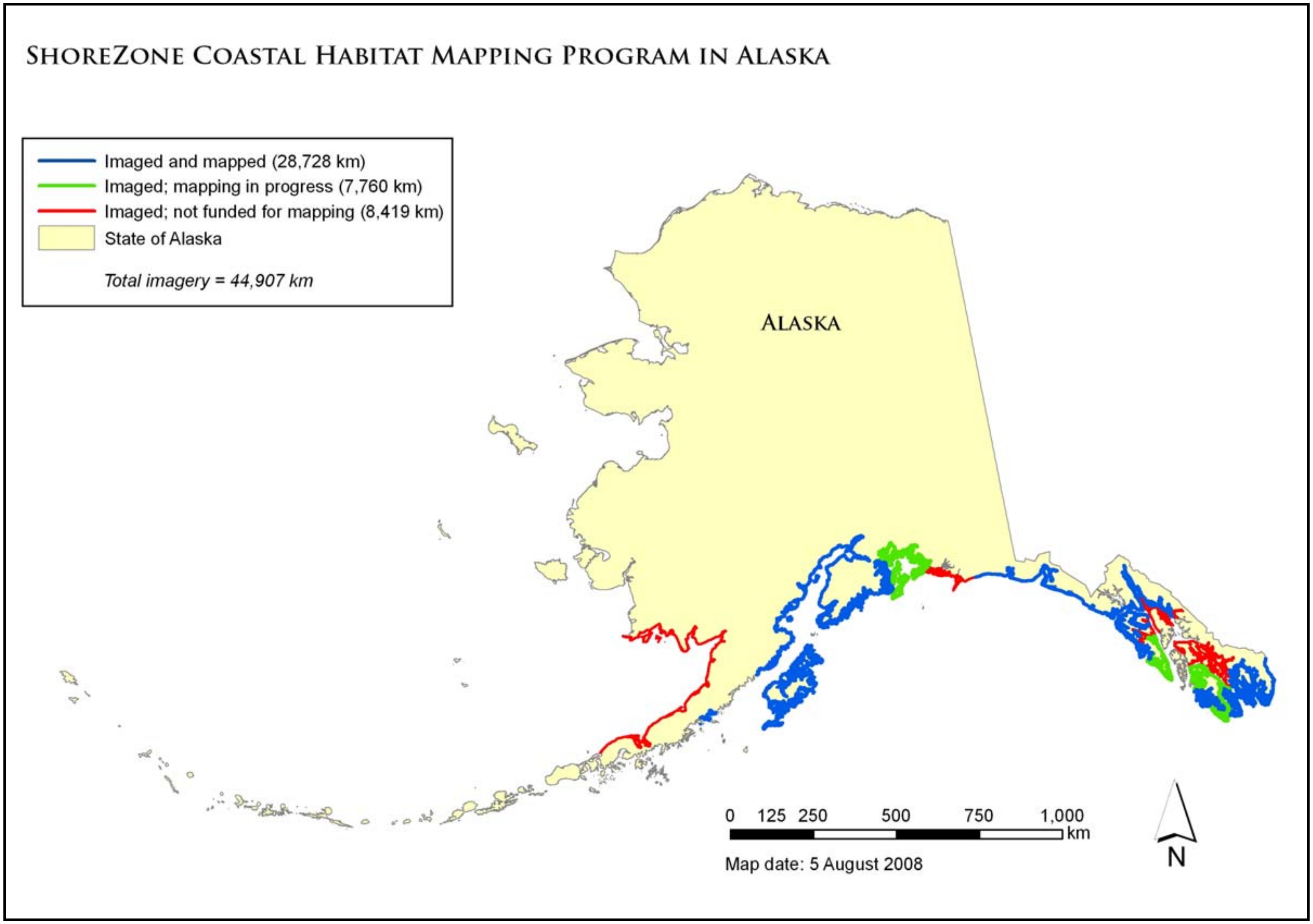


Figure 1.2. Extent of ShoreZone imagery (44,907 km) and coastal habitat mapping in the State of Alaska (as of August 2008).

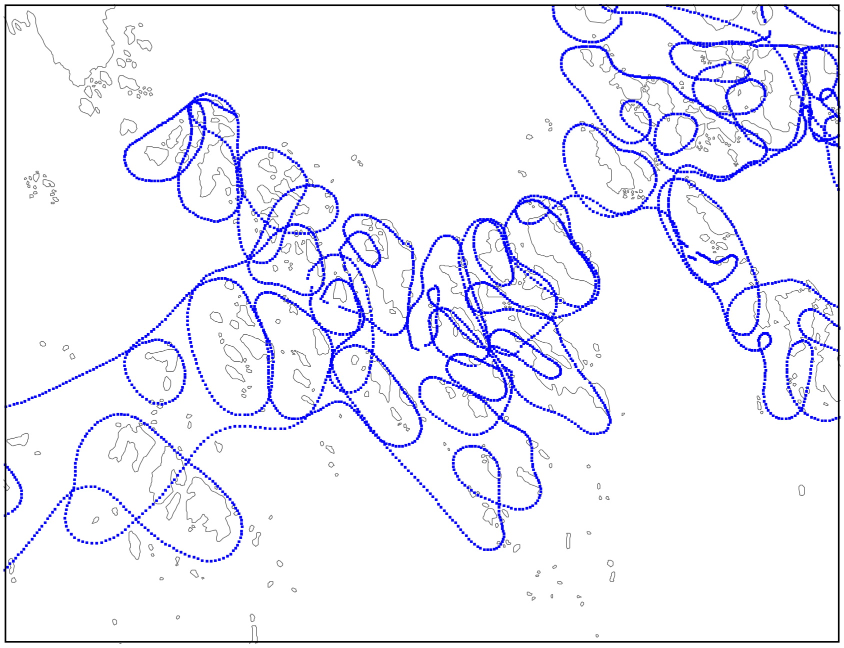


Figure 1.3. Example of recorded flight trackline, showing 1-second GPS navigation fixes (Myriad Islands, western Chichagof Island, SE Alaska).

Figure 1.4. Example of frame capture from video imagery in Foul Bay, northwest Afognak Island in the Kodiak Archipelago. Latitude, longitude, and 6-digit UTC time stamp are burned onto each frame of video imagery.

Figure 1.5. Example of digital still imagery, showing biobands in Icy Strait, SE Alaska. Digital photographs are linked to the recorded digital tracklines by 6-digit UTC time code, providing a GPS position on the shoreline for each image.

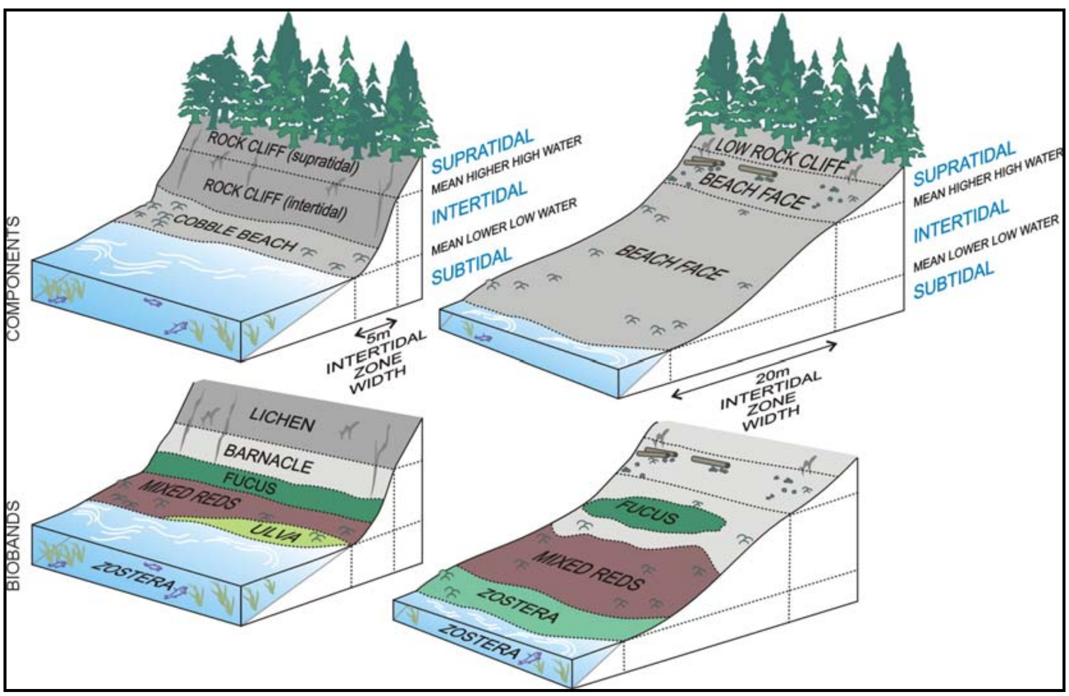


Figure 1.6. Schematic to illustrate how digital shorelines are segmented into alongshore units and across-shore components in the ShoreZone mapping system.

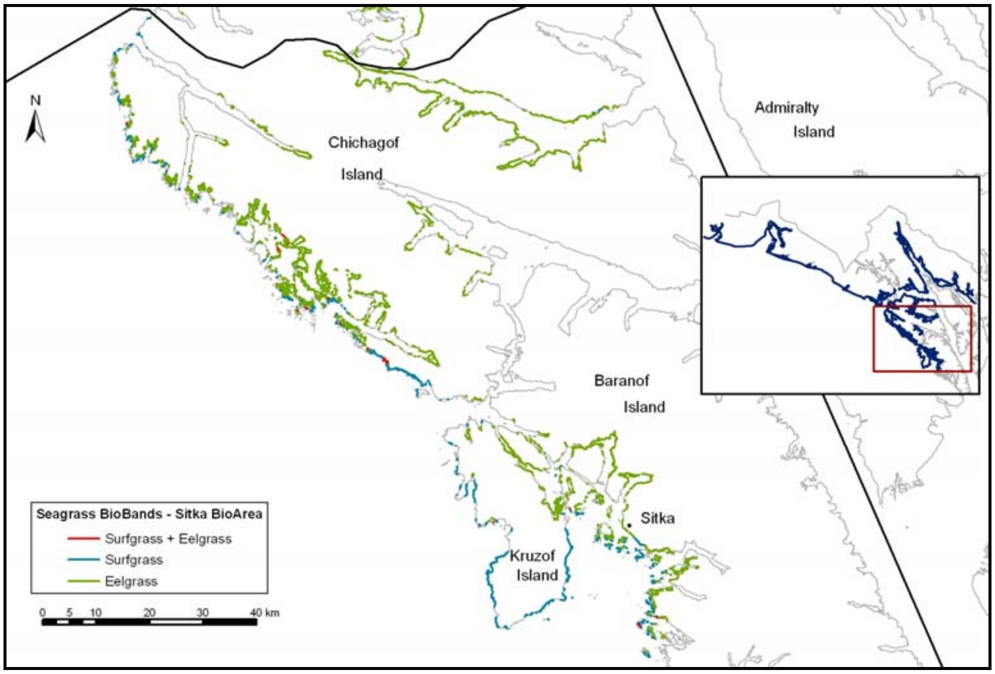


Figure 1.7. Example of mapping of surfgrass and eelgrass ‘biobands’ as observed in the along-shore units in areas of Chichagof and Baranof Islands, Southeast Alaska. Average unit length in this region is 260 m. The inset map shows the shoreline that has been inventoried in blue. Note that the eastern side of these islands has not yet been imaged.

Figure 1.8. Measuring coastal profiles and recording species data during a ground station survey, on northwest Afognak Island in the Kodiak Archipelago, northern Gulf of Alaska.

2.0 SHOREZONE AERIAL VIDEO IMAGING (AVI) SURVEYS

2.1 AVI Survey Overview

Planning for an aerial survey program must begin well in advance (typically months) of the actual field work 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 principal scheduling criteria for the aerial survey program is the selection of “low-tide windows” during which 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. Low tides that are suitable for image collection range between 2.5 to 4 hours per day in duration on the open coast (deep inlets and lagoons may have delayed tides).

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. The minimum amount of time required for refueling is 20-30 minutes, which is ~10% of the potential imaging window.

Imaging is conducted from the left side of the aircraft, thus 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 are important aspects of each daily plan.

Detailed daily flight plans are constructed by the survey geologist (Figure 2.1). Typical personnel functions are summarized in Table 2.1. Pre- and post-flight responsibilities tend to be shared among personnel, but in-flight activities are generally assigned to a particular crew member.

Each survey team is identified with a name and a two-letter abbreviation (e.g. Team Cordova, or “DV”) used in the video tape headers and navigation data files.

Team Cordova (DV)							8	*Homer-Cordova 300 km @ 160km/h = 2 hr = 60 gal
Day	Date	Gal*	Time	Flight Time (hr)	Shoreline (km)	Total (km)	Transit (km)	Location
1	15-May-07	60	*5:05*				20	sunrise 5:09; lift off, transit to outside Boswell Bay, NE tip Hinchinbrook
			5:13		100			**tide opens**; survey N HINCHINBROOK to Shelter Bay (no refuel)
			6:15		100			SW Hinch, Port Etches, Cape Hinch
			7:15		70			Hook Pt to Boswell Bay (finish Hinchinbrook)
	tide=		8:00		10			Mummy Island
	3:23		8:10		#			begin South Hawkins if time/fuel permit
			8:20				10	set down Cordova; refuel after tide
		100	**8:36**	*3:15*		280		**tide closes**
2	16-May-07		*4:50*				120	lift off; transit to Squaw Bay, head of Eaglek (arr 5:40)
			5:46		150			**tide opens**; Eaglek Bay and islands
			7:10		75			Schoppe Bay, Kniklik, Olsen Island
		90	*7:45*	*2:55*			5	setdown and refuel Cannery Creek
			8:15		75		5	liftoff; lower Unakwik to Mueller Bay
	tide=		9:00		100			Mueller Cove, Siwash Bay, Jonah Bay
	3:50		**9:36**					**tide closes** (later in upper Unakwik)
			10:00				130	return to Cordova
		90	*10:50*	*3:05*		400		set down and refuel, Cordova
3	17-May-07		*5:30*				130	lift off; transit to Unakwik (arr 6:20)
			6:28		130			**tide opens**; Jonah to upper Unakwik, Wells Bay
			7:50		80			Cedar Bay, Granite Bay
		100	*8:40*	*3:10*			20	setdown and refuel Cannery Creek
			9:10		40		20	liftoff; Fairmount, Eickelberry Bay
	tide=		9:35		100			Glacier Island
	3:59		**10:27**					**tide closes**
			10:35				100	return to Cordova
		60	*11:15*	*2:05*		350		set down and refuel, Cordova
4	18-May-07		*6:30*				100	lift off; transit to Long Bay (arr 7:10)
			7:16		70			**tide opens**; Long Bay
			7:50		110			Columbia Bay (not all of Heather Isl or Bay); end at 9
		90	*9:15*	*2:45*			35	transit and refuel Tatitlek (set down at time shown)
			9:45				35	liftoff after fuel; return to Heather Is (Columbia Bay)
	tide=		10:00		100			finish Columbia; Valdez Arm up to near Sawmill Bay
	3:55		11:00		50			Port Valdez (won't finish)
			11:11				130	**tide closes**; push tide til 11:30; return to Cordova
		60	*12:10*	*2:10*		330		set down and refuel, Cordova
5	19-May-07		*6:50*				130	lift off; transit to Port Valdez (arr 7:40 to do Valdez early)
			8:11		100			**tide opens**; finish Port Valdez, Jack Bay (by 8:40)
			8:40		130		5	Galena Bay, Tatitlek, Boulder Bay (~30 km past Tatitlek fuel)
		90	*10:00*	*3:10*				setdown and refuel Tatitlek
	tide=		*10:30*		75			liftoff after refuel; Bligh, Busby (Tatlk Narrows tide ends @ 11:20)
	3:38		11:15		75			Copper Mtn Pen, Landlocked Bay, Fish Bay, Port Fidalgo to pass
			11:49				80	**tide closes**; push tide in Fidalgo tli 12:00 (ok to fly Fid-Grav pass)
		60	*12:30*	*2:00*		380		set down and refuel, Cordova
6	20-May-07		*8:35*				80	lift off; transit to head of Port Fildalgo (arrive 9:05)
			9:16		100			**tide opens**; finish Port Fidalgo to Knowles Head
			10:05		100			Port Gravina
			11:05		100			Beartrap Bay to Gravina Pt., Sheep Bay; begin Simpson if fuel permits
	tide=	*105*	*12:05*	*3:30*			30	set down and refuel, Cordova (after tide)
	3:05		**12:21**			300		**tide closes**
				28:05:00	heli time	**2,040**	**km**	
				04:40	avg daily he	**340**	**km/day**	

Notes

- only leave gaps near Cordova; not far field sites!
- 100 km/h survey rate, 150 km/h transit rate
- transits can be faster if clear
- blue refuels are drums Jet-A in the field; others are at base
- push tides (5 min on each side of the window), esp in fjords
- note flight time in italics (between fuels and total each day)
- Tatitlek tides are up to 30 minutes earlier (consult tides sheet; plan as written considers this)

Fuel Placement

- lift off and set down shown in italics; flight time is difference between the two
- gallons of fuel based on flight time in italics

Figure 2.1. Sample daily flight plan. Shown is plan from Prince William Sound AVI survey in May 2007 (Team Cordova).

Table 2.1. Responsibilities of ShoreZone Aerial Video Imaging (AVI) survey personnel.

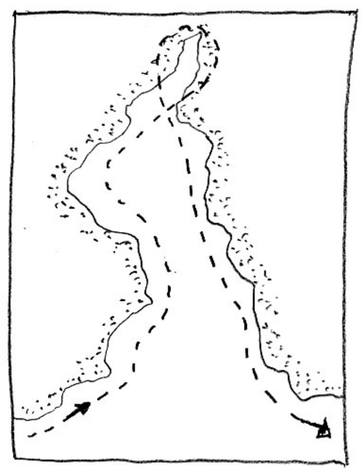
Personnel	**Pre-Flight Activities**	**In-Flight Activities**
Videographer Geologist	• responsible for setting up camera • tests entire system prior to lift off • synchronize video camera clock to GPS clock • synchronize tape deck clock to GPS clock • labels and packs videotapes (with 2-min headers)	• video-imaging and continuous geological description • checks image framing • manually adjusts exposure if necessary • advises pilot re flying corrections • checks camera switches at regular intervals • check audio meters for sound level • checks counter on recorder
Photographer Biologist	• set-up film • tests designated audio-sound track	• provide continuous biological commentary • shoots digital still photos • stores digital media • assists in navigation using paper charts
Navigator	• assists in design of flight track • prepares flight line maps • documents tide window • synchronizes computer clock to GPS clock • brings and uses charts	• checks monitor for framing and exposure • monitors electronic mapping and logging system • coordinates tape changes • directs pilot in general strategy (use clock face for directional instructions) • provides geographic reference points to the geologist for recording on audio track • provides feedback on quality of commentary to biologist and geologist

2.2 Guidelines for Videographer (Geologist) During ShoreZone AVI Surveys

1. **Speed and Altitude:** Typical flight speed is 60 knots and altitude is 250’ (100 km/h survey rate, 150 km/h transit rate). Be careful about the speed as often the pilots unconsciously speeds up or slows down and has to be refreshed. On intricate shorelines, speed will have to be lower and on long straight sections it can be a bit faster. Altitude should vary as width of the shore zone. Wide shore zones require higher altitudes (500-600’ is typical for estuaries). Generally the pilot gets the idea and automatically climbs as he approaches an estuary.

2. **Shooting Angles:** Keep the horizon level (using the treeline helps), shooting about 45 degrees *off the trackline* with the door jamb just out of the right side of the image. The camera should be pointed around 45 degrees *down* so the shoreline is appearing in the right upper corner, passing through the center of the screen and out of the left lower corner (sketch at right). It does help the mappers to shoot ahead occasionally so they get a single view showing the overall complexity (or similarity) of the coast. Also you can follow an interesting feature with a slight zoom in, holding the framing stationary on the feature as the helicopter passes over.

3. **Cornering:** Get the pilot used to always making counter-clockwise turns (see preferred trackline at right). This puts the left side of the helicopter down and allows for better filming, although the camera person will have to lift the camera during the turn. Some pilots persist on doing clockwise, “hover” turns at the end of long narrow inlets but it invariably doesn’t work – the helicopter has to slow down more, is less stable and struts and skids fill the image.



4. **Framing:** Use the monitor to frequently check framing. You should also check that the little red dot is in the image (indicates recording) and that the tape-remaining counter is running. At the same time, make sure you camera is recording (little red light on back of handle). Minimize the sky in the image to avoid silhouetting the shore zone; too much sky will cause the shore zone to be almost black. This is very difficult to avoid in bright surf areas.

5. **Narration:** Generally the morphology doesn’t need to be described because mappers can see this in the videography. Concentrate on the sediment texture, which is not so clear in the imagery; be as precise as possible (“a veneer of pebbles and cobbles over sand”; “medium sand beach face and a pebble sand berm”; “pebbles and sand with scattered boulders.” Provide the description from supra-tidal down to lower intertidal. The other thing to mention is widths, over and over. Be precise (“the beach face is 20 m wide.”) Widths on all components (multiple A, B zones) are helpful but even if you can only provide a few, it is useful to the mappers. Let your enthusiasm be part of the narration – there will be an army of mappers working on this all winter. Geographic names provided by the navigator have to be repeated as the navigator’s comments are not recorded.

6. **Camera settings:** Autofocus with filter adjustments off. Look out for: flashing “ND1” in video camera frame and adjust the filter setting to whatever the camera recommends. Toggle the “display” button to prevent red “REC” and other information appearing in recorder frame. Mate and tape all cables so they are neat and not loose. If recorder becomes black and white, cables are probably loose. If the recorder has lines running through it, recording for a few minutes at the beginning transit is helpful (or running the head cleaner). Make sure the “HiFi sound is set to “2” on both the recorder and the camera. (On the Narcissus / New GVD system, audio is set to “stereo.”)

7. **Time:** Synchronize watch, digital camera, GPS, and laptop at the start of each day.

8. **Mapping Terminology tips:** Use “ramp” for 5-15 degrees slope, “platform” for <5 degrees, and note whether a cliff is MORE or LESS than 35 degrees (Casl vs Cail). Note if widths are more or less than the 30 m benchmark.

9. **Video camera and filming reminders:** Reset white balance according to instructions. Use only a skylight filter, not a polarizing filter. Check small watch batteries that enable memory functions. Look over pilot’s shoulder to see 60 knots speed. Ask navigator to monitor GPS is around 100 km/h speed. Don’t get too close or too far from shore. Try to shoot 45 degrees out the door and 45 degrees down to the ground.

2.3 Guidelines for Photographer (Biologist) During ShoreZone AVI Surveys

1. Keep up a streaming commentary mentioning ALL biobands present even if the biota is not changing and you feel as though you are repeating yourself. More is always better.

2. Use bioband names when describing individual species which are not easily identified.

3. Make note of changes in biological wave exposure and always mention the exposure at the beginning of the day and when starting a new section of shoreline or after a tape change.

4. Pay particular attention to what is at the waterline and in the subtidal as this is the area that is most difficult to see when reviewing the video. Also make note of offshore kelp beds that may not be captured in the video

2.4 Post-Flight Data Processing

The navigation trackline data are processed daily by the survey navigator and updated to a MS Access Master Trackline Database file (Figure 2.2). Trackline position, video imagery, and digital photo times are linked to a GPS location using the six-digit UTC time code.

The survey geologist is responsible for processing start, end, and break times for each tape in the form of a tape log (Figure 2.3).

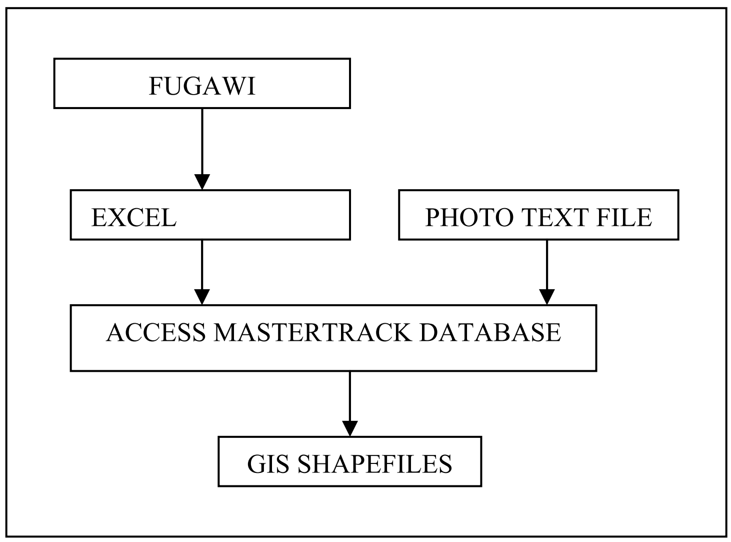


Figure 2.2 Schematic illustrating the processing of navigation data (Fugawi) and the linking to digital photos and video imagery using an MS Access database and GIS shapefiles.

2006 Southeast Alaska Aerial Video Imaging Survey
Team Sand Lance (SL)
(EXAMPLE TAPE LOG)

Tape: **SE06_SL_05** **Date:** **26 May 06**

General Location: West side Behm Canal, Helm Bay to Spacious Bay

Time Start (UTC): 14:00:05 **Geo:** Borecky
Fuel Break: 14:44:02 to 15:22:02 **Bio:** Morris
Time End (UTC): 15:36:12 **Nav:** Anderson
Tape Length: 58 min, 9 sec

Weather: Overcast with sunny periods.

Time (UTC)	Location	Photo
14:02:25	Pt Francis	SE06_MM_01745
14:12:28	Head of Helm Bay	SE06_MM_01859
14:21:56	North side, mouth of Helm Bay	SE06_MM_01950
14:25:28	Heckman Point	SE06_MM_01995
14:36:17	Snail Point	SE06_MM_02126
	Fuel Break: 14:44:02 to 15:22:02	
15:23:20	North side Square Island in Spacious Bay	SE06_MM_02214
15:29:19	Head of Spacious Bay	SE06_MM_02276
15:34:14	Unnamed estuary N. side Spacious Bay	SE06_MM_02329

Figure 2.3. Sample tape log created by the geomorphologist (videographer) for each tape of recorded imagery.

3.0 SHOREZONE PHYSICAL MAPPING PROTOCOL

3.1 Overview of Database Structure

Data are stored in six separate tables within a relational database (Figure 3.1). **Spatial Data** is housed in ArcView and ArcGIS software, linked to units in the ShoreZone database by a unique **physical identifier** (PHY_IDENT field), an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0).

Definitions of field names within each table are provided in the **Data Dictionaries** of the Appendix. **General "rules of thumb"** applied during physical mapping and image interpretation are included in the physical mapping guidelines in Section 3.3. Biological mapping guidelines are provided in Section 5.0. A summary of **mapping repeatability** conducted in 2007 is provided in Section 6.0.

The **Unit Table** includes information related to the entire unit, including geomorphic attributes such as overall coastal morphology type, coastal stability, sediment sources to the unit, wave exposure level, and potential oil residence. Administrative information such as the names of the mappers, editors, videotape number, and date entered are also included within the Unit table.

The **BioUnit Table** is the biological complement to the Unit table. It houses biological information related to the entire unit, including biological wave exposure and habitat class. These attributes are discussed further in Sections 5.0 and 6.0. Administrative information is also included in the BioUnit table, including biomapper and editor names, digital photos for the unit, ground station number, and the sources of information used in the biological interpretations.

The **XShr Table** includes a record (row) for each across-shore zone (A, B, or C) and component (A1, B1, B2…) with attribute information regarding the morphology, sediment texture, width, slope, dominant coastal process, and estimated oil residence index for that particular intertidal zone and component. Further details are provided in Section 3.3. (data entry procedures and guidelines).

The **BioBand** Table is the biological complement to the XShr table. It contains biological information related to each across-shore zone. Band-forming assemblages of biota are recorded in the corresponding zone in which they are observed. These assemblages of coastal biota are referred to as Biobands and grow in a typical across-shore elevation, and at characteristic wave energies and substrate conditions. These attributes are discussed further in Section 5.0.

The **tblBioSlideList** Table is an inclusive list of all digital still photos collected during AVI surveys, providing the image name (e.g. SE06_ML_00001.jpg), the date and time that the photo was collected (in UTC time), and a slide description when appropriate. This table is initially prepared in the field by the biologist (photographer) as part of the image handling protocol (Section 2.0). During physical mapping, each photo in the list is viewed and assigned a pertinent Unit Record identifier (UnitRecID field) when possible. The same UnitRecID may be used for multiple photos. However, each photo may have only one unit with which it is associated. Not all photos will have a UnitRecID assigned, thus the UnitRecID field of the table may be "0."

The **tblBioSlide** Table is a list of digital still images with only non-zero UnitRecID fields. These images are the most pertinent to the mapping data house in the database. The same UnitRecID may be used for multiple photos. However, each photo may have only one unit with which it is associated. In this table, the UnitRecID field will not be "0."

The **tblGroundStationNumber** Table provides information on pertinent records in a separate ground station database, if ground station data exists.

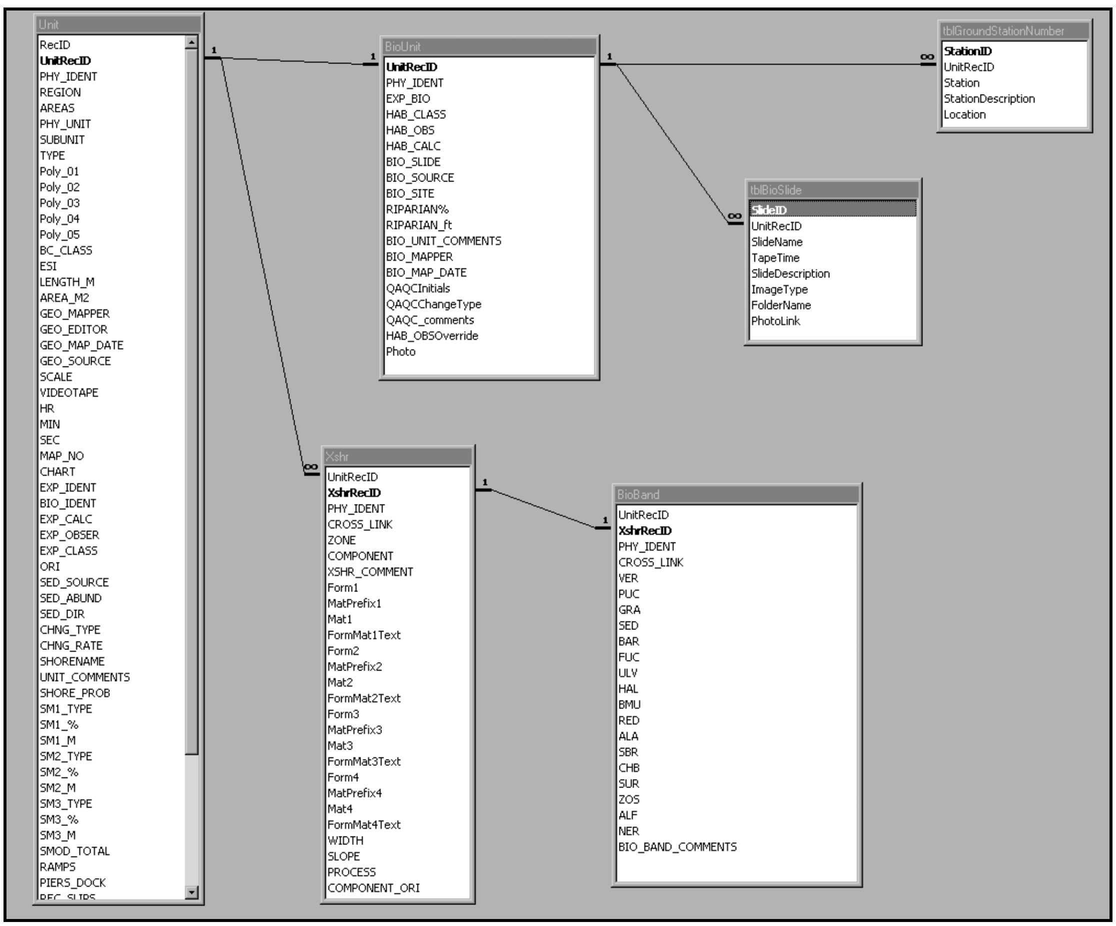


Figure 3.1. Schematic of the six data tables and their relationships housed in an Access relational database.

3.2 Principal Steps in ShoreZone Physical Mapping

1. Assembly of Materials

- data entry reference tables and codes (Appendix A)
- electronic base maps (digital shorelines in ArcView)
- video and digital still photo imagery (DVDs)
- aerial video imaging survey (AVI) flight report
- trackline shapefiles (ArcView)
- region and area shapefiles (ArcView)
- Access database front end containing data entry forms linked to back end on server

2. Physical ShoreZone Mapping

- physical mappers review video, digital still photos, and audio commentary to segment the shoreline into alongshore units (line segments) with occasional point features
- shore unit breaks are hand-drawn on paper maps and later digitized on the electronic shoreline
- along-shore unit attribute data are entered into the Unit table
- across-shore attribute data (Forms and Materials) are entered into the XShr table for each zone and component within the unit
- each digital still image is viewed and linked to pertinent units by entering data (into the tblBioSlideList table)
- 10% of the shoreline units are reviewed by another physical mapper as part of the QA/QC procedure (including Unit, XShr, and tblBioSlideList data)
- database QA/QC is performed by the database manager
- digitizing is synthesized by the GIS manager
- physical mapping database tables, paper maps, and GIS are transferred to biological mappers monthly

3. Biological ShoreZone Mapping

- biological mappers receive physical mapping database tables, paper maps, and GIS of digital, segmented shoreline
- biological mappers review video, digital still photos, and audio commentary to enter along-shore (into the BioUnit table) and across-shore (into the BioBand table) biological attributes for each physically-mapped shore unit
- 10% of the units are reviewed by another biological mapper as part of the QA/QC procedure (including BioUnit, BioBand, tblBioSlide, and Regional Comments)

4. Data Assembly

- database manager receives and imports biological data tables into the master database; relationships are re-established; database QA/QC is performed
- an ArcGIS Geodatabase is created from the master database
- physical and biological themes (shapefiles) are created and maps are produced

5. Preparation of Deliverables

- Access database and ArcGIS products are developed and QA/QC'd
- ReadMe files are written and included with data products on Data DVD
- ShoreZone Coastal Habitat Mapping Summary Report is prepared for the region, summarizing mapped attributes, physical themes, biological themes, the most recent version of the data dictionary, bioband descriptions of the region mapped, and database lookup tables.

Figure 3.2. Photo of mapping station setup with DVD player (left), database window (center screen), and still photo viewer (right). Headphone facilitate audio use. Segmentation (paper) map is at left.

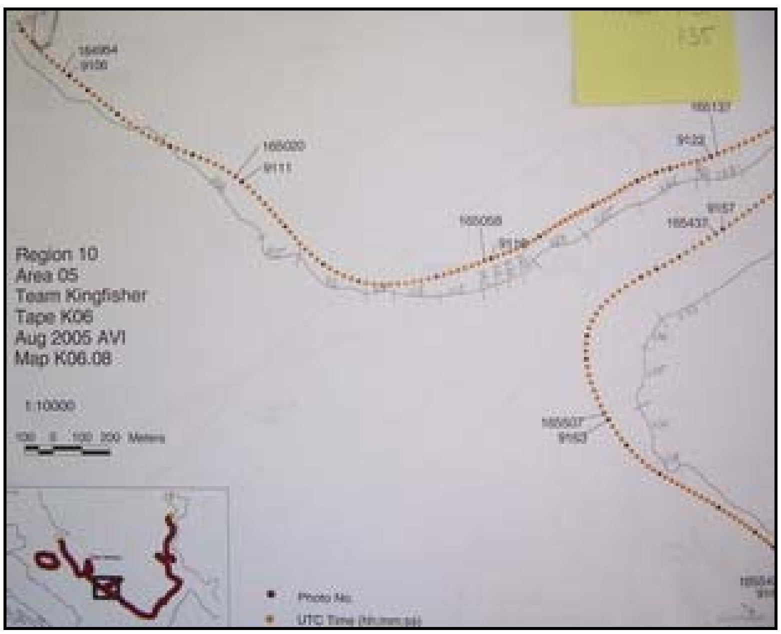


Figure 3.3. Example of annotated trackline map. Red dots are 1-second fix marks from the flight trackline recorded during image collection in the field. The trackline is annotated with 6-digit time codes and a 4-digit photo numbers. The mapper has segmented the high-water line shoreline into a series of alongshore units and added a unit ID for each unit (in pencil). These maps are then used to digitize unit breaks and shoreline changes.

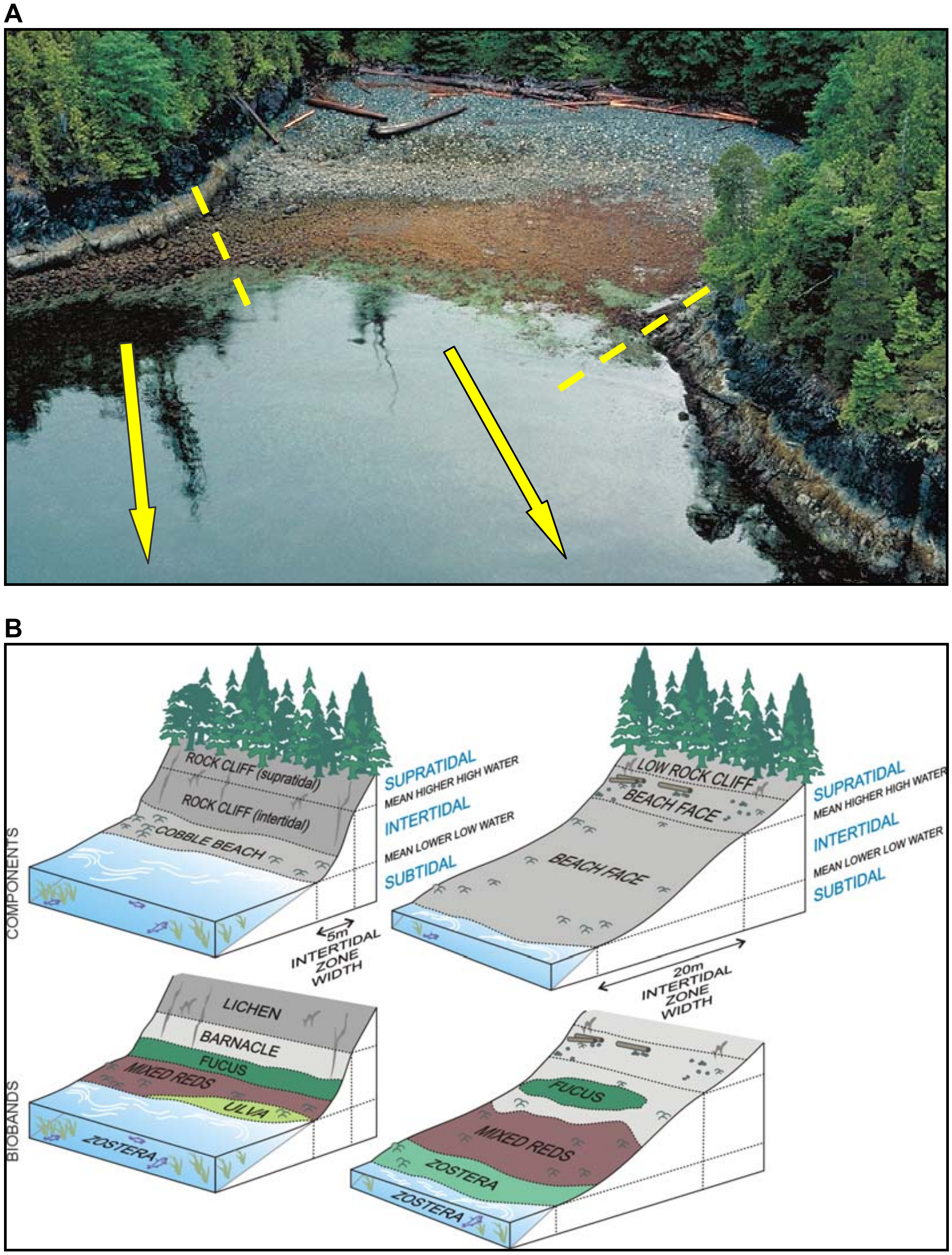
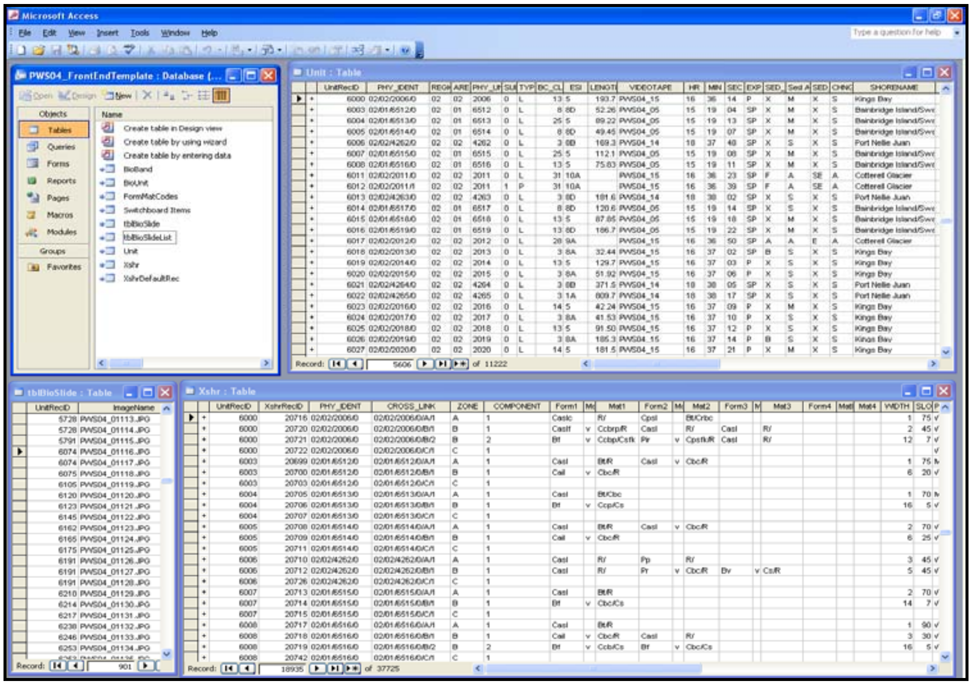


Figure 3.4. Oblique aerial photo (A) illustrating the delineation of an alongshore unit. Each unit is sub-divided into several across-shore zones (B) according to tidal elevation (supratidal, intertidal, subtidal), in which the geomorphic and sedimentary components (e.g. rock cliff, cobble beach) and biobands (e.g. lichen, barnacle, *Fucus*, red and green algae, and eelgrass) are mapped.

A



B

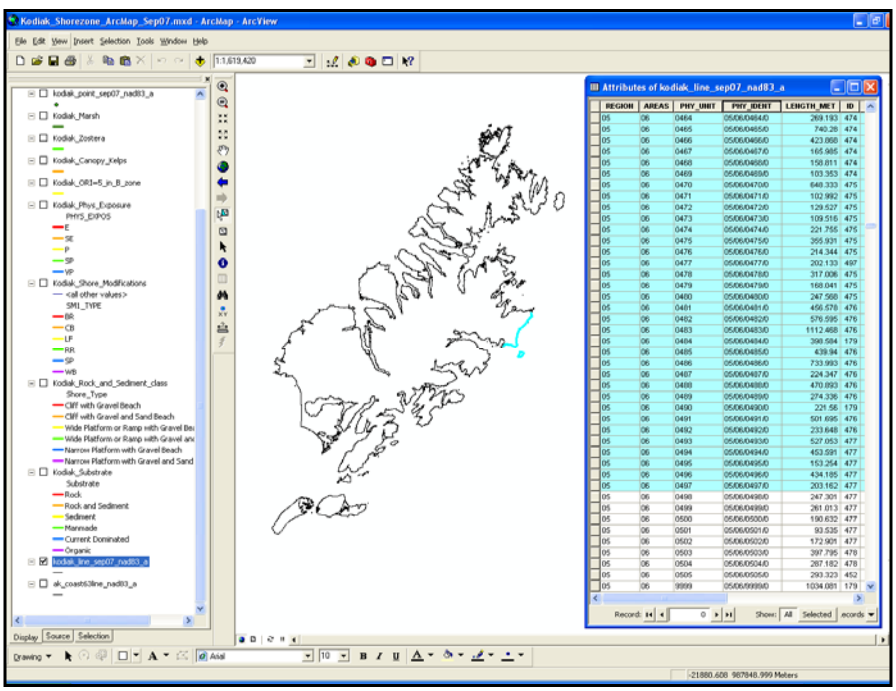


Figure 3.5. Data entered in the relational database (A) are linked to spatial location in ArcGIS (B) by the unique Physical Identifer (PHY_IDENT).

3.3 Physical Mapping Guidelines

Paper maps are created using layouts in ArcGIS software, in which shapefiles (also known as layers or themes) illustrate the digital shoreline, the survey trackline, and the survey photo points for that particular survey and tape. Six-digit UTC time codes at each trackline point link the location on the ArcGIS map to the video and still imagery.

Each map is annotated with region, area, tape number, map number, scale bar, northern arrow, and regional inset. Maps are sequentially numbered by tape, such that Map R09.01 is the first map made for tape SEA2005R-09. Each map should include an inset map of the geographic location and be annotated with important shore names and bodies of water which will be used in the "SHORENAME" field of the database.

Paper maps are used by physical mappers to delineate unit breaks. When physical mapping of a tape is completed, the relevant paper maps for that tape are photocopied and supplied to biological mappers, along with the physical mapping data and GIS files.

Alongshore **units** are delineated primarily on the basis of relatively uniform physical characteristics, including:

- geomorphology
- sediment texture
- degree of wave exposure.

Secondary characteristics that influence the location of unit breaks include:

- general biological patterns
- intertidal slope and width
- coastal process (e.g. mass wasting vs. fluvial)
- human alteration.

The alongshore length of an individual unit varies with shoreline complexity, crenulation, and coastal processes, but averages 200 to 400 meters.

Each along-shore unit is further characterized by the geologist in terms of a collection of **across-shore components** which are geomorphic features ("Forms") such as cliffs, beaches, and tidal flats, with associated texture characteristics ("Materials") (Figure 3.4). The across-shore component attributes are entered into the XSHR table of the database and are linked to the parent data in the UNIT table by the Physical Identifier, or PHY_IDENT.

The across-shore components are described in terms of:

- observed forms and substrates (e.g. a cobble berm)
- a landward to seaward sequence
- the tidal zone in which they occur (supratidal, intertidal or subtidal).

Within a unit, there will be three **zones** (A, B, and C) with at least one component each (i.e. A1, B1, C1 is the minimum entry per unit). In some cases, a single shore unit may contain repeatable sequences of geomorphic forms and textures such as small pocket beaches interspersed with rock headlands. Features that are <10% of the total unit area are not generally mapped.

Coastal processes play a significant role in affecting the geomorphology and sediment texture of a particular unit. For example, fluvial processes transport sediment to the coast where currents and waves distribute it across and along shore, forming different geomorphic features. ShoreZone mapping considers coastal processes and allows for the distinction between such features. For example, a delta fan with a width of 75 m will be mapped using different codes than a beach of 25 m, even if the sediment texture is similar.

Start time for unit: The six-digit UTC time code that is visible when the beginning of the unit break lies in the middle of the screen. If two segments of shoreline are visible in one frame, different units may have the same start time. In this case, a comment such as “unit in backshore” or “islet in foreground” is entered in the UNIT_COMMENTS field (discussed below).

End time for unit: While the ending time of a unit is not explicitly entered; it is generally considered the beginning of the next unit. There are cases when the end time of one unit will not be the start time of the next unit. An example of this would be an area of islets with flight line loops, often there is “dead” time between units in these cases while the helicopter is looping or while transiting between islets.

Once the unit boundaries are delineated, the mapper fills the database with attribute codes to characterize the unit both along-shore (**Unit Table**) and across-shore (**XShr Table**). Specific data-entry procedures and guidelines are discussed below, generally structured in the order of data fields in the Unit and XShr tables (left to right and top to bottom). However, most mappers fill in the across-shore component data fields first, because sediment characteristics and across-shore widths are important in classifying the overall unit type (BC Class).

General “rules of thumb” applied during physical mapping and image interpretation are included in the guidelines for Unit and XShr data entry below. Definitions of each field in the data tables can be found in the **data dictionaries** of the Appendix.

Guidelines for Along-Shore Physical Data Entry (Unit Table)

SUBUNIT: Subunits are set to 0 for line features (units) or non-zero for point features (also called variants). Variants are point features that are mapped and digitized within a linear unit segment. Usually variants are streams or rivers but can also be point features such as lagoon outlets, cultural sites such as fish traps, and structures such as wharves. There may be more than one variant per unit and are thus numbered as "subunits," which becomes the last number in the PHY_IDENT string. Several variants in a unit are numbered sequentially (1, 2, 3…) according to the time within the unit.

Time: Generally the time of the mapped point feature is entered when it is positioned in the center of the screen, rather than at the start time of the unit. Occasionally it is not possible to center the point feature on the screen due to flight line loops, in which case the start time of the unit is used for the point feature time.

Rivers (R): In the main unit data, a Form "R_" should be mapped in any zone through which a stream or river crosses, even if the feature is less than 10% of the unit. The R must have at least one lowercase modifier; for example, single stream channels are mapped as Form Rs.

Rivers as variants: The Form "R_" can be mapped in the A zone only, or in both the A and B zones, depending on if the stream passes through both the supratidal and the intertidal. A river is mapped as a variant (non-zero Subunit and "P" Unit type) only when it is a Form in *both* the A and B zones.

If the river does not appear in any B zones, then it may be mapped as a Form of intermittent river (Ri), but a variant (subunit) is not defined.

BC Class of subunits: This and the ESI class of the variant must be the same as the unit the variant is related to.

Width: The width field of the subunit for a variant must be the sum of the widths of the A and B zones across which the river flows.

BC CLASS: Coastal class or "shore type" of the unit; derived from the Howes et al. (1994) system applied in coastal British Columbia. Definitions are listed in the Appendix (Table A-2). There are 35 BC Classes, based primarily on substrate type, across-shore width, and slope. The BC Class should be assigned on the basis of the flowchart.

Width: The **intertidal zone width** is the sum of the widths of the B zone components (B1+B2+B3…) and is very important in assigning the BC Class. The intertidal width must be classified as "narrow" (<30 m) or wide (>30 m), thus a width of "30" is not used. Widths of "29" or "31" are occasionally used to express that the width is very close to 30 m.

Rock (BC Classes 1-5): Rock substrate dominates the intertidal zone of the unit, with little or no unconsolidated sediment or organics (<10% of the overall unit area).

Rock and Sediment (BC Classes 6-20) vs. Sediment-Dominated (BC Classes 21-31): When a unit consists of a beach with rock outcrops/platforms, the BC Class should be coded to emphasize the beach sediment (BC Class 21 to 30) unless the rock outcrops/platforms make up 25% or more of the **total area** of the unit. When the rock outcrops are 25% or more, the BC Class should be coded to reflect the influence that the rock has on the unit (BC Class 6 to 20).

Supratidal rock with intertidal beaches: When a unit consists of a supratidal cliff/ramp with an intertidal beach, the BC Class should be coded to reflect the importance of the beach (BC Classes 21 to 30) even if the cliff/ramp slightly infringes (<3 m) on the high intertidal zone. When the cliff/ramp significantly infringes on the intertidal zone (>3 m), a "Rock and Sediment" classification should be applied (BC Classes 6 to 20).

BC Class 11: When a unit consists of a prominent cliff in the supratidal and > 3 meters in the intertidal, in conjunction with a beach face containing sand and gravel (>25% of unit) and an intertidal zone wider than 30 meters, slope is ignored and BC Class 11 is used.

BC Class 13: When a unit consists of a significant cliff in the supratidal and > 3 meters in the intertidal, in conjunction with a beach face containing sand and gravel (>25% of unit) and an intertidal zone < 30 meters, slope is observed and BC Class 13 is used.

Sand Rule: To include sand in BC Class assignment, particles that are 2 mm and finer must be observed as 10% or more of the sediment type, or when a patch of sand is 10 m or more in diameter.

Sand Veneer: When a boulder/cobble/pebble beach is observed in a protected or semi-protected area, it should be noted that these materials are almost always a veneer overlying sand. This should be taken into consideration when coding the materials and choosing a BC Class. If the geologist's commentary mentions sand in nearby units with similar wave exposures, apply the presence of sand to the unit. Close examination of the lower intertidal in the digital still photos will often reveal the presence of sand, even if the commentary lacks mention of it. If there is no evidence or commentary regarding sand, do not assume it is present.

BC Class 31 (Organic Shorelines): Organics and vegetation dominate the unit; may characterize units with large marshes in the supratidal (A) zone (if the marsh represents >50% of the combined supratidal and intertidal area of the unit), even if the unit has another dominant intertidal feature such as a wide tidal flat or sand beach. This "50% rule" may be ignored and a BC Class 31 applied if a significant amount of marsh (25% or more) infringes on the intertidal (B) zone.

BC Class 32 and 33 (Anthropogenically-Altered): Units exhibit >50% human alteration the **area of the intertidal** (B) zone to be classified as anthropogenically-altered. Shore modifications may be mapped in the XShr Forms and Materials, and in the SHORE_MOD fields of the Unit table, without applying a BC Class 32 or 33 to the entire unit.

Current-dominated (BC Class 34): Usually occur in channels between islands or at constricted entrances to large lagoons, bays, or inlets. Water movement will be visible within the channel but not outside the channel. The biota tends to be lush within these channels. This BC Class does not occur in estuaries.

ESI: Environmental Sensitivity Index (shore unit classification; Table A-4). Shore types are classified from exposed shoreline at the top of the table to protected shoreline at the bottom of the table. Care must be taken to ensure the mapped wave exposure level is consistent with the ESI class.
<u>ESI 9A:</u> Applied when across-shore width is >30 m and slope is <3°.
<u>ESI 6C:</u> Applied to man-made beaches or berms (rip rap).

ASSIGNING ESI BASED ON BC CLASS

BC Rock

<u>BC 1 and 2</u>	If Exp. >= SE then ESI 2A If Exp. <= SP then ESI 8A (possible 8B if sediment pockets present or lots of fissures)
<u>BC 3, 4, and 5</u>	If Exp. >= SE then ESI 1A If Exp. <= SP then ESI 8A (possible 8B if sediment pockets present or lots of fissures)

BC Rock and Sediment

<u>BC 6 and 7</u>

If >=50% beach sediment then ESI 6A and 6B
If > 50% rock with beach pockets and Exp. >= SE then 2A

If > 50% rock with cobble/pebble beach pockets and Exp. <= SP then 8B
(boulders can be present but less abundant than cobble/pebble)

If > 50% rock with boulder/rubble beach pockets and Exp. <= SP then 8D
(cobble/pebble can be present but less abundant than boulder)

<u>BC 8, 9, and 10</u>

If >=50% beach in unit then ESI 6A and 6B
If mostly talus and Exp. >= SE then 1C

If mostly cobble/pebble talus and Exp. <= SP then 8B
(boulders can be present but less abundant than cobble/pebble)

If mostly boulder/rubble talus and Exp. <= SP then 8D
(cobble/pebble can be present but less abundant than boulder)

BC 11 to 15
There must be >25% sand in the unit for these BC classes to be assigned.
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A
Otherwise assign ESI 5. If sand is <25%, reassess the BC class.

BC 16 to 20
There must be >25% sand in the unit for these BC classes to be assigned.
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A
Otherwise assign ESI 3A or 4. If sand is <25%, reassess the BC class. Refer to BC 27 for guidelines on sediment size.

BC Sediment

BC 21 to 23
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A
If it does not meet the above requirements then ESI 6A or 6B

BC 24
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A
If it does not meet the above requirements then ESI 5

BC 25 and 26 – ESI 5

BC 27
If sediment size if less than 2 mm then ESI 3A
If sediment size is greater than 2 mm up to pebbles then ESI 4
If there are pebbles in the XShr then lean towards ESI 4; if there are no pebbles then lean towards ESI 3A.

BC 28
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A
If it does not meet the above requirements then ESI 3A or 4. Refer to BC 27 for guidelines on sediment size.

BC 29
If Exp. >= SE and it meets ESI 7 requirements (see protocol) then ESI 7
If Exp. <= SP and it meets ESI 9A requirements (see protocol) then ESI 9A

BC 30
ESI 3A or 4 (refer to BC 27)

BC Organics, Manmade, Channel, Ice

BC 31
If >50% marsh in the A and B zone combined then ESI 10A
If the biologist comments on the marsh being predominately freshwater, ESI 10B can be used.
If the ESI 9A requirements are met (see protocol), then 9A can be used for large tidal flats or deltas and 9B can be used in lagoon areas.
If none of the above requirements are met, assign ESI class based on the dominant Form.

BC 32
If it is riprap then ESI 6C
If Exp. <=SP then 8B
If Exp. >=SE then 1B

BC 33
If Exp. <=SP then 8B
If Exp. >=SE then 1B

BC 34
Decide what BC class you would assign if you did not assign a BC 34, then assign and ESI class based on that.

BC 35
ESI 8A (refers to “impermeable” scarps)

Other ESI classes

2B, 3B, 3C, 8E, 9C, 10C, 10D, 10E

These classes are not generally used in the Gulf of Alaska. If ShoreZone expands into other areas of Alaska, these classes may be more relevant, and this document will be revised.

EXP_OBSER: An estimate of the wave exposure as observed by the physical mapper, as a function of the relative fetch (Table A-5), with a consideration of geomorphology.

Transitions in exposure: Although it does occasionally happen, it is a rare to have the exposure change directly from E to P in adjacent units. In most cases there will be a transition zone that includes a few units of SE or SP or both. For example, the entrance to a bay will tend to have a bit higher exposure than the head of the bay due to its location and processes such as wave refraction. This transition zone needs to be recognized when mapping exposures.

Biological wave exposure: After physical mapping is complete, biological mappers assign each unit a “Biological Wave Exposure” category on the basis of observed biota (see detail in Section 5.0). This value and that of EXP_OBSER may not be identical. The Oil Residence Index (ORI) for the overall unit is assigned on the basis of biological wave exposure (field EXP_BIO in the BioUnit table). (Note: ORI for the across-shore components (in the XShr table) is assigned on the basis of the exposure observed by physical mappers (EXP_OBSER).

SED_SOURCE: A code indicating the estimated sediment source for the unit:

(A)longshore

(B)ackshore

(F)luvial

(O)ffshore

(X) indicates sediment source cannot be identified

Examples: accretionary spits are classified as Alongshore; landslides are classified as Backshore; rivers are classified as Fluvial; offshore bars are classified as Offshore.

SED_ABUND: A code indicating the estimated sediment abundance in the unit.

(A)bundant (areas with accretional landforms and highly mobile sediments)

(M)oderate (some mobile sediment but not likely to rapidly move)

(S)carce (areas of bare rock or rock with occasional cobble/boulder veneer)

SED_DIR: One of the eight cardinal points of the compass indicating dominant sediment transport direction (N, NE, E, SE, S, SW, W, NW). (X) Indicates transport direction could not be discerned from imagery. This field is interpreted from the features observed within the unit.

CHNG_TYPE: A code indicating the stability of the shore unit, reflecting the relative degree of “measurable change” during a 3-5 year time span. Bare rock would be classified as stable, because it will likely not reveal measurable changes on that timescale. Accretional features are indicated by an abundance of sediment and a healthy sediment source (such as a river and delta system). Erosional features are indicated by landslides and by undercutting from waves. The following codes are used:

(A)ccretional

(E)rosional

(S)table

SHORE_PROB: Comment on nature of difference between digital shoreline and observed shoreline.

Significant changes to the digital shoreline: During mapping, draw significant shoreline changes clearly on the paper map. Make a comment in the SHORE_PROB field of the Unit table to explain it to users and to assist biomappers (such as "islet is attached headland"). If the discrepancy is significant enough to change in the GIS when digitizing, make a note in both the SHORE_PROB and UNIT_COMMENTS field (such as "islet is attached headland; fixed in GIS." If the change is pertinent at the across-shore level, also enter a comment in the XShr table (such as for tombolos connecting B zones).

"Missing" shoreline features: When digitizing shoreline changes, features present in the digital shoreline but not observed in the imagery are generally *not deleted*. (These could be offshore reefs that were not flown but should remain part of the basemap. These features may be coded "9999" to indicate they are a part of the shoreline but not mapped.

Adding shoreline features: Features observed in imagery but not present in either of the digital shoreline basemaps may be digitized on the basis of the imagery if they are significant (such as large accretion spits that are vegetated or otherwise appear intransient). Additions to the digital shoreline should be noted in the SHORE_PROB field in all cases, and in the UNIT_COMMENTS and XSHR_COMMENT field when appropriate.

SM1_TYPE: The primary type of shore modification occurring within the unit. At least one SM field must be completed if an anthropogenic Form ("A") is entered in the XShr table.

Data entered in the SM type fields must be two capital letters and be one of the following values:

BR = boat ramp
CB = concrete bulkhead
LF = landfill
SP = sheet pile
RR = rip rap
WB = wooden bulkhead

For every SM type, there must be an SM %. The sum of the SM %s must be entered in the SMOD_TOTAL field.

Special cases (anthropogenic features): Aa, Af, Ah, and At

Pilings (Aa) are not considered a shore modification unless they are driven in side-by-side to form a retaining wall, in which case the shore modification code for wooden bulkhead (WB) would be used.

Floats (Af) do not require a shore modification entry; floats should be mapped in the A and B zones only.

Village sites (Ah) such as shell middens, fish traps, weirs, and clam gardens do not require a shore modification entry.

Fill and tailings (At) placed deliberately at landings, garbage dumps, or around structures should be coded LF. Domestic trash and debris around a house is not considered a LF.

Guidelines for Across-Shore Data Entry (XShr Table)

ZONE: A code indicating the across-shore position (tidal elevation) of the component:
(A) supratidal
(B) intertidal
(C) subtidal (shallow nearshore)

Supratidal (A zone): This zone is the upper limit of the marine influence and is rarely inundated; also known as the "splash zone." The top of the A zone is often marked by the presence of a storm berm (Form "Bs") or log line. On rocky substrates, it is characterized as the area between the black lichen *Verrucaria* and terrestrial vegetation (grass or trees). Grass and trees are mapped as a Materials in the A zone when within a marsh or when overhanging, rooted in, or covering any part of the supratidal zone.

Intertidal (B zone): Across-shore position between the mean high-tide line (often indicated by a line of debris or a change in color) and the low-water line. This region is completely inundated by daily tides.

Shallow subtidal (C zone): Across-shore position below the low-water line (tidal elevations at 0 datum and deeper); also known as the shallow nearshore zone. Non-draining pools on delta flats could be considered subtidal if they are deep enough, but river channels would not be. Vegetation in river channels not at the seaward delta edge would be considered part of the B zone and would be biomapped in the component's Rs Form.

Forms and Materials are occasionally entered in the C zone, including lagoons (Form Lo or Lc), tidal flats or channels (Form Tt or Tc), and anthropogenic features. Forms in the C zone do not require a Material but should include one if anthropogenic.

Anthropogenic features in the C zone: If the feature extends into C zone (e.g. pilings or breakwater), map these features into the Forms and Materials of the C zone. Floats should be mapped in the A and B zone but not in the C zone.

Absence of a C zone: Some units (such as tombolos) lack a true subtidal zone. In these cases, delete the C zone row and enter "no C zone" in the XShr comment field of the LOWEST B ZONE. This assists in database QA/QC and in biological mapping.

COMPONENT: Further subdivisions of zones, numbered from highest to lowest elevation within across-shore profile (e.g. A1 is the highest supratidal component; A2 is lower and closer to the intertidal; B1 is the highest intertidal component; B2 is lower intertidal). Each zone must have at least one component (A1, B1, C1 is the minimum entry). Multiple components within a zone are required if the zone is very wide or if there is a significant change in slope, geomorphology, or sediment texture across-shore. For example, the B1 could be dominated by a sand beach face (Form Bf), while the B2 is characterized by a wide tidal flat (Form Tt).

Form1: The principal geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11). The first letter is uppercase, followed by up 5 lowercase modifiers (e.g. Casl or Bfr). Forms should be listed in order of their relative prevalence in the zone.

Anthropogenic features: When an anthropogenic feature is mapped as a Form, further data about this feature should be entered in the "shore modification" fields of the unit table. A few exceptions do apply: pilings (Aa), floats (Af), village sites, fish traps and clam gardens (Ah) do not require a "shore modification" field entry (see also see SM_TYPE description above).

Cliffs: Active vs. Passive (Casl vs. Cpsl): A cliff is considered active when there is bare substrate showing (this is the most common case). A cliff is considered passive when it has substantial vegetation growing on it, suggesting a highly stable surface.

Beach Berm vs. Beach Storm Ridge (Bb vs. Bs): A beach berm receives frequent marine influence, contains more mobile sediment, and may be found in the intertidal zone. A beach storm ridge only receives occasional marine influence and may only be mapped in the supratidal zone. There will often be vegetation growing on a beach storm ridge (grasses and trees), suggesting it is relatively more stable. A beach berm will not have vegetation growing on it, owing to its more mobile nature.

Beach face vs. Beach veneer (Bf vs. Bv): A beach *face* is solely composed of mobile sediments and shows no evidence of underlying bedrock. A beach *veneer* code is used when a rock platform has a heavy covering of sediment atop it. The underlying rock platform will be obvious and poke through the sediment.

Beach low-tide terrace vs. Tidal flat (Bt vs. Tt): A Bt can be used for flat beaches (<2 degrees) that occur in the upper B zone. It can also be used in the lowest B zone IF the width of that zone is <10% of the overall intertidal zone width. Typically a Tt is used when the width of that B zone is >30 m.

Beach plain (Bp): A beach plain is a supratidal feature and should not be used as a code in the intertidal zone. Generally they are rare features but can be found on outer exposed coastlines, such as in the Yakutat area. Beach plains are wide, flat features that receive occasional marine influence (once or twice a year) during large storm events. It is not uncommon to observe washover features as a result of such marine events; this observation can be coded using the washover fan modifier (w) in the coding, i.e. Bpw.

Beach inclined (Bi): Generally this code is not used because it is vague and lacks a clear definition.

Tidal channel vs. River single channel: (Tc vs. Rs): Most rivulets that occur on tidal flats are Rs or Ri, but not Tc. A Tc should be mapped only when the tidal flat is wide (>200 m), flat (<3°), and there is no visible fluvial source.

Offshore Island (O): This code is only used when a main shore unit has an offshore islet **grouped** with it. For example: If the islet consists of a low cliff with a boulder veneer it will be mapped as follows: Form 1: Ol – Cb/R. When mapping the same islet as a separate unit it will be mapped as follows: Form 1: Cail – Cb/R.

If islets are shown on the electronic shoreline, they will normally be mapped as their own unit (several islets can be grouped together as one unit), unless the islets have no vegetation in the A zone (in which case they are considered a reef, Form R). If islets are not on the electronic shoreline they can be mapped as a form on the main shoreline unit using the Offshore Island (O) code. Generally the (O)ffshore Islet code is avoided, because a better characterization is achieved using the appropriate geomorphic form code.

Reefs vs. Islands: Islands that are vegetated are mapped according to the aforementioned rules. Reefs are not vegetated and are thus mapped as a secondary form of the main shore unit using the reef (F) code.

MatPrefix1: Veneer indicator field; blank = no veneer; “v” = veneer; use “v” when unconsolidated sediment overlies rock or other sediment (e.g. v Cbc/Cps); do not use when organics overlie substrate (e.g. Bt/Cps or At/Casl)

Mat1: Material (substrate and/or sediment type) that best characterizes Form1, described by a specific set of codes (Table A-12). The first letter is uppercase, followed by at least 1 and up 5 lowercase modifiers (e.g. Cbc or Btg). All Forms must have a Material code, unless it is a lagoon (L) or tidal channel (Tc) mapped in the C zone. In these cases it is acceptable to leave the Material code out because the material is often not obvious.

Clastic Materials (C): Sediments should be listed in the order of abundance. For example, a sand and gravel beach comprised of mostly sand, some pebbles, and occasional cobbles should be coded as Cspc. If it is obvious that one type of material overlies another, use the veneer modifier (e.g. v Cbc/Cps).

Veneer (v): Layers of sediment over top of other sediment should also be coded in order of abundance. For example, if there is an abundance of boulders and some cobbles overlying sand, this would be coded as v Cbc/Cs.

The lowercase v is not used for organics (such as trees, grass, or logs) overlying substrate. If there are logs in the A zone overlying boulders and cobbles, which are overlying rock, code as follows. Form 1: Pr - At/Cbc, Form 2: Pr – v Cbc/R. In general the logs should be mapped in Form 1 unless the logs are very scarce.

Biogenic logs (Bl) vs Anthropogenic logs (At):

Biogenic logs (Bl): Logs that have eroded or fallen from a forested shoreline owing to coastal, fluvial, or mass wasting processes. In most cases, these logs will have a root ball or some portion of the roots still attached, suggesting that they have not been cut. In other cases they may by lying across the intertidal zone while still being attached to the ground in the supratidal zone.

Anthropogenic logs (At): Logs that have been cut due to logging activities. These logs have most likely escaped from log booms and will not have any roots or branches attached.

Most logs that are in the supratidal and high intertidal zones are At and should be coded as such. When there are also living trees and grasses, avoid trying to lump the logs into the biogenic code by using a Bltg code. For example: When both trees and logs over boulders and cobbles are present, and the logs are the most abundant/significant, use the following coding for Materials: Mat 1: At/Cbc, Mat 2: Bt/Cbc. When trees and organics are most abundant/significant, use the following coding for Materials: Mat 1: Bt/Cbc, Mat 2: At/Cbc. Note that no veneer (v) is used for either of these Material codes.

WIDTH: The average across-shore component width (in meters). Only the width for the **primary** component (e.g. A1, B1) may be entered, and it must be consistent with the BC Class assignment (that is, the sum of B zones <30 m are different classes than those >30 m; see Table A-2).

SLOPE: The estimated across-shore slope of the mapped primary geomorphic form (in degrees). Only the slope for the **primary** component (e.g. A1, B1) may be entered, and it must be consistent with the Form codes (Table A-11).
For example, a flat platform (Pf) must have <5° slope; a ramp (Pr) must have slope between 5° and 19°; an inclined cliff (Cail) must have a slope between 20° and 35°; a steep cliff (Casl) must have a slope >35°.
PROCESS: The dominant coastal process affecting the morphology of the component:
(F)luvial
(M)ass wasting (landslides)
(W)aves
(C)urrents
(E)olian (wind, as with dunes)
(O)ther
If the dominant coastal process is tidal, "O" is used in this field and a comment should be made in the Unit_Comment field about this.
COMPONENT_ORI: Oil Residence Index (Tables A-5 and A-6); defines the persistence of oil residence on the basis of substrate type on scale of 1 to 5, in which 1 reflects probable short oil residence (days to weeks) and 5 reflects the potential of long oil residence (months to years).
<u>Rules for defining ORI:</u> The ORI is supplied for each subdivision (component) of the A and B zones but can only be entered for Form1. The ORI and materials in Form1 should be consistent, rather than refer to sensitive items in Forms 2 or 3. If necessary, move the sensitive items to Form 1 or break the unit accordingly.
The ORI code is determined by the most sensitive material in the component. For example: Biogenic grass over sand and pebbles (Bl/Csp) in a semi-protected exposure (SP) will have an ORI of 5, owing to the grass in the component.
Table A-5 does not provide an ORI code for organics and vegetation when the exposure is SE, E, or VE. There are some occasions when organics do occur in the supratidal zone within these exposures (marshes and lagoons). In these cases, an ORI of 5 is assigned to recognize the existence of these organics.

Guidelines for Processing Still Photos (tblBioSlideList Table)

The first field in the Unit table is the "Slide" field, in which a box can be checked to indicate the existence of a representative digital still photo for the unit. When the "Slide" box contains a checkmark, the following data is entered in the tblBioSlideList Table:

SlideID: Automatically-generated unique Slide ID (no data entry required)
UnitRecID: This field links the BioSlideList to the Unit table. Enter (or copy and paste) the UnitRecID from the Unit table into this field of the tblBioSlideList Table if the unit is visible in the photo. The same UnitRecID may be used for several slides, if appropriate. Each slide can only have one UnitRecID, so the most representative unit for that slide should be selected.
SlideName: Assigned slide name from field survey (e.g. SE06_MM_21310)
ImageName: Assigned image name (JPG format) (e.g. SE06_MM_21310.jpg)
TapeTime: UTC time that image was collected during field survey; used to link digital imagery to along-shore units; format: month/day/year/hh:ss:mm
SlideDescription: Comments made during physical or biological mapping
ImageType: "Digital" or "Slide"
FolderName: Name of the folder in which the images are stored on the network.
PhotoLink: Enables links to photos to be established in the database.
PHY Good Example: Box may be checked to indicate the photo is a good example of the feature or BC Class.
PHY SlideComment: Comments made by physical mapper.
Enter "can also see unit…" in the comment field if other units can be clearly seen in the photo. Use the PHY_IDENT (10/01/8888) (don't have to include /0) to enable searches on any photos of the unit.
Note: If units are deleted, be sure the reference RecID is removed from the tblBioSlideList table.

Guidelines for Mapping Anthropogenic Forms and Materials

Breakwaters, groins, and jetties are all coastal modification structures that impose a **physical barrier** in the nearshore zone and **perform a function** – to block the flow of littoral drift or reduce wave energy (Table 3.1). Sample images are shown in Figure 3.6.

Table 3.1. Definitions of structural and non-structural anthropogenic forms. Non-structural forms and materials should also be mapped if they represent more than 10% of the area of the supratidal (A zone) or intertidal (B zone).

Structure	**Function**
Breakwater	barrier that breaks the force of waves, as in harbor works
Bulkhead	retaining structure of timber, steel, or reinforced concrete, used for shore protection or harbors
Jetty	pier or structure projecting into the sea or other body of water to protect a harbor, deflect energy
Sheet pile	usually flat, driven side by side to retain earth or to prevent seepage into an excavation
Wharf	structure built on the shore of or projecting into a harbor, stream, etc., so that vessels may be moored alongside to load or unload or to lie at rest; also called a quay or a pier.
Non-structural	**Sample codes**
plastic, junk	Form At, Mat Adwf
fishing net sets	Form Af, Mat Adw

Breakwater, riprap and rubble
Form “Ab,” Material “Ar,” Shore Mod “RR”
Sitka, AK

Wooden bulkhead
Form “As,” Material “Aw,” Shore Mod “WB”
Alaska

Jetty, structural concrete and metal
Form “Aj,” Material “Aao”
Ketchikan, AK (image SE06_MM_00208)

Jetty / pier, wooden
Form “Aj,” Material “Aw”
Annette Island, AK (image SE06_MM_07656)

Metal sheet pile – Alaska
Form “As,” Material “Aa,” Shore Mod “SP”

Concrete sheet pile – Alaska
Form “As,” Material “Ac,” Shore Mod “SP”

Figure 3.6. Sample images and codes for mapping anthropogenic Forms and Materials.

4.0 PHYSICAL ILLUSTRATIONS: SHORE TYPES AND GEOMORPHIC FEATURES MAPPED IN KODIAK AND SOUTHEAST ALASKA

Shore Type: Rock (BC Classes 1-5)
Shore Type: Rock and Sediment (BC Classes 6-20)
Shore Type: Sediment (BC Classes 21-30)
Shore Type: Organic Shorelines, Marshes, and Estuaries (BC Class 31)
Shore Type: Examples of Shorelines *Not* Classified as BC Class 31
Shore Type: Anthropogenically-Altered Shorelines (BC Classes 32-33)
Shore Type: Current-Dominated Channels (BC Class 34)
Shore Type: Glaciers (BC Class 35)
Geomorphic Features: Deltas, Mudflats, and Tidal Flats
Geomorphic Features: Lagoons
Geomorphic Features: Beach Berms and Ridges
Anthropogenic Features: Coastal Structures and Shore Modifications
Anthropogenic Features: Potential Archaeological Sites
Other Interesting Features: Drowned Forests
Sediment Abundance Categories: Abundant, Moderate, Scarce

Shore Type: Rock (BC Classes 1-5) **Southeast Alaska**

	
Steep high cliff (Form "Cash"); fixed-wing aerial survey photo	Low-tide, irregular rock platform with tidepools (Form "Pihp")
Taiya Point, Lynn Canal (Unit 10/04/3200)	Yakobi Island (Unit 10/02/1632)
SE05_ML_0831.jpg	SE05_MM_0632.jpg

	
Steep low cliff (Form "Casl")	Rock cliffs that are steep and moderate in height (Form "Casm") and inclined, low in height (Forms "Casm" and "Cail")
Lisianski Inlet (Unit 10/02/1753)	Yakobi Island (Unit 10/02/1864)
SE05_MM_0221.jpg	SE05_MM_0335.jpg

	
Rock classes represent 6% of mapped shorelines. Steep, narrow rock cliffs like the one shown (BC Class 3) comprise 3.5% of mapped shorelines in the Kodiak archipelago.	Wide (>30 m) rock ramp (BC Class 1).
Three Saints Bay (Unit 05/04/8383)	Afognak Island (Unit 06/02/1453)
KDKavi05_08861.jpg	KDKavi05_2090.jpg

Shore Type: Rock and Sediment (BC Classes 6-20) **Southeast Alaska**

	
Mixed rock and sediment units comprised of low and moderate cliffs (Forms “Casl” and “Casm”), rock ramps (Form “Pr”), and cobble-sand beaches (Form “Bf”)	Cobbles, boulders, and rubble overlying rock ramps (Form “Pr”) and low cliffs (Form “Casl”); submerged rocky reefs offshore are also present in this unit (Form “Fir”)
Point Whidbey, Lynn Canal (Units 10/04/2194-2196)	Lisianski Inlet (Unit 10/02/1915)
SE05_ML_0188.jpg	SE05_MM_0390.jpg

	
Wide (>30 m) platform (<5° slope) with gravel beach (BC Class 7).	Steep cliff (>20°) with narrow (<30 m) gravel beach (BC Class 8).
Geese Channel (Unit 05/04/8011)	Geese Channel (Unit 05/04/8030)
KDKavi05_08086.jpg	KDKavi05_08160.jpg

Steep cliff (>20°) with narrow (<30 m) gravel beach (BC Class 8). Geomorphic features mapped in this unit include a steep, low cliff (Form “Cpsl”) with beach veneer of boulders, cobbles and pebbles over rock (Materials “Cbcp/R”),	Wide rock ramp (>30 m, 5-20° slope) with gravel beach (BC Class 11). Geomorphic features mapped in this unit include the ramp with tidepools covered by a veneer of cobbles and boulders (Form “Pirp,” Materials “Ccb/R”) and a beach face of cobbles overlying pebbles and sand (Form “Bf,” Materials “Cc/Cps”).
Twoheaded Island (Unit 05/04/8139)	Village Islands (Unit 06/03/7032)
KDKavi05_08466.jpg	KDKavi05_3528.jpg

	
Wide gravel flat (BC Class 21)	Wide sand and gravel fan (BC Class 24)
Yakobi Island (Unit 10/01/3530)	West shore of Lynn Canal (Unit 10/04/2620)
SE05_MM_0902.jpg	SE05_ML_0520.jpg

	
Wide sand and gravel flat (>30 m wide, <5° slope) (BC Class 24)	Sand and gravel flat with a washover berm (Form “Bsw”), beach face composed of cobbles, pebbles, and sand (Form “Bf,” Materials “ccps”) (BC Class 24)
Ban Island (Unit 06/01/1128)	Sitkinak Island (Unit 05/03/114)
KDKavi05_1879.jpg	KDKavi05_07222.jpg

	
Narrow sand and gravel beach (>30 m wide, <5° slope) (BC Class 25), where the beach face (Form "Bf") is composed of boulders and cobbles in the upper intertidal (Materials "Cbc") and cobbles and boulders overlying pebbles and sand in the lower intertidal (Material "Ccb/Cps").	Recurved spits along the narrow beach face (Form "Bf") and tidal bar ("Tb") are composed of a veneer of pebbles and cobbles overlying sand (Material "Cpc/Cs") (BC Class 25).
Weasel Cove, Spiridon Bay (Unit 06/03/5003)	Kaiugknak Bay (Unit 05/04/8234)
KDKavi05_3932.jpg	KDKavi05_08726.jpg

	
Estuary with forms of high marsh ("Mh"), low continuous marsh ("Mlc"), river with multiple channels ("Rm"), and tidal flats with multiple bars and channels ("Ttbs")	Estuary with forms of high marsh ("Mh"), low continuous marsh ("Mlc"), river with multiple channels ("Rm"), and tidal flats with multiple bars and channels ("Ttbs")
St. James Bay, Lynn Canal (Unit 10/04/2105)	North Passage, between Icy Strait and Sitakaday Narrows (Unit 10/03/4845)
SE05_ML_0117.jpg	SE05_ML_1695.jpg

Shore Type: Organic Shorelines, Marshes, and Estuaries (BC Class 31) **Southeast Alaska**

	
Unit with mapped Forms of high (supratidal) marsh (“Mh”), low, discontinuous marsh (“Ml”), and delta flat (“Df”) comprised of boulders and cobbles and overlying pebbles and sand (Material “Cbc/Cps”). This unit is BC class 31 owing to the obvious encroachment of organics into the intertidal zone.	Unit mapped with Forms for brackish, supratidal, and mid to low marsh (“Msl”), tidal flat with channels, pools, and bars (“Ttcpb”), a delta fan (“Df”), and multiple river channels (“Rm”), classified as a BC class 31 owing to the estuarine environment.
Duke Island, SE Alaska (Unit 12/04/5367)	Mary Island, SE Alaska (Unit 12/07/3288)
SE06_MM_09728.jpg	SE06_MM_24170.jpg

	
A high marsh with ponds and a drowned forest (Form “Mhof”) is mapped in this unit, along with a delta fan with multiple channels (“Dfm”) and a river with multiple channels (“Rm”).	A high marsh (Form “Mh”) and tidal flat (“Tt”) are features of this estuary, classified as an organic shoreline (BC Class 31).
Zachar Bay (Unit 06/03/5300)	Ayakulik Island (Unit 05/01/0075)
KDKavi05_4114.jpg	KDKavi05_5610.jpg

	
Vegetation is mapped in the supratidal (A) zone of this unit, but the unit is not classified as organic (BC Class 31). The delta flat is the most dominant feature (Form "Df"), and the unit is best characterized by the BC Class 24 (sand and gravel flat or fan, >30 m wide, <5° slope).	A high marsh with ponds (Form "Mho") is mapped in the supratidal (A) zone of this unit, but the unit is not classified as organic (BC Class 31). The wide rock ramp is the most dominant feature, and the unit is best characterized by the BC Class 1 (rock ramp, >30 m wide, 5-20° slope).
Fillmore Inlet, SE Alaska (Unit 12/03/2577)	Suemez Island, SE Alaska (Unit 12/07/4172)
SE06_ML_10536.jpg	SE06_MM_24805.jpg

Shore Type: Anthropogenically-Altered Shorelines (BC Classes 32-33) **Southeast Alaska**

	
The entire unit is classified as altered by human activities, including Form for wharf (“Aw”),	The entire unit is classified as altered by human activities, including Forms for wharf (“Aw”), tailings and fill (“At”)
Ward Cove, Ketchikan (Unit 12/01/0058)	Town of Pelican in Lisianski Inlet (Unit 10/02/2010)
SE06_MM_00052.jpg	SE05_MM_0579.jpg

	
Shorelines classified as altered by human activities are mapped along 25 km of shoreline in the Kodiak Archipelago. Shown is a unit that includes Forms for a wharf (“Aw”) and pilings (“Aa”), assigned a BC Class 32.	The unit in the foreground includes Forms for breakwater (“Ab”) composed of riprap (Materials=”Ar”).
Port William, Shuyak Island (Unit 06/01/2900)	Larsen Bay (Unit 06/03/0951)
KDKavi05_0207.jpg	KDKavi05_4639.jpg

Shore Type: Current-Dominated (BC Class 34) **Southeast Alaska**

	
Current-dominated units on southwest Yakobi Island	Current-dominated units on southwest Yakobi Island
Takanis Bay (Unit 10/01/3824)	Deer Harbor (Unit 10/01/3572)
SE05_MM_1112.jpg	SE05_MM_0944.jpg

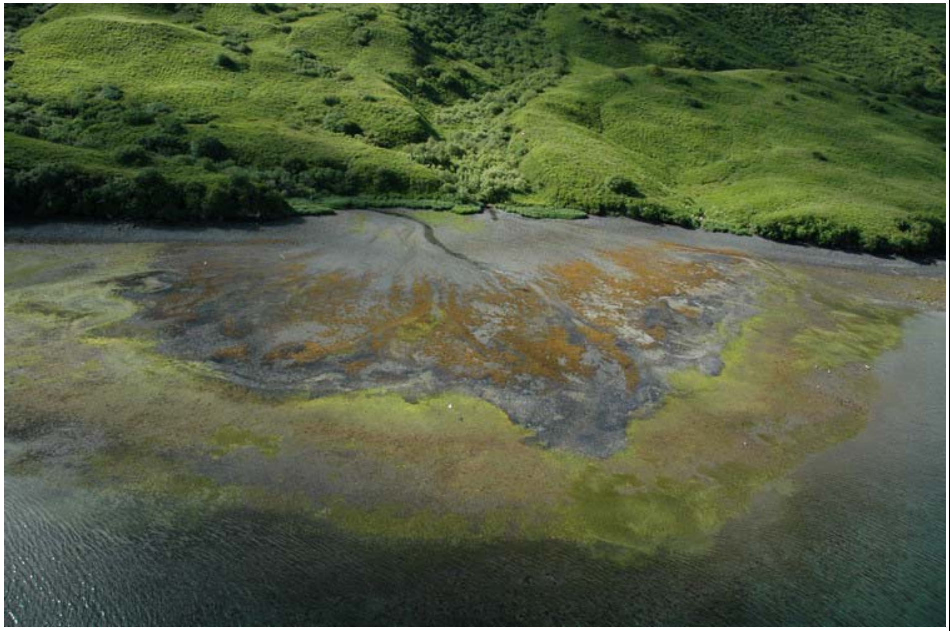
	
Current-dominated channels (BC Class 34).are mapped along 25.6 km of shoreline (<1%) but are important in terms of geomorphic processes and biological diversity.	A high, supratidal marsh and drowned forest (Form “Mhsf”) with ponds (Form “Mo”) and tidal creeks (Form “Mc”) are mapped in the A zone, with a tidal flat (Form “Tc”) mapped in the lower intertidal B zone.
Big Fort Island (Unit 05/08/3039)	Shuyak Island (Unit 06/01/3651)
KDKavi05_0283.jpg	KDKavi05_0768.jpg

	
Glaciers of Russel Fjord (Form "Ig")	Glaciers of Tsaa Fjord, with high cliffs and waterfalls (Forms "Ig," "Cash," and "Rm")
Northern Yakutat Bay (Unit 09/02/0145)	Icy Bay (Units 09/01/0345-0349)
SE05_ML_4494.jpg	SE05_ML_3976.jpg

	
Delta fan with multiple river channels (Forms “Df” and “Rm”)	Delta (Form “Df”) and tidal flat (Form “Tt”) with single river channel (“Rs”)
Disenchantment Bay, northern Yakutat Bay (Unit 09/02/0107)	Pleasant Island, near Glacier Bay (Unit 10/03/4950)
SE05_ML_4868.jpg	SE05_ML_6137.jpg

	
Wide mud flat (BC Class 29) with Forms for tidal flat with bars ("Ttb"), beach face ("Bf"), berm ("Bb"), and river channel ("Rs")	Sand flat (BC class 28) with Forms for tidal flat ("Tt"), beach face and berm ("Bf" and "Bb"), and man-made tailings and fill ("At") associated with the logging camp
William Henry Bay, Lynn Canal (Unit 10/04/2273)	Logging camp near Morain Island, SE Icy Bay (Unit 09/01/0044)
SE05_ML_0248.jpg	SE05_ML_3438.jpg

	
Unit classified as a sand and gravel fan (BC Class 24) with Forms for relict beach ridge (“Bn”), beach face (“Bf”), and tidal flat with bars (“Ttb”)	High marsh (Form “Mh”) and tidal flat (“Tt”) in a unit classified as organic-dominated shoreline (BC Class 31)
Point Riou Spit, near entrance of Icy Bay (Unit 09/01/0010)	St. James Bay, Lynn Canal (Unit 10/04/2124)
SE05_ML_3392.jpg	SE05_ML_0138.jpg

	
Delta fan (Form “Df”) and tidal flat (Form “Tt”).	Flood tide delta with tide pools (Form “Tfp”) composed of sand (Material “Cs”).
Shuyak Island (Unit 06/01/3733)	Low Cape (Unit 05/01/0121)
KDKavi05_10125.jpg	KDKavi05_11057.jpg

	
A wide tidal flat (Form “Tt”), a middle- to low-intertidal discontinuous marsh (Form “Ml”), and an open lagoon (Form “Lo”) are mapped in this unit.	A tidal flat (Form “Tt”) with a veneer of cobbles and boulders overlying sand (Material “Cbc/Cs”) is mapped on this semi-exposed coastline.
Kempf Bay (Unit 05/02/0205)	Low Cape (Unit 05/01/0121)
KDKavi05_6094.jpg	KDKavi05_5695.jpg

	
Open lagoon (Form "Lo"), high marsh (Form "Mh"), and tidal flat ("Tt")	Open lagoon (Form "Lo"), Rock Platform ("Pf") and tidal flat ("Tt")
Takanis Peninsula (Unit 10/01/3685)	San Fernando Island (Unit 12/07/1601)
SE05_MM_1023.jpg	SE06_MM_22928.jpg

<table>
<tr><td></td><td></td></tr>
<tr><td>A closed lagoon (Form “Lc”) mapped in the supratidal (A zone), separated from the beach face by a relic beach ridge (Form “Bn”) and a modern storm berm (Form “Bs”).</td><td>An open lagoon (Form “Lo”) and tidal flat (Form “Tt”) mapped in the intertidal (B zone) of this unit.</td></tr>
<tr><td>Tanner Head (Unit 05/02/0065)</td><td>Alitak Lagoon (Unit 05/02/0036)</td></tr>
<tr><td>KDKavi05_5959.jpg</td><td>KDKavi05_5878.jpg</td></tr>
</table>

	
Relic beach ridges (Form "Bn"), modern storm berms ("Bs"), beach berms ("Bb"), and beach face ("Bf").	A single bar in the low- to mid-intertidal is mapped as a beach ridge (Form "Br") in this unit.
Pivot Point, Kiliuda Bay, Kodiak Island (Unit 05/05/0589)	Nest Island, Kiliuda Bay, Kodiak Island (Unit 05/05/0835)
KDKavi05_10486.jpg	KDKavi05_10827.jpg

	
All buildings and structures are mapped as wharves (Form "Aw"); other Forms include marina ("Am"), breakwater ("Ab"), and debris classified as fill and tailings ("At").	Breakwater (Form "Ab")
Town of Pelican, Lisianski Inlet (Units 10/02/2008-2012)	Port Chilkoot, Lynn Canal (Unit 10/04/3064)
SE05_MM_0577.jpg	SE05_ML_0778.jpg

	
House (Form "Aw") and pilings (Form "Aa") in a unit classified as a wide sand and gravel flat (BC Class 24).	Unit classified as man-made (BC Class 32) with Forms for port facility, jetty, wharf, pilings ("Apjwa"), seawall ("As"), and fill/tailings ("At").
Chichagof Island (Unit 10/01/9005)	Excursion Inlet, Icy Strait (Unit 10/03/5188)
SE05_MM_2498.jpg	SE05_ML_6474.jpg

	
Coastal structures mapped in the unit include a wharf (Aw) and pilings (Aa). Buildings such as this cannery are generally mapped as Form Aw.	This building is mapped as Form "Aw" (wharf) with Materials "Adw" (wood and debris).
Larsen Bay (Units 06/03/0942 and 0943)	Olga Bay (Unit 05/02/1087)
KDKavi05_4634.jpg	KDKavi05_07654.jpg

	
Shell midden (Form “Ah”)	Shell midden (Form “Ah”)
Myriad Islands, west of Chichagof Island (Unit 10/01/9381)	Islands south of Ogden Passage, west of Chichagof Island (Unit 10/06/0509)
SE05_MM_2815.jpg	SE05_MM_3185.jpg

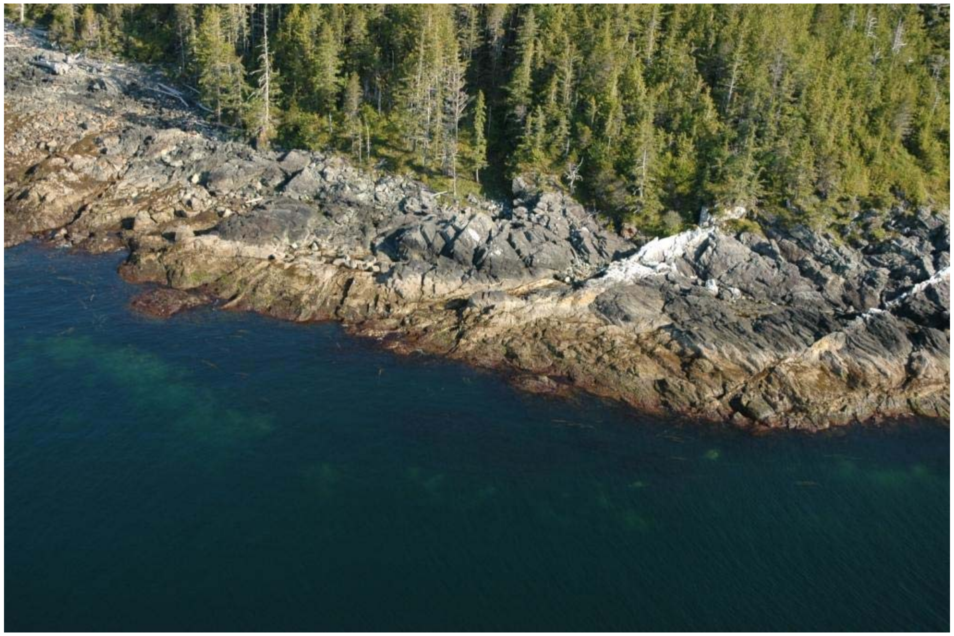
	
A fish trap (Form “Ahb”) mapped in the intertidal B zone.	A shell midden (Form “Ah”) is mapped in the supratidal (A zone) of this unit, just to the right of the center of the photo.
Shuyak Island (Unit 06/01/3712)	Muskomee Bay (Unit 06/02/2064)
KDKavi05_0866.jpg	KDKavi05_2377.jpg

	
Drowned forests are mapped as Form "Mf." Other geomorphic features mapped in this unit include a beach face ("Bf") and tidal flat ("Tt").	The drowned forest in this unit is mapped with a high marsh ("Mhf"), a tidal flat ("Tt") and an open lagoon ("Lo").
Big Fort Island (Unit 05/08/3028)	Big Fort Island (Unit 05/08/3036)
KDKavi05_0270.jpg	KDKavi05_0279.jpg

	
Sediment is considered abundant in this unit dominated by a Tidal Flat (Form "Tt") comprised of sand, pebbles and cobbles (Materials "Cspc").	Sediment is considered abundant in this unit dominated by a delta with multiple stream channels (Form "Dfm") comprised of pebbles and occasional cobbles overlying sand. A high marsh (Form "Mh") is mapped in the supratidal (A zone), but the unit is best characterized by the BC Class 24 (wide sand and gravel flat or fan).
Duke Island, SE Alaska (Unit 12/04/6152)	Hidden Inlet, SE Alaska (Unit 12/03/2873)
SE06_MM_15499.jpg	SE06_ML_11341.jpg

	
Sediment abundance is moderate in this unit, owing to the boulders and cobbles perched in the upper intertidal.	Sediment abundance is moderate in this unit comprised of a narrow cobble-boulder beach overlying pebbles and sand (Form “Bf,” Materials “Cbc/Cps”).
Southern Suemez Island, SE Alaska	Pearse Canal, SE Alaska (Unit 12/03/2815)
SE06_MM_24863.jpg	SE06_ML_11156.jpg

Sediment Abundance: Scarce **Southeast Alaska**



Sediment abundance is scarce in this unit dominated by a rocky intertidal zone and cliff.	While the intertidal rock platform is mapped with a veneer of boulders and rubble (Form “Pr,” Materials “Cbr/R”), sediment abundance is scarce in this unit overall.
NW Suemez Island, SE Alaska	Mary Island, SE Alaska (Unit 12/04/5525)
SE06_MM_25184.jpg	SE06_MM_10203.jpg

5.0 SHOREZONE BIOLOGICAL MAPPING PROTOCOL

Biological ShoreZone mapping is based on the observation of patterns of biota in the coastal zone, with data recorded from observation of the occurrence and extent of species assemblages (called '**biobands'**) that is related to both the degree of wave exposure and the substrate on the shore. The observations of presence, absence and relative distribution of the biobands within each alongshore unit are recorded in the mapping, and from those observations, the biological mapper assigns interpreted classifications of **biological wave exposure** and **habitat class** to each unit.

5.1 Bioband Definitions and Illustrated Examples: Southeast Alaska

A **bioband** is an observed assemblage of coastal biota, which grows in a typical across-shore elevation, with characteristic wave energies and substrate conditions. Bands are spatially distinct, with alongshore and across-shore patterns of color and texture that are visible in aerial imagery (Figure 5.1). Biobands are described across the shore, from the high supratidal to the shallow nearshore subtidal elevations; and are named for the dominant species or group that best represents the entire band (Table 5.1). Some biobands are characterized by a single indicator species (such as the Blue Mussel band (BMU)), while others represent an assemblage of co-occurring species (such as the Red Algae band (RED)). Bioband occurrence is recorded as 'patchy' (observed in less than half of the unit length) or 'continuous' (observed in more than half of the unit length).

Upper intertidal biota tend to be consistent between different wave exposure categories and geographic areas and are thus considered weak indicators of exposure. For example, the ubiquitous Barnacle band (BAR) is found across all exposure categories. In contrast, lower intertidal biobands are often diagnostic of particular wave exposures. For example, the Surfgrass band (SUR) is indicative of Semi-Exposed (SE) settings, while the Eelgrass band (ZOS) is indicative of Semi-Protected (SP) and Protected (P) environments.

Figure 5.1. Example of biobands. Alongshore biobands of color and texture formed by biological assemblages of species in the intertidal zone. Shown is a rocky shoreline along the Semi-Exposed (SE) side of San Fernando Island, west of Craig, Alaska. (SE06_MM_23079.jpg)

As ShoreZone biological mapping has been accomplished throughout Alaska, differences in the species assemblages that characterize coastal habitats have been observed on a broad geographic scale. Differences in biota are most obvious in the lower intertidal, and these lower intertidal bands are also the most diagnostic indicators of wave exposure categories used in the ShoreZone classification system.

To recognize region-specific species assemblages, as well as to identify broad-scale trends in coastal habitats, a number of **bioareas** have been defined in Alaska (Tables 5.2 and A-7). A similar approach was applied in British Columbia to recognize the broad-scale ‘ecoregional’ differences, and seven bioareas have been defined for the ShoreZone mapping there.

Table 5.1. Bioband definitions for aerial video interpretation: Southeast Alaska.

Zone	Bioband Name	Database Label	Colour	Diagnostic Indicator Species	Exposure *
Supratidal	Splash Zone	**VER**	Black or bare rock	Encrusting black lichens	Width varies with exposure
	Dune Grass	**GRA**	Pale blue-green	*Leymus mollis*	P to E
	Sedges	**SED**	Bright green to yellow-green	*Carex lyngbyei* *Carex* spp.	VP to SP
	Salt Marsh	**PUC**	Light or bright green	*Puccinellia* sp. Other salt-tolerant herbs and grasses	VP to SE
Upper to Mid-Intertidal	Barnacle	**BAR**	Grey-white to pale yellow	*Balanus* sp. *Semibalanus* sp.	P to E
	Rockweed	**FUC**	Golden-brown	*Fucus* sp.	P to SE
	Green Algae	**ULV**	Green	*Ulva* sp. Other small green algae	P to E
	Blue Mussel	**BMU**	Black or blue-black	*Mytilus trossulus*	P to E
	California Mussel	**MUS ****	Grey-blue	California Mussel (*M. californianus*), gooseneck barnacles (*Pollicipes polymerus)*	SE to E
	Bleached Red Algae	**HAL**	Olive, golden or yellow-brown	Bleached foliose or filamentous red algae *Palmaria* sp. *Odonthalia* sp.	P to SE
Lower Intertidal and Nearshore Subtidal	Red Algae	**RED**	Dark to bright red or pink (corallines)	*Odonthalia* sp. *Neorhodomela* sp. *Palmaria* sp. Other foliose red algae, and other coralline algae	P to E
	Alaria	**ALA**	Dark brown	*Alaria* sp.	SP to E
	Soft Brown Kelps	**SBR**	Yellow-brown, olive brown or brown.	*Saccharina latissima* *Cystoseira* sp.	VP to SE
	Dark Brown Kelps	**CHB**	Dark chocolate brown	Stalked *Laminaria* sp. *Cymathere* sp. Other bladed kelps	SE to E
	Surfgrass	**SUR**	Bright green	*Phyllospadix* sp.	SP to SE
	Eelgrass	**ZOS**	Bright to dark green	*Zostera marina*	VP to SP
Subtidal	Urchin Barrens	**URC ****	Underwater coralline white	*Strongylocentrotus franciscanus*	SP to SE
	Dragon Kelp	**ALF**	Golden-brown	*Alaria fistulosa*	SP to SE
	Giant Kelp	**MAC**	Golden-brown	*Macrocystis integrifolia*	P to SE
	Bull Kelp	**NER**	Dark brown	*Nereocystis luetkeana*	SP to E

* Wave Exposure Codes: E = Exposed, SE = Semi-Exposed, SP = Semi-Protected, P = Protected, VP = Very Protected. (The highest Biological Exposure Very Exposed (VE) does not occur in the region included in this summary report.)

** California Mussel (MUS) and Urchin Barrens (URC) biobands have been added to the biological mapping in the area of southernmost Southeast Alaska. Previously, MUS and URC were mapped in British Columbia, but have not been observed elsewhere in Alaska.

Bioareas are based on overview interpretation of biomapping and the distribution of major species (e.g., the canopy kelp species – Dragon Kelp (ALF), Giant Kelp (MAC), and Bull Kelp (NER)) as well as overall coastal habitats (e.g. relief, geomorphology, dominant shoreline characteristics).

To recognize differences between species present in lower intertidal biobands, four bands have definitions that are specific to the bioarea where they are observed. These four biobands are: Bleached Red Algae (HAL), Red Algae (RED), Soft Brown Kelps (SBR) and Dark Brown Kelps (CHB). As ground surveys are completed, detail will be added to the definitions of indicator and associated species for each of the four lower intertidal biobands, and separate bioband definitions will be written for each bioarea.

As the imagery for Alaska is acquired and the mapping completed, the boundaries between these bioareas will be adjusted on the basis of observed biota. Additional bioareas may be added, if necessary.

Table 5.2. Description of bioareas identified in Alaska (as of August 2008).

Bioarea Code	Bioarea	Characteristics
KENA	Outer Kenai coast	Rugged coastline, dominated by extremely steep shores and Very Exposed wave energy. Fjord heads with tidewater glaciers. Absence of Dragon Kelp and Giant Kelp biobands.
COOK	Cook Inlet	Sediment-dominated, wide, low-slope shorelines, moderate to lower wave exposures. Affected by silt-laden freshwater input, absence of Giant Kelp and Dragon Kelp. Very wide complexes of salt marshes and estuaries.
KODI	Kodiak archipelago, southeast, on Gulf of Alaska coast	Diversity of habitats and wave exposures, from Very Protected estuaries to Exposed rock cliffs. Fully marine and open to Gulf of Alaska. Lush lower intertidal brown algae, red algae and canopy kelps, in particular at north end. Southwest coast has wide rock platforms with surfgrass beds and sediment dominated offshore islands.
KATM	Katmai coast / northwest coast of Kodiak archipelago	Moderate to high wave exposures, affected by outflow from Cook Inlet, and separated from open Gulf of Alaska by Kodiak archipelago. Limited diversity of lower intertidal browns and canopy kelps, with diversity of red algae characterizing higher exposure sites. Includes both coasts of Shelikof Strait.
ANIA	Aniakchak	High wave exposure, wide bedrock platforms and mobile sediment beaches. Included in KATM bioareas for species descriptions, pending further delineation of bioarea boundaries. Likely transitional to Aleutian bioareas.
SEYA	Southeast Alaska -- Yakutat	Exposed west-facing coast, open to Gulf of Alaska. Mobile, high-energy sediment beaches dominant. Limited canopy kelp distribution.
SEFJ	Southeast Alaska -- Lynn Canal	Fjord landscape, bedrock dominated, moderate to low wave exposures, glacial silty waters. Low species diversity in intertidal, dense Blue Mussel bioband, absence of Dragon Kelp and Giant Kelp biobands.
SEIC	Southeast Alaska -- Icy Strait	Glacial silty water with wide, sediment-dominated beaches, wide estuary flats and fringing salt marsh common. Only moderate and lower wave exposures. Dragon Kelp dominant canopy kelp.
SESI	Southeast Alaska -- Sitka	Fully marine, west coast. Includes diversity of species, exposure and habitat categories, from Exposed to Very Protected. Giant Kelp abundant, Dragon Kelp limited distribution.
SEMJ	Southeast Alaska -- Misty Fjords	Fjord landscape, bedrock-dominated, low wave exposures. Low species diversity. Absence of Giant Kelp and Dragon Kelp.
SECR	Southeast Alaska -- Craig	Fully marine, west coast. High species diversity and habitat heterogeneity. Northern limit of California Mussel and Urchin Barrens biobands and certain species of other lower intertidal kelps. Southern limit of Dragon Kelp.
PRWS	Prince William Sound	Diverse habitat, with high Semi-Exposed to Very Protected wave exposures. Differences between conditions in eastern and western Sound, with interaction of circulation complexities. Numerous tidewater glaciers and affects of Copper River. Absence of Giant Kelp and Dragon Kelp. Possibly will divide into more than one bioarea, pending completion of the classification from aerial imagery.

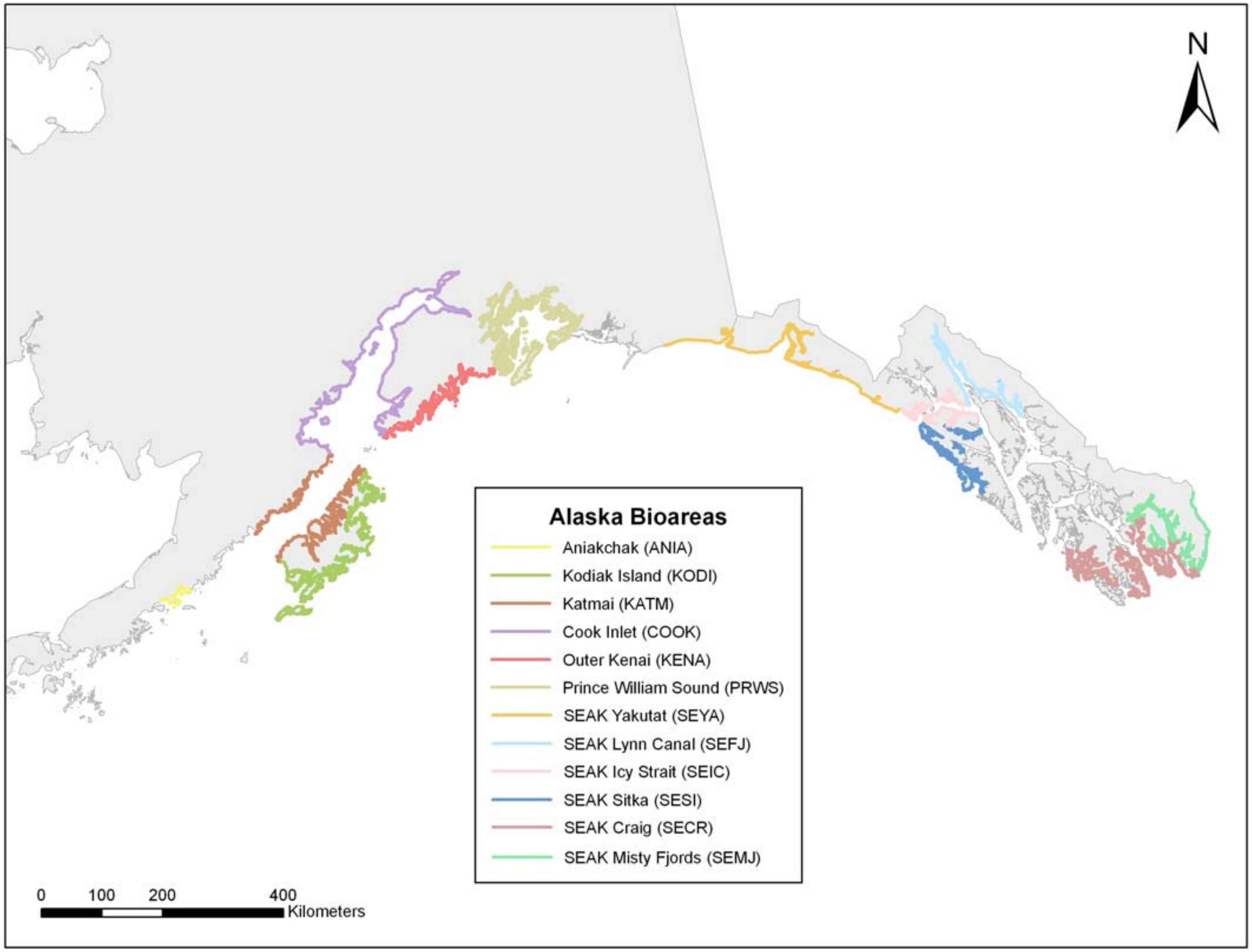


Figure 5.2. Map of bioareas identified in Alaska (as of August 2008). Bioareas are delineated on the basis of observed differences in the distribution of lower intertidal biota, nearshore canopy kelps, and coastal habitat classification.

Example illustrations and full definitions of the Southeast Alaska biobands are presented below. Each bioband is shown with photographic illustrations, as well as expanded descriptions of the characteristic across-shore elevation, colour, wave exposures where the band is most likely to be observed, and indicator and associated species. Each bioband photo is labelled by bioareas and by location.

Note that there are numerous examples from other bioareas, including Prince William Sound and the Kodiak Archipelago, but for simplicity, only examples from Southeast are used throughout the Biological Mapping sections of this report. Illustrated examples for other bioareas are available in each regional summary report and are available for download at the Coastal and Oceans website: www.coastalandoceans.com.

The Splash Zone (VER) Bioband

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 wide Splash Zone (VER) band of *Verrucaria* can be seen on this immobile Semi-Exposed (SE) shore in Round Islands.	A dark black stripe of *Verrucaria* representing the Splash Zone (VER) is distinct above underlying bands of Rockweed (FUC) and Red Algae (RED) on the northern tip of Duke Island.
SE06_ML_01339.jpg	SE06_MM_15303.jpg
Bioarea SECR	Bioarea SECR

The Dune Grass (GRA), Sedges (SED), and Salt Marsh (PUC) Biobands

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Dune Grass**	**GRA**	Pale blue-green	*Leymus 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	**Sedges**	**SED**	Bright green, yellow-green to red-brown.	*Carex lynbyei*	Appears in wetlands around lagoons and estuaries. Usually associated with freshwater. This band can exist as a wide flat pure stand or be intermingled with dune grass. Often the PUC band forms a fringe below.	VP-SP	*Carex* spp.
A	**Salt Marsh**	**PUC**	Light, bright, or dark green, with red-brown	*Puccinellia* sp. *Plantago maritima* *Glaux maritima*	Appears around estuaries, marshes, and lagoons. Usually associated with freshwater. Often fringing the edges of GRA and SED bands. PUC can be sparse *Puccinellia* and *Plantago* on coarse sediment or a wetter, peaty meadow with assemblage of herbs and sedges (including *Potentilla, Spergularia, Achillea, Dodecatheon* and other associated species).	VP-SE	*Carex sp.* *Potentilla anserine* *Honckenya peploides* *Salicornia virginica* *Triglochin maritima*

A mixture of tall, blue-green Dune Grass (GRA), lush Sedges (SED) and Salt Marsh (PUC) can be seen in this Protected (P) Estuary in Shinaku Inlet, Prince of Wales Island.

SE06_MM_19867.jpg

Bioarea SECR

A Protected (P) Estuary at the end of Frederick Cove, Prince of Wales Island, displaying extensive Dune Grass (GRA) and Salt Marsh (PUC) biobands.

SE06_MM_12046.jpg

Bioarea SECR

The Barnacle (BAR) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
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.*

Located below the *Verrucaria* (VER), a continuous band of Barnacles (BAR) is visible in the high intertidal range of this Semi-Exposed (SE) shoreline in the Barrier Islands.

SE06_ML_02279.jpg

Bioarea SECR

A distinct band of creamy white Barnacles (BAR) extends across the Semi-Protected (SP) shore of this islet south of St. Phillip Island.

SE06_MM_18990.jpg

Bioarea SECR

The Rockweed (FUC) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
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.*

Golden-brown Rockweed (FUC) underlies a medium Splash Zone (VER) along the shores of Cholmondeley Sound.

SE06_MM_14698.jpg

Bioarea SECR

A dense covering of Rockweed (FUC) forms a continuous band along the flats this Protected (P) estuary in Shinaku Inlet, Prince of Wales Island.

SE06_MM_19937.jpg

Bioarea SECR

The Green Algae (ULV) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
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.

	
Bright Green Algae (ULV) forms a continuous band at the waterline along the Protected (P) Partially Mobile beach of Goat Island.	A lush Green Algae (ULV) band extends across the lower intertidal range of this Semi-Protected shoreline in the Barrier Islands.
SE06_MM_27520.jpg	SE06_ML_01693.jpg
Bioarea SECR	Bioarea SECR

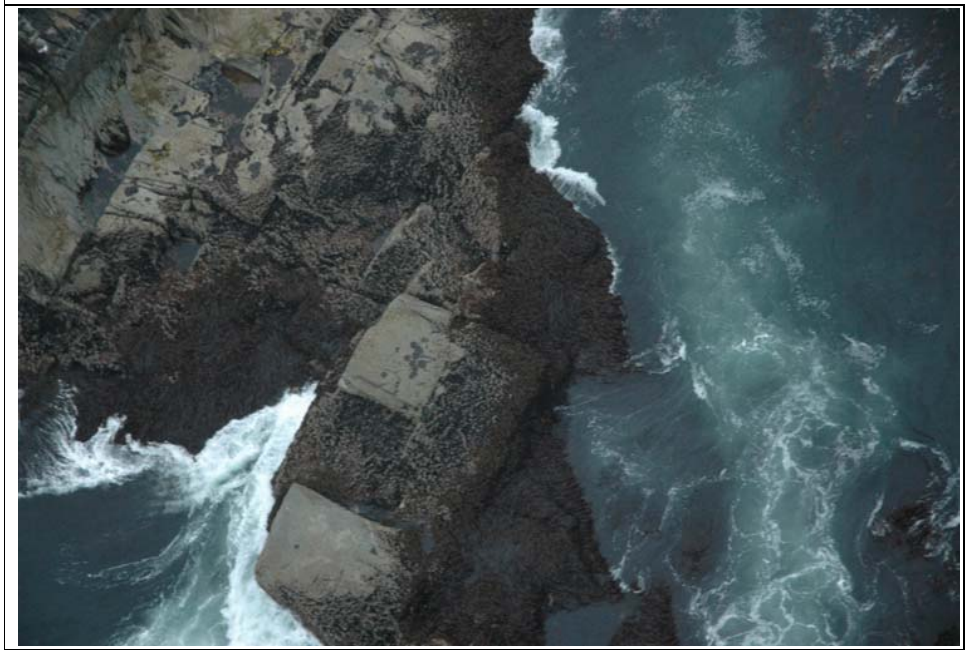
The Blue Mussel (BMU) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Blue Mussel**	**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.*

	
A thick Blue Mussel (BMU) bioband dominates this Semi-Protected (SP) shoreline in Portland Canal. Note the difference between the distinct blue-black band of Blue Mussel (BMU) below, and the *Verrucaria* (VER) band of the Splash Zone above.	Continuous bands of Blue Mussel (BMU) and Rockweed (FUC) contrast in the intertidal zone along this Protected (P) Estuary in the West Arm of Cholmondeley Sound, Prince of Wales Island.
SE06_HA_1880.jpg	SE06_MM_14444.jpg
Bioarea SEMJ	Bioarea SECR

The California Mussel (MUS) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**California Mussel**	**MUS**	Grey-blue	*Mytilus californianus*	Dominated by a complex of California mussels (*Mytilus californianus)* and thatched barnacles (*Semibalanus cariosus*) with gooseneck barnacles (*Pollicipes polymerus*) seen at higher exposures.	SE-VE	*Semibalanus cariosus* *Pollicipes polymerus*

	
Thick California Mussel (MUS) bioband on the Exposed west side of Baker Island, west of Craig, Alaska.	Wide splashzone with California Mussel (MUS) bioband above the Dark Brown Kelps (CHB) bioband at Cape Addington, Noyes Island
SE06_MM_23948.jpg	SE06_MM_21828.jpg
Bioarea SECR	Bioarea SECR

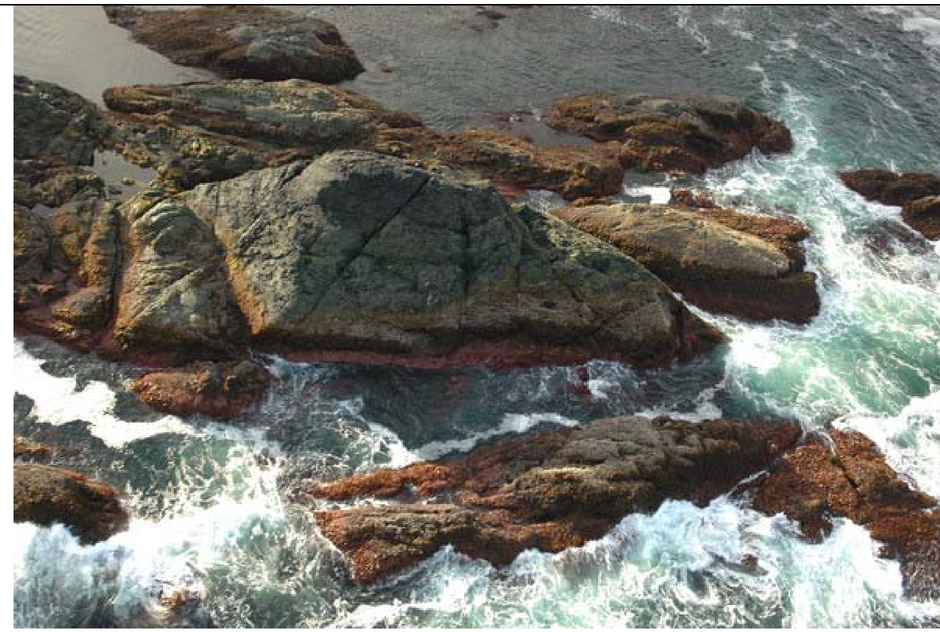
The Bleached Red Algae (HAL) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Bleached Red Algae**	**HAL**	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 RED band by colour. The bleached colour usually indicates lower wave exposure than where the RED band is observed, and may be caused by nutrient deficiency.	P-SE	*Halosaccion glandiforme* *Mazzaella sp.* Filamentous green algae

	
Bleached Red Algae (HAL) spans across the intertidal zone in the Tatoosh Islands off western Betton Island in Behm Canal.	Dense Giant Kelp (MAC) is offshore of the low turf of Bleached Red Algae (HAL) on the lower platform of this islet just north of Culebra Island, inside the Maurelle Islands Wilderness area, mid-west side of Prince of Wales Island.
SE06_MM_05228.jpg	SE06_MM_18859.jpg
Bioarea SEMJ	Bioarea SECR

The Red Algae (RED) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Red Algae**	**RED**	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.	P-VE	*Pisaster sp.* *Nucella sp.* *Katharina tunicata* mixed large browns of the CHB bioband

	
Along this Semi-Protected (SP) shoreline on Slim Island, a bright band of Red Algae (RED) is visible in the lower intertidal above subtidal Urchin Barrens (URC).	A band of coralline Red Algae (RED) can be seen at the waterline on this Exposed (E) shore on the West side of St. Joseph Island.
SE06_ML_07667.jpg	SE06_MM_18625.jpg
Bioarea SECR	Bioarea SECR

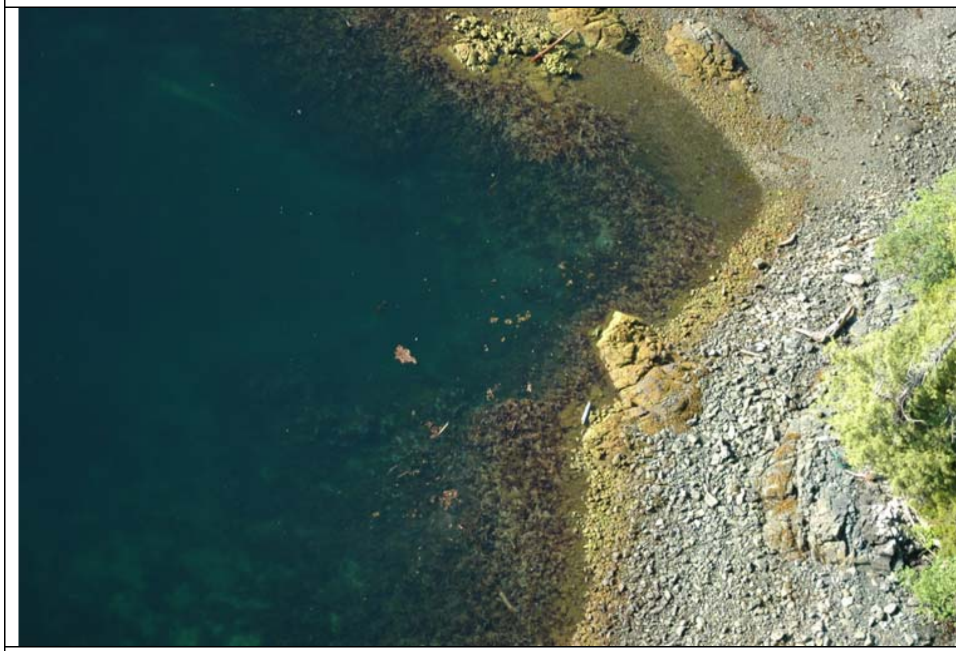
The Alaria (ALA) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
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.*

	
Alaria (ALA) can be seen here draped over the immobile bedrock along with a large patch of Surfgrass (SUR) on the shore of Suemez Island, a Semi-Protected island in Bucareli Bay.	*Alaria* (ALA) caps the tops of these offshore reefs of Duck Island and can be easily identified by its ribbon-like texture and red-brown colour.
SE06_MM_25233.jpg	SE06_MM_09984.jpg
Bioarea SECR	Bioarea SECR

The Soft Brown Kelps (SBR) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Soft Brown Kelps**	**SBR**	Yellow-brown, olive brown or brown.	*Saccharina latissima* *Cystoseira sp.* *Sargassum muticum*	This band is defined by non-floating large browns and 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.* *Saccharina sessile* (bullate)

	
Soft Brown Kelps (SBR) form a continuous band in the subtidal zone of Kendrick Bay, Southeast Prince of Wales Island.	Lush Soft Brown Kelps (SBR) are visible just below the edge of the water off Ingraham Bay, Southeast Prince of Wales Island.
SE06_MM_10623	SE06_MM_10949.jpg
Bioarea SECR	Bioarea SECR

The Dark Brown Kelps (CHB) Bioband

Zone	Bio-band Name	Databas e Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Dark Brown Kelps**	**CHB**	Dark chocolate brown	*Laminaria setchelli* *Saccharina subsimplex* *Lessoniopsis littoralis* *Hedophyllum sessile* (smooth)	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery, shiny, and smooth. A mixture of species occurs at the moderate wave exposures, while single-species stands of *Lessoniopsis* occur at high exposures.	SE-VE	*Cymathere sp.* *Pleurophycus sp.* *Costaria sp.* *Alaria sp.* Filamentous and foliose red algae

A band of Dark Brown Kelps (CHB) occurs here in the lower intertidal and extends into the subtidal zone of this Semi-Exposed (SE) islet in the Percy Islands.

SE06_MM_15751.jpg

Bioarea SECR

Along the western side of Gravina Island the shiny smooth blades of Dark Brown Kelps (CHB) are visible in the lower intertidal zone and nearshore subtidal along with Bull Kelp (NER). This band is indicative of higher wave exposures, as is seen here along this Semi-Exposed (SE) shoreline.

SE06_MM_00742.JPG

Bioarea SECR

The Surfgrass (SUR) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**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 cross-shore profile, where wave energy is dissipated by wave run-up across the broad intertidal zone.	SP-SE	Foliose and coralline red algae

Surfgrass (SUR) is visible on underwater boulders with Bull Kelp (NER) dominating the surrounding subtidal zone of St. Joseph Island, a Semi-Protected, Partially Mobile island southwest of the Maurelle Islands.

SE06_MM_18615.jpg

Bioarea SECR

Patches of Surfgrass (SUR) mixed with lush Dark Brown Kelps (CHB) are visible in this Semi-Exposed (SE) rock platform in the Percy Islands.

SE06_MM_15744.jpg

Bioarea SECR

The Eelgrass (ZOS) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
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*.

Eelgrass (ZOS) is visible in the subtidal zone with a Soft Brown (SBR) band underneath on this Partially Mobile shore in Nichols Bay.

SE06_ML_04695.jpg

Bioarea SECR

A lush Eelgrass (ZOS) band is located in the lower intertidal and subtidal zones of this Partially Mobile islet shore in Klawock Inlet, Prince of Wales Island.

SE06_MM_20471.jpg

Bioarea SECR

The Urchin Barrens (URC) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Urchin Barrens**	**URC**	Underwater, coralline white	*Strongylocentrotus franciscanus*	Shows rocky substrate clear of macroalgae. Often has a pink-white colour of encrusting coralline red algae. May or may not see urchins.	SP-SE, current	

	
Urchin Barrens (URC) surround this Semi-Protected islet off Edge Point, Mary Island. Individual *Strongylocentrotus franciscanus* (red sea urchin) are visible in excavated holes etched out of the underlying bedrock.	Urchin Barrens (URC), and even individual urchins, are visible here in the underwater zone below a canopy of *Macrocystis* (MAC) and *Nereocystis* (NER) on a Southeastern islet in the Percy Islands.
SE06_MM_12922.jpg	SE06_MM_15979.jpg
Bioarea SECR	Bioarea SECR

The Giant Kelp (MAC) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Giant Kelp**	**MAC**	Golden-brown	*Macrocystis integrifolia*	Canopy-forming giant kelp, long stipes with multiple floats and fronds. If associated with NER, it occurs inshore of the bull kelp.	P-SE	*Nereocystis luetkeana* *Alaria fistulosa**

	
A lush canopy of Giant Kelp (MAC) dominates the subtidal zone of this Semi-Protected islet north of Pt. Mirraballis. The long stipe, multiple floats and fronds characteristic of this kelp are highly visible.	Wide spread, dense beds of Giant Kelp (MAC) are characteristic of the Craig bioareas, as seen along the shore of this islet north of Rosary Island, San Cristoval Channel, west Prince of Wales Island.
SE06_MM_21102.jpg	SE06_MM_19131.jpg
Bioarea SECR	Bioarea SECR

* ALF – Dragon Kelp was not observed in the project area included in this summary report, but does occur further north in other bioareas in Southeast Alaska.

The Bull Kelp (NER) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	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* and *Macrocystis*. Often indicates higher current areas if observed at lower wave exposures.	SP-VE	*Alaria fistulosa** *Macrocystis integrifolia*

	
The long blades, floating bulb and long stipe diagnostic of Bull Kelp (NER) are seen here as a continuous band in the subtidal zone of an islet in the Cruz Islands (north of San Fernando Island).	Bull Kelp (NER) is easily identified by the floating bulb and long stipe of each plant, as seen here on Cat Island north of Duke Island.
SE06_MM_23221.jpg	SE06_MM_10044.jpg
Bioarea SECR	Bioarea SECR

* ALF – Dragon Kelp was not observed in the project area included in this summary report, but does occur further north in other bioareas in Southeast Alaska.

5.2 Guidelines for Mapping Biobands in the Bioband Table

Definitions of Patchy and Continuous

The presence of a Bioband, except the Splash Zone, is always recorded as either Continuous or Patchy. These codes are a subjective assessment of both the relative cover (the 'density') of the species assemblage, and the distribution (the 'patchiness') of the bioband within the unit.

Continuous – the bioband is present with dense enough cover to be visible in more than half of the along-shore unit length, at typical band intertidal elevation.

Patchy – the bioband is present with dense enough cover to be visible in less than half of the along-shore length of the unit.

Generally, the lower limit to the Patchy category is that the bioband is present in at least one-quarter of the alongshore length of the unit; however, some biobands are easier to see at lower cover than others. For example, the Eelgrass (ZOS) and the canopy kelps (Bull Kelp (NER), Giant Kelp (MAC) and Dragon Kelp (ALF)) may be noted, even though the distribution is less than one-quarter of the unit length. Eelgrass may occur in scattered, dense clumps and canopy kelps can be established as a bed of sparsely distributed large plants. Strictly interpreted, neither of the observation of these biobands would be recorded, in particular in longer units; however, when the Eelgrass or canopy kelps biobands are observed with confidence, they are recorded as Patchy occurrence even at less than one-quarter distribution.

Guidelines for the Identification of Biobands

Splash Zone (VER):

1. Is recorded by width: Narrow (N -- less than 1m); Medium (M -- 1 to 5m); or Wide (W – greater than 5m).
2. Is only mapped if considered to be present with dense enough cover to be visible in less than half of the along-shore length of the unit (Patchy).
3. Colour is dark grey to black on bedrock or boulders.
4. Is only mapped in one A zone, the one that most closely matches it, even if it stretches across multiple zones it would, for example, only get mapped as wide (W) in the A1.
5. White lichen (*Coccotrema maritimum*) can be present in the A zone but should not be included in the VER band width estimation.

Dune Grass (GRA):

1. Blue-green in colour and taller than low-lying bright green PUC band.
2. Can be found fringing in areas not considered wetland (i.e., in dunes or loglines on beaches).

3. Easily distinguishable from the greener terrestrial grasses and wetland biobands so confidence level of identification would be high.

Sedges (SED):
1. Bright green in colour and tall – similar in height to the dune grass and taller than the low-lying marsh grasses found in the PUC band. If flying took place into the late summer/ early fall the sedges may have turned an orange-brown colour.
2. Found in thick expansive stands at the heads of estuaries.
3. Often appear to be in circular clumps.
4. Generally only mapped in large estuaries where stand of pure sedge are observed and not in fringing wetlands where sedges are mixed with other salt-tolerant grasses and herbs (because these would be encompassed in the mapping of the PUC band).

Salt Marsh (PUC):
1. Species assemblage of salt-tolerant grasses, sedges and herbs.
2. One of the indicator biobands for estuary areas, when associated with stream or river freshwater.
3. Low-lying assemblage showing little to no shadow or height.
4. Usually occurs on lower elevation than Dune Grass.
5. This is a supratidal band but can be mapped in the first B zone in a low marsh (form MI).
6. Sedges are included in this band and when observed in combination with other salt marsh species are mapped as PUC.

Barnacle (BAR):
1. Visible as a white, cream or yellow band.
2. Often found in the upper intertidal but can be in the middle and lower (usually covered by algae and not visible).
3. Sometimes visible as two separate bands that can be slightly different colours depending on the species of barnacle.

Rockweed (FUC):
1. Brown band ranging from golden-brown to orangey-brown.
2. Found in the upper intertidal, sometimes mixed with the BAR band, sometimes a distinct band below the BAR.
3. Observed at all but the highest wave exposures.
4. Can be confused with *Endocladia* or *Gloiopeltis*, both low turf red algae, which can be seen at higher wave exposures in place of or mixed together with *Fucus*. When these species are observed they are mapped in the Rockweed bioband because they are considered associate species of this band.

Green Algae (ULV):

1. Bright to dark green in colour.
2. Variable in species composition, including both foliose and filamentous green algae species.
3. Can form a dark band in the lower intertidal when mixed with red algae. Both biobands would get mapped as continuous if they are present in equal proportions.
4. If *Enteromorpha* is present within the splash zone, ULV can be recorded in the A zone. This can occur in areas where there is a lot of freshwater seepage.
5. *Prasiola* is a species of green algae that can be seen in or above the Splash Zone at higher wave exposures. It is considered an associate species to the VER band and is not included in the ULV band.

Blue Mussel (BMU):

1. The appearance of BMU can vary dramatically depending on the substrate, exposure and amount of silt in the water.
2. Colour varies from dark black to blue-grey.
3. BMU usually occurs below the FUC and BAR bands but above the ULV or RED bands.

California Mussel (MUS)

1. The colour of the MUS is dusky blue-grey (may be confused with the blue-grey from of BMU but they do not form a black band like BMU often do)
2. They are found at relatively high wave exposures and in Alaska, only in the SECR bioarea of Southeast Alaska.
3. Closely associated with Gooseneck barnacles making them difficult to spot. Can be observed as black specks "peppered" throughout a white band.

Bleached Red Algae (HAL):

1. Colour ranges from orangey-pink to yellowy-green.
2. Assemblage of species of bleached foliose and filamentous red algae often mixed with green algae and sometimes indistinguishable from bleached greens.

Red Algae (RED):

1. Red algae include filamentous, foliose and coralline algae, and different species assemblages occur at different wave exposures.
2. Foliose and coralline RED algae disappear before the exposure drops to Protected and are some very good indicators of this transition when they are present.
3. A low turf of filamentous RED is often mixed with diatom scum and is found in higher Protected / Semi-Protected wave exposure environments. It is not a strong indicator of the transition from Semi-Protected to Protected.
4. Coralline RED algae is found at a wide range of exposures. It is almost always found in the highest exposures (Exposed) but is often obscured under other lower intertidal biobands (i.e., ALA, Dark Brown Kelps (CHB) and/or foliose RED).

Alaria (ALA):

1. Named for the monoculture of *Alaria* that is observed as a bioband at upper elevation edge of Soft Brown Kelps (SBR) or Dark Brown Kelps (CHB) biobands.
2. The species *Alaria* also occurs in the kelp assemblages of the Soft Brown Kelps (SBR) or Dark Brown Kelps (CHB) and tolerates a range of exposures from high Semi-Protected to Very Exposed.

Soft Brown Kelps (SBR):

1. Observed in the lower intertidal and nearshore subtidal.
2. Characterize Semi-Protected and Protected wave exposure, but also are seen in low Semi-Exposed.
3. SBRs most often are visible as ruffled, wide brown fronds in the nearshore subtidal.
4. Can have diatoms and bryozoans on them, which emphasize the ruffled subtidal appearance.

Dark Brown Kelps (CHB):

1. Dark, shiny brown kelps, often stalked species observed in the lowest intertidal.
2. Usually a mixture of species of large brown algae, although it can be monoculture of single species at the highest wave exposure (i.e., *Lessoniopsis*).

Surfgrass (SUR):

1. Bright green in colour. Always attached to hard substrate (i.e., bedrock or immobile boulder/cobble).
2. Found at higher wave exposures and some species of surfgrass have been observed mixed with eelgrass, during ground surveys. Although surfgrass is considered a good indicator of Semi-Exposed and eelgrass

indicates a lower exposure (Semi-Protected or Protected) both biobands can co-occur in transition zones.

3. Mapping confidence is generally high, except in lower exposure transition zones when SUR may be adjacent to eelgrass.
4. Can be observed as bleached white on upper elevation of wide rock platforms (surfgrass bleaches, while eelgrass does not).

Eelgrass (ZOS):

1. Bright green in colour.
2. Only found on soft substrate such as sand or fines.
3. Found at lower wave exposures.

Urchin Barrens (URC)

1. High densities of red sea urchins graze the macroalgae to leave only encrusting coralline red algae barrens.
2. Can be recognized by an underwater “bare” zone below a well-defined line or lower limit to a lush nearshore kelp bed
3. Can see individual urchins if conditions are clear and it is relatively shallow
4. Appear in Semi-Protected to Semi-Exposed areas and in areas influence by current.
5. In Alaska, occurs only in the SECR bioarea of Southeast Alaska.

Dragon Kelp (ALF):

1. Always seen as canopy kelp, in nearshore subtidal.
2. Limited distribution depending on bioarea.
3. Has a long hollow mid-rib that floats creating a spaghetti-like appearance on the surface of the water.
4. Indicates Semi-Exposed or high Semi-Protected wave exposures.

Giant Kelp (MAC):

1. Always seen as canopy kelp species, in nearshore subtidal.
2. Distinctive pattern of large plants, with fronds and small floats.
3. Limited distribution depending on bioarea.
4. Indicates Semi-Exposed or Semi-Protected wave exposures.

Bull Kelp (NER):

1. Always seen as canopy kelp species, in nearshore subtidal.
2. Distinctive single long stipe, with bulb float and multiple fronds.
3. Occurs in current-affected and current-dominated areas.
4. Occurs in Semi-Protected and up to the highest wave exposures.
5. Wide geographic distribution.

See Appendix A, Table A-13 for further explanation of database fields in the Bioband Table.

5.3 Biological Wave Exposure Definitions and Illustrated Examples: Southeast Alaska

Biological wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are defined on the basis of a set of indicator species and a typical set of biobands. Biological wave exposure is a classified attribute that is determined during biological mapping from observations of the presence and abundance of biota in each alongshore unit, where the assemblage of biota observed in the shore unit is used as a proxy for the energy conditions at that site. The value determined is recorded in the EXP_BIO field in the database.

The six biological wave exposure categories are the same as those used in the physical ShoreZone mapping to characterize wave exposure of an alongshore unit on the basis of fetch window estimates and coastal geomorphology (EXP_OBSER in the UNIT table of the database); however the biological categories are defined by presence or absence of indicator species and biobands rather than from wave fetch; and have been determined to be a better index of exposure than are scores derived from fetch measurements. The biological wave exposure category is used in determining the Oil Residence Index (ORI).

Wave energy tolerances of the species assemblages that comprise the ShoreZone biobands are known from scientific literature and expert knowledge. Some biobands are observed in all wave exposure categories and are considered “associated species” bands in determining wave exposure (e.g. the Barnacle band (BAR)), while other biobands are considered “indicators” because they are closely associated with particular exposures. For example, the Dark Brown Kelps band (CHB) is consistently associated with higher wave exposures (Semi-Exposed to Exposed).

Species and biobands listed for each wave exposure category are considered “typical” but not “obligate.” That is, not all species occur in every unit classified with a particular biological wave exposure. The combination of biobands, indicator species, and interpretation by biological mappers determines the wave exposure category for each unit.

Typical indicator and associated species and biobands are summarized for each biological wave exposure category from mapped areas in Southeast Alaska with example illustrations in Tables 5.3 through 5.6 and Figures 5.3 through 5.6.

It should be noted that the “Very Exposed” category has only been applied in biological mapping of the Outer Kenai coast, in Kenai Fjords National Park, and on the southwest coast of Moresby Island, British Columbia. Species assemblages are a subset of those found in Exposed shorelines. In these Very Exposed locations, the shoreline morphology consists of very steep cliffs, and the coastline is open to the full force of ocean waves from the north Pacific.

Also note that the indicator and associated species listed for the exposure categories in these examples from Southeast Alaska are not based on formal ground survey data, but are instead based on opportunistic observations and photos collected during the aerial surveys, as well as on expert knowledge and ground surveys from other regions of Alaska. Illustrated examples for other regions are part of the summary reporting compiled for ShoreZone mapping in other areas, including listed indicator and associated species that are typical of different bioareas. These reports are available for download from ShoreZone websites.

Table 5.3. Typical and associated species of biobands for the Very Exposed (VE) and Exposed (E) biological wave exposure categories, in Southeast Alaska.

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
Supratidal & Upper Intertidal		*Leymus mollis*	Dune Grass	GRA
	Verrucaria		Splash Zone	VER
		Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussel	BMU
Lower Intertidal & Subtidal		*Mytilus californianus*	California Mussel	MUS *
	Coralline red algae		Red Algae	RED
	Alaria 'nana' morph		Alaria	ALA
	Lessoniopsis littoralis		Dark Brown Kelps	CHB
	Laminaria setchellii		Dark Brown Kelps	CHB
	Nereocystis luetkeana		Bull Kelp	NER

* California Mussel occurs only in the Craig bioarea of Southeast Alaska (SECR).

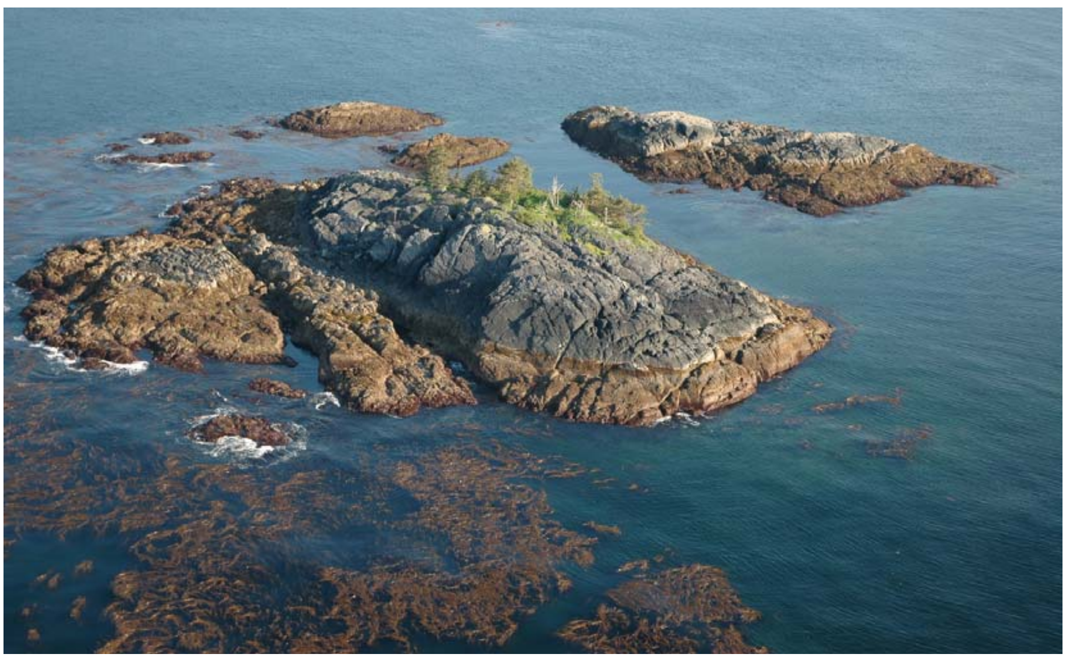


Figure 5.3. Biological wave exposure: Exposed.
Exposed (E) bedrock shoreline at offshore Kelp Islet, along the south-facing shore of Duke Island. A wide Splash Zone (VER) band of *Verrucaria* overlies bands of Barnacle (BAR), Red Algae (RED), *Alaria* (ALA), Dark Brown Kelps (CHB) and Bull Kelp (NER) in the nearshore subtidal. Shore units classified as Exposed (E) are uncommon in the section of Southeast Alaska covered in this summary report, and include about 4% of the shoreline. (SE06_MM_09550.jpg)

Table 5.4. Typical and associated species of biobands for the Semi-Exposed (SE) biological wave exposure category, in Southeast Alaska.

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
Supratidal & Upper Intertidal		*Leymus mollis*	Dune Grass	GRA
	Verrucaria		Splash Zone	VER
		Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussel	BMU
Lower Intertidal & Subtidal	mixed filamentous and foliose red algae		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Phyllospadix sp.		Surfgrass	SUR
	Laminaria setchellii		Dark Brown Kelps	CHB
	Saccharina subsimplex		Dark Brown Kelps	CHB
	Saccharina sessile smooth morph		Dark Brown Kelps	CHB
	Alaria fistulosa		Dragon Kelp	ALF *
		Strongylocentrous fransciscanus	Urchin Barrens	URC **
		Macrocystis integrifolia	Giant Kelp	MAC
	Nereocystis luetkeana		Bull Kelp	NER

* ALF – Dragon Kelp was not observed in the project area included in this summary report, but does occur further north in other bioareas in Southeast Alaska.
** URC – only in the Craig bioarea of Southeast Alaska (SECR)

Figure 5.4. Biological wave exposure: Semi-Exposed.
The Semi-Exposed (SE) bedrock of these islands off Kelp and Duke Island show biological components typical of this exposure category. This includes a medium Splash Zone (VER) band of *Verrucaria* and biobands of Barnacle (BAR), Red Algae (RED), a nearshore fringe of Bull Kelp (NER) and subtidal Urchin Barrens (URC). (SE06_MM_09563.jpg)

Table 5.5. Typical and associated species of biobands for the Semi-Protected (SP) biological wave exposure category, in Southeast Alaska.

Zone	Indicator species	Associated Species	Bioband Name	Bioband Code
Supratidal & Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp. *	Sedges	SED
		Puccinellia *	Salt Marsh	PUC
		Plantago maritima *	Salt Marsh	PUC
		Glaux maritima *	Salt Marsh	PUC
	Verrucaria		Splash Zone	VER
Lower Intertidal & Subtidal		*Balanus glandula* *Semibalanus balanoides*	Barnacle	BAR
	Semibalanus carriosus		Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Mytilus trossulus		Blue Mussel	BMU
		Ulva spp.	Green Algae	ULV
	Bleached mixed red algae		Bleached Red Algae	HAL
	Mixed red algae including *Odonthalia*		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Zostera marina		Eelgrass	ZOS
	Saccharina latissima		Soft Brown Kelps	SBR
		Nereocystis luetkeana	Bull Kelp	NER
	Macrocystis integrifolia		Giant Kelp	MAC

* Associated with estuaries and fringing wetlands at this wave exposure.

Figure 5.5. Biological wave exposure: Semi-Protected.
Biobands of Barnacle (BAR), Rockweed (FUC), Green Algae (ULV) and Red Algae (RED) cover this western platform of Duke Island, with Soft Brown Kelps (SBR) and Giant Kelp (MAC) in the nearshore subtidal. This collection of biobands is typical of the Semi-Protected (SP) exposure category of southern Southeast Alaska. (SE06_MM_15536.jpg)

Table 5.6. Typical and associated species of biobands for the Protected (P) and Very Protected (VP) biological wave exposure categories, in Southeast Alaska.

Zone	Indicator species	Associated Species	Bioband Name	Bioband Code
Supratidal & Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp. *	Sedges	SED
		Puccinellia *	Salt Marsh	PUC
		Plantago maritima *	Salt Marsh	PUC
		Glaux maritima *	Salt Marsh	PUC
	Verrucaria		Splash Zone	VER
		Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
		Fucus with epiphyte *Pilayella*	Rockweed	FUC
	Mytilus trossulus		Blue Mussel	BMU
Lower Intertidal & Subtidal	*Ulva* spp.		Green Algae	ULV
	Zostera marina		Eelgrass	ZOS
	Saccharina latissima (not in Very Protected)		Soft Brown Kelps	SBR

* Associated with estuaries and fringing wetlands at this wave exposure.

Figure 5.6. Biological wave exposure: Protected.
The bioband assemblage of fringing Salt Marsh (PUC), Rockweed (FUC), Green Algae (ULV), and Soft Brown Kelps (SBR) in the nearshore subtidal indicates the low wave exposure of this Protected (P) shoreline in Traitors Cove. (SE06_MM_04037.jpg)

5.4 Guidelines for Determining Exposure Categories in the BioUnit Table

The **Biological Wave Exposure** (EXP_BIO) is recorded as the highest exposure category observed in the unit, according to the observations or inference from the biota in the unit. In units where shoreline is complex, or where there are wide platforms, there may actually be a range of exposures and indicators species across the unit, from the waterline (where it is usually highest) to the splash zone (where it is the lowest). For example, on a high exposure coast, a unit can include the full range of exposure categories, from Exposed on the outermost reef to Protected, on the upper platforms.

Very Protected:

1. Use of this category is limited to areas of very low wave exposure and limited diversity of biota, as are seen at the extremely sheltered heads of inlets or in ponded lagoons with a limited intertidal range.
2. Often only the wetland biobands will be present, and the intertidal is often bare of attached biota.

Protected

1. Limited attached biota present in the Protected areas.
2. The biobands often seen include Barnacle, Rockweed and Green Algae (BAR, FUC and ULV) in the intertidal and Eelgrass (ZOS) or sparse Soft Brown Kelps (SBR) in the subtidal.
3. If the Splash Zone is present it is often narrow.
4. The riparian overhang is often 100%.
5. No canopy kelps present. Canopy kelps in otherwise Protected areas indicate a current dominated Semi-Protected Habitat Class.

Semi-Protected

1. The same biobands are present as in the Protected areas, but they tend to be lusher. As the exposure increases, Red Algae and Alaria biobands (RED and ALA) are often observed.
2. Eelgrass (ZOS) occurs in the lower Semi-Protected areas and Surfgrass (SUR) can in the higher Semi-Protected areas.
3. The Splash Zone will usually be medium in width.

Semi-Exposed:

1. Exposure category with the highest biodiversity.
2. Semi-Exposed is indicated by the presence of Dark Brown Kelps (CHB), lush Red Algae (RED), Alaria (ALA) and in some locations, Surfgrass (SUR) biobands.
3. All three canopy kelp biobands can be observed in Semi-Exposed, depending on the bioarea.
4. The Splash Zone will usually be medium to wide in width.

Exposed:

1. Upper intertidal can be bare-looking in Exposed areas, with only a thick Barnacle (BAR) bioband visible.
2. Lower intertidal tends to have lush Dark Brown Kelp (CHB) mixed with Red Algae (RED).
3. Nearshore canopy kelp will be Bull Kelp (NER).
4. The Splash Zone is wide.

Very Exposed:

1. This exposure category is used only for areas of very high exposure as seen along the high steep cliffs of the Kenai region.
2. Splash Zone is extremely wide.

See Appendix A, Table A-7 for further explanation of database fields in the BioUnit Table.

5.5 Habitat Class Definitions and Illustrated Examples: Southeast Alaska

Habitat use by coastal species is determined by both physical and biological characteristics. The ShoreZone habitat mapping system considers geomorphic, energetic, and physical attributes, as well as the distribution and ecological function of organisms, to classify coastal areas and describe their habitats.

Habitat Class is a summary classification that combines both physical and biological characteristics observed for a particular shoreline unit. It is intended to provide a simplified biophysical characterization of the unit on the basis of detailed alongshore and cross-shore attributes that have been mapped.

The species assemblages observed at a particular location are a reflection of both the physical characteristics of that shore segment as well as the wave exposure. Thus, the species assemblage observed on an Exposed (E) shore with a mixture of rock and mobile sediment will be distinct from the species assemblage observed on a Protected (P) shore with a wetland complex. Figures 5.7 to 5.13 below illustrate examples of habitat classes observed in Southeast Alaska. Further descriptions of the habitat class definitions are presented in Appendix A, Table A-8 and A-9. Examples from other regions of Alaska are available in summary reports available for download from ShoreZone websites.

Where the dominant structuring process in the shore unit is wave energy, the interaction of the wave exposure and the substrate type determines the **substrate mobility**. Stability of the substrate determines the presence and abundance of attached biota. Where the substrate is stable, such as bedrock, well-developed epibenthic assemblages occur. Where the substrate is mobile, such as on sandy beaches, the epibenthic community may be sparse or absent. Most units have the habitat class category determined by wave energy as the dominant structuring process.

The three classes of substrate mobility used in ShoreZone habitat characterization are:

- **Immobile or Stable:** substrates such as bedrock, boulders, and cobbles (could even be pebbles on a low-exposure coast) (Figure 5.7).
- **Partially Mobile:** mixed substrates such as a rock platform with a beach or sediment veneer, or units where energy varies across the beach. The partial mobility of the sediment limits the development of a full bioband assemblage that would likely occur on a stable rock shoreline (Figure 5.8).
- **Mobile:** substrates such as sandy beaches where coastal energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota (Figure 5.9).

Less common Habitat Classes are those determined by dominant structuring processes other than wave energy (Appendix A, Table A-8, A-9). These other habitat classes have only limited occurrence along the coast and, except for the anthropogenic shorelines, are also highly valued habitats. These habitat types are:

- **Estuary:** wetland and salt marsh vegetation along low energy sediment shores influenced by freshwater (Figure 5.10).
- **Current-Dominated:** channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units (Figure 5.11).
- **Glacier:** areas where glacial ice interacts directly with the supratidal, intertidal and/or subtidal zones (Figure 5.12).
- **Anthropogenic:** features where the shoreline has been modified or disturbed. This category distinguishes between permeable and impermeable anthropogenic material, however for reporting purposes both categories have been combined. Examples include wharves or areas of rip rap or fill (Figure 5.13).
- **Lagoon:** enclosed or constricted area of brackish or salty water, often found in the supratidal; however, large shallow lagoons sometimes form the subtidal zone in multiple consecutive units (Figure 5.14). Lagoons are mapped only as ‘secondary habitat classes’.

Figure 5.7. Habitat Class: Semi-Protected, Immobile.
Example of the Semi-Protected, **Immobile** habitat class on Gravina Island. The bedrock supports a dense cover of biobands, including Barnacles (BAR), Red Algae (RED) and *Alaria* (ALA), with a medium Splash Zone (VER) band of *Verrucaria* above. (SE06_MM_00930.jpg)

Figure 5.8. Habitat Class: Semi-Protected, Partially Mobile.
This Semi-Protected, **Partially Mobile** shoreline of Annette Point on Annette Island shows a dense cover of biota on the stable bedrock platform, with bare mobile sediment on adjacent beaches. (SE06_MM_08514.jpg)

Figure 5.9. Habitat Class: Semi-Protected, Mobile.
This Semi-Protected, **Mobile** beach in Hall Cove, Duke Island, is bare of attached biota. (SE06_MM_09242.jpg)

Figure 5.10. Habitat Class: Estuary.
This is an example of an **Estuary** habitat class at the head of Traitors Cove. Dune Grass (GRA), Sedges (SED) and Salt Marsh (PUC) biobands cover a large area in the supratidal, while the delta fan has a sparse cover of Rockweed (FUC) and Barnacle (BAR) biobands. (SE06_MM_04099.jpg)

Figure 5.11. Habitat Class: Current Dominated.
This **Current-Dominated** channel habitat creates a biologically rich and diverse area in Traitors Cove owing to its current energy. Biobands of Barnacles (BAR), Rockweed (FUC), Red Algae (RED), Alaria (ALA) and Dark Brown Kelps (CHB) are abundant. These types of habitats are rare and limited in distribution. (SE06_MM_04152.jpg)

Figure 5.12. Habitat Class: Glacier.
The Yahtse glacier at the head of Icy Bay is an example of a **Glacier** habitat class. (SE05_ML_3803.jpg)

Figure 5.13. Habitat Class: Anthropogenic.
This modified shoreline in Yes Bay is an example of an **Anthropogenic** habitat class. (SE06_MM_02659.jpg)

Figure 5.14. Secondary Habitat Class: Lagoon.
This backshore **Lagoon** on Duke Island is an example of a shore unit where the lagoon secondary habitat class was mapped. This feature is associated with wetland biobands such as Dune Grass (GRA), Salt Marsh (PUC) and Sedges (SED) surrounding an isolated basin of brackish water. (SE06_MM_09061.jpg)

5.6 Guidelines for Determining Habitat Class in the BioUnit Table

The first three Habitat Classes refer to areas where the wave energy is the dominant structural process: Immobile, Partially Mobile, and Mobile. All other Habitat Classes refer to areas where wave energy *influences* the unit but some other factor is the dominant structural process (e.g. fluvial/estuarine processes, current energy, glacier processes and man-modified).

Immobile
1. Usually bedrock platforms or cliffs.
2. Depending on the exposure, this category may include units with bedrock and large boulders covered in algae or even sediment only beaches (if the sediment size is large and the wave exposure is low).
3. If the area of the unit contains <10% mobile sediment it is still classified as immobile (this should assure that the Habitat Class matches Coastal Class)

Partially Mobile
1. Can range from totally mobile beaches with bedrock outcrops to bedrock platforms with pockets of sediment.
2. Units are categorized as Partially Mobile if sediment areas of the unit are bare of attached biota.

Mobile
1. *Usually* totally bare beaches.
2. Can have supratidal biobands (i.e., Dune Grass) or nearshore subtidal biobands (e.g., Soft Brown Kelps) but the intertidal is often bare of attached biota or has only drift algae. Sparse to patchy of one or two biobands is acceptable.
3. If the area of the unit contains <10% immobile sediment it is still classified as mobile (this should assure that the Habitat Class matches Coastal Class).

Estuaries

Have all of the following:
1. A *flowing* river or stream as fresh water source (mapped as an Rs; intermittent streams (Ri) would not provide enough freshwater influence).
2. A combination of one or more of the Dune Grass, Sedges or Salt Marsh biobands that are associated with the river or stream. A zones consisting of Dune Grass exclusively do not qualify as estuarine wetlands.
3. A delta fan morphology (and thus small enough size sediment for the flow of the river or stream to be strong enough to create a delta fan). Delta fans may sometimes be submerged if the tide is higher, and the extent of a delta fan may also be lessened by BMU.

Note: Fringing wetlands (often included in Coastal Class 31) usually have one or more of the Dune Grass, Sedges or Salt Marsh biobands but are not categorized with the Estuary habitat class because they lack the river/stream morphology.

Current Dominated Channels

1. Salt-water, high current channels caused by tidal flow. Current dominated tidal channels are usually found between islands or at the constricted entrances to saltwater lagoons. Generally water movement is visible within the channel but not outside it.
2. The biota tends to be highly diverse and lusher within the channel (compared to outside the channel) indicating higher *energy* conditions in the channel (due to the current flow, rather than wave exposure).
3. The biology associated with current channels is anomalous from the surrounding environment and includes assemblages that are unique and rare within a particular region. These features are rare habitats that are limited in distribution.
4. *Almost* always mapped as a higher wave exposure than the surrounding area because the current increases the wave energy and often results in the presence of bands that are only observed at higher exposures.

Glaciers

1. Units can be part or all ice.
2. Seawater around the glacier and leading up to the glacier is very silty from the influence of the glacial meltwater and can be bright aquamarine in colour.
3. Chunks of ice are often seen on the beaches surrounding the glacier
4. Glaciers are seen at the heads of bays in Prince William Sound, on the Kenai coast and in Southeast Alaska.

Anthropogenic:

1. Man-made structures and human modified beaches (i.e. wharves, old log sorts)
2. Influence the biology of the unit (i.e. dredged ponds, flattened areas with ruined or recovering marsh vegetation).
3. Majority of the features observed are permeable, like landfill or wooden docks and pilings. Only concrete features are mapped as impermeable.
4. For *shoreline* modifications only. Does not include things in the C zone, like log booms (unless of course the actual shoreline is modified as well).
5. Archaeological features, such as village sites, canoe runs and fish-traps or ponds, are not classified as anthropogenic features, but should be noted in the Bio_Unit Comments field.

Lagoons:

Ponded water features in the supratidal or backshore area with salty or brackish water. Lagoons generally have:

1. Limited outlet to the open water.
2. A combination of one or more of the Dune Grass, Sedges or Salt Marsh biobands.
3. Standing water at low tide.

Note: Single units classified as lagoons often have the lagoon form in the supratidal zone; however, some lagoons are large and may encompass several units when the lagoon form is mapped as the subtidal zone.

See Appendix A, Table A-7 for further explanation of database fields in the BioUnit Table.

5.7 Definitions of tblBioSlide and tblGroundStationNumber Tables

The tblBioSlide Table provides a list of all photographs that are attached to the units mapped by the physical mappers. The still images provide valuable information and can help provide additional views of features that may not be captured in the video. It is for this reason that it is important to view all images attached to the unit.

In addition to the image information, there is a comment field as well as a good example tick box in the table. These fields enable the biomappers to identify potential photographs that will be useful later in compiling the summary report.

The tblGroundStationNumber Table contains information on groundstation surveys conducted in the area. This table acts as a link between the aerial and ground information.

See Appendix A, Tables A-14 and A-15 for further explanation of database fields in the tblBioSlide and tblGroundStationNumber Tables.

6.0 SHOREZONE ASSESSMENT SUMMARY

ShoreZone Coastal Habitat Mapping is accomplished through the interpretation of oblique aerial video and digital still imagery of the coastal zone collected during summer low tides, usually from a helicopter flying at <100 meters altitude. Image interpretation and mapping is performed by a team of physical and biological scientists with formal academic science degrees and experience in geography, mapping, and environmental projects. Junior mappers undergo a three- to six-month training internship during which their work is supervised by a senior mapper with at least one year of experience. A quality assurance and control (“QA/QC”) protocol requires 10% of each physical and biological mappers’ work to be reviewed by another mapper. Database QA/QC and data-entry integrity is ensured by a database manager with two years of ShoreZone mapping experience.

A number of factors influence the complexity of shoreline mapping, including: natural geomorphology, coastal crenulation, quality of the imagery and associated commentary, quality of the digital shoreline basemap, and experience of the physical and biological mappers.

In 2007 and 2008, the ShoreZone mapping technique has been assessed to establish qualitative and quantitative confidence levels in ShoreZone maps and data: (1) a study of the repeatability of mapping in Southeast Alaska and (2) field verification in Victoria, British Columbia. This section summarizes the principal findings of each study. On the basis of what was learned from these studies, recommendations for improvement are provided.

6.1 Mapping Repeatability Study

The Nature Conservancy provided funding for a study of the repeatability of physical and biological mapping procedures (performed by Coastal and Ocean Resources, Inc. and Archipelago Marine Research, Ltd., respectively). The **principal objective** of this study was to examine the repeatability of ShoreZone mapping techniques using imagery collected in Southeast Alaska in 2005 and 2006. Three 10-km test sections in Southeast Alaska were randomly selected and mapped by three physical mappers and three biological mappers. Variability between mappers was assessed with respect to:

- segmentation (unit breaks) delineated by physical mappers
- along-shore unit classifications
- across-shore component data within units
- geomorphic feature inventory, and
- bioband inventory, biological exposure and habitat class categories

Sources of variability identified in this study included:
- Delineation of along-shore unit boundaries according to mapper interpretation;
- Digitizing of unit breaks on the digital shoreline;
- Mappers' individual decision-making, recognition, and experience; and
- Human error.

The **principal conclusions** of this study included:
- Shoreline segmentation (unit boundary delineation) by physical mappers showed the most variability but did not preclude the ability to inventory the geomorphic and biologic features of the shoreline.
- Poor matches or mismatches between physical data attributes were not common, but the sources of variability for such cases included: discerning the relative importance (abundance) of sand in the intertidal, the interpretation of slope in rock outcrops, and decision-making in transitional units (such as those dominated by rock but with some gravel).
- Principal geomorphic features, sediment types, and wave exposures were included in the inventory of each physical mapper's interpretation, regardless of the degree of variability in coding.
- The consistency in interpretation of biological exposure categories (mapped at the unit level) was high, with nearly all units mapped in all three sections scoring as matches. Similarly, the interpretation of the habitat class categories (also mapped at the unit level) showed 77% match or better in all three Test Sections.
- Much of the consistency in biological data was attributable to the nature of data entry, in which bioband observations were restricted to three choices (blank/absent, patchy, or continuous). Unit-level classifications were assigned on the basis of these presence/absence observations of biota. In addition, fields left blank by more than one mapper (indicating an absence of that bioband) were included in the evaluation and considered matches.
- Nearshore canopy kelp biobands (Giant Kelp (MAC), Bull Kelp (NER) and Dragon Kelp (ALF)) were easily identified in aerial imagery, were recorded with the most confidence, and were highly consistent between mappers. Similarly, Eelgrass (ZOS) and Surfgrass (SUR) were recorded with confidence, and observations of these biobands were highly consistent between mappers.
- The lowest bioband match scores were for the Red Algae (RED) and the Soft Brown Kelps (SBR), particularly in habitats with low wave exposure.

An **external review** conducted by Carl Schoch of CoastWise Services, Inc. (Homer, Alaska) suggested the following principal sources of error in the ShoreZone mapping technique:
1. Segmentation errors caused by human subjectivity in the determination of alongshore unit boundaries.
2. Non-standardized resolution GIS vector basemaps and trying to join ShoreZone data to existing low resolution shoreline delineations.

3. Classification errors caused by ambiguity of feature descriptors and the overall qualitative nature of ShoreZone.
4. Inability of the ShoreZone classification to consistently describe actual shoreline features within a specified minimum (or maximum) mapping unit.
5. Numbers 1-4 above lead to a lack of repeatability by the same or different observers/mappers.

6.2 Field Verification Study (British Columbia)

The Integrated Land Management Bureau of the Province of British Columbia provided funding for a study on Vancouver Island to collect ground data using the same codes, individual mappers, and protocols as specified in aerial mapping. The **principal objective** of this study was to compare aerial mapping interpretations to ground survey observations in order to evaluate detection limits of physical and biological attributes. Ground crews were provided with unit boundaries so unit delineation was not compared. Site selection was not random because of the need to meet several requirements: shoreline accessibility; walk-able, contiguous sections of units; as many different exposure categories as possible; maximize time during the low tide window.

The **principal conclusions** of this study included:
- Coastal class assignment (to along-shore units, by different mappers on the ground and using aerial data) matched in 80% of cases.
- Shore modifications mapped using aerial imagery underestimated by 12% compared to ground observations, owing to seawalls covered by vegetation that were indistinct during flight.
- Across-shore component data matched in 85% of comparisons.
- Wide, spatially-complex shorelines were most commonly mismatched, reiterating the findings of the repeatability study.

6.3 Recommendations for Improvement

Improvements to enhance consistency and communication among mappers continues to be a principal priority in the ShoreZone mapping protocol. Activities to this end include:
- Update of the mapping procedures and guidelines in the 2007 ShoreZone Coastal Habitat Mapping Protocol for the Gulf of Alaska (Harney et al. 2007).
- More explicit rules for assigning coastal class.
- More explicit rules for segmentation (unit delineation).
- Develop and implement a protocol for testing mapper performance to a standard.
- Explicit definition of a mean, minimum, and maximum mapping unit at the “unit” level (segmentation) and at the “feature” level (forms and materials mapped into across-shore zones and components).

- Testing mappers to some performance standard.
- Weekly mapper meetings that discuss mapping guidelines and provide training on particular issues such as unit delineation and coastal class assignment (regularly practiced during the last year).
- Low-tide field excursions in which mappers are provided the opportunity to examine mapped data on the ground, identify geomorphic and sedimentary features, and measure actual widths and slopes using beach profiling techniques (regularly practiced during the last year).

6.4 Access and Use Constraints

Protocols for data access and distribution are established by the program partner agencies. Please see www.coastalandoceans.com for a list of partner agencies and related web sites. Video imagery can be viewed and digital stills downloaded online at www.alaskafisheries.noaa.gov/maps/szintro.htm. Any hardcopies or published data sets utilizing ShoreZone products shall clearly indicate their source. To ensure distribution of the most current public information or for correct interpretation, contact the ShoreZone project manager at Coastal and Ocean Resources, Inc. At the time of publication, that person is Dr. Jodi Harney.

To effectively and appropriately use ShoreZone data, the user shall refer to the ShoreZone Coastal Habitat Mapping Protocol (2008) available at www.coastalandoceans.com. Data provided are derived from large, regional databases that are continually being updated and modified. The accuracy of some information is subject to change. Any published data sets utilizing ShoreZone products (printed, digital, or online) shall clearly indicate their source. If the user has modified the data in any way, the user is obligated to describe the types of modifications performed. The user specifically agrees not to misrepresent these data, nor to imply that changes made were approved by the ShoreZone program or its partners.

7.0 REFERENCES

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ShoreZone reports and protocols are available for download online at:
http://www.coastalandoceans.com/downloads.html

8.0 ACKNOWLEDGMENTS

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APPENDIX A DATA DICTIONARY

Appx Table	Description
A-1	Data dictionary for UNIT table
A-2	Classification of shore types employed in ShoreZone mapping (derived from the Howes et al. [1994] “BC Class” system in British Columbia)
A-3	Environmental Sensitivity Index (ESI) Shore Type classification (after Peterson et al. [2002])
A-4	Exposure matrix used for estimating observed physical exposure (EXP_OBSER) on the basis of fetch distance
A-5	Oil Residence Index (ORI) definitions
A-6	Oil Residence Index (ORI) look-up matrix based on exposure (columns) and substrate type (rows)
A-7	Data dictionary for BIOUNIT table
A-8	Habitat Class Codes
A-9	Habitat Class Definitions
A-10	Data dictionary for across-shore component table (XSHR) (after Howes et al. 1994)
A-11	‘Form’ Code Dictionary (after Howes et al. 1994)
A-12	‘Material’ Code Dictionary (after Howes et al. 1994)
A-13	Data dictionary for the BIOBAND table
A-14	Data dictionary for the BIOSLIDE table (“tblBioSlide”)
A-15	Data dictionary for the GroundStationNumber table

Table A-1. Data dictionary for UNIT table

Field Name	Type	Description
UnitRecID	N	Automatically-generated number field; the database “primary key” for unit-level relationships
PHY_IDENT	T	Unique physical identifier; an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0); this field is completed by the database manager using an update query
REGION	T	2-digit coastal region number (see reference maps and GIS materials)
AREAS	T	2-digit coastal area number (see reference maps and GIS materials)
PHY_UNIT	T	4-digit physical along-shore unit number; segmented during physical mapping and delineated on paper maps and in GIS
SUBUNIT	T	Set to 0 for line features (units) or non-zero for point features (also called variants); several subunits in a unit are numbered sequentially (1, 2, 3…) according to the order occurring within the unit (based on UTC time)
TYPE	T	Single-letter description of Unit type: a (L)ine (unit) or (P)oint feature (variant)
BC_CLASS	N	Coastal class or “shore type” of the unit based primarily on substrate type, across-shore width, and slope; derived from the Howes et al. (1994) system applied in coastal British Columbia (Table A-2)
ESI	T	Environmental Sensitivity Index (shore unit classification (Table A-3)
LENGTH_M	N	Along-shore length in meters; calculated after digitizing using ArcGIS and updated using database query
GEO_MAPPER	T	Last name of the physical mapper
GEO_EDITOR	T	Last name of the physical mapper who QA/QCs the work (10% of all units are reviewed by an editor)
GEO_MAP_DATE		blank; the mapping date is automatically recorded in the DATE_ENTERED field
VIDEOTAPE	T	Title of the videotape (DVD imagery) used for mapping; naming convention for 2006 and on is SE06_GL_08, in which 06 is year, GL is team, 08 is tape
HR	T	Hour at which unit starts; based on the first two digits of the 6-digit UTC time on video when start of unit is at center of screen
MIN	T	Minute at which unit starts; based on third and fourth digits of 6-digit UTC time on video when start of unit is at center of screen
SEC	T	Seconds at which unit starts; based on the last two digits of the 6-digit UTC time on video when start of unit is at center of screen
EXP_OBSER	T	Estimate of wave exposure as observed by the physical mapper, as a function of the relative fetch (Table A-5), with a consideration of geomorphology.
SED_SOURCE	T	Estimated sediment source for the unit: (A)longshore, (B)ackshore, (F)luvial, (O)ffshore, (X) not identifiable
SED_ABUND	T	Code indicating the relative sediment abundance within the shore-unit, (A)bundant, (M)oderate, (S)carce

[continued]

Table A-1. Data dictionary for UNIT table (continued)

Field Name	Type	Description
SED_DIR	T	One of the eight cardinal points of the compass indicating dominant sediment transport direction (N, NE, E, SE, S, SW, W, NW). (X) Indicates transport direction could not be discerned from imagery.
CHNG_TYPE	T	Code indicating the stability of the shore unit, reflecting the relative degree of "measurable change" during a 3-5 year time span: (A)ccretional, (E)rosional, (S)table
SHORENAME	T	Name of a prominent geographic feature near the unit (from nautical chart or gazetteer)
UNIT_COMMENTS	T	Text field used for miscellaneous comments and notes during physical mapping
SHORE_PROB	T	Comment on nature of difference between digital shoreline and observed shoreline
SM1_TYPE	T	2-letter code indicating the *primary* type of shore modification occurring within the unit: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM%	N	Estimated % occurrence of the primary shore modification type in tenths (i.e. "2" = 20% occurrence with the unit alongshore)
SM2_TYPE	T	2-letter code indicating the *secondary* type of shore modification occurring within the unit
SM2%	N	Estimated % occurrence of the *secondary* type of shore modification occurring within the unit
SM3_TYPE	T	2-letter code indicating the *tertiary* type of shore modification occurring within the unit
SM3%	N	Estimated % occurrence of the *tertiary* seawall type in tenths (i.e., "2" = 20% occurrence within the unit)
SMOD_TOTAL	N	Total % occurrence of shore modification in the unit in tenths
RAMPS	N	Number of boat ramps that occur within the unit; ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate
PIERS_DOCK	N	Number of piers or wharves that occur within the unit; piers or docks must extend at least 10 m into the intertidal zone; does not include anchored floats
REC_SLIPS	N	Estimated number of recreational slips at docks of the unit; based on small boat length ~<50'
DEEPSEA_SLIP	N	Estimated number of slips for ocean-going vessels in the unit; based on ship length ~>100'
ITZ	N	Sum of the across-shore width of all the intertidal components (B zones) within the unit
EntryDate ModifiedDate	D/T	Date and time the unit was physically mapped (or modified)

Table A-2. Classification of shore types employed in ShoreZone mapping
(derived from the Howes et al. [1994] "BC Class" system in British Columbia)

SUBSTRATE	SEDIMENT	WIDTH	SLOPE	COASTAL CLASS	NO.
ROCK	N/A	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Rock Ramp, wide	1
			FLAT (<5°)	Rock Platform, wide	2
		NARROW (<30 m)	STEEP (>20°)	Rock Cliff	3
			INCLINED (5-20°)	Rock Ramp, narrow	4
			FLAT(<5°)	Rock Platform, narrow	5
ROCK & SEDIMENT	GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp with gravel beach, wide	6
			FLAT (<5°)	Platform with gravel beach, wide	7
		NARROW (<30 m)	STEEP (>20°)	Cliff with gravel beach	8
			INCLINED (5-20°)	Ramp with gravel beach	9
			FLAT (<5°)	Platform with gravel beach	10
	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp w gravel & sand beach, wide	11
			FLAT (<5°)	Platform with G&S beach, wide	12
		NARROW (<30 m)	STEEP (>20°)	Cliff with gravel/sand beach	13
			INCLINED (5-20°)	Ramp with gravel/sand beach	14
			FLAT (<5°)	Platform with gravel/sand beach	15
	SAND	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp with sand beach, wide	16
			FLAT (<5°)	Platform with sand beach, wide	17
		NARROW (<30 m)	STEEP (>20°)	Cliff with sand beach	18
			INCLINED (5-20°)	Ramp with sand beach, narrow	19
			FLAT (<5°)	Platform with sand beach, narrow	20
SEDIMENT	GRAVEL	WIDE (>30 m)	FLAT (<5°)	Gravel flat, wide	21
		NARROW (<30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Gravel beach, narrow	22
			FLAT (<5°)	Gravel flat or fan	23
	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	n/a	
			FLAT (<5°)	Sand & gravel flat or fan	24
		NARROW (<30 m)	STEEP >20°)	n/a	
			INCLINED (5-20°)	Sand & gravel beach, narrow	25
			FLAT (<5°)	Sand & gravel flat or fan	26
	SAND / MUD	WIDE (>30m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Sand beach	27
			FLAT (<5°)	Sand flat	28
			FLAT (<5°)	Mudflat	29
		NARROW (<30m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Sand beach	30
			FLAT (<5°)	n/a	n/a
	ORGANICS	n/a	n/a	Estuaries	31
ANTHRO-POGENIC	Man-made	n/a	n/a	Man-made, permeable	32
			n/a	Man-made, impermeable	33
CHANNEL	Current	n/a	n/a	Channel	34
GLACIER	Ice	n/a	n/a	Glacier	35

Table A-3. Environmental Sensitivity Index (ESI) Shore Type classification

(after Peterson et al. [2002])

ESI No.	Description
1A	Exposed rocky shores; exposed rocky banks
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	Gravel Beaches (cobbles and boulders)
6C	Rip rap (man-made)
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 rip rap
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; ,angroves
10E	Inundated low-lying tundra

Table A-4. Exposure matrix used for estimating observed physical exposure (EXP_OBSER) on the basis of fetch distance

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

Codes for exposures:		
	very protected	**VP**
	protected	**P**
	semi-protected	**SP**
	semi-exposed	**SE**
	exposed	**E**
	very exposed	**VE**

Table A-5. Oil Residence Index (ORI) definitions

Persistence	Oil Residence Index	Estimated persistence
Short	1	Days to weeks
	2	**Weeks** to months
Moderate	3	Weeks to **months**
	4	**Months** to years
Long	5	Months to **years**

Table A-6. Oil Residence Index (ORI) look-up matrix based on exposure (columns) and substrate type (rows)

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 w/ pebble, cobble, or boulder	1	2	3	4	5	5
sand w/o pebble, cobble, or boulder	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-7. Data dictionary for BIOUNIT table

Field Name	Type	Description
UnitRecID	N	Automatically-generated number field; the database “primary key” required for relationships between tables
PHY_IDENT	T	Unique physical identifier; an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0)
BIOAREA	T	Geographic division used to describe regional differences in observed biota and coastal habitats (*additional note follows)
EXP_BIO	T	Biological Exposure, estimated on the basis of observed indicator species (see Section 3.2 for details)
HAB_CLASS	T	Primary Habitat Classification determined by the biological mapper that combines the exposure (EXP_BIO) and the geomorphic features of the shoreline (see Table A-8 and A-9)
HAB_OBS	N	Original categories used to classify habitat type; not used in current protocol but kept for backward-compatibility with earlier projects; replaced by HAB_CLASS
HAB_CLASS_LTRS	T	Habitat Class in alphabetic code, derived from the HAB CLASS lookup table
BIO_SOURCE	T	The source used to interpret coastal zone biota: **V**ideotape, (**V2**) lower quality video imagery, **S**lide, **I**nferred
HAB_CLASS2	N	Secondary Habitat Classification determined by the biological mapper used to denote lagoon habitat types (**additional note follows)
HC2_SOURCE	T	Source used to interpret the Secondary Habitat Class (HC2) “lagoon”: **OBS**erved as viewed from video, **L**oo**KUP** referring to ‘Form’ Code (Table A-11) **Lo** or **Lc** in across-shore physical component table (XShr)
HC2_Note	T	Comment field for Secondary Habitat Class (HC2)
RIPARIAN%	N	Estimate of the percentage of alongshore length of the intertidal zone, in which the shoreline is shaded by overhanging riparian vegetation; all substrate types (***additional note follows)
RIPARIAN_M	N	Length in meters, of the unit shaded by overhanging riparian vegetation; all substrate types; calculated using LENGTH_M field of UNIT table
BIO_UNIT_COMMENT	T	Biological comments regarding the entire along-shore unit
BIO_MAPPER	T	The initials of the biological mapper that provided the biological interpretation of the imagery
BIO_MAP_DATE	D/T	Date of biological mapping
PHOTO	Y/N	Identifies if there is a photo (digital or slide) associated with the unit (see BIOSLIDE table)

[continued]

Table A-7. Data dictionary for BIOUNIT table (continued)

*** Further description of the BIOAREA attribute:**

BIOAREA NAME (Alaska ShoreZone mapping to date)	**BIOAREA Code**	**SUFFIX used in database to identify bioarea**
Outer Kenai	KENA	8
Cook Inlet	COOK	9
Kodiak Island	KODI	10
Katmai / Shelikof Strait side of Kodiak Island	KATM	11
Aniakchak	ANIA	11
Southeast Alaska -- Lynn Canal (fjord)	SEFJ	12
Southeast Alaska -- Sitka	SESI	12
Southeast Alaska -- Icy Strait	SEIC	12
Southeast Alaska -- Yakutat	SEYA	12
Southeast Alaska -- Misty Fjords	SEMJ	12
Southeast Alaska -- Craig	SECR	12
Prince William Sound	PRWS	13

**** Further description of the HabClass2 attribute:**

The 'Secondary Habitat Class' was added as an attribute in the BioUnit Table during biological mapping of the Kodiak Archipelago in order to specifically identify *lagoon* habitats. Many backshore lagoons were observed in the Kodiak region, and they represent an unusual coastal habitat that differs from other estuaries and marshes.

Units classified as *lagoons* contain brackish or salt water contained in a basin with limited drainage. They are often associated with wetlands and may include wetland biobands in the upper intertidal. Single units classified as lagoons often have the lagoon form in the A zone; however, some lagoons are large and may encompass several units when the lagoon form is mapped as the C zone. Further detail is provided in the Physical Mapping section.

***** Further description of the Riparian% attribute:**

As an attribute in the BioUnit table, this category is intended to be an index for the potential habitat for upper beach spawning fishes.

The value recorded in the 'Riparian%' field is an estimate of the percentage of the unit's total alongshore length in which riparian vegetation (trees and shrubs) shades the upper intertidal zone. Shading of the highest high water line is a good estimate of riparian shading; therefore, shading of wetland herbs and grasses is not included in the estimate, nor is any shading of the splash zone alone.

Shading must be visible in the upper intertidal zone, and the shading vegetation must be woody trees or shrubs. Riparian overhanging vegetation is also an indicator of lower wave exposures, in which the splash zone is narrow. Shading may occur in on sediment-dominated or in rocky intertidal settings.

Table A-8. Habitat Class Codes

Habitat Class attribute is a classification of the biophysical characteristics of an entire unit, and provides a single attribute that describes the typical intertidal biota together with the geomorphology. That is, a typical example of a Habitat Class includes a combination of biobands, and their associated indicator species (which determine the Biological Exposure category) and the geomorphological features of the Habitat Class.

The biological mapper observes and records the biobands in the unit, if any, and determines the Biological Exposure Category (EXP_BIO). The Habitat Class is determined on the basis of presence/absence of biobands, exposure category, geomorphology, and spatial distribution of biota within the unit.

Within the database, both a numeric code and an alpha code are used. Both codes are listed in Table A-9, in which the matrix includes all combinations of Dominant Structuring Process on the vertical axis, and Biological Exposure on the horizontal axis.

Biological Exposure Categories

VE	– Very Exposed
E	– Exposed
SE	– Semi-Exposed
SP	– Semi-Protected
P	– Protected
VP	– Very Protected

Dominant Structuring Process Categories

Wave	Stability of the substrate depends on the type of substrate and on the wave energy level – Immobile: on Bedrock; or Bedrock & Sediment; or Sediment-dominated (in low energy settings) – Partially Mobile on Rock & Sediment; or Sediment – Mobile on Sediment (bare beach)
Fluvial	– Estuary (saltmarsh vegetation associated with freshwater stream, often with delta form)
Current	– Current-Dominated saltwater channel
Glacial	– Glacier ice
Anthropogenic	– Man-modified impermeable substrate – Man-modified permeable substrate
Lagoon	– Backshore lagoon, only recorded as a Secondary Habitat Class

Table A-9. Habitat Class definitions

*shaded boxes in the Habitat Class matrix are not applicable in most regions

Dominant Structuring Process	Substrate Mobility	Coastal Type	Description	Biological Exposure Category*					
				Very Exposed **VE**	Exposed **E**	Semi-Exposed **SE**	Semi-Protected **SP**	Protected **P**	Very Protected **VP**
Wave Energy	***Immobile***	***Rock or Rock & Sediment or Sediment***	The epibiota in the immobile mobility categories is influenced by the wave exposure at the site. In high wave exposures, only solid bedrock shorelines will be classified as 'immobile'. At the lowest wave exposures, even pebble/cobble beaches may show lush epibiota, indicating an immobile Habitat Class.	10 VE_I	20 E_I	30 SE_I	40 SP_I	50 P_I	60 VP_I
	Partially Mobile	***Rock & Sediment or Sediment***	These units describe the combination of sediment mobility observed. That is, a sediment beach that is bare in the upper half of the intertidal with biobands occurring on the lower beach would be classed as 'partially mobile'. This pattern is seen at moderate wave exposures. Units with immobile bedrock outcrops intermingled with bare mobile sediment beaches, as can be seen at higher wave exposures, could also be classified as 'partially mobile'.	11 VE_P	21 E_P	31 SE_P	41 SP_P	51 P_P	61 VP_P
	Mobile	***Sediment***	These categories are intended to show the 'bare sediment beaches', where no epibenthic macrobiota are observed. Very fine sediment may be mobile even at the lowest wave exposures, while at the highest wave exposures; large-sized boulders will be mobile and bare of epibiota.	12 VE_M	22 E_M	32 SE_M	42 SP_M	52 P_M	62 VP_M
Fluvial/Estuarine Processes		***Estuary***	Units classified as the 'estuary' types always include salt marsh vegetation in the upper intertidal, are always associated with a freshwater stream or river and often show a delta form. Estuary units are usually in lower wave exposure categories.	13 VE_E	23 E_E	33 SE_E	43 SP_E	53 P_E	63 VP_E
Current energy		***Current-Dominated channel***	Species assemblages observed in salt-water channels are structured by current energy rather than by wave energy. Current-dominated sites are limited in distribution and are rare habitats.	14 VE_C	24 E_C	34 SE_C	44 SP_C	54 P_C	64 VP_C
Glacial processes		***Glacier***	In a few places in coastal Alaska, saltwater glaciers form the intertidal habitat. These Habitat Classes are rare and include a small percentage of the shoreline length.	15 VE_G	25 E_G	35 SE_G	45 SP_G	55 P_G	65 VP_G
Man-modified		***Anthropogenic – Impermeable***	Impermeable man-made Habitats are intended to specifically note units classified as Coastal Class 33.	16 VE_X	26 E_X	36 SE_X	46 SP_X	56 P_X	66 VP_X
		Anthropogenic – Permeable	Permeable man-made Habitats are intended to specifically note shore units classified as Coastal Class 32.	17 VE_Y	27 E_Y	37 SE_Y	47 SP_Y	57 P_Y	67 VP_Y
Lagoon		***Lagoon***	Units classified as Lagoons in the Secondary Habitat Class contain brackish or salty water that is contained within a basin that has limited drainage. They are often associated with wetlands and may include wetland biobands in the upper intertidal.	18 VE_L	28 E_L	38 SE_L	48 SP_L	58 P_L	68 VP_L

Table A-10. Data dictionary for across-shore component table (XShr)
(after Howes et al. 1994)

Field Name	Type	Description
UnitRecID	N	Automatically-generated number field; the database “primary key” for unit-level relationships
XshrRecID	N	Automatically-generated number field; the database “primary key” for across-shore relationships
PHY_IDENT	T20	Unique physical identifier; an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0)
CROSS_LINK	T20	Unique across-shore identifier; an alphanumeric string comprised of the PHY_IDENT followed by the Zone and Component separated by slashes (e.g. 12/03/0552/0/A/1)
ZONE	T1	Code indicating the across-shore position (tidal elevation) of the component: (A) supratidal, (B) intertidal, (C) subtidal
COMPONENT	Is	Subdivision of zones, numbered from highest to lowest elevation in across-shore profile (e.g. A1 is the highest supratidal component; B1 is the highest intertidal; B2 is lower intertidal)
Form1	T20	Principal geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix1	T1	Veneer indicator field; blank = no veneer; “v” = veneer
Mat1	T20	Material (substrate and/or sediment type) that best characterizes Form1, described by a specific set of codes (Table A-12)
FormMat1Txt	T50	Automatically-generated field that is the translation of codes used in Form1 and Mat1 into text
Form2	T20	Secondary geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix2	T1	Veneer indicator field; blank = no veneer; “v” = veneer
Mat2	T20	Material (substrate and/or sediment type) that best characterizes Form2, described by a specific set of codes (Table A-12)
FormMat2Txt	T50	Automatically-generated field that is the translation of codes used in Form2 and Mat3 into text
Form3	T20	Tertiary geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix3	T1	Veneer indicator field; blank = no veneer; “v” = veneer
Mat3	T20	Material (substrate and/or sediment type) that best characterizes Form3, described by a specific set of codes (Table A-12)
FormMat3Txt	T50	Automatically-generated field that is the translation of codes used in Form3 and Mat3 into text
Form4	T20	Fourth-order geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix4	T1	Veneer indicator field; blank = no veneer; “v” = veneer
Mat4	T20	Material (substrate and/or sediment type) that best characterizes Form4, described by a specific set of codes (Table A-12)
FormMat4Txt	T50	Automatically-generated field that is the translation of codes used in Form4 and Mat4 into text
WIDTH	N	Mean across-shore width of the component (e.g. A1) in meters
SLOPE	N	Estimated across-shore slope of the mapped geomorphic Form in degrees; must be consistent with Form codes (Table A-11)
PROCESS	T4	Dominant coastal process affecting the morphology: (F)luvial, (M)ass wasting (landslides), (W)aves, (C)urrents, (E)olian (wind, as with dunes) (O)ther
COMPONENT_ORI	N	Oil Residence Index on the basis of substrate type; 1 is least persistent, 5 is most persistent (Tables A-5 and A-6)

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

A = Anthropogenic

a	pilings, dolphin
b	breakwater
c	log dump
d	derelict shipwreck
f	float
g	groin
h	shell midden
i	cable/ pipeline
j	jetty
k	dyke
m	marina
n	ferry terminal
o	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 (intertidal or supratidal)
c	washover channel
f	face
i	inclined (no berm)
m	multiple bars / troughs
n	relic ridges, raised
p	plain
r	ridge (single bar; low to mid intertidal)
s	storm ridge (occas marine influence; supratidal)
t	low tide terrace
v	thin veneer over rock (also use as modifier)
w	washover fan

C = Cliff

stability/geomorph	
a	active / eroding
p	passive (vegetated)
c	cave
slope	
i	inclined (20°-35°)
s	steep (>35°)

Cliff cont.

height	
l	low (<5m)
m	moderate (5-10m)
h	high (>10m)
modifiers (optional)	
f	fan, apron, talus
g	surge channel
t	terraced
r	ramp

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
o	ponds
r	ridge/swale
p	parabolic
v	veneer
w	vegetated

F = Reef

(no vegetation)	
f	horizontal (<2°)
i	irregular
r	ramp
s	smooth

I = Ice

g	glacier

L = Lagoon

o	open
c	closed

M = Marsh

c	tidal creek
e	levee
f	drowned forest
h	high
l	mid to low (discontinuous)
o	pond
s	brackish, supratidal

O = Offshore Island

(not reefs)	
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

(slope <20°)	
f	horizontal
g	surge channel
h	high tide platform
i	irregular
l	low tide platform
r	ramp (5-19°)
t	terraced
s	smooth
p	tidepool

R = River Channel

a	perennial
i	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
p	tidepool
s	multiple tidal channels
t	flats

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
o	concrete (solid cement blocks)
r	rubble, rip rap
t	logs (cut trees)
w	wood (structural)

B = Biogenic

c	coarse shell
f	fine shell hash
g	grass on dunes
l	dead trees (fallen, not cut)
o	organic litter
p	peat
t	trees (living)

C = Clastic

(strike-out items out are no longer used but remain for reference)

a	angular blocks (>25cm diameter)
b	boulders (rounded, subrounded,>25cm)
c	cobbles
d	diamicton (poorly-sorted sediment containing a range of particles in a mud matrix)
f	fines/mud (mix of silt/clay, <0.0.63 mm diameter)
g	gravel (unsorted mix pebble, cobble, boulder >2 mm)
k	clay (compact, finer than fines/mud, <4 μm diameter)
p	pebbles
r	rubble (boulders>1 m diameter)
s	sand (0.063 to 2 mm diameter)
$	silt (0.0039 to 0.063 mm)
x	angular fragments (mix of block/rubble)
v	sediment veneer (used as modifier)

R = Bedrock

rock type:

i	igneous
m	metamorphic
s	sedimentary
v	volcanic

rock structure:

1	bedding
2	jointing
3	massive

SEDIMENT TEXTURE

(Simplified from Wentworth grain sizescale)

GRAVELS

boulder	> 25 cm diameter
cobble	6 to 25 cm diameter
pebble	0.5 cm to 6 cm diam

SAND

very fine to very coarse:
0.063 mm to 2 mm diameter

FINES ("MUD")

includes silt and clay

silt	0.0039 to 0.063 mm
clay	<0.0039 mm

TEXTURE CLASS BREAKS

sand / silt	63 μm (0.063 mm)
pebble / granule	0.5 cm (5 mm)
cobble / pebble	6 cm
boulder / cobble	25 cm

SHORE MODIFICATIONS

WB	wooden bulkhead
BR	boat ramp
CB	concrete bulkhead
LF	landfill
SP	sheet pile
RR	riprap

% are 0-10 (default value 0)

Note: The 'material' descriptor consists of one primary term code and associated modifiers (e.g. Cash). If only one modifier is used, indicated material comprises 75% of the volume of the layer (e.g. Cs). If more than one modifier is used, they are ranked in order of relative volume. A surface layer can be described by prefix *v* for veneer (e.g. vCs/R). Grayed items are not used in the Alaska ShoreZone program.

Table A-13. Data dictionary for the BIOBAND table

Field	Type	Description
UnitRecID	N	Automatically-generated number field; the database "primary key" required for relationships between tables
XshrRecID	N	Automatically-generated number field; the database "primary key" required for relationships between tables
PHY_IDENT	T20	Unique physical identifier; an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0)
CROSS_LINK	T20	Unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT fields
Note: all Biobands are coded **P**atchy (<50% cover) or **C**ontinuous (>50% cover) except the **VER** band, which is coded by width: **N**arrow (<1m), **M**edium (1-5m) or **W**ide (>5m). See Section 3.1.		
VER	T1	Bioband for Splash Zone (black lichen **VER***ucaria*) in supratidal
GRA	T1	Bioband code for Dune **GRA**ss in supratidal
SED	T1	Bioband for **SED**ges in supratidal
PUC	T1	Bioband for Salt Marsh grasses, including **PUC***cinellia* and other salt tolerant grasses, herbs and sedges, in supratidal
BAR	T1	Bioband for **BAR**nacle (*Balanus/Semibalanus)* in upper intertidal
FUC	T1	Bioband for Rockweed, the **FUC**us/barnacle in upper intertidal
ULV	T1	Bioband for Green Algae, including mixed filamentous and foliose greens (**ULV***a*, *Cladophora, Acrosiphonia*) in mid-intertidal
BMU	T1	Bioband for **B**lue **MU**ssel (*Mytilus trossulus)* in mid-intertidal
MUS	T1	Bioband for California **MUS**sel/gooseneck barnacle assemblage (*Mytilus californianus/Pollicipes polymerus*) in mid-intertidal
HAL*	T1	Bioband for Bleached Red Algae, including mixed filamentous and foliose reds (*Palmaria, Odonthalia,* **HAL***osaccion*) in mid-intertidal
RED*	T1	Bioband for **RED** Algae, including mixed filamentous and foliose reds (*Odonthalia, Neorhodomela, Palmaria*) in lower intertidal
ALA	T1	Bioband for stand of large or small morph of **ALA***ria spp*.
SBR*	T1	Bioband for **S**oft **B**rown **K**elps, including unstalked large-bladed laminarins, in lower intertidal and nearshore subtidal
CHB*	T1	Bioband for Dark Brown Kelps, including stalked bladed dark **CH**ocolate-**B**rown kelps in lower intertidal and nearshore subtidal
SUR	T1	Bioband for **SUR**fgrass (*Phyllospadix*) in lower intertidal and nearshore subtidal
ZOS	T1	Bioband for **ZOS***tera* (Eelgrass) in lower intertidal and subtidal
URC	T1	Bioband for **URC**hin Barrens (*Strongylocentrotus fransicanus*) in nearshore subtidal
ALF	T1	Bioband for Dragon Kelp (**AL***aria* **F***istulosa*) in nearshore subtidal
MAC	T1	Bioband for Giant Kelp (**MAC***rocystis integrifolia*) in nearshore subtidal
NER	T1	Bioband for Bull Kelp (**NER***eocystis luetkeana*) in nearshore subtidal

***Further Description of BIOBAND by BIOAREA (see also Table A-7 and footnotes)**

Different species assemblages in four lower intertidal biobands are observed, and are used to help define geographic regions in ShoreZone as separate bioareas. In addition to the BIOAREA code assigned to each unit in the BIOUNIT table, the lower intertidal biobands: Bleached Red Algae, Red Algae, Soft Brown Kelps, and Dark Brown Kelps (**HAL**, **RED**, **SBR** and **CHB** bands) are labeled with a suffix number to specifically match the bioband code to a particular bioarea. More bioareas are being defined as new coastal areas are being mapped. Details of the species composition in these diagnostic lower intertidal bands are being added as ground station surveys are completed in mapped areas.

Table A-14. Data dictionary for the BIOSLIDE table ("tblBioSlide")

Field Name	Type	Description
SlideID	N	A unique numeric ID assigned to each slide or photo
UnitRecID	N	Automatically-generated number field; the database "primary key" required for relationships between tables
SlideName	T50	A unique alphanumeric name assigned to each slide or photo
ImageName	T75	Full image name with .jpg extension (required to enable "PhotoLink")
TapeTime	D/T	Exact time during aerial video imaging (AVI) survey when digital image was collected; used to link photo to digital trackline and position
SlideDescription	T255	Text field for biological comments regarding the digital photo or slide
Good Example?	Y/N	When set to "Y," photo is representative of a particular biological feature or classification type
ImageType	T10	Media type of original image: "Digital" or "Slide"
FolderName	T50	Name of the folder in which digital images are stored (required to enable "PhotoLink")
PhotoLink	Hyper-link	Enables linkage to photos placed in directories near the database
PHY Good Example?	Y/N	When set to "Y," photo is geomorphological representative of a particular feature or classification type
PHY SlideComment	T255	Text field for geomorphological comments regarding the digital photo or slide

Table A-15. Data dictionary for the GroundStationNumber table

Field Name	Type	Description
StationID	N	A unique numeric ID given to each ground station
UnitRecID	N	Automatically-generated number field; the database "primary key" required for relationships between tables
Station	T50	Unique alphanumeric name assigned to each ground station
StationDescription	T255	Text field for comments regarding the ground station
Location	T50	General location of each ground station