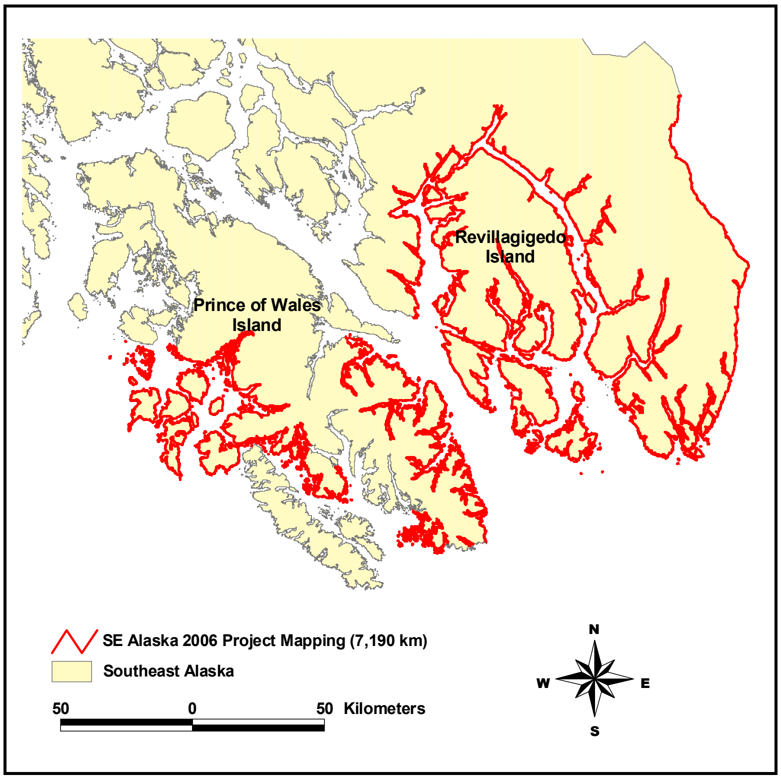
CORI Project: 2006-20 August 2008

ShoreZone Coastal Habitat Mapping Data Summary Report

2006 Survey Area, Southeast Alaska:
Revillagigedo Island, Misty Fjords National Monument, and southern Prince of Wales Island



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SUMMARY

ShoreZone is a coastal habitat mapping and classification system in which georeferenced aerial imagery is collected specifically for the interpretation and integration of geological and biological features of the intertidal zone and nearshore environment.

This interim data summary report provides information on **geomorphic and biological features** of 7,274 km of shoreline mapped in the 2006 survey area in Southeast Alaska (Revillagigedo Island, Misty Fjords National Monument, and portions of southern Prince of Wales Island). The habitat inventory is comprised of 22,672 along-shore segments (units), averaging 321 m in length.

Because much of the region included in this summary report occurs in sheltered inlets and fjords, most of the shoreline (85%) is classified as semi-protected and lower wave exposures. Organic shorelines (such as estuaries) are mapped along 789 km (10.8%) of the study area. Bedrock shorelines (BC Classes 1-5) comprise 1,229.2 km (16.9%) of mapped shorelines. More than half of the mapped coastal environment is characterized as mixed rock and sediment shorelines (BC Classes 6-20: 3,721.4 km or 51.2%). Sediment-dominated shorelines (BC Classes 21-30) comprise 1,475.2 km of the study area (20.3%). Of these, wide sand and gravel flats (BC Class 24) are the most common, mapped along 776.5 km of shoreline (10.7% of the total study area).

The distribution of beaches and tidal flats on the basis of ESI class reveals that mixed sand and gravel beaches constitute 2,372.2 km of shoreline in the study area (32.6). Gravel beaches composed mainly of cobbles and boulders are mapped along 870.3 km (12%) of shoreline. Tidal flats comprised of organic material, fine sediment, sand, and some gravel (cobble and boulder veneer) constitute 646.2 km (9%) of shoreline, generally confined to relatively protected areas at the heads of inlets.

Shorelines classified as man-modified (having more than 50% of the unit altered by human activities) occur along 36 km (0.5%) of shoreline in the study area. The most common type of shore modification observed is riprap (333 units), followed by wooden bulkheads (169 units) and landfill (160 units). Most anthropogenic features occur in the communities of Ketchikan, Klawock, and Craig.

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).

1 INTRODUCTION

1.1 Overview of the ShoreZone Coastal Habitat Mapping Program

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).

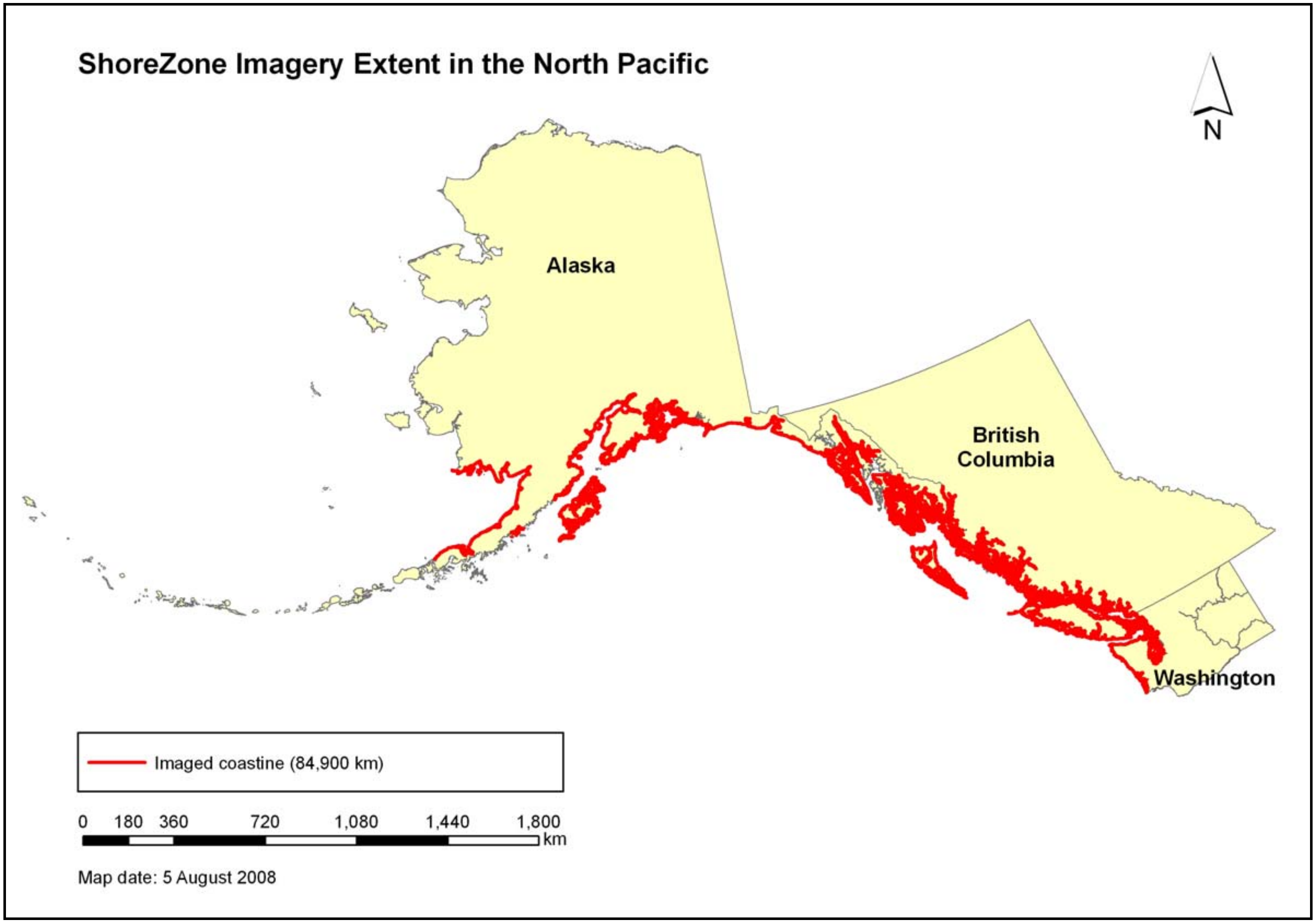


Figure 1.1. Extent of ShoreZone imagery in Alaska, British Columbia, and Washington State: 84,900 km as of August 2008).

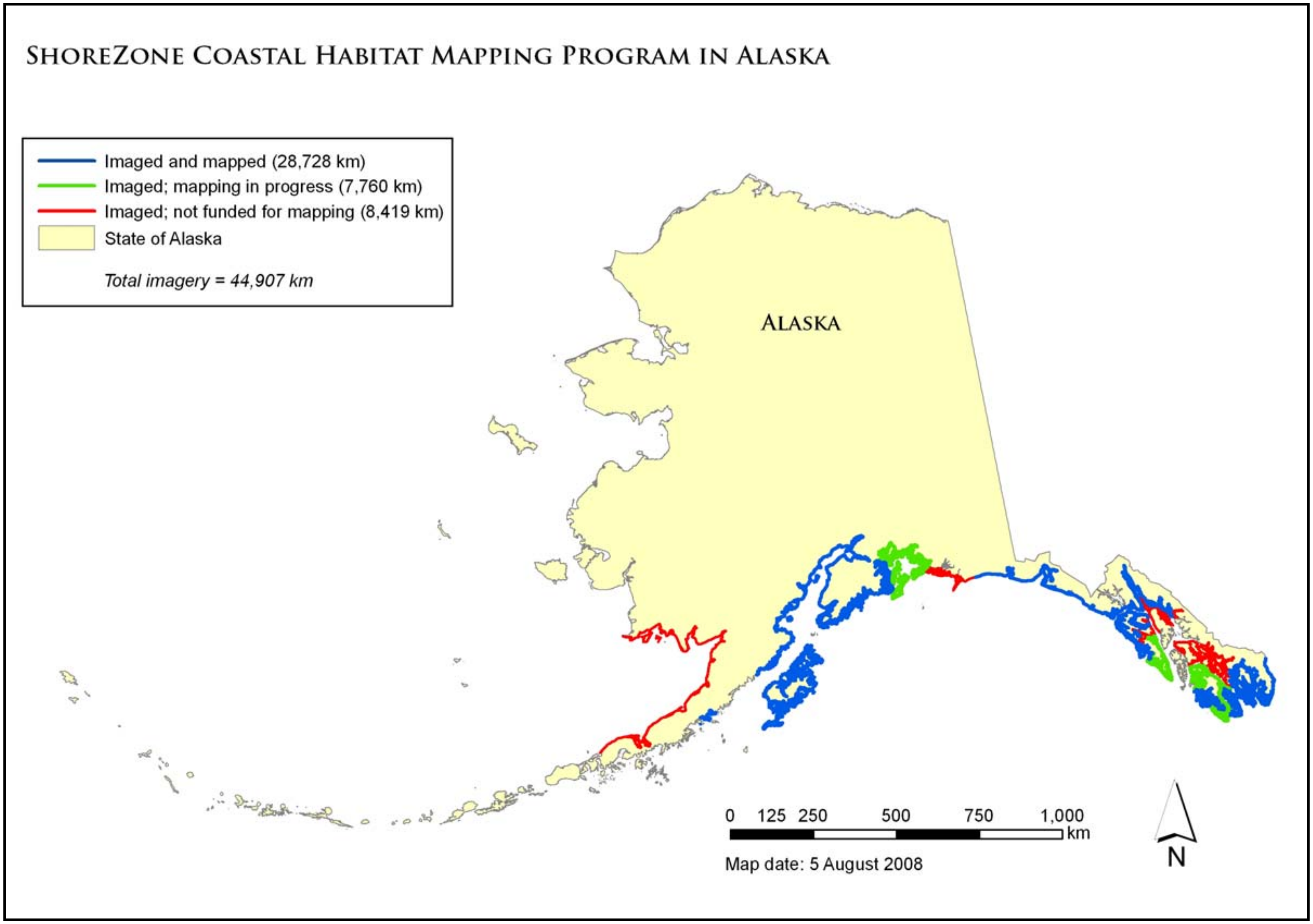


Figure 1.2. Extent of ShoreZone imagery (44,907 km) and coastal habitat mapping in the State of Alaska (as of August 2008).

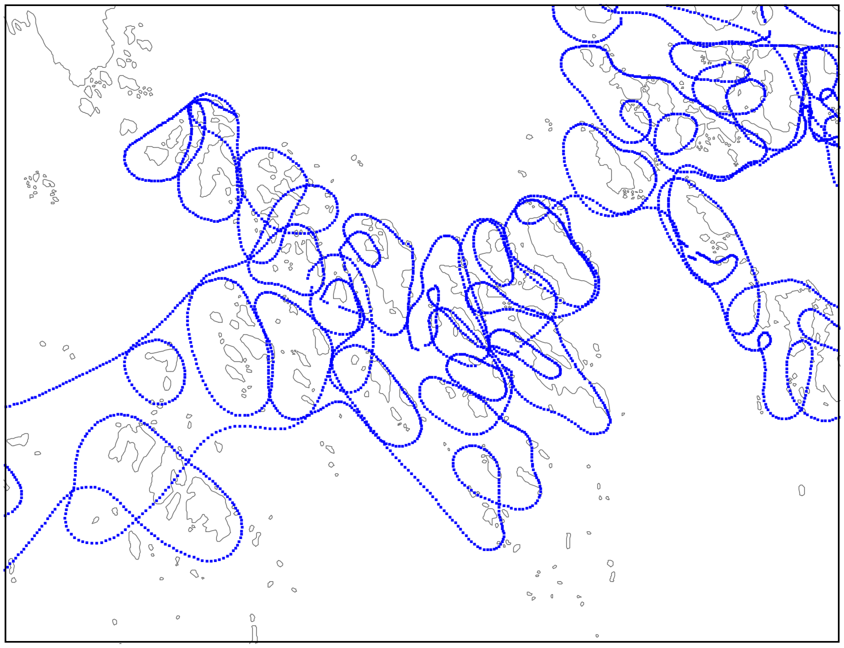


Figure 1.3. Example of recorded flight trackline, with blue dots showing 1-second GPS navigation fixes (Myriad Islands, western Chichagof Island, SE Alaska).

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 flight survey trackline by 6-digit UTC time code, providing a GPS position for each image.

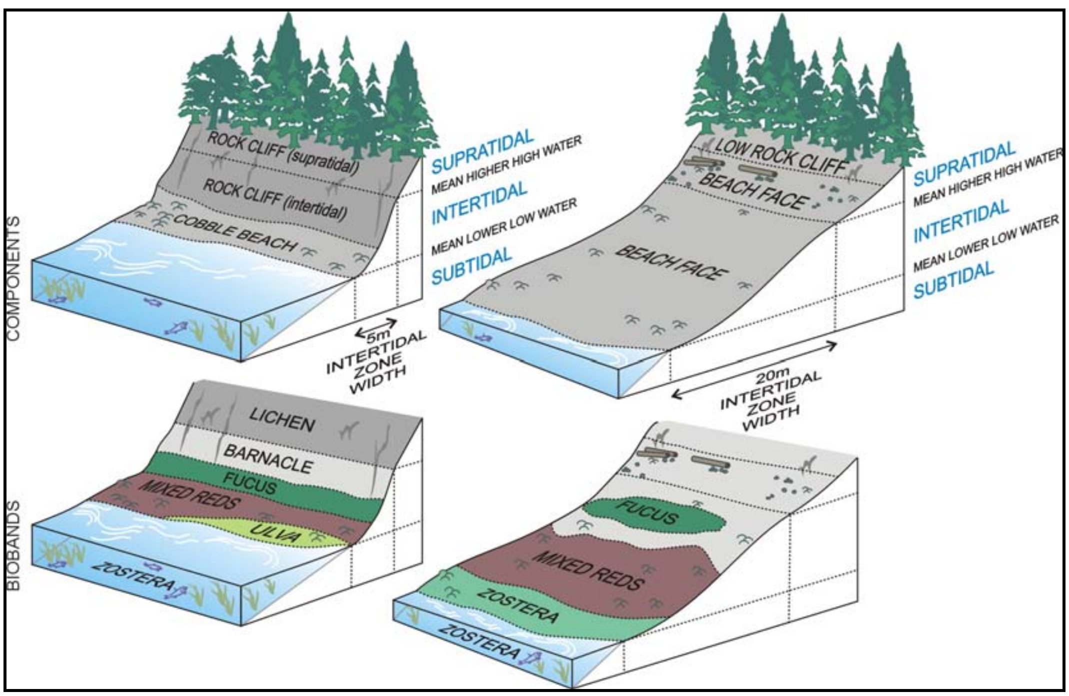


Figure 1.6. Schematic to illustrate how digital shorelines are segmented into alongshore units and across-shore components in the ShoreZone mapping system.

1.2 ShoreZone Mapping of Southeast Alaska 2006 Imagery: Revillagigedo Island, Misty Fjords National Monument, and portions of southern Prince of Wales Island

Field surveys in Southeast Alaska in 2006 collected aerial video and digital still photographs of the coastal and nearshore zone during zero-meter tide levels and lower. The imagery and associated audio commentary are used to map the geomorphic and biological features of the shoreline according to the ShoreZone Coastal Habitat Mapping Protocol (Harney et al. 2008).

The purpose of this report is to provide a summary of the physical (geomorphic) and biological data mapped in the study area (Revillagigedo Island, Misty Fjords National Monument, and portions of Prince of Wales Island, Southeast Alaska; Figure 1.7). The database associated with this interim summary report also includes 84 km of mapping between Icy Cape and the Tsiu River, which will link the Southeast Alaska and Prince William Sound data sets (Figure 1.8). Thematic for this northern area are not included in this report.

The along-shore length of shoreline mapped in the SE06 database (including the Icy Cape section) is **7,274 kilometers**, in 22,672 along-shore segments (units), averaging 321 m in length. Physical and biological data are summarized with illustrations in Sections 2 and 3, respectively.

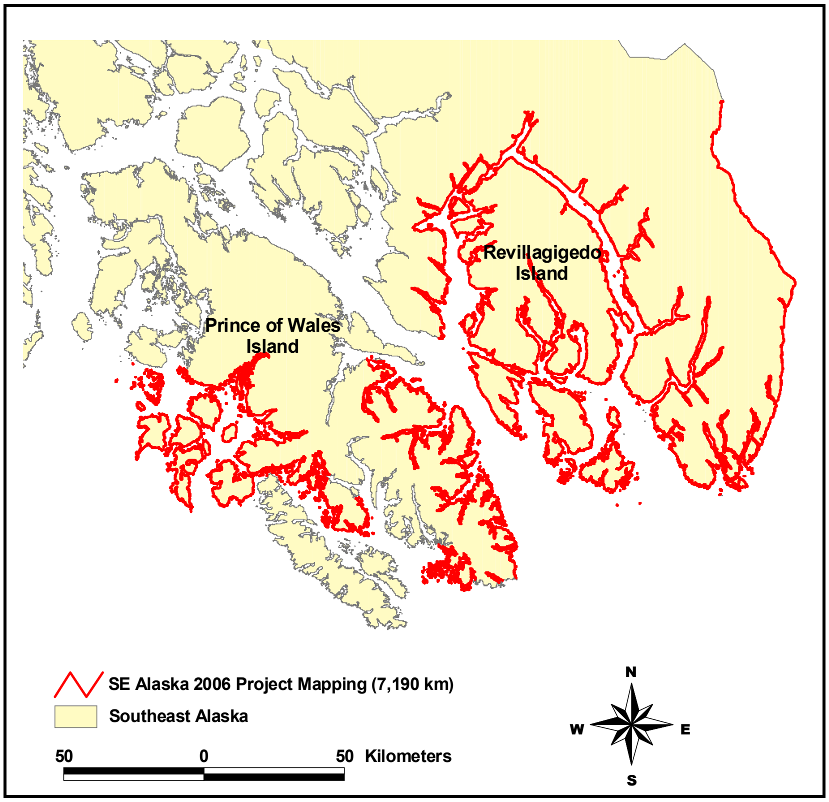


Figure 1.7. Map of the study area imaged in Southeast Alaska in 2006, for which physical (geomorphic) and biological ShoreZone data are summarized in this report (7,190 km).

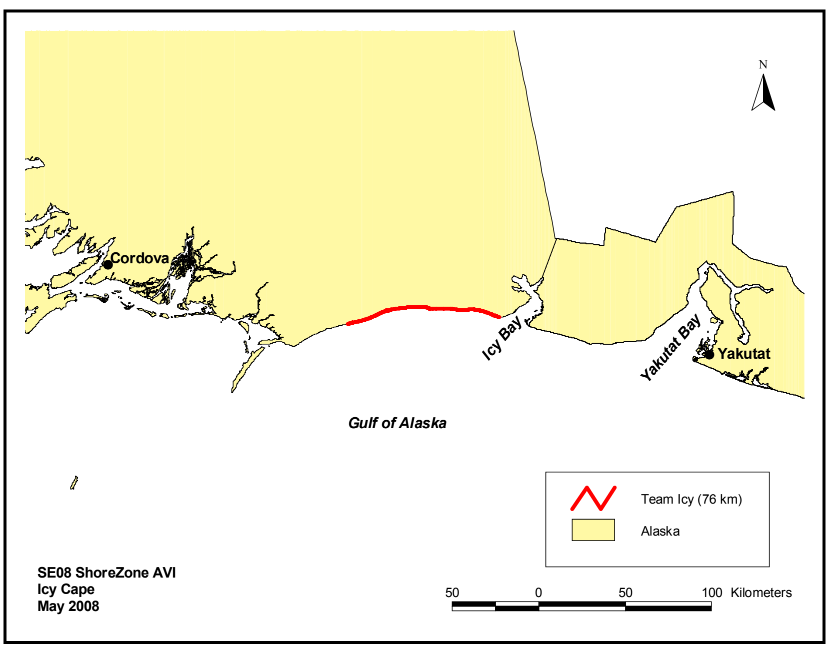


Figure 1.8. Map showing the location of the mapped shorelines between Icy Bay and the Tsiu River, for which data are included in the SE06 database and GIS (84 km).

2 PHYSICAL SHOREZONE DATA SUMMARY

2.1 Shore Types

The principal characteristics of each along-shore segment are used to assign an overall unit classification or “shore type” that represents the unit as a whole. ShoreZone mapping employs two along-shore **unit classification** systems: coastal shore types defined for British Columbia (“BC Class”) and the “Environmental Sensitivity Index” (ESI) class developed for oil-spill mitigation. A third shoreline classification system unique to ShoreZone (“Habitat Class”) is defined in Section 3.3.

The BC Class system is used to describe along-shore coastal units as one of 34 shore types defined on the basis of the principal geomorphic features, substrates, sediment textures, across-shore width, and slope of that section of coastline (after Howes et al. 1994; Table A-2). Coastal classes also characterize units dominated by organic shorelines such as marshes and estuaries (BC Class 31), man-made features (BC Classes 32 and 33), high-current channels (BC Class 34), and glaciers (BC Class 35).

The occurrence of BC shore types in the study area is listed in Table 2.1. Grouped BC Classes are useful to illustrate mapped distributions (Figure 2.1) and to summarize data in graphic form (Figure 2.2). **Bedrock shorelines** (BC Classes 1-5) comprise 1,229.2 km (16.9%) of mapped shorelines. More than half of the mapped coastal environment is characterized as **mixed rock and sediment shorelines** (BC Classes 6-20: 3,721.4 km or 51.2%). These shore types are further distinguished on the basis of geomorphology and sediment texture, shown in Figures 2.3 and 2.4).

Sediment-dominated shorelines (BC Classes 21-30) comprise 1,475.2 km of the study area (20.3%). Of these, wide sand and gravel flats (BC Class 24) are the most common, mapped along 776.5 km of shoreline (10.7% of the total study area). Photographic examples of BC Class shore types in this area of Southeast Alaska are provided in Section 2.3.

The **NOAA Environmental Sensitivity Index (ESI Class)** is a shoreline classification system developed to categorize coastal regions on the basis of their oil-spill sensitivity. The ESI system uses wave exposure and principal substrate type to assign alongshore coastal units a ranking of 1-10 to indicate the relative degree of sensitivity to oil spills (1=least sensitive, 10=most sensitive) as well as a general shore type (Peterson et al. 2002; Table A-3). The ESI system is an integral component of oil-spill contingency planning, emergency response, and coastal resource management. Substrate permeability is of principal importance in estimating the residence time of oil on the shoreline, thus sediment texture is a key element in determining the ESI class. The occurrence of ESI shore types in the study area is listed in Table 2.2. The distribution of beaches and tidal flats (on the basis of mapped ESI class referring to sediment texture) is shown in Figure 2.5.

Table 2.1. Summary of shore types by BC Class for the 7,274 km of mapped shoreline in the study area (Revillagigedo Island, Misty Fjords National Monument, and portions of southern Prince of Wales Island, Southeast Alaska). Data are shown in map form in Figure 2.1 and in pie chart form in Figure 2.2.

Substrate Type	Shore Type (BC Class)	Shore Type (BC Class)	Sum of Unit Length (km)	# of Units	% Occurrence (by length)	Cumulative Occurrence (%, km)
Rock	1	Rock Ramp, wide	75.9	142	1.0%	**16.9%**
	2	Rock Platform, wide	15.9	41	0.2%	**1,229.2 km**
	3	Rock Cliff	939.2	2352	12.9%	
	4	Rock Ramp, narrow	194.9	590	2.7%	
	5	Rock Platform, narrow	3.3	14	0.0%	
Rock &	6	Ramp with gravel beach, wide	299.3	819	4.1%	**51.2%**
Sediment	7	Platform with gravel beach, wide	104.9	272	1.4%	**3,721.4 km**
	8	Cliff with gravel beach	623.7	1843	8.6%	
	9	Ramp with gravel beach	872.6	2688	12.0%	
	10	Platform with gravel beach	14.1	52	0.2%	
	11	Ramp w gravel & sand beach, wide	540.9	1714	7.4%	
	12	Platform with G&S beach, wide	470.1	1385	6.5%	
	13	Cliff with gravel/sand beach	118.9	409	1.6%	
	14	Ramp with gravel/sand beach	633.7	2153	8.7%	
	15	Platform with gravel/sand beach	35.0	115	0.5%	
	16	Ramp with sand beach, wide	2.2	9	0.0%	
	17	Platform with sand beach, wide	2.2	7	0.0%	
	18	Cliff with sand beach	0.6	2	0.0%	
	19	Ramp with sand beach, narrow	3.2	10	0.0%	
	20	Platform with sand beach, narrow	0.0	0	0.0%	
Sediment	21	Gravel flat, wide	50.7	258	0.7%	**20.3%**
	22	Gravel beach, narrow	111.0	495	1.5%	**1,475.2 km**
	23	Gravel flat or fan	3.1	16	0.0%	
	24	Sand & gravel flat or fan	776.5	3468	10.7%	
	25	Sand & gravel beach, narrow	314.5	1170	4.3%	
	26	Sand & gravel flat or fan	23.3	106	0.3%	
	27	Sand beach	75.0	47	1.0%	
	28	Sand flat	70.2	139	1.0%	
	29	Mudflat	50.6	99	0.7%	
	30	Sand beach	0.3	2	0.0%	
Organics/Marsh	31	Estuaries, marshes	789.2	2039	10.8%	**10.8%** **789.2 km**
Man-made	32	Man-made, permeable	34.1	124	0.5%	**0.5% (36 km)**
	33	Man-made, impermeable	1.7	6	0.0%	
Channel	34	Channel	23.5	86	0.3%	**0.3% (23 km)**
Glacier/Ice	35	Glacier	0	0		**0%**

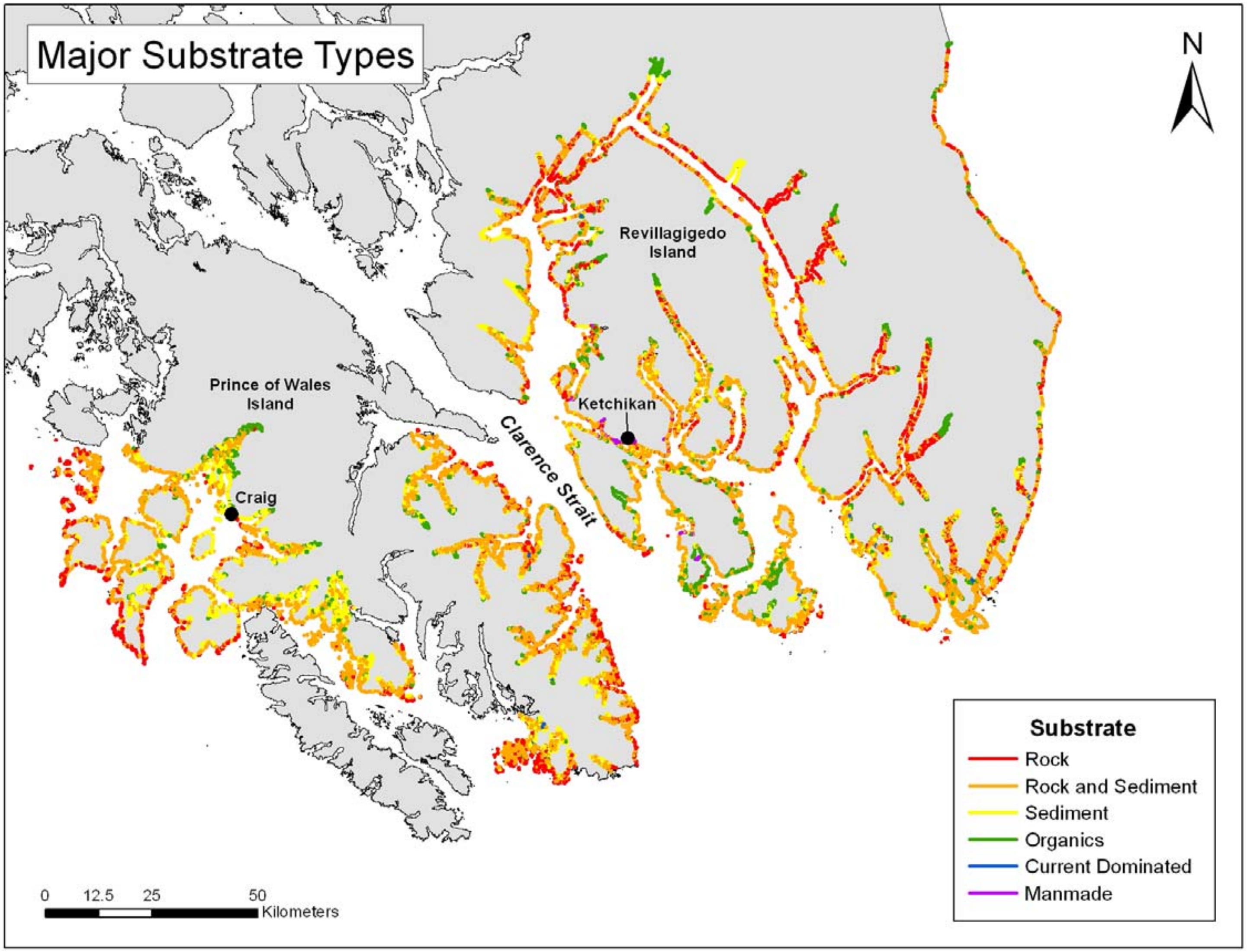


Figure 2.1. Map of the distribution of principal substrate types (on the basis of grouped BC Classes) in the study area. Data are listed by individual class and summarized by grouped classes in Table 2.1.

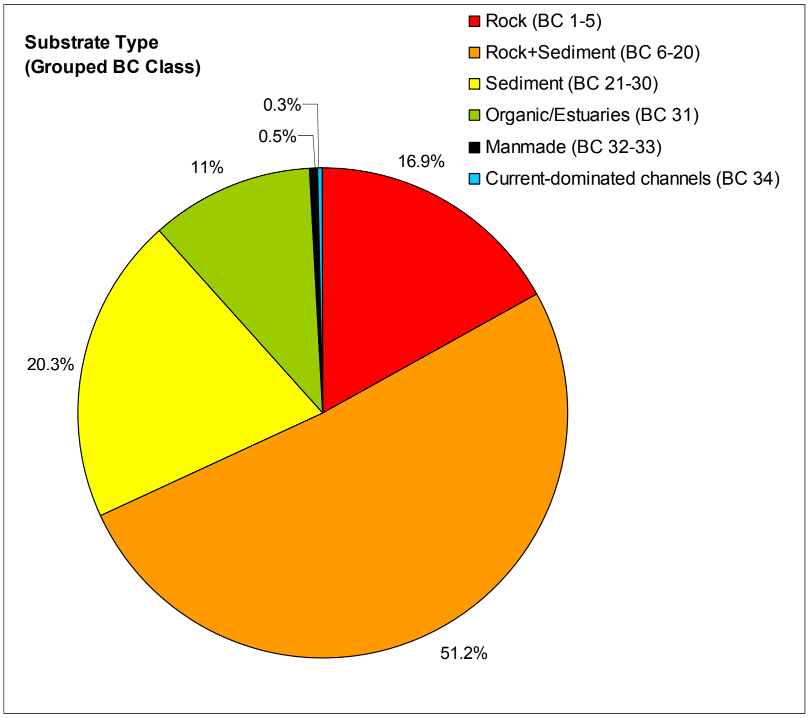


Figure 2.2. Relative abundance of principal substrate types (on the basis of grouped BC Classes) in the study area. Data are summarized in Table 2.1. See Section 2.3 for shore type example photographs.

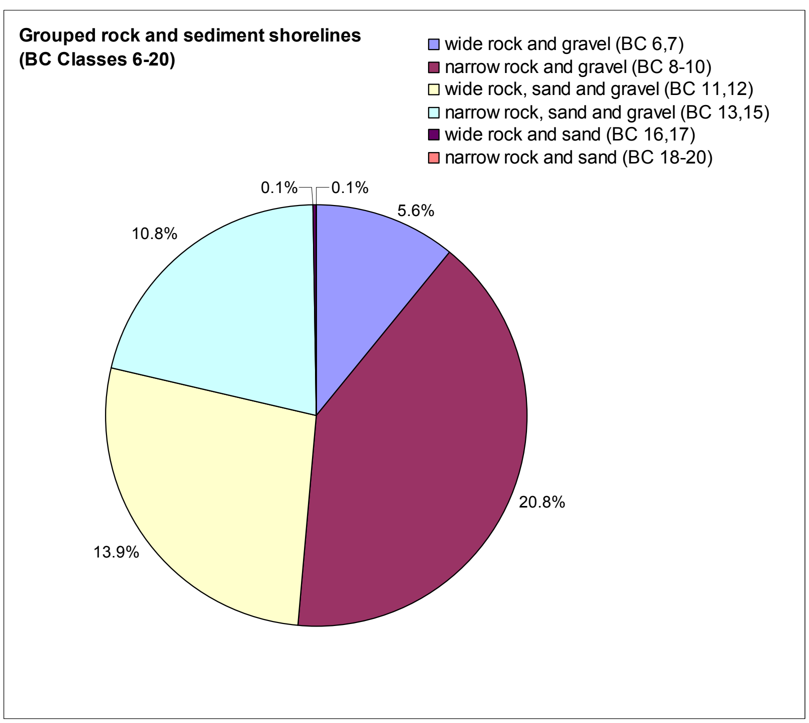


Figure 2.3. Relative abundance of mixed rock and sediment shorelines (BC classes 6-20) in the study area.

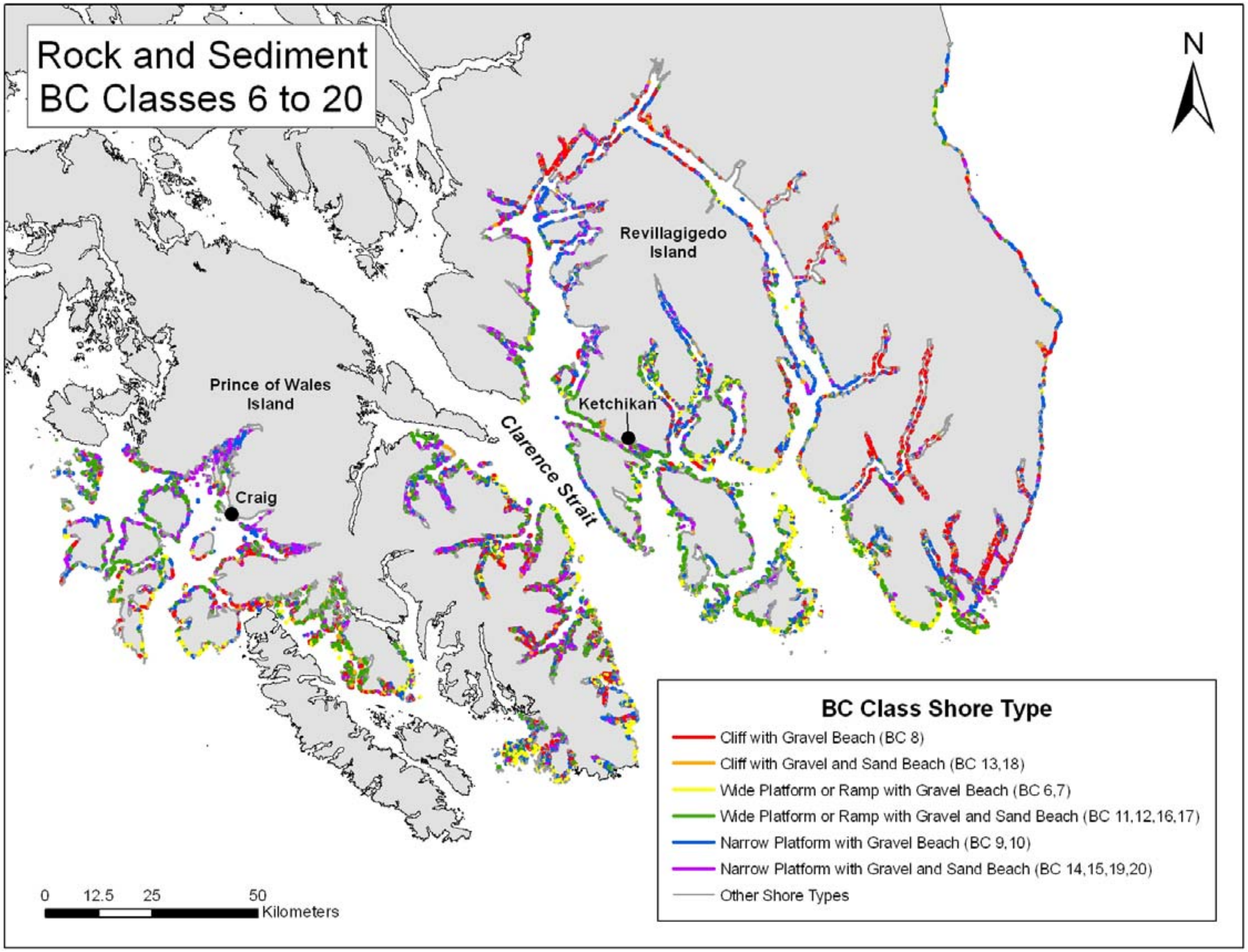


Figure 2.4. Map of the distribution of mixed rock and sediment shorelines (BC Classes 6-20, grouped by geomorphology) in the study area. Data are summarized in Table 2.1.

Table 2.2. Summary of shore types by ESI Class for the 7,274 km of mapped shoreline in the study area (Revillagigedo Island, Misty Fjords National Monument, and portions of southern Prince of Wales Island, Southeast Alaska).

ESI Class	Description	Sum of Unit Length (km)	# of Units	% Occurrence (by length)
1A	Exposed rocky shores and banks	290.0	599	4.0%
1B	Exposed, solid, man-made structures	0	0	0.0%
1C	Exposed rocky cliffs with boulder talus base	83.4	165	1.1%
2A	Exposed wave-cut platforms in bedrock, mud, or clay	147.0	334	2.0%
2B	Exposed scarps and steep slopes in clay	0	0	0.0%
3A	Fine- to medium-grained sand beaches	57.8	43	0.8%
3B	Scarps and steep slopes in sand	0	0	0.0%
3C	Tundra cliffs	0	0	0.0%
4	Coarse-grained sand beaches	49.9	53	0.7%
5	Mixed sand and gravel beaches	2322.3	8187	31.9%
6A	Gravel beaches (granules and pebbles)	123.1	457	1.7%
6B	Gravel beaches (cobbles and boulders)	747.3	2590	10.3%
6C	Rip rap (man-made)	0.7	4	0.0%
7	Exposed tidal flats	22.6	55	0.3%
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	662.4	2009	9.1%
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	318.2	809	4.4%
8C	Sheltered riprap (man-made)	19.9	59	0.3%
8D	Sheltered rocky rubble shores	1035.4	2952	14.2%
8E	Peat shorelines	0	0	0.0%
9A	Sheltered tidal flats	646.2	2496	8.9%
9B	Vegetated low banks	11.1	52	0.2%
9C	Hypersaline tidal flats	0	0	0.0%
10A	Salt- and brackish-water marshes	695.4	1790	9.6%
10B	Freshwater marshes	41.7	18	0.6%
10C	Swamps	0	0	0.0%
10D	Scrub-shrub wetlands; mangroves	0	0	0.0%
10E	Inundated low-lying tundra	0	0	0.0%

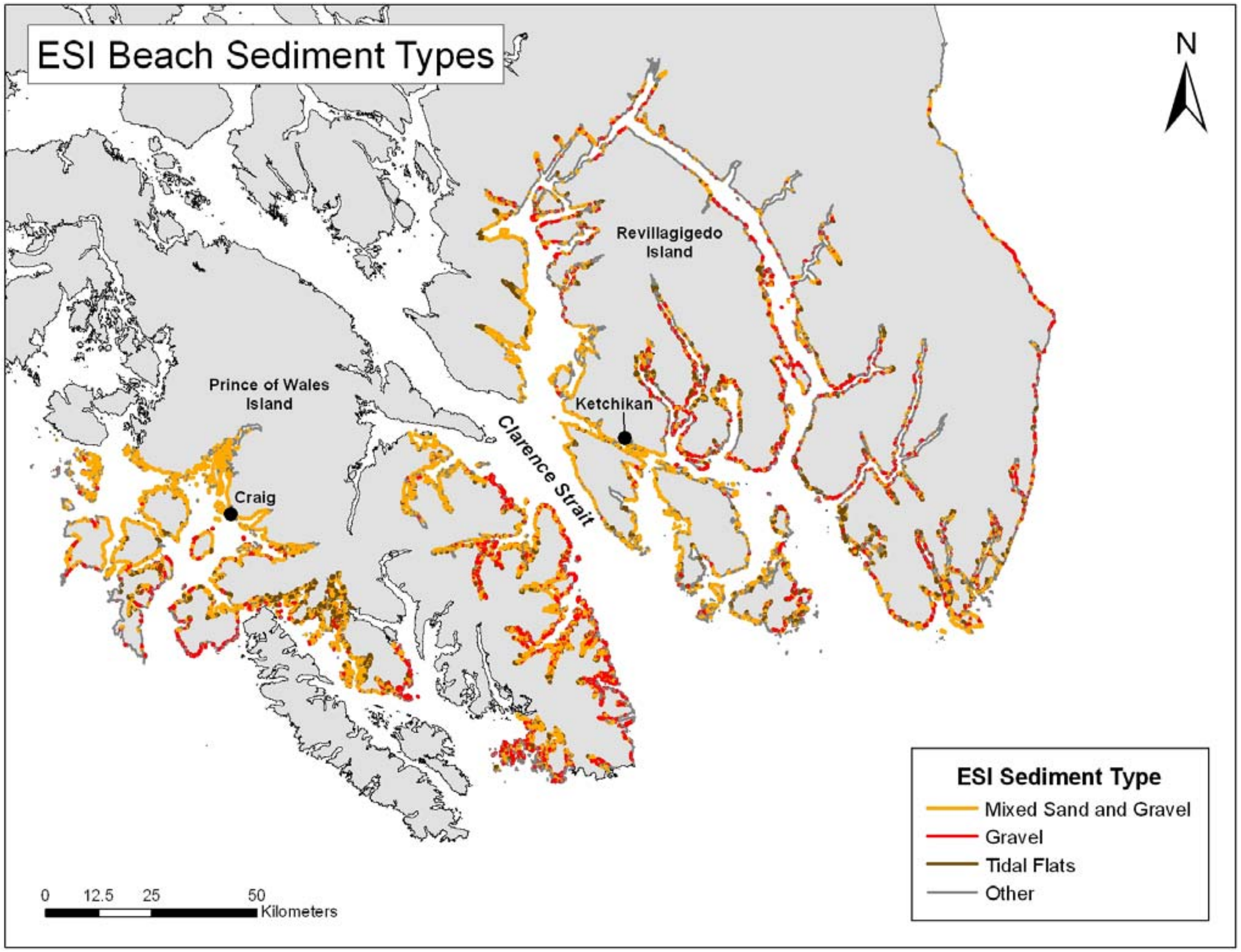


Figure 2.5. Distribution of beaches and tidal flats on the basis of ESI class. Mixed sand and gravel beaches refer to ESI classes 4 and 5 (2,372.2 km of shoreline, or 32.6% of the study area). Gravel beaches refer to ESI classes 6A and 6B (870.3 km, or 12%) and are composed mainly of cobbles and boulders. Tidal flats (ESI class 9A, 646.2 km, or 9%) are >30 m wide and may contain organic material, fine sediment, sand, and some gravel (cobble and boulder veneer); they are generally confined to relatively protected areas at the heads of inlets.

2.2 Anthropogenic Shore Modifications

Shore-protection features and coastal access constructions such as seawalls, rip rap, docks, dikes, and wharves are enumerated in ShoreZone mapping data. Overall, shorelines classified as man-modified (having more than 50% of the unit altered by human activities, assigned BC Classes 32 and 33) occur along 36 km (0.5%) of shoreline in the study area, mostly in the communities of Ketchikan, Klawock, and Craig. The types of shore modification features (such as boat ramps, bulkheads, and rip rap) and their relative proportions of the intertidal zone are mapped into the database in the "SHORE_MOD" fields of the UNIT table (see Table A-1 for a description of these fields). The distribution of shore modifications mapped in the study area (Table 2.3) is shown in Figure 2.6.

Table 2.3. Summary of shore modifications mapped in the 7,274 km of mapped shoreline in the study area. Map is shown in Figure 2.6.

Shore Modification	Code	# of occurrences
wooden bulkhead	WB	169
boat ramp	BR	119
concrete bulkhead	CB	31
landfill	LF	160
sheet pile	SP	9
riprap	RR	333

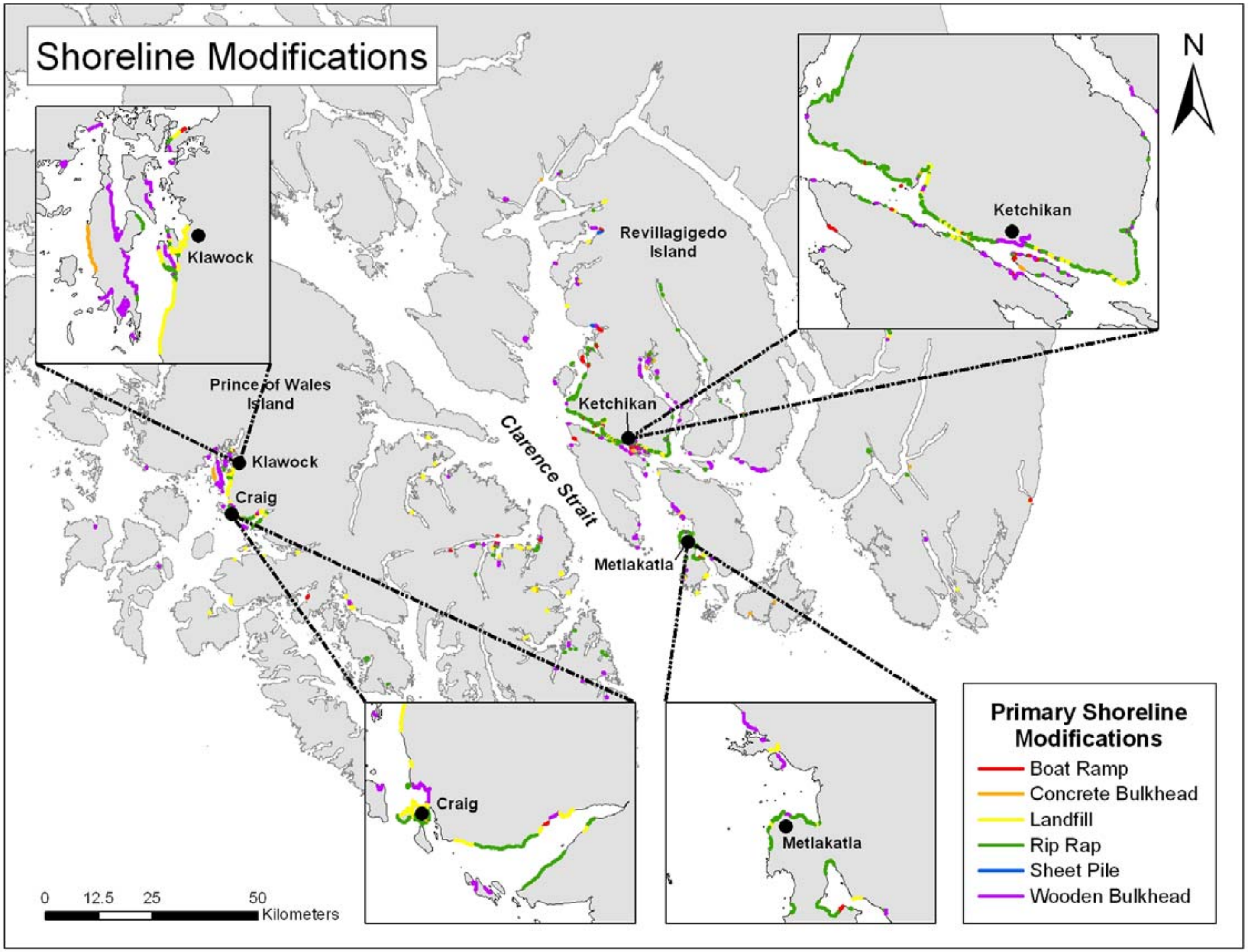


Figure 2.6. Map of the distribution of units in which shore modification features were observed in the study area. Data are summarized in Table 2.3.

2.3 Physical Illustrations: Shore Types and Geomorphic Features

The following pages provide illustrated examples of shore types and geomorphic features mapped in the study area (Ketchikan and portions of Revillagigedo Island).

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: Human-Altered Shorelines (BC Classes 32-33)
Shore Type: Current-Dominated Channels (BC Class 34)
Geomorphic Features: Marshes and Wetlands
Geomorphic Features: Deltas, Mudflats, and Tidal Flats
Geomorphic Features: Beach Berms and Ridges
Geomorphic Features: Lagoons
Anthropogenic Features: Coastal Structures and Seawalls

Shore Type: Rock (BC Classes 1-5)

	
BC Class 2 (wide rock platform)	BC Class 3 (steep rock cliff)
Cape Chacon (12/05/9206)	Outer Point, Baker Island (Unit 12/07/3181)
SE06_ML_04784.JPG	SE06_MM_04981.JPG

Shore Type: Rock (BC Classes 1-5)

	
BC Class 4 (narrow rock ramp)	BC Class 5 (narrow rock platform)
Kasaan Bay, southeast Prince of Wales Island (Unit 12/08/5058)	Behm Canal (Unit 12/01/8133)
SE06_MM_16261.JPG	SE06_MM_04299.JPG

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

	
BC Class 6 (wide ramp with gravel beach)	BC Class 11 (wide ramp with gravel and sand beach)
Cape Northumberland, southern Duke Island (Unit 12/04/5220)	San Juan Bautista Island, west of Craig, Prince of Wales Isl. (Unit 12/07/3043)
SE06_MM_09433.JPG	SE06_MM_23329.JPG

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

	
BC Class 14 (narrow ramp with gravel and sand beach)	BC Class 16 (wide ramp with sand beach)
Gravina Island (12/04/0384)	Cape Fox, eastern Revillagigedo Channel (Unit 12/03/0085)
SE06_MM_00560.JPG	SE06_ML_07617.JPG

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

	
BC Class 17 (wide platform with sand beach)	BC Class 19 (narrow ramp with sand beach)
Annette Island (12/04/1484)	Neets Bay, northwest Revillagigedo Island (Unit 12/01/9044)
SE06_MM_07678.JPG	SE06_MM_03720.JPG

Shore Type: Sediment (BC Classes 21-30)

	
BC Class 22 (narrow gravel beach)	BC Class 24 (wide sand and gravel flat or fan)
Hidden Inlet, southern Misty Fjords (Unit 12/03/2872)	Port St. Nicholas, western Prince of Wales Island (Unit 12/07/1010)
SE06_ML_11330.JPG	SE06_MM_20986.JPG

Shore Type: Sediment (BC Classes 21-30)

	
BC Class 25 (narrow sand and gravel beach)	BC Class 29 (wide mudflat)
Willard Inlet, southern Misty Fjords (Unit 12/03/2095)	Shinaku Inlet, west Prince of Wales Island (Unit 12/07/0733)
SE06_ML_09249.JPG	SE06_MM_19883.JPG

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

	
BC Class 31 (organic shorelines, marshes, and estuaries)	BC Class 31 (organic shorelines, marshes, and estuaries)
Dunbar Inlet, Sukkwan Island, west of Craig (Unit 12/06/4477)	Shinaku Creek Estuary, western Prince of Wales Island (Unit 12/07/0744)
SE06_MM_28633.JPG	SE06_MM_19937.JPG

Shore Type: Human-Altered Shorelines (BC Classes 32-33)

	
BC Class 32 (man-made, permeable)	BC Class 32 (man-made, permeable)
Klawock Inlet near Craig, west Prince of Wales Island (Unit 12/07/0950)	Ward Cove, Revillagigedo Island (Unit 12/01/0058)
SE06_MM_20686.JPG	SE06_MM_00052.JPG

Shore Type: Current-Dominated Channels (BC Class 34)

	
BC Class 34 (current-dominated channel)	BC Class 34 (current-dominated channel)
Tah Bay (Unit 12/05/1050)	Big Salt Lake, near Klawock, western Prince of Wales Island (12/07/0758)
SE06_ML_02666.JPG	SE06_MM_19974.JPG

Geomorphic Features: Marshes and Wetlands

	
Forms mapped in this unit: high marsh (Mh), closed lagoon (Lc), beach berm (Bb), multiple river channels (Rm), tidal flat (Tt), tidal bar (Tb), and tide pools (Tp). BC Class 31.	Forms mapped in this unit: Forms Msh (supratidal, high, brackish marsh) and Mloc (low, discontinuous marsh with ponds and tidal creeks). BC Class 31.
Shinaku Creek Estuary, western Prince of Wales Island (Unit 12/07/0744)	Near Minx Island, Thorne Arm, Revillagigedo Island (Unit 12/01/2049)
SE06_MM_19933.JPG	SE06_MM_06819.JPG

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

	
BC Class 24, Form Tt (tidal flat)	BC Class 31, Form Tt (tidal flat), Tp (tide pools), and Mh (high supratidal marsh)
Duke Island (Unit 12/04/6152)	Shinaku Inlet, Prince of Wales Island (Unit 12/07/0736)
SE06_MM_15499.JPG	SE06_MM_19890.JPG

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

	
BC Class 31, Form Dfm (delta fan with multiple channels)	BC Class 24, Form Df (delta fan)
Margarite Bay (Unit 12/01/8102)	Traitors Cove (Unit 12/01/8045)
SE06_MM_04217.JPG	SE06_MM_04111.JPG

Geomorphic Features: Beach Berms and Ridges

	
BC Class 24, Form Bb (beach berm)	BC Class 25, Form Bf (beach face)
Tatoosh Islands (Unit 12/01/8412)	Gnat Cove (Unit 12/01/1797)
SE06_MM_05217.JPG	SE06_MM_06356.JPG

Geomorphic Features: Lagoons

	
BC Class 31, Form Lo (open lagoon)	BC Class 12, Form Lo (open lagoon)
Revillagigedo Island (Unit 12/01/2117)	Pennock Island (Unit 12/01/0228)
SE06_MM_06881.JPG	SE06_MM_00350.JPG

Anthropogenic Features: Coastal Structures and Shore Modifications

	
BC Class 32, Form Aw (wharf)	BC Class 32, Forms Aw (wharf), As (seawall), and Af (floats)
Ward Cove (Unit 12/01/0068)	Revillagigedo Island (Unit 12/01/0140)
SE06_MM_00065.JPG	SE06_MM_00191.JPG

3 BIOLOGICAL SHOREZONE DATA SUMMARY

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 classification of **biological wave exposure** and **habitat class** to each unit.

3.1 Biobands

A **bioband** is an observed assemblage of coastal biota, which grows in a typical across-shore elevation, and at characteristic wave energies and substrate conditions. Bands are spatially distinct, with alongshore and cross-shore patterns of color and texture that are visible in aerial imagery (Figure 3.1). 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 3.1). 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, so are considered weak indicators of exposure. An example is the ubiquitous Barnacle band (BAR), which is found across all exposure categories. 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 3.1. 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 completed throughout Alaska, differences in the species assemblages that characterize the coastal habitats have 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 as indicators of wave exposure categories used in the ShoreZone classification.

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 3.2 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 3.1. Summary of bioband definitions for 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
Sub-tidal	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 included in this summary report. Previously, MUS and URC were mapped in British Columbia, but have not been observed elsewhere in Alaska.

Bioareas are delineated on the basis of observed differences in the distribution of lower intertidal biota, nearshore canopy kelps, and coastal habitat classification (Table 3.2). For example, the ‘Southeast Alaska – Lynn Canal’ area is dominated with steep, bedrock shorelines, has moderate to protected wave exposures, and is characterized by dense Blue Mussel bioband and absence of canopy kelps; while the outer coast ‘Southeast Alaska – Sitka’ bioarea has a full range of wave exposures, dense nearshore canopy kelps and a diverse array of coastal morphologies.

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). So far in Southeast Alaska, in the absence of species detail from on-the-ground sites, separate bioband definitions have not been compiled for each of the different bioareas. Southeast 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, dominate shoreline characteristics) (Table 3.2). 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.

Biomapping for the northern part of Southeast Alaska (the shoreline imaged during 2004 and 2005 surveys) have been assigned to four bioareas: Yakutat (SEYA), Lynn Canal (SEFJ), Icy Strait (SEIC), and Sitka (SESI) (Figure 3.2). The 2006 imagery summarized in this report has been assigned to two more bioareas: Craig (SECR) and Misty Fjords (SEMJ). As the imagery and mapping for Southeast Alaska is completed, the boundaries between these bioareas will be adjusted, based on the observed biota. Additional bioareas may be added, if necessary.

Table 3.2. Description of bioareas identified in Southeast Alaska (to date).

Bioarea Codes	**Bioarea**	**Characteristics**
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, wide, sediment-dominated beaches common, fringing salt marsh common, moderate and lower wave exposures, wide estuary flats common. 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.

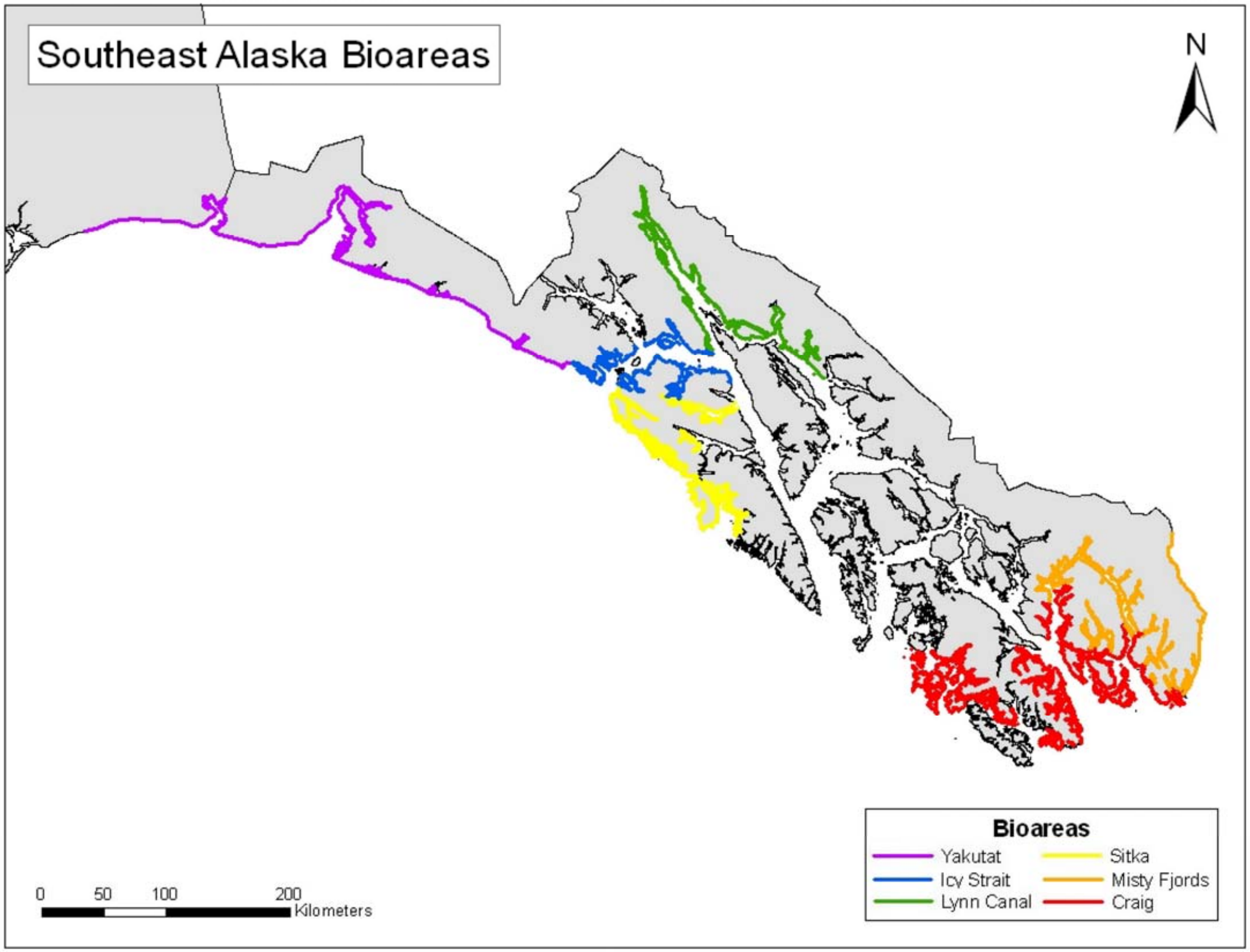


Figure 3.2. Map of bioareas identified in Southeast Alaska (to date). Bioareas are delineated on the basis of observed differences in the distribution of lower intertidal biota, nearshore canopy kelps, and coastal habitat classification.

Example illustrations and full definitions of the biobands mapped in this project area of Southeast Alaska are presented below. Each bioband is shown with example photos, as well as expanded definitions of description 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.

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.

SE06_MM_27520.jpg

Bioarea SECR

A lush Green Algae (ULV) band extends across the lower intertidal range of this Semi-Protected shoreline in the Barrier Islands.

SE06_ML_01693.jpg

Bioarea SECR

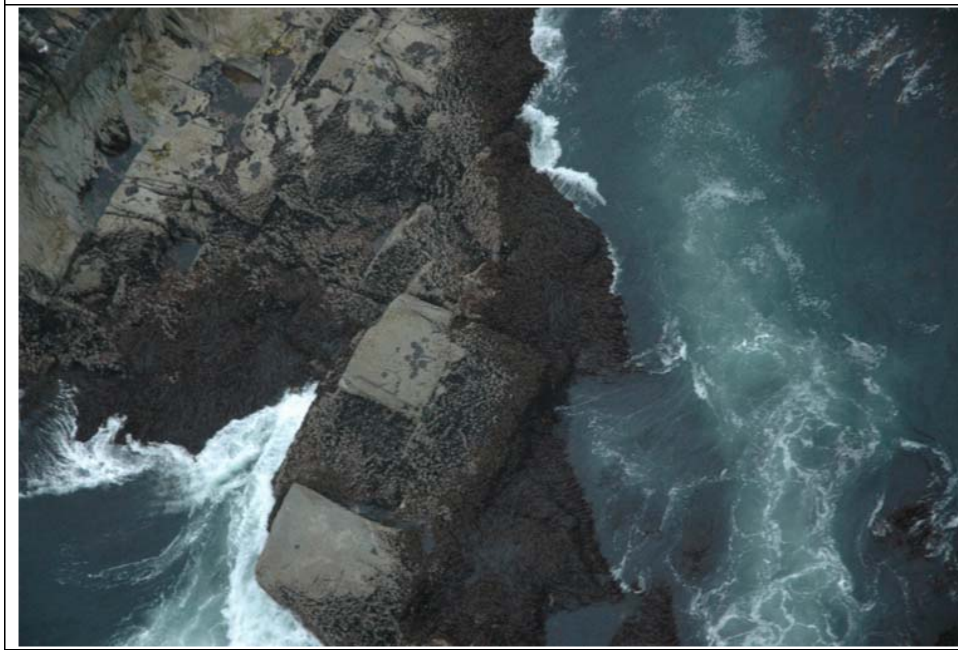
The Blue Mussel (BMU) Bioband

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

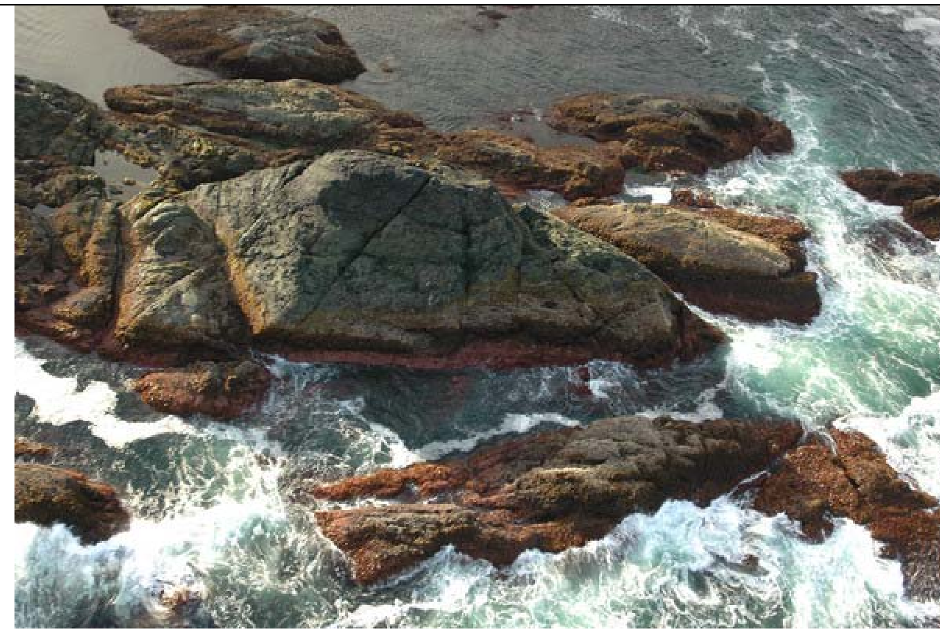
The Bleached Red Algae (HAL) Bioband

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.

SE06_MM_25233.jpg

Bioarea SECR

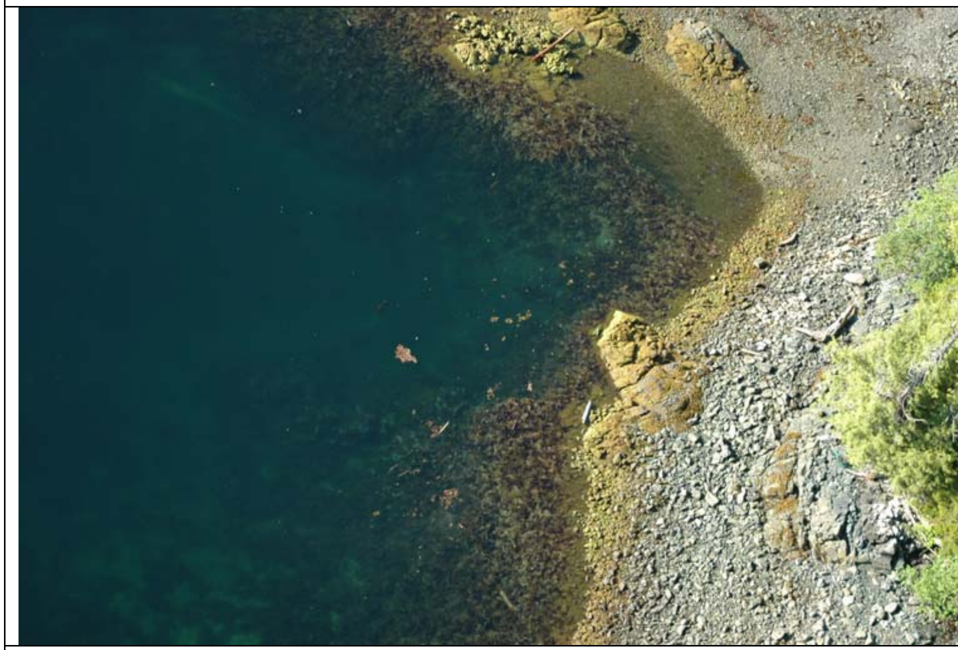
Alaria (ALA) caps the tops of these offshore reefs of Duck Island and can be easily identified by its ribbon-like texture and red-brown colour.

SE06_MM_09984.jpg

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.

SE06_MM_10623

Bioarea SECR

Lush Soft Brown Kelps (SBR) are visible just below the edge of the water off Ingraham Bay, Southeast Prince of Wales Island.

SE06_MM_10949.jpg

Bioarea SECR

The Dark Brown Kelps (CHB) Bioband

Zone	Bio-band Name	Database 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.	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_15751.jpg	SE06_MM_00742.JPG
Bioarea SECR	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.	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_ML_04695.jpg	SE06_MM_20471.jpg
Bioarea SECR	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.

The occurrence of biobands mapped in the SE06 project area is summarized in Table 3.3 and in Figure 3.3.

Table 3.3. Bioband abundances mapped in the SE06 project area of Southeast Alaska.

Bioband Names	Code	Continuous		Patchy		Total (km)	% of Mapped
		(km)	%	(km)	%		
Dune Grass	GRA	786	11	1,424	20	2,210	31
Sedges	SED	244	3	366	5	610	8
Salt Marsh	PUC	1,692	23	1,590	22	3,282	45
Barnacle	BAR	5,149	71	1,709	24	6,858	95
Rockweed	FUC	4,892	67	1,804	25	6,696	92
Green Algae	ULV	4,196	58	1,990	27	6,186	85
Blue Mussel	BMU	608	8	728	10	1,336	18
California Mussel	MUS	2	<1	80	1	82	<2
Bleached Red Algae	HAL	147	2	362	5	509	7
Red Algae	RED	2,569	35	1,334	18	3,903	53
Alaria	ALA	525	7	674	9	1,199	16
Soft Brown Kelps	SBR	2,699	37	1,754	24	4,453	61
Dark Brown Kelps	CHB	624	9	308	4	932	13
Surfgrass	SUR	58	1	345	5	403	6
Eelgrass	ZOS	637	9	1,002	14	1,639	23
Urchin Barrens	URC	233	3	266	4	499	7
Giant Kelp	MAC	917	13	282	4	1,199	17
Bull Kelp	NER	600	8	507	7	1,107	15

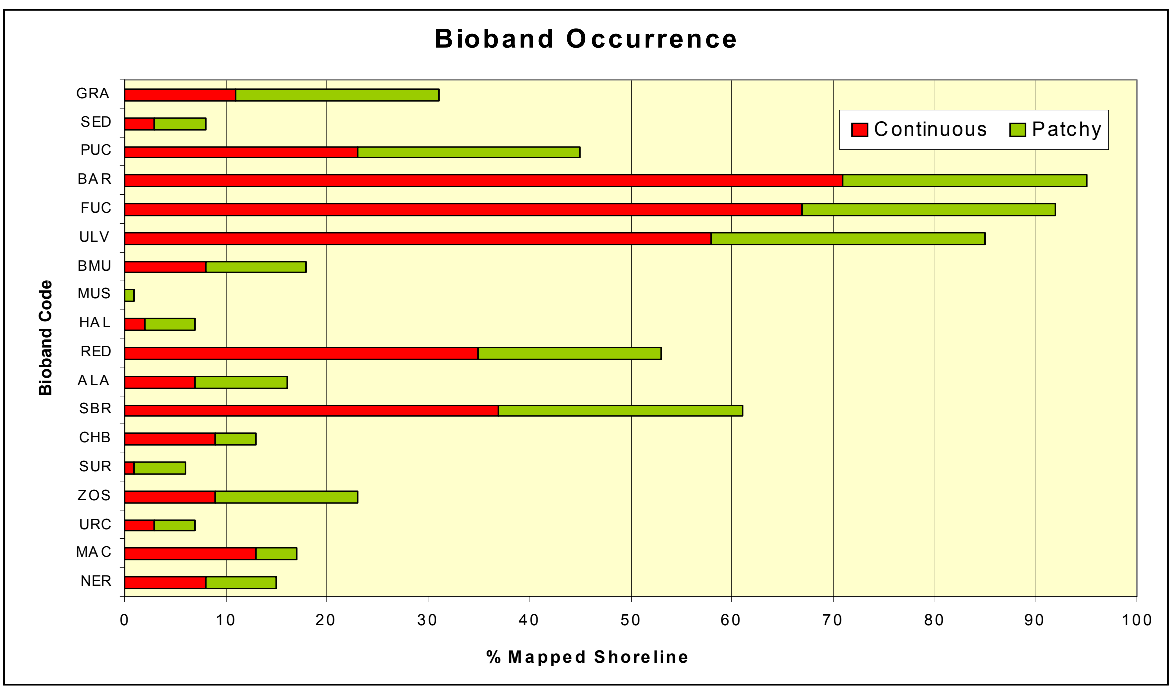


Figure 3.3. Occurrence of biobands mapped in the 2006 survey area of Southeast Alaska.

Bioband Distributions

The distributions of select bioband combinations are mapped below in Figures 3.4 – 3.8 to highlight regional differences observed in Southeast Alaska. Combinations of the various biobands also act as indicators for the different biological wave exposures and habitat classes.

Salt-tolerant Grass, Sedge, and Herb Biobands

In biological ShoreZone mapping, combinations of the three biobands of salt-tolerant grasses, sedges and herbs (Dune Grass – GRA; Sedges – SED; and Salt Marsh – PUC) are used to define saltmarsh and estuary habitats. Shorelines where all three biobands co-occur are at the largest wetland complexes.

The Dune Grass bioband is also often observed without the other salt marsh bands, growing in the beach berm, among the driftwood log line and can be present at all wave exposures, from high energy bare beaches, to sheltered salt meadows.

Combinations mapped:

Dune Grass (GRA) – good indicator of dunes on upper beach berms on mobile beaches, or at narrow fringing salt marsh.

Dune Grass + Salt Marsh (GRA + PUC) – good indicator of fringing salt marsh or smaller salt marsh/estuary areas

Salt Marsh (PUC) – good indicator of fringing salt marsh or smaller salt marsh/estuary areas

Dune Grass + Sedges (GRA + SED) – good indicator of smaller salt marsh/estuary areas

Dune Grass + Sedges + Salt Marsh (GRA + PUC + SED) – best indicator of contiguous salt marsh/estuary areas

Sedges + Salt Marsh (SED + PUC) – good indicator of smaller salt marsh/estuary areas

Sedges (SED) – good indicator of freshwater input, usually associated with streams

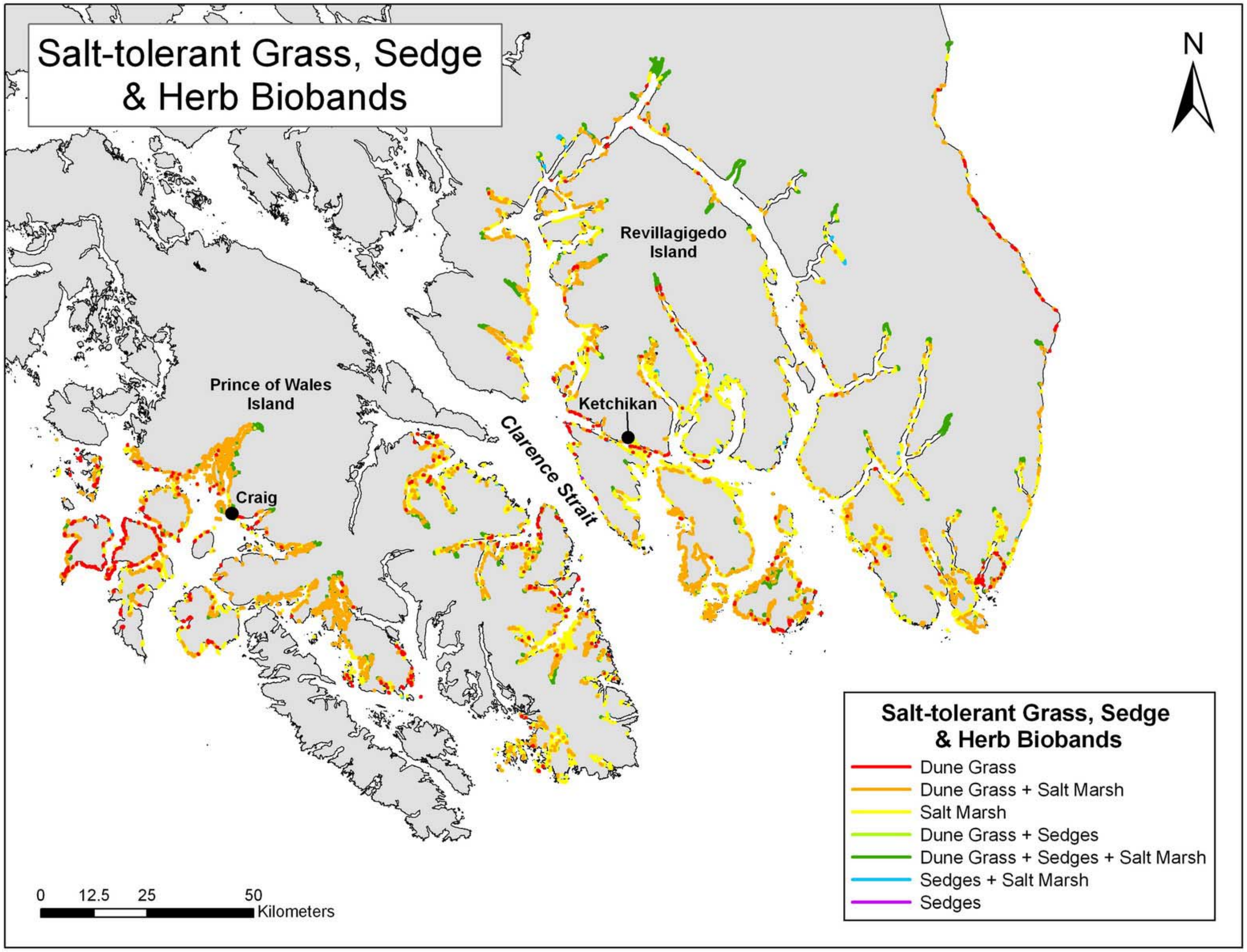


Figure 3.4. Distribution of salt-tolerant grass, sedge and herb biobands mapped in the 2006 survey area of Southeast Alaska.

Mussel Biobands

The distribution of the Blue Mussel and California Mussel biobands is shown in Figure 3.5.

In Behm Canal and Portland Canal, the immobile substrate and the fjord habitat has continuous Blue Mussel. Other areas have patchy occurrence of Blue Mussel in protected shorelines, usually associated with freshwater streams and lower wave exposures. The California Mussel bioband was only observed in the highest wave exposures on the open west side of the islands west of Craig. The region mapped with California Mussel in this project area likely the northern-most extend of this bioband. There were no occurrences observed of the two species together.

Example photos and further descriptions of the characteristics of these biobands can be found in Section 3.2.

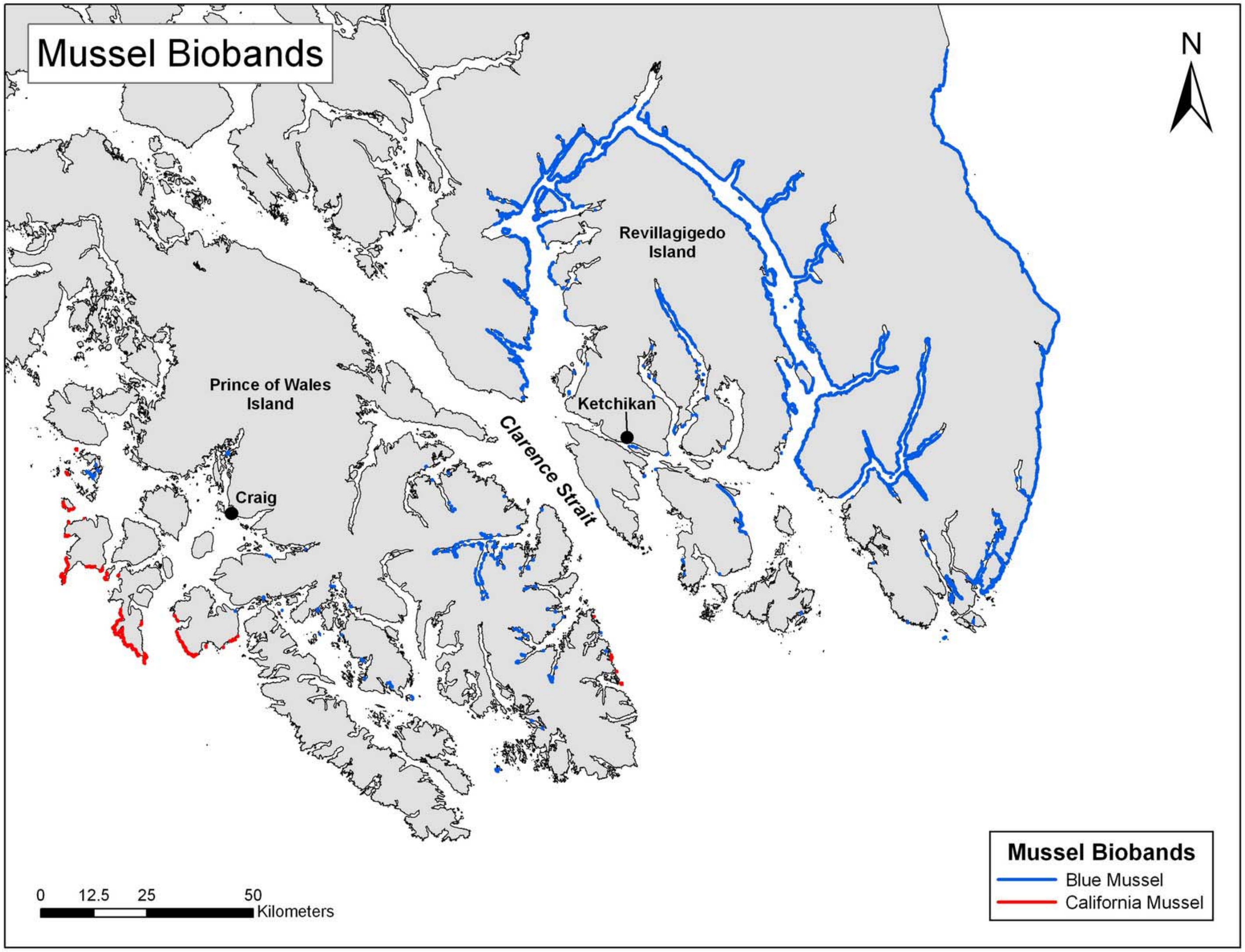


Figure 3.5. Distribution of Mussel biobands mapped in the 2006 survey area of Southeast Alaska.

Lower Intertidal Biobands

The combination of the lower intertidal biobands (Red Algae – RED; Alaria – ALA; Soft Brown Kelps – SBR; and Dark Brown Kelps – CHB) is the most diagnostic of differences between wave exposures and between regions, and represent the gradation in wave exposure across the area. Only the top seven most frequently occurring combinations were mapped (out of 15).

Combinations mapped:

1. Dark Brown Kelps + Red Algae (CHB + RED) – good indicator of Exposed
2. Dark Brown Kelps + Alaria + Red Algae (CHB + ALA + RED) – good indicator of low Exposed to Semi-Exposed
3. Alaria + Red Algae (ALA + RED) – good indicator of Semi-Exposed to high Semi-Protected
4. Alaria + Soft Brown Kelps + Red Algae (ALA + SBR + RED) – good indicator of Semi-Exposed to high Semi-Protected
5. Red Algae (RED) – good indicator of Semi-Protected
6. Soft Brown Kelps and Red Algae (SBR + RED) – good indicator of Semi-Protected
7. Soft Brown Kelps (SBR) – good indicator of Semi-Protected

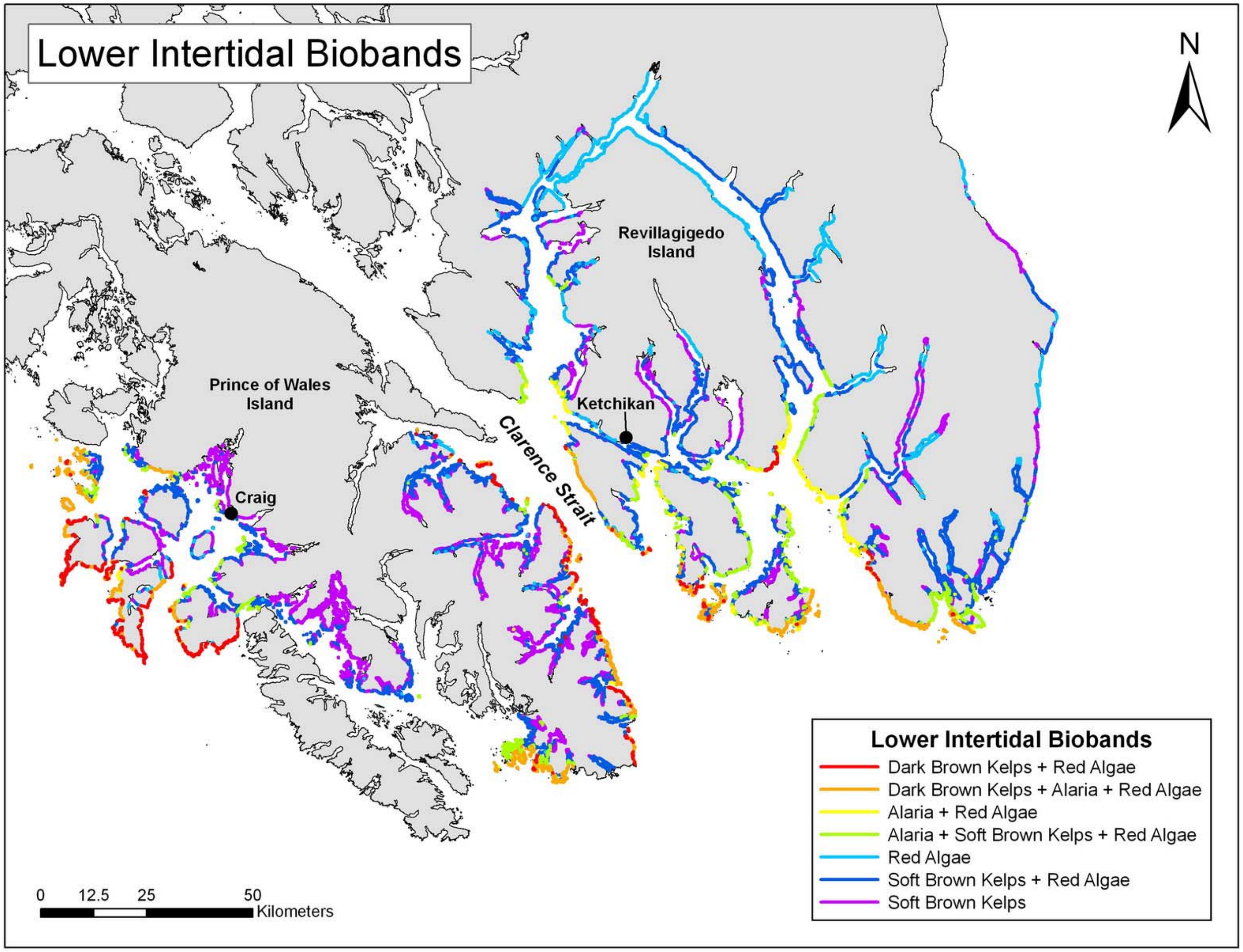


Figure 3.6. Distribution of lower intertidal biobands mapped in the 2006 survey area of Southeast Alaska.

Seagrass Biobands

The two species of seagrasses (Eelgrass – ZOS and Surfgrass – SUR) have different energy tolerances. Eelgrass is found in the lower to moderate energy wave exposures on sandy substrate, while Surfgrass is found in moderate to higher energy wave exposures on stable substrate.

The regional distribution of the seagrass biobands (Figure 3.7) reflects the wave exposures of the area, with most of the Surfgrass (SUR) observed on the outer, higher energy shorelines and the Eelgrass (ZOS) observed in the sheltered inlets and protected bays. Note that only Eelgrass was observed in the fjord regions.

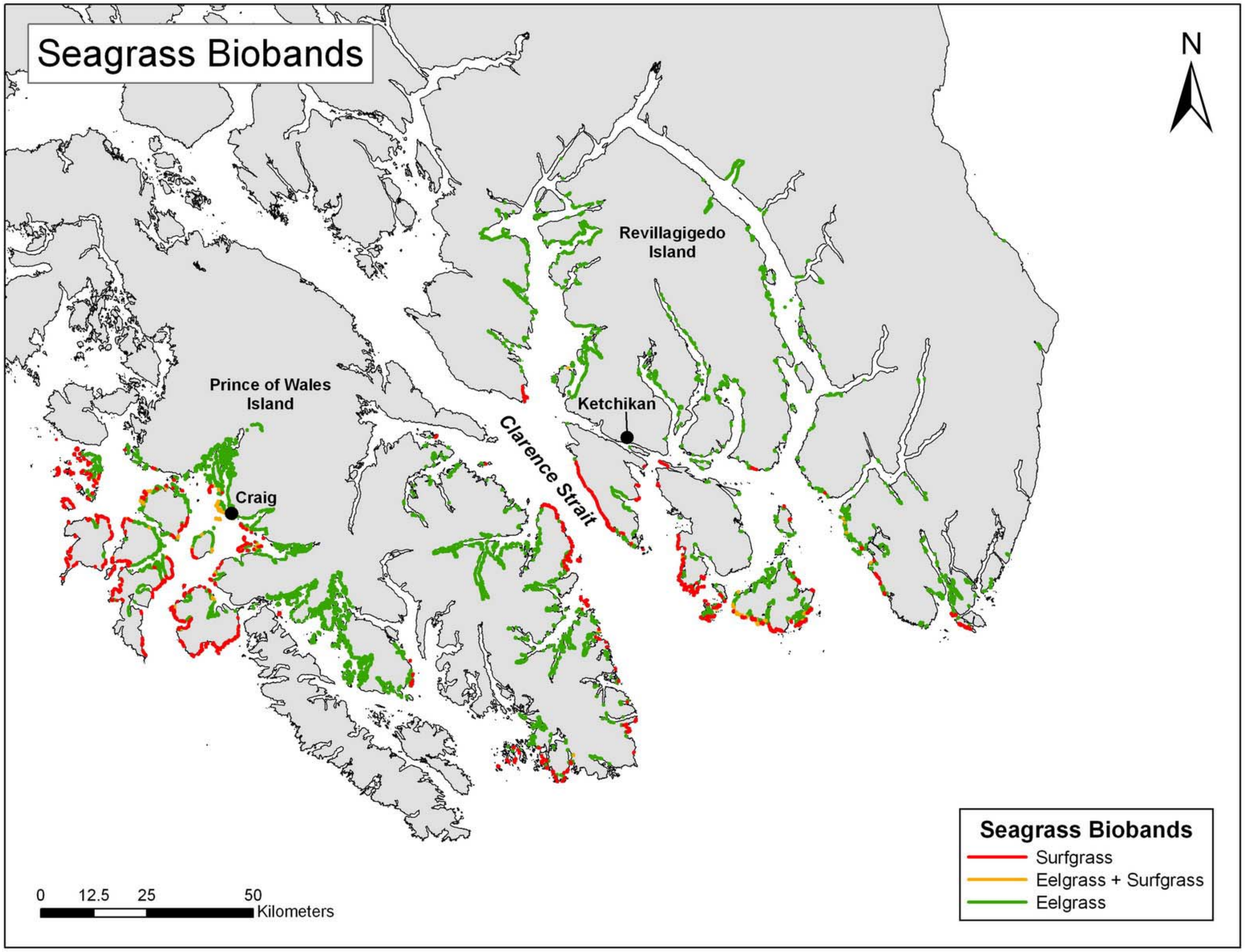


Figure 3.7. Distribution of seagrass biobands mapped in the 2006 survey area of Southeast Alaska.

Canopy Kelp Biobands

The three species of canopy kelps (Bull Kelp – NER; Dragon Kelp – ALF; and Giant Kelp *Macrocystis* – MAC) have different energy tolerances. Bull Kelp is found in the highest-energy areas on stable substrates and also in current-affected areas; Dragon Kelp is observed in moderate exposures; and *Macrocystis* is found in moderate to lower wave exposures.

In the SE06 project area, only Bull Kelp and Giant Kelp were observed (Figure 3.8). Dragon Kelp, which is abundant further north and is mapped in 2004 imagery, was not mapped in this project area; however, from observations during the 2007 aerial surveys, the southern limit of the species is just north of the western edge of Prince of Wales Island, shown in Figure 3.8.

Giant Kelp (MAC) is mostly confined to the outer west coast in the SE06 mapping and is the dominant kelp on the west coast of Prince of Wales Island, where as Bull Kelp (NER) is the dominant kelp in the inner coast and fjords areas (Figure 3.8).

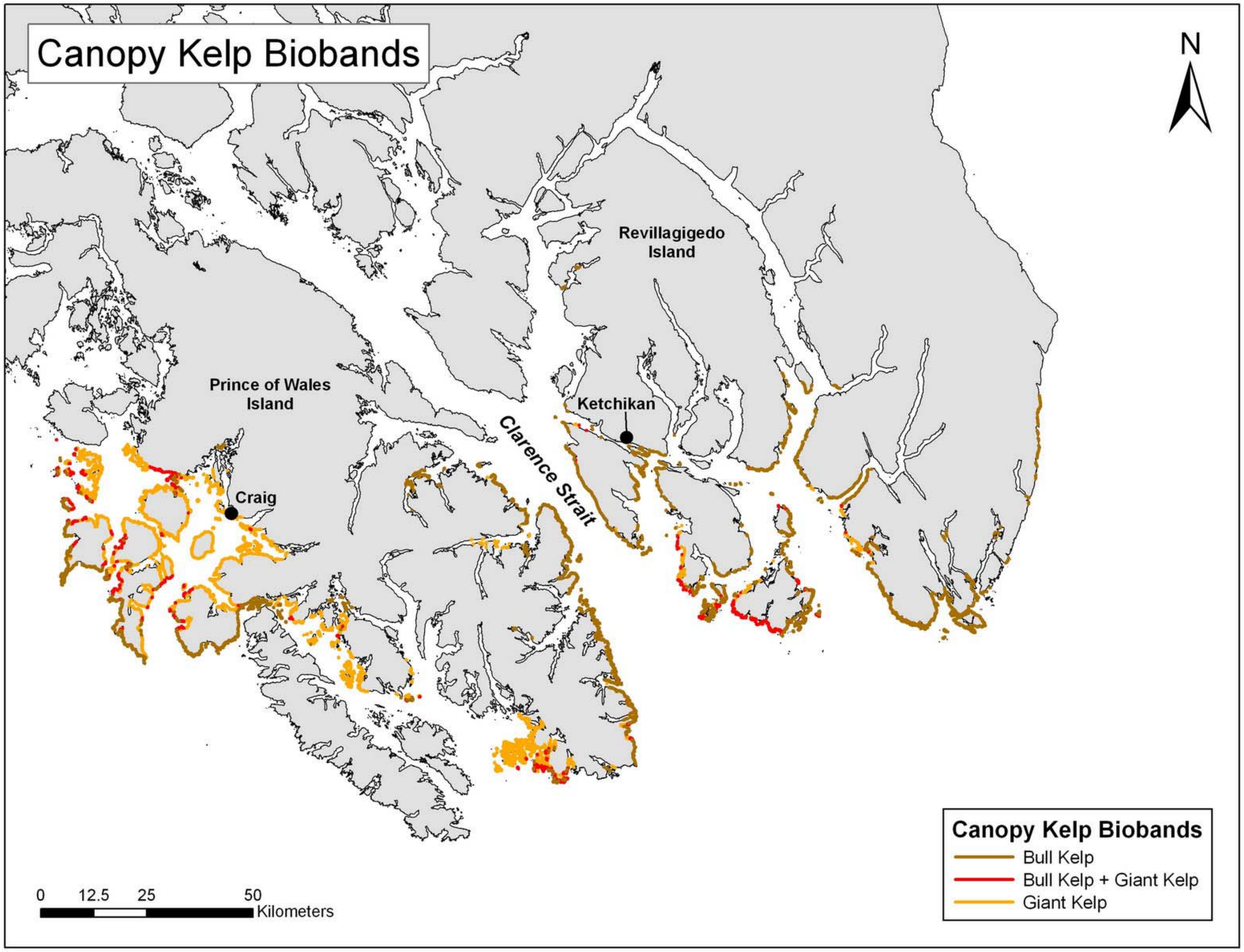


Figure 3.8. Distribution of canopy kelp biobands mapped in the 2006 survey area of Southeast Alaska.

3.2 Biological Wave Exposure

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 3.4 through 3.7 and Figures 3.9 through 3.12.

Note that the indicator and associated species listed for the exposure categories 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 outside of Southeast Alaska.

Table 3.4. Typical and associated species of biobands for the Very Exposed (VE)* and Exposed (E) biological wave exposure categories.

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
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		*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

* Very Exposed (VE) was not observed in the project area included in this summary report.
** California Mussel occurs only in the Craig bioarea of Southeast Alaska (SECR).

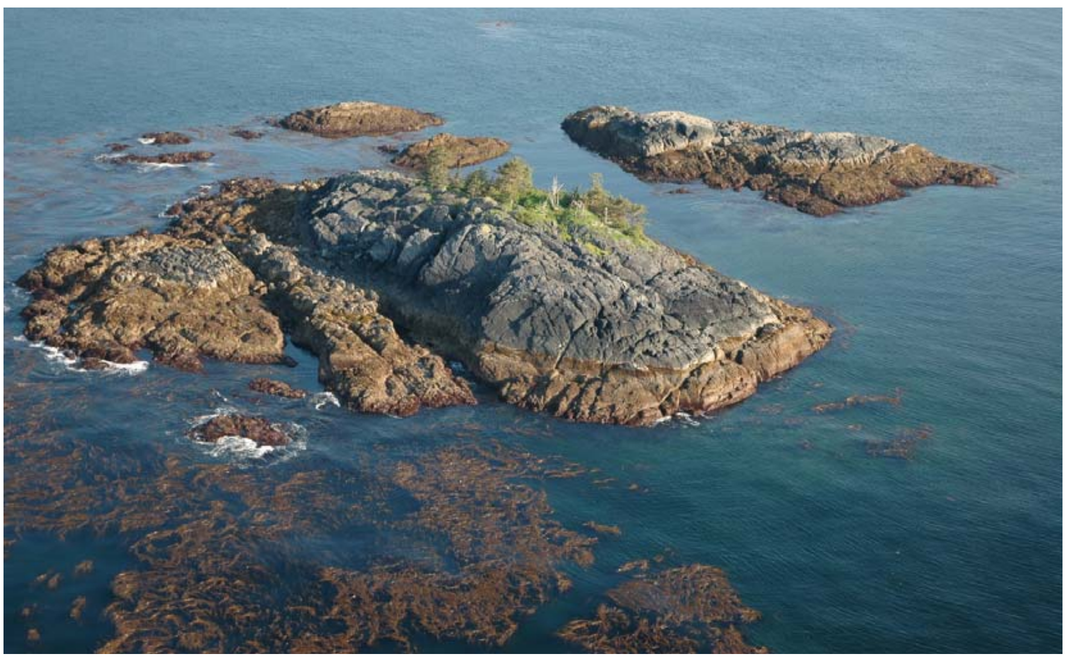


Figure 3.9. Biological wave exposure: Exposed.
Exposed (E) bedrock shoreline at offshore Kelp Islet, along the south-facing shore of Duke Island. A wide Splash Zone (VER) band of *Verrucaria* overlies bands of Barnacle (BAR), Red Algae (RED), *Alaria* (ALA), Dark Brown Kelps (CHB) and Bull Kelp (NER) 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 3.5. Typical and associated species of biobands for the Semi-Exposed (SE) biological wave exposure category.

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
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 and Nearshore 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 3.10. 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 3.6. Typical and associated species of biobands for the Semi-Protected (SP) biological wave exposure category.

Zone	Indicator species	Associated Species	Bioband Name	Bioband Code
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 and Nearshore 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 3.11. 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 3.7. Typical and associated species of biobands for the Protected (P) and Very Protected (VP) biological wave exposure categories.

	Indicator species	Associated Species	Bioband Name	Bioband Code
Upper Iintertidal		*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	*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 3.12. 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)

The occurrence of five biological wave exposure categories mapped in the study area is summarized for Southeast Alaska in Table 3.8. Almost all of the shoreline in the study area was classified with a wave exposure of Semi-Protected or lower (85%). Only a few units were considered as Exposed (4% of the mapped shoreline length) and about 11% of the shoreline was mapped in the moderate Semi-Exposed category. A summary map of the distribution of the biological wave exposure categories mapped is shown in Figure 3.13.

Table 3.8. Summary of biological wave exposure categories in the 2006 survey area of Southeast Alaska.

Biological Wave Exposure		**Length (km)**	**% of Mapping**
Exposed	E	272	4
Semi-Exposed	SE	816	11
Semi-Protected	SP	2749	38
Protected	P	3238	44
Very Protected	VP	200	3

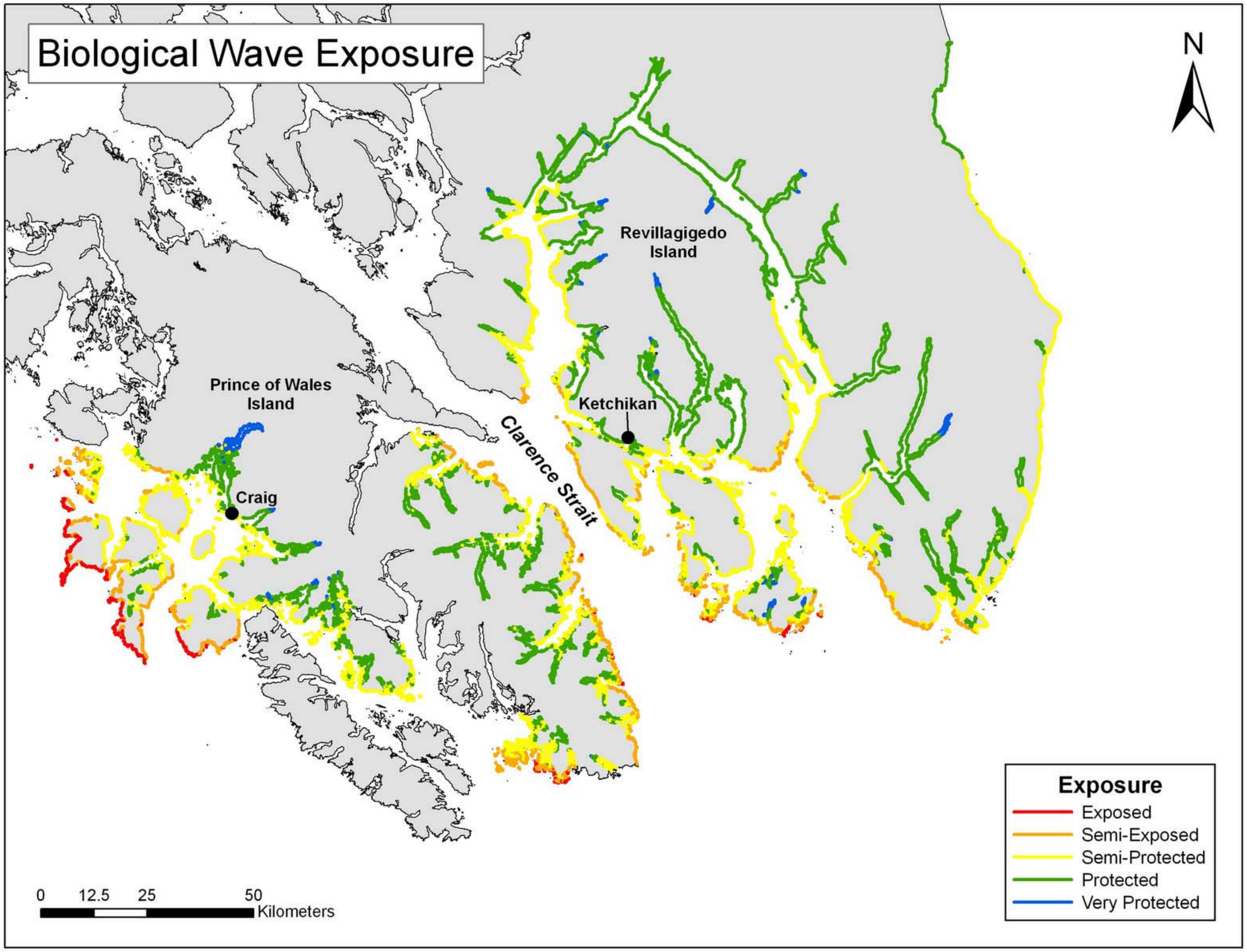


Figure 3.13. Distribution of biological wave exposure categories mapped in the 2006 survey area Southeast Alaska.

3.3 Habitat Class

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 3.14 to 3.20 below illustrate examples of habitat classes observed in the area included in this summary report. Further descriptions of the habitat class definitions are presented in Appendix A, Table A-8 and A-9.

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.

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 3.14).
- **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 3.15).
- **Mobile:** substrates such as sandy beaches where coastal energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota (Figure 3.16).

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** types with wetlands and salt marsh vegetation along low energy sediment shores influenced by freshwater (Figure 3.17).
- **Current-Dominated** channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units (Figure 3.18).
- **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 3.19).
- **Lagoon** units that have enclosed or constricted area of brackish or salty water (Figure 3.20), often found in the supratidal; however, large shallow lagoons sometimes form the subtidal zone in multiple consecutive units. Lagoons are mapped only as 'secondary habitat classes'.

Figure 3.14. 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 3.15. 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 3.16. 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 3.17. 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 3.18. 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 3.19. Habitat Class: Anthropogenic.
This modified shoreline in Yes Bay is an example of an **Anthropogenic** habitat class. (SE06_MM_02659.jpg)

Figure 3.20. 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)

The occurrence of habitat classes in the 2006 survey area southernmost Southeast Alaska is summarized in Table 3.9. Approximately 87% of all habitat classes mapped are structured by wave energy, with 72% in the Semi-Protected and lower wave energy categories. Twelve percent of the shoreline was mapped as the Estuary habitat class, in which the salt-tolerant grass, sedge and herb biobands occur, associated with fresh water streams. Fluvial processes are the dominant structuring force in this habitat class. Less than 1% of the shoreline was classified as Anthropogenic (human-modified) shoreline; nearly all of that observed occurred in and around the city of Ketchikan.

A summary map of the distribution of habitat classes mapped in the 2006 survey area of Southeast Alaska is shown in Figure 3.21.

Table 3.9. Summary of habitat classes mapped in the 2006 survey area of Southeast Alaska.

Dominant Structuring Process	**Habitat Class**		**Habitat Class Codes ***	**Length (km)**	**% of Mapping**
	Exposure Category	**Substrate Mobility**			
Wave Energy	Exposed	Stable	20	120	2%
		Partially Mobile	21	73	1%
		Mobile	22	79	1%
	Semi-Exposed	Stable	30	257	4%
		Partially Mobile	31	537	7%
		Mobile	32	16	<1%
	Semi-Protected	Stable	40	320	4%
		Partially Mobile	41	2239	31%
		Mobile	42	22	<1%
	Protected	Stable	50, 60	499	7%
		Partially Mobile	51, 61	2164	30%
		Mobile	52, 62	18	<1%
Fluvial	Estuary		33,43, 53, 63	829	12%
Current-dominated	Current-Dominated		34, 44, 54	54	1%
Modified	Anthropogenic**		46, 47, 56, 57, 66, 67	43	<1%
		TOTALS:		**7274**	**100%**
Lagoon ***	Lagoon		38, 48, 58, 68	193	3%

* See Appendix A, Tables A – 8 and A – 9 for full definitions of Habitat Class rationale and codes.
**Not all Anthropogenic categories occurred.
*** Lagoons are only mapped as a 'Secondary Habitat Class'.
Note that the Very Exposed (VE) categories were not mapped in the study area.

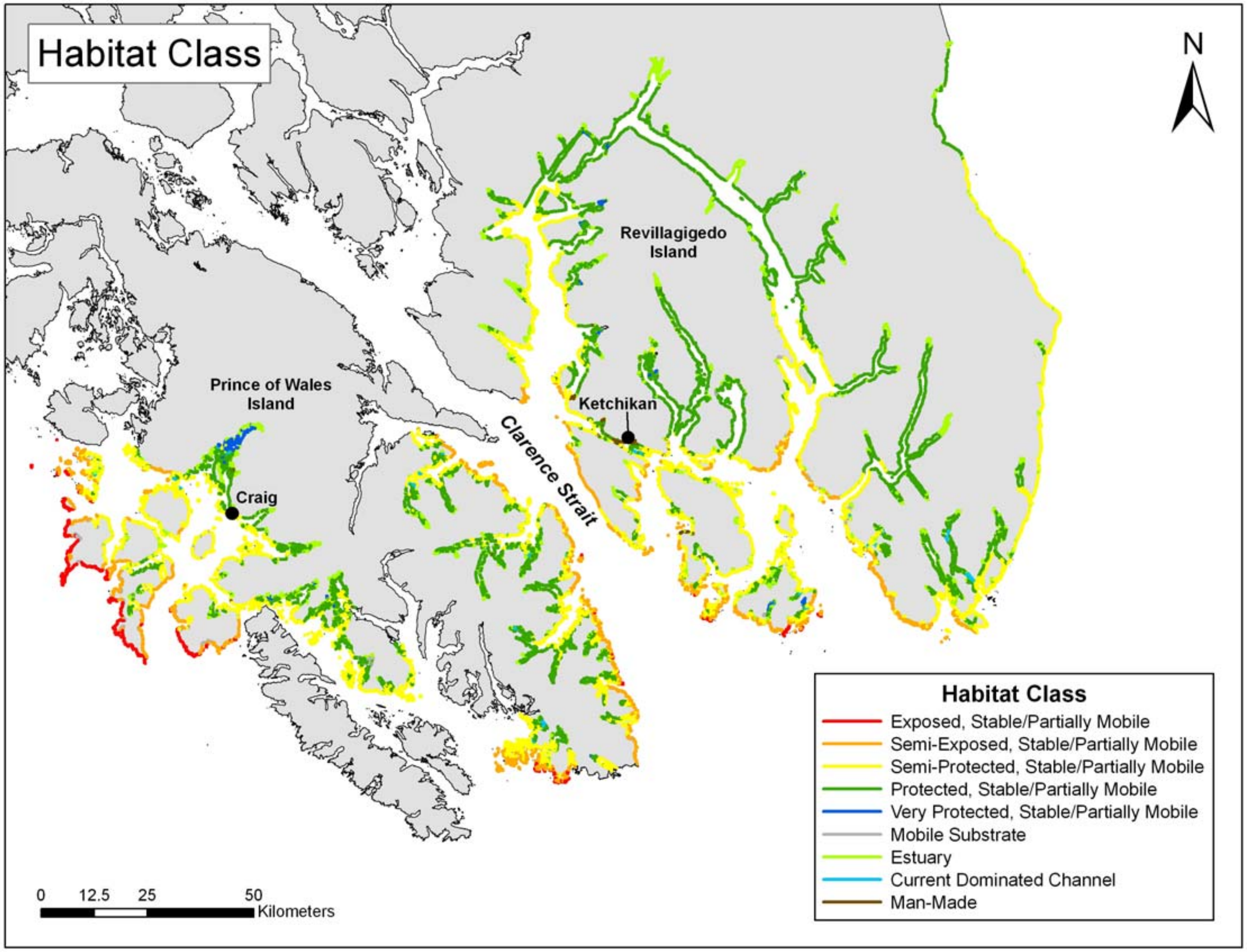


Figure 3.21. Distribution of habitat class categories in the 2006 survey area of Southeast Alaska.

4.0 REFERENCES AND ACKNOWLEDGMENTS

4.1 References

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

4.2 Acknowledgments and Use Constraints

The ShoreZone program is a partnership of scientists, GIS specialists, web specialists, non-profit organizations, and governmental agencies. We gratefully acknowledge the support of organizations working in partnership for the Alaska ShoreZone effort, including: 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

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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 (2007) 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.

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	
ROCK	N/A	WIDE (>30 m)	INCLINED (5-20°)	Rock Ramp, wide	1
ROCK	N/A	WIDE (>30 m)	FLAT (<5°)	Rock Platform, wide	2
ROCK	N/A	NARROW (<30 m)	STEEP (>20°)	Rock Cliff	3
ROCK	N/A	NARROW (<30 m)	INCLINED (5-20°)	Rock Ramp, narrow	4
ROCK	N/A	NARROW (<30 m)	FLAT(<5°)	Rock Platform, narrow	5
ROCK & SEDIMENT	GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
ROCK & SEDIMENT	GRAVEL	WIDE (>30 m)	INCLINED (5-20°)	Ramp with gravel beach, wide	6
ROCK & SEDIMENT	GRAVEL	WIDE (>30 m)	FLAT (<5°)	Platform with gravel beach, wide	7
ROCK & SEDIMENT	GRAVEL	NARROW (<30 m)	STEEP (>20°)	Cliff with gravel beach	8
ROCK & SEDIMENT	GRAVEL	NARROW (<30 m)	INCLINED (5-20°)	Ramp with gravel beach	9
ROCK & SEDIMENT	GRAVEL	NARROW (<30 m)	FLAT (<5°)	Platform with gravel beach	10
ROCK & SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
ROCK & SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	INCLINED (5-20°)	Ramp w gravel & sand beach, wide	11
ROCK & SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	FLAT (<5°)	Platform with G&S beach, wide	12
ROCK & SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	STEEP (>20°)	Cliff with gravel/sand beach	13
ROCK & SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	INCLINED (5-20°)	Ramp with gravel/sand beach	14
ROCK & SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	FLAT (<5°)	Platform with gravel/sand beach	15
ROCK & SEDIMENT	SAND	WIDE (>30 m)	STEEP (>20°)	n/a	
ROCK & SEDIMENT	SAND	WIDE (>30 m)	INCLINED (5-20°)	Ramp with sand beach, wide	16
ROCK & SEDIMENT	SAND	WIDE (>30 m)	FLAT (<5°)	Platform with sand beach, wide	17
ROCK & SEDIMENT	SAND	NARROW (<30 m)	STEEP (>20°)	Cliff with sand beach	18
ROCK & SEDIMENT	SAND	NARROW (<30 m)	INCLINED (5-20°)	Ramp with sand beach, narrow	19
ROCK & SEDIMENT	SAND	NARROW (<30 m)	FLAT (<5°)	Platform with sand beach, narrow	20
SEDIMENT	GRAVEL	WIDE (>30 m)	FLAT (<5°)	Gravel flat, wide	21
SEDIMENT	GRAVEL	NARROW (<30 m)	STEEP (>20°)	n/a	
SEDIMENT	GRAVEL	NARROW (<30 m)	INCLINED (5-20°)	Gravel beach, narrow	22
SEDIMENT	GRAVEL	NARROW (<30 m)	FLAT (<5°)	Gravel flat or fan	23
SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	INCLINED (5-20°)	n/a	
SEDIMENT	SAND & GRAVEL	WIDE (>30 m)	FLAT (<5°)	Sand & gravel flat or fan	24
SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	STEEP >20°)	n/a	
SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	INCLINED (5-20°)	Sand & gravel beach, narrow	25
SEDIMENT	SAND & GRAVEL	NARROW (<30 m)	FLAT (<5°)	Sand & gravel flat or fan	26
SEDIMENT	SAND / MUD	WIDE (>30m)	STEEP (>20°)	n/a	
SEDIMENT	SAND / MUD	WIDE (>30m)	INCLINED (5-20°)	Sand beach	27
SEDIMENT	SAND / MUD	WIDE (>30m)	FLAT (<5°)	Sand flat	28
SEDIMENT	SAND / MUD	WIDE (>30m)	FLAT (<5°)	Mudflat	29
SEDIMENT	SAND / MUD	NARROW (<30m)	STEEP (>20°)	n/a	
SEDIMENT	SAND / MUD	NARROW (<30m)	INCLINED (5-20°)	Sand beach	30
SEDIMENT	SAND / MUD	NARROW (<30m)	FLAT (<5°)	n/a	n/a
SEDIMENT	ORGANICS	n/a	n/a	Estuaries	31
ANTHRO-POGENIC	Man-made	n/a	n/a	Man-made, permeable	32
ANTHRO-POGENIC	Man-made	n/a	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
Wave Energy	***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
Wave Energy	***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
Man-modified		***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, they are ranked in order of volume. A surface layer can be described by prefix *v* for veneer (e.g. vCs/R).

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