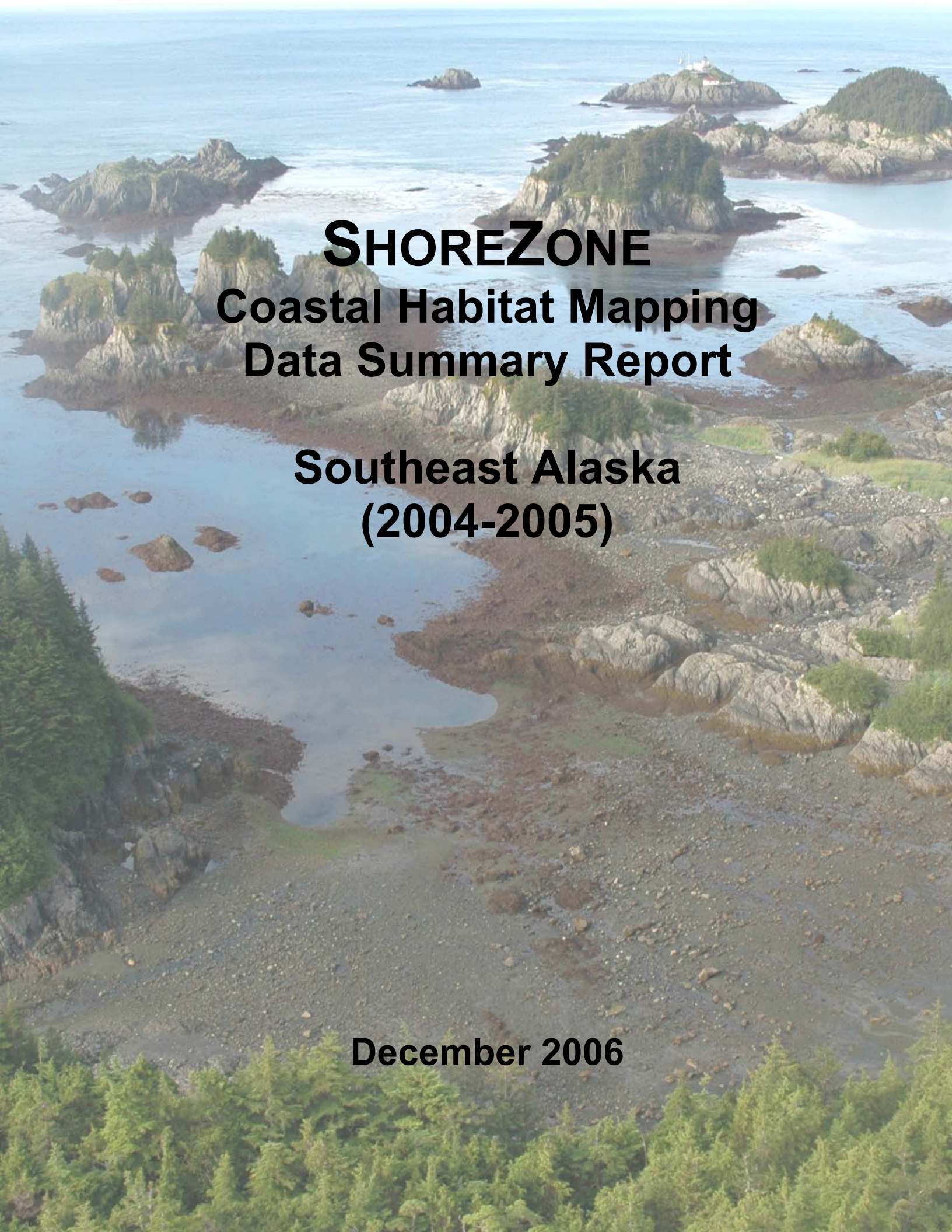

SHOREZONE
Coastal Habitat Mapping
Data Summary Report

Southeast Alaska
(2004-2005)

December 2006

CORI Projects: 05-09, 05-18 December 2006

ShoreZone Mapping Data Summary
Southeast Alaska (2004-2005)

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1 INTRODUCTION

1.1 ShoreZone Coastal Habitat Mapping

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. Oblique low-altitude aerial video and digital still imagery of the coastal zone is collected during summer low tides (zero tide level or lower), usually from a helicopter flying at <100 m altitude. The flight trackline is recorded at 1-second intervals using Fugawi electronic navigation software and is continuously monitored in-flight to ensure all shorelines have been imaged. Video and still images are georeferenced and time-synchronized. Video imagery is accompanied by continuous, simultaneous commentary by a geologist and a biologist aboard the aircraft.

The imagery and commentary are used in the definition of discrete along-shore coastal habitat **units** and the "mapping" of observed physical, geomorphic, sedimentary, and biological across-shore **components** within those units (Figure 1.1). Units are digitized as shoreline segments in ArcView or ArcGIS, then integrated with the along-shore and across-shore geological and biological data housed in a Microsoft Access database. Mapped habitat features include degree of wave exposure, substrate type, sediment texture, intertidal flora and fauna, subtidal algae, and some subtidal fauna. Data and imagery are posted on regional websites (such as www.coastalaska.net for SE Alaska and www.shim.bc.ca/gulfislands/atlas.htm for the Gulf Islands in British Columbia, Canada).

ShoreZone provides a spatial framework for coastal habitat assessment on local and regional scales. Mapped regions now include more than 16,000 km of coastline in the Gulf of Alaska and 45,000 km of coastline in British Columbia and Washington state (from the Columbia River mouth to the Alaska/BC border), with additional Alaska surveys conducted in 2006.

Research and practical applications of ShoreZone coastal mapping data and imagery include:

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

The ShoreZone Coastal Mapping Program is a partnership of scientists, GIS specialists, internet specialists, non-profit organizations, and governmental agencies. Field programs, data management and processing, and product deliveries are coordinated and executed primarily by coastal geologists John Harper and Jodi Harney of Coastal and Ocean Resources Inc. (Sidney BC, Canada) and biologist Mary Morris from Archipelago Marine Research Ltd. (Victoria BC). The processing, mapping, integration, and analysis of physical and biological data takes place in both organizations by a group of mapping specialists who possess advanced academic and technical degrees. More information on techniques, methodology, and applications is included in the ShoreZone Protocol for the Gulf of Alaska available on the Coastal and Ocean Resources website (www.coastalandoceans.com).

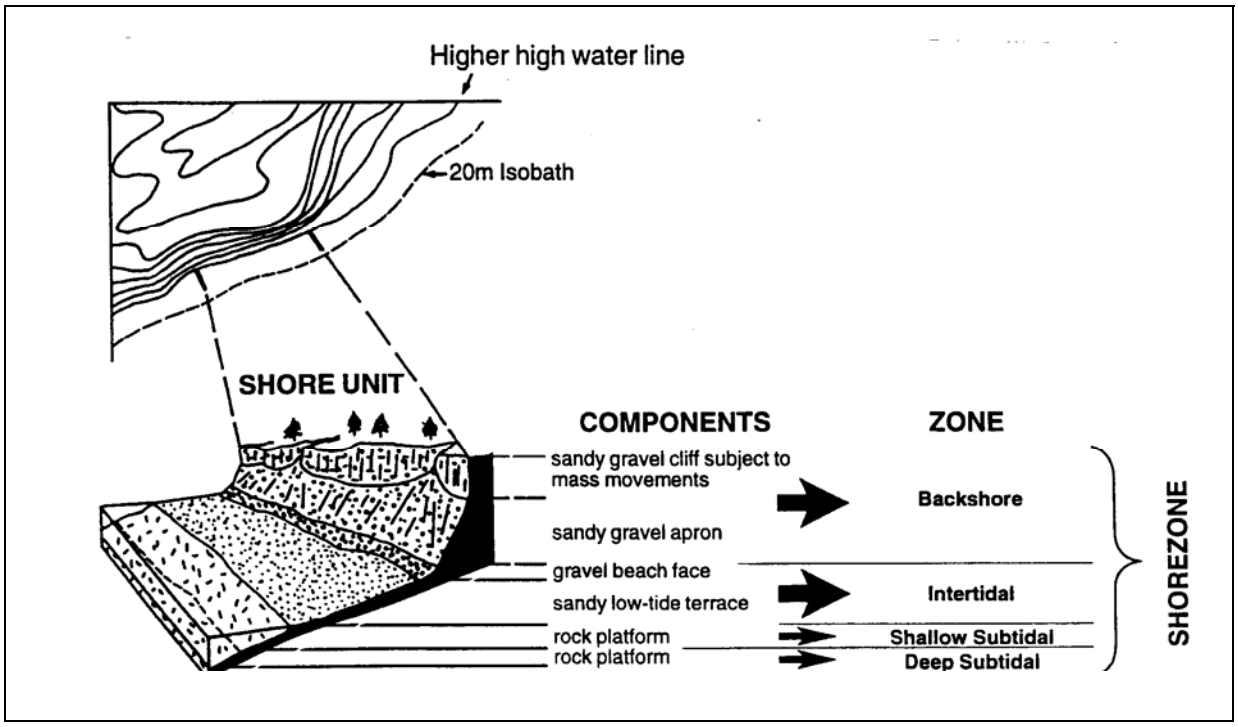


Figure 1.1. Schematic to illustrate how digital shorelines are segmented into alongshore units and across-shore components in the ShoreZone mapping system.

1.2 ShoreZone Mapping in Southeast Alaska (2004-2005)

Field surveys in Southeast Alaska in 2004 and 2005 collected more than 6,400 km of aerial video and digital still photographs of the coastal and nearshore zone at zero-tide and lower. The imagery was used to map the geological and biological resources of the region from Sitka Sound to Icy Bay (Figure 1.2). The purpose of this report is to provide a summary of the data for mapped shorelines in the region. Mapping data (in GIS and Access database formats) is in the form of line segments and point features. Line segments are the principal spatial features, representing along-shore units. Point features (also called "variants") are those that are too small to be represented as a line segment, such as streams and are digitized as points, as well as mapped into the unit that contains it.

1.3 Biogeographic Areas of Southeast Alaska

The regions of mapping interest in Southeast Alaska are divided into four biogeographic areas on the basis of differences in bioband occurrence, species composition within the biobands, and geographic boundaries. (Biobands are discussed in detail in Section 3.) These "BioAreas" are defined in Table 1.1 and shown in Figure 1.3. Briefly, the Yakutat BioArea (SEYA) is characterized by sparse biota, high wave exposure and few canopy kelps. The Icy Strait BioArea (SEIC) is the only area with significant amounts of the Dragon Kelp bioband (*Alaria fistulosa)*. The Fjords BioArea (SEFJ) shows milky glacial-fed inlets, with many units with coralline reds in the Red Algae bioband (), especially in sections with Semi-protected exposures. The Sitka BioArea (SESI) has fully marine waters, with a full range of wave exposures, and has a lush mixture of canopy kelps, particularly the giant kelp bioband (*Macrocystis integrifolia)* .

Table 1.1. Biogeographic areas ("BioAreas") defined in mapped regions of Southeast Alaska. See Fig. 1.3 for mapped location. Biobands are discussed in detail in Section 3.

BioArea Code	BioArea Name	BioBand Suffix	Description
SEYA	SE Alaska Yakutat	12	Icy Point north to Icy Cape
SEIC	SE Alaska Icy Strait	12	North coast of Icy Strait from Icy Point at Boussole Bay east to Couverden Island; south coast of Icy Strait from Point Lucan east to the north end of Chatham Strait
SEFJ	SE Alaska Fjords	12	Lynn Canal north of Couverden Island and southeast to Stevens Passage
SESI	SE Alaska Sitka / Outer Coast	12	Point Lucan in Cross Sound south to Sitka and the inlets, including Tenakee Inlet on the west side of Chatham Strait

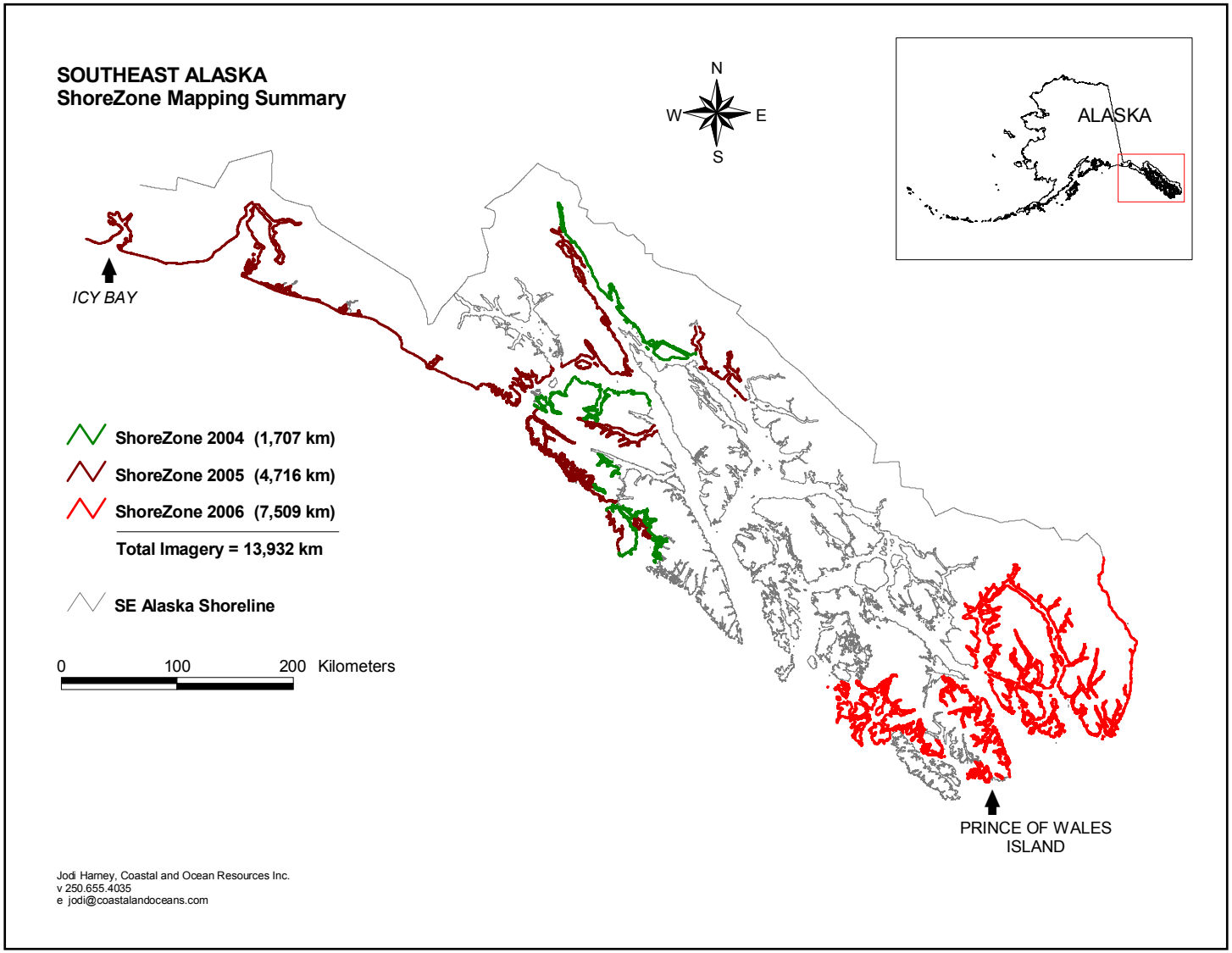


Figure 1.2. Shoreline of Southeast Alaska mapped in 2004 and 2005 using the ShoreZone technique. Shorelines flown in 2006 are shown in red (unmapped).

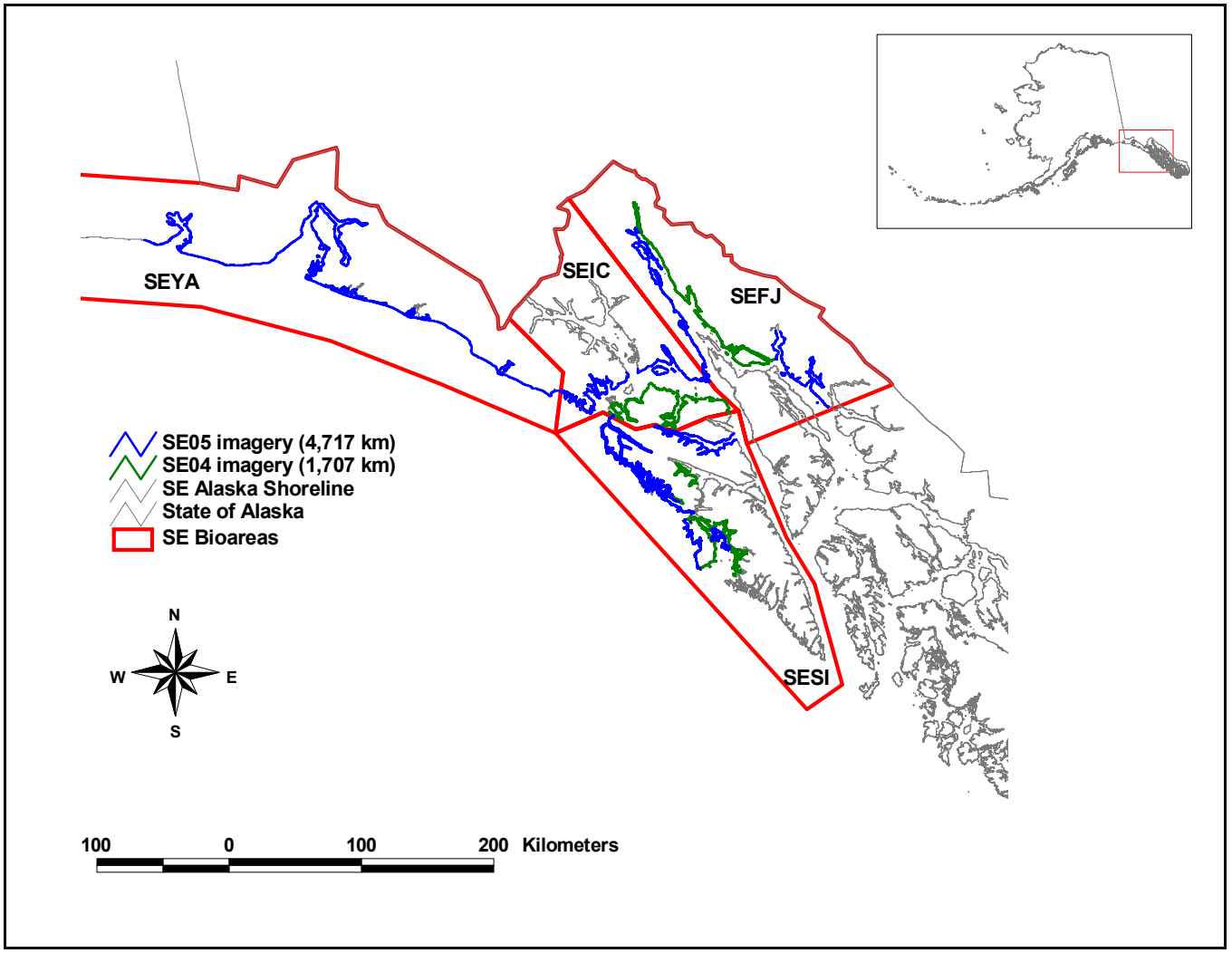


Figure 1.3. Map showing the distribution of biogeographic areas ("BioAreas") in Southeast Alaska as defined in the ShoreZone mapping program (SEYA, SEIC, SEFJ, and SESI). See Table 1.1 for definitions.

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 unit classification systems: coastal shore types defined for British Columbia (“BC Class”) and the “Environmental Sensitivity Index” (ESI) class developed for oil-spill mitigation.

The BC Class system is used to describe alongshore 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 (Table 2.1; Howes et al. 1994). Coastal classes that characterize units dominated by man-made features (BC Classes 31 and 32), organic material (such as marshes and estuaries), high-current channels, and glaciers are also included in the BC class system. Figure 2.1 summarizes the distribution of BC shore types in mapped regions of SE Alaska.

The NOAA Environmental Sensitivity Index (ESI) is a shoreline classification system developed in the mid-1970s 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). In addition to the relative rank, each unit is also assigned one of 27 possible shore type classes (Table 2.3; Peterson et al. 2002). The ESI system has been used to map most of the coastline in the U.S., including Alaska, and is an integral component of oil-spill contingency planning, emergency response, and coastal resource management.

Table 2.1. Shore Type classification employed in the ShoreZone mapping methodology (after Howes et al. 1994 for British Columbia).

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

Table 2.2. Summary of shore types by BC Class for mapped areas of SE Alaska.

Shore Type (BC Class)	Sum of Unit Length (m)	Average Unit Length (m)	# of Units	Sum of Unit Length (km)	% Occur-rence	Sum of % Occur-rence	General Substrate Type
1	41,368	376	110	41	0.7%		
2	62,200	319	196	62	1.0%		
3	441,405	234	1,928	441	7.0%		
4	217,216	229	951	217	3.5%		
5	20,255	199	102	20	0.3%	12%	Rock
6	93,388	223	430	93	1.5%		
7	161,967	253	651	162	2.6%		
8	292,829	183	1,620	293	4.7%		
9	523,296	185	2,852	523	8.4%		
10	51,885	193	273	52	0.8%		
11	109,691	186	627	110	1.8%		
12	240,555	259	995	241	3.8%		
13	139,537	211	707	140	2.2%		
14	259,518	155	1,732	260	4.1%		
15	45,929	206	236	46	0.7%		
16	4,008	154	27	4	0.1%		
17	7,041	243	35	7	0.1%		
18	25,272	308	88	25	0.4%		
19	6,084	196	32	6	0.1%		
20	466	155	3	0	0.0%	31%	Rock+Sediment
21	109,345	280	422	109	1.7%		
22	149,737	195	796	150	2.4%		
23	4,089	215	20	4	0.1%		
24	845,366	309	3,431	845	13.5%		
25	529,777	233	2,640	530	8.5%		
26	50,778	219	274	51	0.8%		
27	22,287	378	72	22	0.4%		
28	395,479	739	647	395	6.3%		
29	57,930	369	201	58	0.9%		
30	15,785	376	47	16	0.3%	35%	Sediment
31	1,194,181	691	3,254	1,194	19.1%	19%	Organics / Marsh
32	57,105	213	278	57	0.9%		
33	3,885	134	31	4	0.1%	1%	Man-made
34	60,600	415	158	61	1.0%	1%	Channel
35	21,262	2658	8	21	0.3%	0.3%	Glacier
Total	**6,261,516**	**242**	**25,874**	**6,262**	**100%**	**100%**	

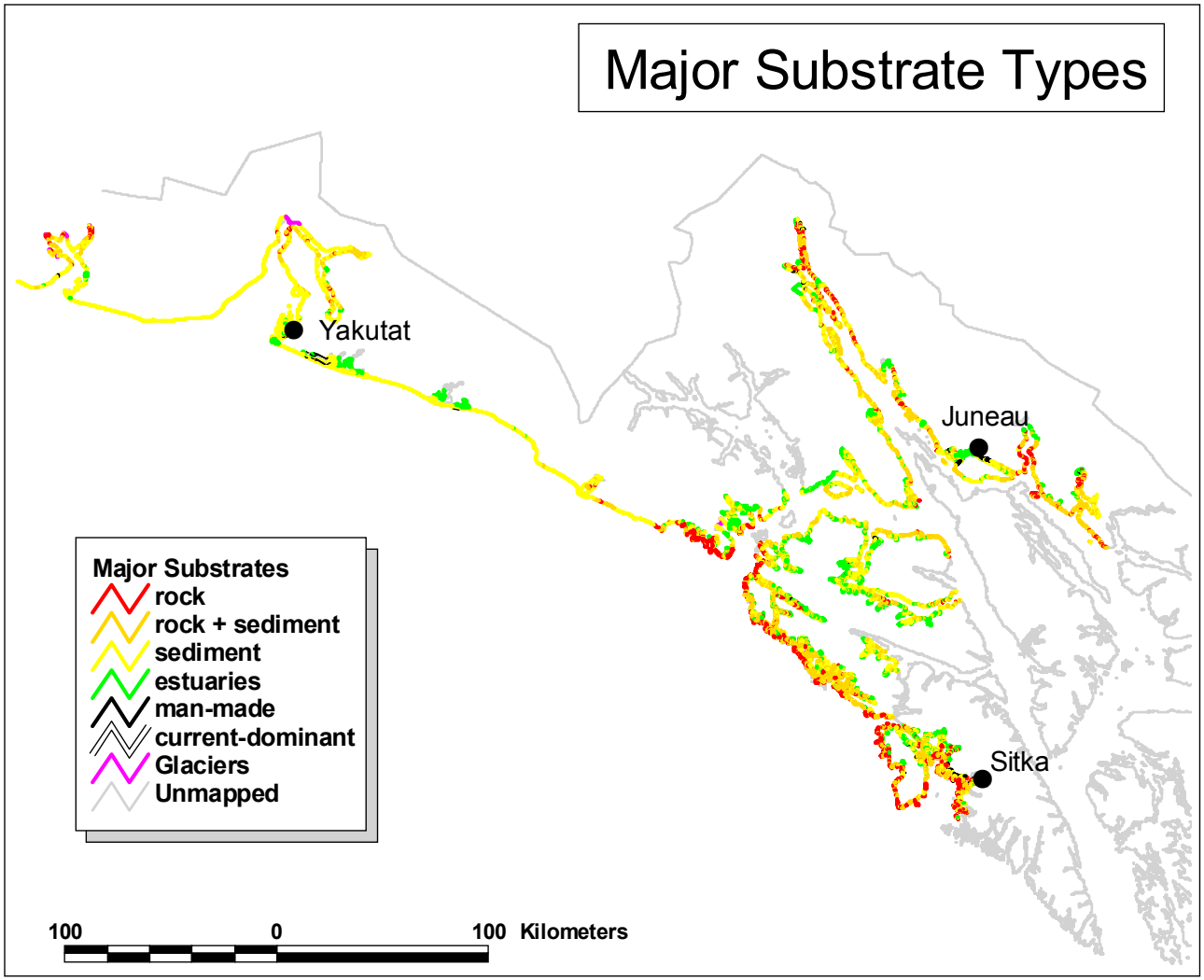


Figure 2.1. Distribution of principal substrate types (based on grouped BC Classes) in mapped areas of SE Alaska.

Table 2.3. Environmental Sensitivity Index ("ESI") classification (after Peterson et al 2002).

ESI Class	Description
1A	Exposed rocky shores and 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 (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 riprap (man-made)
8D	Sheltered rocky rubble shores
8E	Peat shorelines
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10A	Salt- and brackish-water marshes
10B	Freshwater marshes
10C	Swamps
10D	Scrub-shrub wetlands; mangroves
10E	Inundated low-lying tundra

2.2 Physical Wave Exposure

Wave exposure is an important attribute of coastal habitats, strongly influencing physical processes as well as the biotic character of the intertidal and nearshore zones. **Physical Exposure** is estimated by geologic mappers on the basis of incident wave energy, which is generally correlated to fetch distance (Table 2.5). Physical exposure is recorded as “EXP_OBSER” in the database (see data dictionary in Section 5 for other database references).

Table 2.4. Definition of physical wave exposure categories employed in ShoreZone mapping.

Code	Physical Exposure	Relative Fetch
VE	Very Exposed	> 500 km
E	Exposed	> 500 km
SE	Semi-exposed	50 - 500 km
SP	Semi protected	10 - 50 km
P	Protected	< 10 km
VP	Very Protected	<1 km

Because intertidal species generally have specific energy tolerances, observations of indicator species and biotic community assemblages can be used to define **biological exposure** in each shore unit (“EXP_BIO” in the database). This measure of exposure is discussed in Section 3.

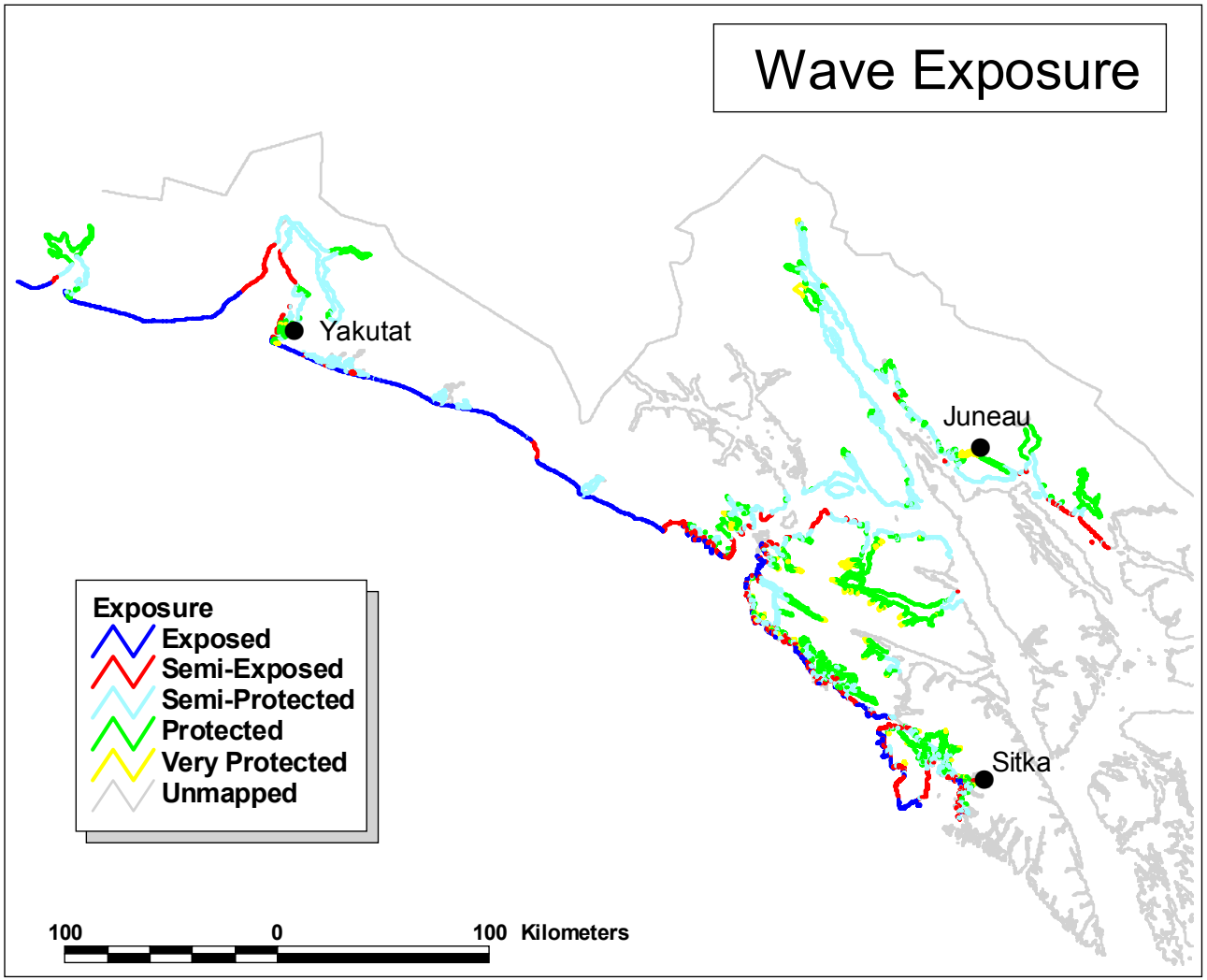


Figure 2.2. Distribution of biological wave exposure categories for mapped bioareas in SE Alaska.

2.3 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. Several coastal communities in Southeast Alaska have significant shore modifications mapped in the intertidal zone (such as Juneau, Sitka, and Skagway).

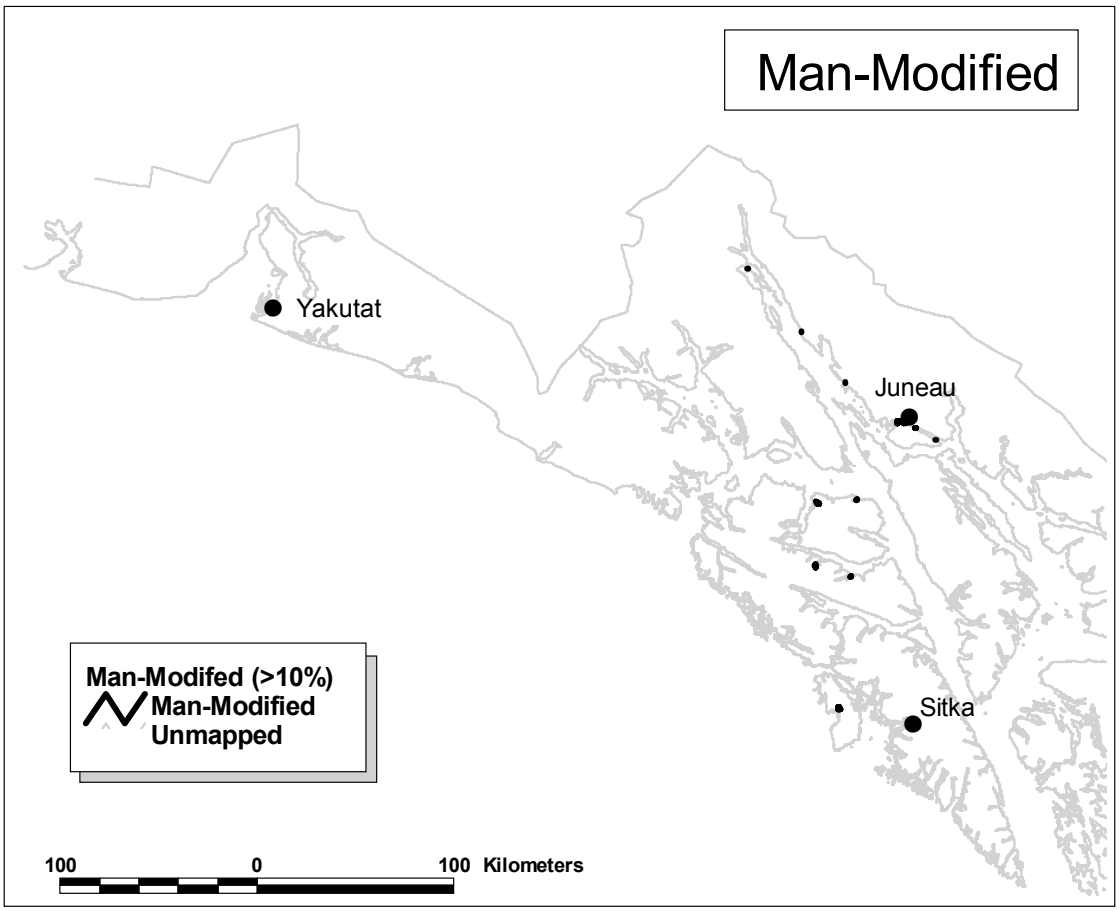


Figure 2.3. Distribution of units with more than 10% human-altered shoreline features.

2.4 Oil Residence Index (ORI)

ShoreZone coastal mapping data is potentially useful for oil spill contingency planning. In addition to the imagery and biological mapping data, physical attributes of the shoreline can be used to estimate the potential oil residence time on the basis of substrate type and wave exposure level.

Substrate permeability is of principal importance in estimating the residence time of oil on the shoreline. Impermeable surfaces such as rock or sheet piling form a barrier and have shorter oil residence times. In contrast, coarse sediments are highly permeable, can trap large volumes of oil, and have lengthy oil residence periods. In general, high-energy shorelines have short oil residence times, owing to the dissipative action of waves. Low-energy shorelines have lengthy oil residence times.

The ORI is defined for each across-shore intertidal component (zone). The ORI of the unit is calculated on the basis of those defined for each zone within the unit (Tables 2.8 and 2.9).

Table 2.5. Definitions of Oil Residence Index (ORI).

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

Table 2.6. Lookup table used to assign an Oil Residence Index (ORI) to each unit on the basis of physical exposure and sediment texture.

Substrate	VE	E	SE	SP	P	VP
Rock	1	1	1	2	3	3
Man-made, impermeable	1	1	1	2	2	2
Boulder	3	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	--	--	--	3	3	3
Organics, vegetation	--	--	--	5	5	5
Man-made, permeable	2	2	3	3	5	5

2.5 Physical Illustrations: Shore Types and Geomorphic Features

The following pages provide illustrated examples of shore types and geomorphic features mapped in Southeast Alaska.

BC Classes 1-5: Rock
BC Classes 6-20: Rock and Sediment
BC Classes 21-30: Sediment
BC Class 31: Organics (marshes, estuaries)
BC Classes 32-33: Anthropogenically-altered shorelines
BC Class 34: Current-dominated channels
BC Class 35: Glaciers
Geomorphic Features: Deltas, Mudflats, Tidal Flats, Lagoons
Anthropogenic Features: Wharves (buildings), Seawalls, and Breakwaters
Anthropogenic Features: Village Sites and Shell Middens

BC Shore Types: Rock (BC Class 1-5)

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

BC Shore Types: Rock (BC Classes 1-5, continued)

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

BC Shore Types: Rock and Sediment (BC Classes 6-20, continued)

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

BC Shore Types: Sediment (BC Classes 21-30)

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

BC Shore Types: Organic-dominated Shorelines (BC Class 31): Marshes and Estuaries

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

BC Shore Types: Anthropogenically-altered Shorelines (BC Classes 32-33)

	
The entire unit is classified as altered by human activities, including Forms for wharf ("Aw"), tailings and fill ("At")	The entire unit is classified as altered by human activities, including Forms for wharf ("Aw"), tailings and fill ("At")
Town of Pelican in Lisianski Inlet (Unit 10/02/1998)	Town of Pelican in Lisianski Inlet (Unit 10/02/2010)
SE05_MM_0524.jpg	SE05_MM_0579.jpg

BC Shore Types: Current-dominated (BC Class 34)

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

BC Shore Types: Glaciers (BC Class 35)

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

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

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

Geomorphic Features: Deltas, Mud Flats, and Tidal Flats

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

Geomorphic Features: Deltas, Mud Flats, and Tidal Flats

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

Geomorphic Features: Lagoons

	
Open lagoon (Form “Lo”), high marsh (Form “Mh”), and tidal flat (“Tt”)	Open lagoon (Form “Lo”), high marsh (Form “Mh”), and tidal flat (“Tt”)
Takanis Peninsula (Unit 10/01/3685)	Takanis Bay (Unit 10/01/3816)
SE05_MM_1023.jpg	SE05_ML_0138.jpg

Anthropogenic Features: Wharves (buildings), Seawalls, and Breakwaters

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

Anthropogenic Features: Wharves (buildings), Seawalls, and Breakwaters

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

Anthropogenic Features: Village Sites and Shell Middens

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

3 BIOLOGICAL SHOREZONE DATA SUMMARY

3.1 Biobands

Biological ShoreZone mapping includes both observed and interpreted data. A **bioband** is an observed assemblage of coastal biota with a characteristic color and cross-shore elevation, from the high supratidal to the shallow subtidal. Biobands are named for the dominant species or group that best represents the entire band (Table 3.1). Bands are spatially distinct, with alongshore and cross-shore patterns of color and texture that are visible in aerial imagery (Figure 3.1). Some biobands are characterized by a single indicator species (such as the "Blue Mussel" band, code "BMU"), while others represent an assemblage of co-occurring species (such as the "Red Algae" band, code "RED").

Biological ShoreZone mapping is based on the principle that the occurrence and extent of biobands is directly related to both the degree of wave exposure and the substrate type in the coastal zone. The observed presence, absence, and distribution (mapped as "continuous" or "patchy") of biobands within an alongshore unit are used to assign the interpreted characteristics of **biological wave exposure** and **habitat class** for the unit.

Figure 3.1. Linear "bands" of color and texture alongshore formed by biological assemblages of species in the intertidal zone. Shown is a steep, rocky shoreline in Lynn Canal (Bioarea SEFJ).

Some biobands are observed in all wave exposure categories and are considered weak as indicators (such as the ubiquitous Barnacle bioband). Other biobands are clear indicators of a particular wave exposure category (e.g. Dark Brown Kelps are always associated with higher wave exposures).

Upper intertidal biota tend to be similar between different wave exposure categories and between geographic areas, while lower intertidal biobands are often diagnostic of particular wave exposures. For example, the “Surfgrass” bioband (code “SUR”) is indicative of semi-exposed settings, while the “Eelgrass” bioband (code “ZOS”) is indicative of semi-protected and protected environments.

Four lower-intertidal biobands are particularly important as biological indicators of wave exposure: Bleached Red Algae (HAL), Red Algae (RED), Soft Brown Kelps (SBR) and Dark Brown Kelps (CHB).

Table 3.1. Biobands of 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 sp.*	VP to SP
	Marsh grasses, herbs and sedges	**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 Mussels	**BMU**	Black or blue-black	*Mytilus trossulus*	P to E
	Bleached Red Algae	**HAL**	Olive, golden or yellow-brown	Bleached foliose or filamentous red algae	P to SE
	Red Algae	**RED**	dark to bright red (non-corallines) or pink (corallines)	*Odonthalia sp.* *Neorhodomela sp.* *Palmaria sp.* other red algae, and other coralline algae	P to E
Lower Intertidal and Nearshore Subtidal	Surfgrass	**SUR**	Bright green	*Phyllospadix sp.*	SP to SE
	Alaria	**ALA**	Dark brown	*Alaria sp.*	SP to E
	Soft brown Kelps	**SBR**	Yellow-brown, olive brown or brown.	*Laminaria saccharina* morph	VP to SP
	Dark brown Kelps	**CHB**	Dark chocolate brown	Stalked *Laminaria sp.* *Lessoniopsis littoralis* other bladed kelps	SE to E
	Eelgrass	**ZOS**	Bright to dark green	*Zostera marina*	VP to SP
Sub-tidal	Dragon Kelp	**ALF**	Golden-brown	*Alaria fistulosa*	SP to E
	Macrocystis	**MAC**	Golden-brown	*Macrocystis integrifolia*	P to SE
	Bull Kelp	**NER**	Dark brown	*Nereocystis luetkeana*	SP to E

**Wave Exposure Codes: VP = Very Protected, P = Protected, SP = Semi-Protected, SE = Semi-Exposed, E = Exposed

Table 3.2. Bioband occurrence in mapped areas of Southeast Alaska

Bioband Names	Code	Continuous		Patchy		Total	% of
		(km)	%	(km)	%	(km)	Mapped
Dune Grass	GRA	2,365	38%	984	16%	3,349	54%
Sedges	SED	754	12%	482	8%	1,235	20%
Marsh grasses & herbs	PUC	1,114	18%	933	15%	2,047	33%
Barnacle	BAR	2,802	45%	1,109	18%	3,911	62%
Rockweed	FUC	1,619	26%	1,496	24%	3,115	50%
Green Algae	ULV	1,066	17%	1,504	24%	2,570	41%
Blue Mussels	BMU	914	15%	886	14%	1,800	29%
Bleached Red Algae	HAL	149	2%	199	3%	348	6%
Red Algae	RED	1,448	23%	630	10%	2,078	33%
Surfgrass	SUR	74	1%	117	2%	192	3%
Alaria	ALA	1,000	16%	453	7%	1,453	23%
Soft Brown Kelps	SBR	1,033	17%	779	12%	1,812	29%
Dark Brown Kelps	CHB	402	6%	148	2%	551	9%
Eelgrass	ZOS	767	12%	506	8%	1,274	20%
Dragon Kelp	ALF	190	3%	123	2%	313	5%
Macrocystis	MAC	420	7%	164	3%	584	9%
Bull Kelp	NER	359	6%	271	4%	629	10%

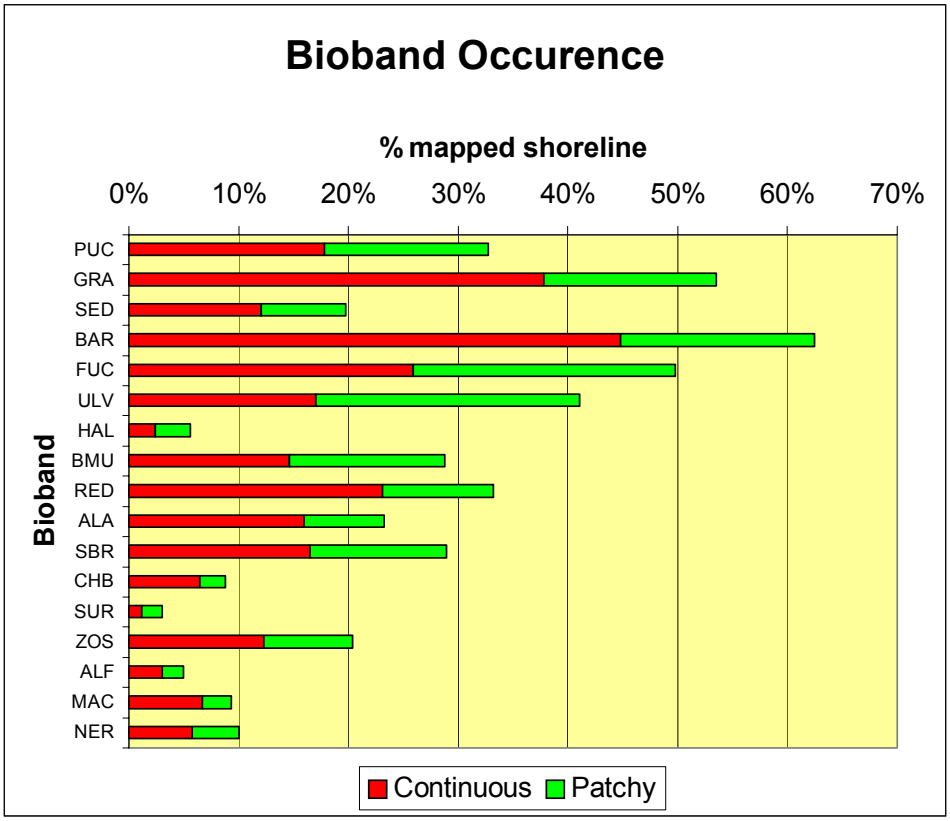


Figure 3.2. Occurrence of Biobands in Southeast Alaska as a percentage of mapped shoreline length.

3.2 Biological Illustrations: Biobands

The following pages provide illustrated examples, physical descriptions, and species assemblages for biobands mapped in Southeast Alaska.

The Splash Zone (VER) Bioband
The Dune Grass (GRA), Sedges (SED), and Marsh grasses (PUC) Biobands
The Barnacle (BAR) Bioband
The Rockweed (FUC) Bioband
The Green Algae (ULV) Bioband
The Blue Mussel (BMU) Bioband
The Bleached Red Algae (HAL) Bioband
The Red Algae (RED) Bioband
The Surfgrass (SUR) Bioband
The *Alaria* (ALA) Bioband
The Soft Brown Kelps (SBR) Bioband
The Dark Brown Kelps (CHB) Bioband
The Eelgrass (ZOS) Bioband
The Dragon Kelp (ALF) Bioband
The *Macrocystis* (MAC) Bioband
The Bull Kelp (NER) Bioband

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*.

This is a typical exposed area, on Greentop Island off Yakobi Island, with a very wide VER band. Below this band, the BAR and CHB bands are readily visible with some NER in the foamy surf.

SE05_MM_1226.jpg

BioArea SESI

The narrow banding of *Verrucaria* can be seen here as a dark stripe under the overhanging riparian on Krestof Island in Krestof Sound. Also seen are the Rockweed and filamentous Green Algae bands with Soft Brown Kelps in the subtidal. The combination of these bands indicates that the biological wave exposure is protected.

SE05_MM_6285.jpg

BioArea SESI

The Dune Grass (GRA), Sedges (SED), and Marsh grasses, herbs and sedges (PUC) Biobands

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Dune Grass**	**GRA**	Pale blue-green	*Elymus mollis*	Found in the upper intertidal zone, on dunes or beach berms. This band is often the only band present on high-energy beaches.	P-E	
A	**Sedges**	**SED**	Bright green, yellow-green to red-brown. Often appears as a mosaic of greens.	*Carex ramenskii* *Carex lynbyei* *Carex sp.* *Eleocharis sp.* *Eriophorum sp.*	Appears in wetlands around lagoons and estuaries. 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	* species referenced for this band from Cook Inlet ground survey reports: Bennett, 1996 and Tande, 1996.
A	**Marsh grasses, herbs and sedges**	**PUC**	Light, bright, or dark green, with red-brown	*Puccinellia sp.* *Plantago maritima* *Triglochin sp.* *Honkenya peploides*	Appears in wetlands around lagoons, marshes, and estuaries. Usually associated with freshwater. Often fringing the edges of GRA and SED bands.	VP-SE	*Carex sp.*

The lush tall sedges (SED) can be seen mixed with dune grass (GRA) in this protected estuary at the head of Dundas Bay, Icy Strait.

SE05_ML_1346.jpg

BioArea SEIC

The lower-lying bright green PUC band can be easily distinguished from the taller blue-green dune grass (GRA) in this estuary located at the head of Lisianski Inlet.

SE05_MM_1424.jpg

BioArea SESI

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.*

There is a nice beige frosting of barnacles in the upper intertidal of this beach on Mite Island in Lisianski Inlet.

SE05_MM_0315.jpg

BioArea SESI

The barnacles form an extensive band above the dark chocolate brown kelps on this exposed islet off Kruzof Island in Port Mary.

SE05_MM_5906.jpg

BioArea SESI

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.*

There is a thick golden orange FUC band on this beach in Tenakee inlet. Also present are the GRA and PUC bands in the supratidal and bright green ZOS on the lower flats and extending down into the subtidal.

SE05_ML_8001.jpg

BioArea SESI

The Fucus forms a continuous band in the mid-intertidal of this rocky shoreline on outer Yakobi Island.

SE05_MM_0799.jpg

BioArea SESI

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.

	
The ULV band can be seen here plastered over this nearshore reef at the current dominated junction of Lisainski Strait and Lisianski Inlet. Also notable is the extensive canopy of Nereocystis surrounding the reef.	The bright green algae band in the mid-intertidal can be readily distinguished from the darker green eelgrass band below on this beach at the northern tip of Hogan Island.
SE05_MM_0227.jpg	SE_MM_2417.jpg
BioArea SESI	BioArea SESI

The Blue Mussel (BMU) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Blue Mussels**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Appears in dense clusters that form distinct black patches or bands, either above or below the barnacle band.	P-VE	*Fucus sp.* *Semibalanus sp.* *Balanus sp.* Filamentous red algae.

Blue mussels were a dominant feature in Lynn Canal and can be seen here near the Chilkat River outlet forming a dark grey band with the orange Fucus band.

SE05_ML_0648.jpg

BioArea SEFJ

The dusky, sediment covered blue mussels form a very striking band along the bedrock shoreline in Speel Arm of Port Snettisham.

SE05_ML_9353.jpg

BioArea SEFJ

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

The golden yellow HAL band is mixed with green algae at the waterline of this islet on outer Chichagof Island.

SE05_MM_1725.jpg

BioArea SESI

These lava formations in Shelikof Bay on Kruzof Island have bleached red algae with bleached surfgrass on the upper platform. Alaria is covering the lower platform and there is a thick bed of *Macrocystis* in the subtidal.

SE05_MM_5956.jpg

BioArea SESI

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

There is a diversity of lush foliose dark red algae at waterline of this pocket beach on outer Yakobi Island.

SE05_MM_0676.jpg

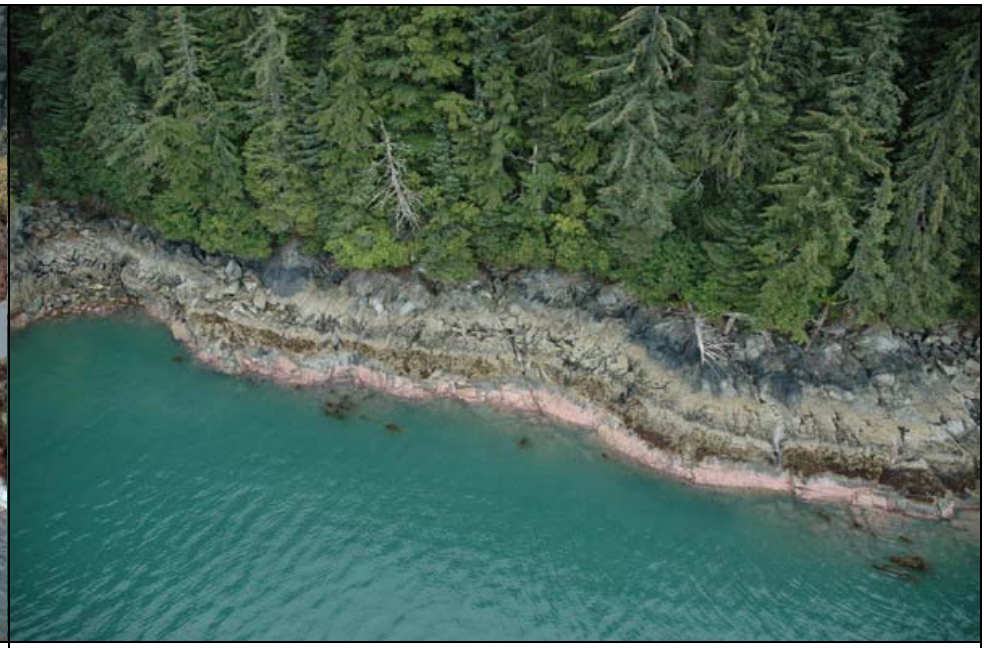
BioArea SESI

The red alga forms a beautiful brick red band at the waterline in this current dominated area of Lisianski Strait where it meets Lisianski Inlet. There is also a lush bed of Nereocystis in the nearshore subtidal.

SE05_MM_1508.jpg

BioArea SESI

The Red Algae (RED) Bioband (continued)

	
Coralline red algae, in combination with a thick barnacle band and lower intertidal Alaria and other dark brown kelps, acts as a good indicator of high wave exposure, as seen here on outer Herbert Graves Island.	Lithothamnion forms a striking light pink band on the bedrock in the lower intertidal of Stephens Passage just northwest of Taku Harbour.
SE05_MM_2668.jpg	SE05_ML_8945.jpg
BioArea SESI	BioArea SEFJ

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

This piece of semi-protected shoreline in Takanis Bay on Yakobi Island has surfgrass underwater mixed with a canopy of Macrocystis. This area acts as a good example of where surfgrass would be found at the lowest wave energy level.

SE05_MM_1079.jpg

BioArea SESI

The bright green surfgrass can be seen on the lower platform and extending down into the subtidal near Middle Island in Sitka Sound.

SE05_MM_5135.jpg

BioArea SESI

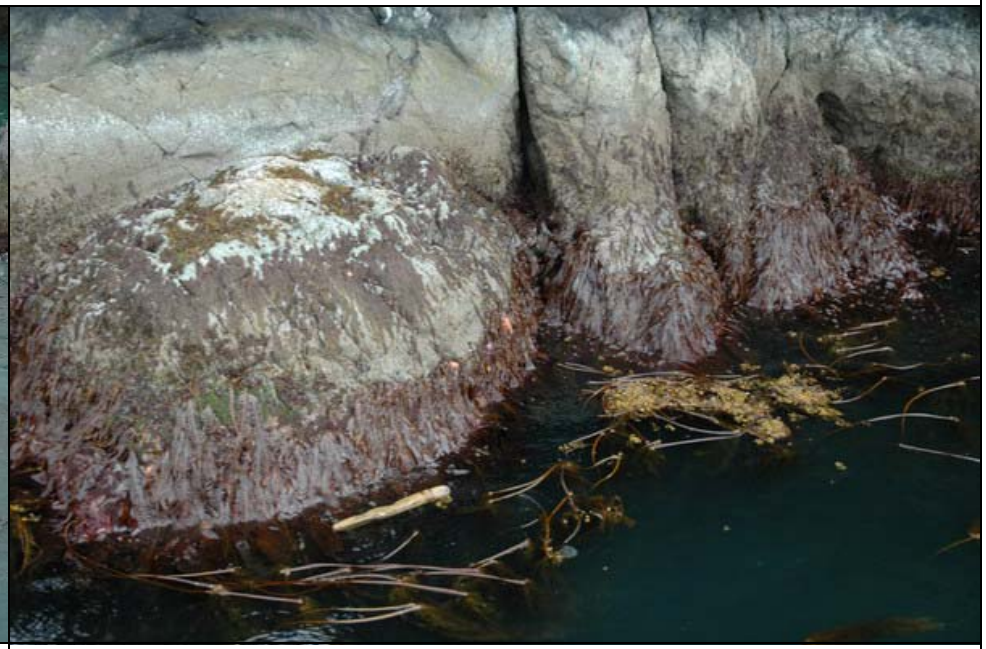
The *Alaria* (ALA) Bioband

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.*

These semi-exposed steep rocky cliffs in North Inian Pass, Cross Sound, have a lush ALA band at the waterline. This band alone is a good indicator for a high level of wave energy.

SE05_ML_1287.jpg

BioArea SEIC



The ALA band in Salisbury Sound, Chichagof Island, just northwest of Neva Strait, is an iridescent, deep red band in the lower intertidal. Bright orange and purple *Pisaster* sea stars cling to bedrock draped by *Alaria*. Long, shiny stipes of the bull kelp *Nereocystis* are also seen in the nearshore subtidal.

SE05_MM_4991.jpg

BioArea SESI

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.	*Laminaria saccharina* *Cystoseira sp.*	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.* *Hedophyllum sessile* (bullate)

There is a lush SBR band in the outflow of this large tidal pool on Herbert Graves Island off outer Chichagof Island.

SE05_MM_2636.jpg

BioArea SESI

The ruffled soft brown kelps form a continuous band in the subtidal throughout Slocum Arm heading into Ford Arm on Chichagof Island.

SE05_MM_3912.jpg

BioArea SESI

The Soft Brown Kelps (SBR) Bioband (continued)

	
This is an excellent example of a protected biological wave exposure on Kruzof Island in Kruzof Sound with Fucus in the intertidal zone and encrusted soft brown kelps in the subtidal.	The SBR band can be seen as dark patches under the blue-green water of Icy Strait on northwest Pleasant Island. The presence of this band is a good indicator of a lower biological wave exposure. Also notable is the bright green colour of the ULV band on the lower beach and platform.
SE05_MM_6287.jpg	SE05_ML_6184.jpg
BioArea SESI	BioArea SEIC

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* *Laminaria bongardiana* *Laminaria yezoensis* *Lessoniopsis littoralis* *Hedophyllum sessile* (smooth)	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery, 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.* *Neoptilota sp.*

A dense band of dark brown kelps is the dominant biota in this exposed area of Takanis Peninsula on Yakobi Island. This band alone can be considered a good indicator of a high biological wave exposure.

SE05_MM_0993.jpg

BioArea SESI

This reef off southwest Kruzof Island has a diversity of red algae, Alaria and dark brown kelps out of the water and extending below the waterline and Nereocystis subtidally.

SE05_MM_5982.jpg

BioArea SESI

The Dark Brown Kelps (CHB) Bioband (continued)

	
Laminaria setchelli stalks can be seen sticking up out of the water on this reef offshore Cape Spencer in Cross Sound. Often this species can be identified from the bent over stalks, with large fronds attached, when out of the water at low tide. A dense canopy of *Alaria fistulosa* mixed with *Nereocystis luetkeana* surrounds the reef.	There are dark brown kelps forming a continuous CHB band around this reef south of Graves Harbour in Cross Sound.
SE05_ML_1127.jpg	SE05_ML_1130.jpg
BioArea SEIC	BioArea SEIC

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*.

There is a continuous expanse of dense eelgrass offshore this protected stretch of coastline deep in Surge Bay on Yakobi Island.

SE05_MM_0791.jpg

BioArea SESI

This protected estuary on Krestof Island in Krestof Sound has a thick bed of eelgrass on the lower flats and underwater. The green algae band can be seen out of the water on the tombolo to the left and can be distinguished from the eelgrass band by its lighter lime green colour.

SE05_MM_6227.jpg

BioArea SESI

The Dragon Kelp (ALF) Bioband

Zone	Bio-band Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with very long blade and hollow floating midrib, found in nearshore habitats. If associated with NER, it occurs inshore of the bull kelp.	SP-E	*Alaria sp.* *Nereocystis luetkeana*

The ALF band forms an extensive canopy in the subtidal, with NER farther offshore, at Point Gustavus in Icy Strait.

SE05_ML_5987.jpg

BioArea SEIC

Long, narrow strands of dark brown dragon kelp can be seen in the subtidal of this boulder-cobble beach in Gilbert Bay, Port Snettisham. The kelp can be identified by its rope-like appearance imparted by hollow, floating midribs and long blades.

SE05_ML_9672.jpg

BioArea SEFJ

The *Macrocystis* (MAC) Bioband

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

Macrocystis can be identified by its long stipes with multiple floats and fronds as shown here in the subtidal zone off Yakobi Island on the eastern side of Takanis Bay.

SE05_MM_1121.jpg

BioArea SESI

The golden brown giant kelp forms extensive canopies along outer Chichagof Island, as seen here in Islas Bay.

SE05_MM_1673.jpg

BioArea SESI

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*	A distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa* and *Macrocystis*. Often indicates higher current areas if observed at lower wave exposures.	SP-VE	*Alaria fistulosa* *Macrocystis integrifolia*

Bull kelp (*Nereocystis*) can be seen here in North Inian Pass, Cross Sound, forming a thick canopy swirling around the offshore reefs.

SE05_ML_1279.jpg

BioArea SEIC

The floating bulb and long stipe of each *Nereocystis* plant can be easily identified in the nearshore of this rocky islet off Yakobi Island. The presence of *Nereocystis* indicates higher wave exposure.

SE05_MM_0748.JPG

BioArea SESI

3.3 Bioband Distribution Maps by BioArea

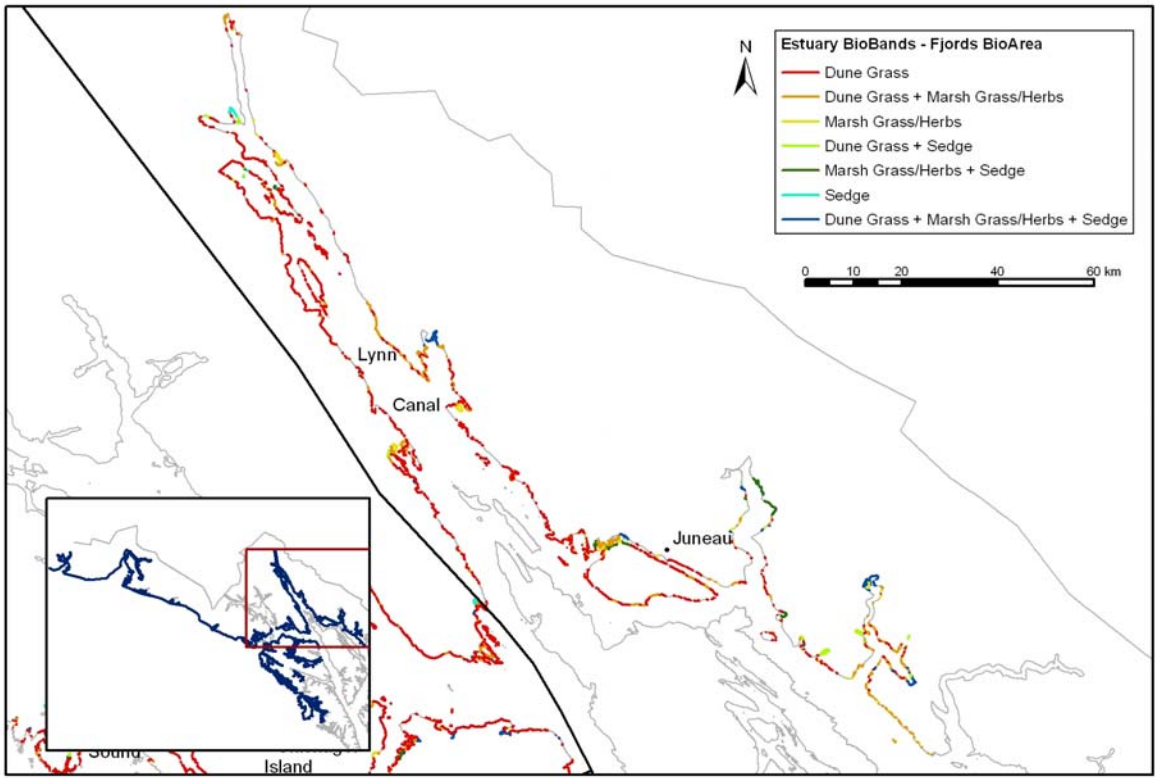
Distribution of Saltmarsh Biobands by Bioarea

In biological ShoreZone mapping, three biobands of salt-tolerant grasses and herbs (GRA, PUC, and SED) are used to define saltmarsh and estuary habitats. Shorelines where all three biobands co-occur are at the largest wetland complexes. Only the Dune Grass bioband occurs frequently without the other two salt-tolerant herb bands, usually in the log line of beaches, and not necessarily associated with estuaries.

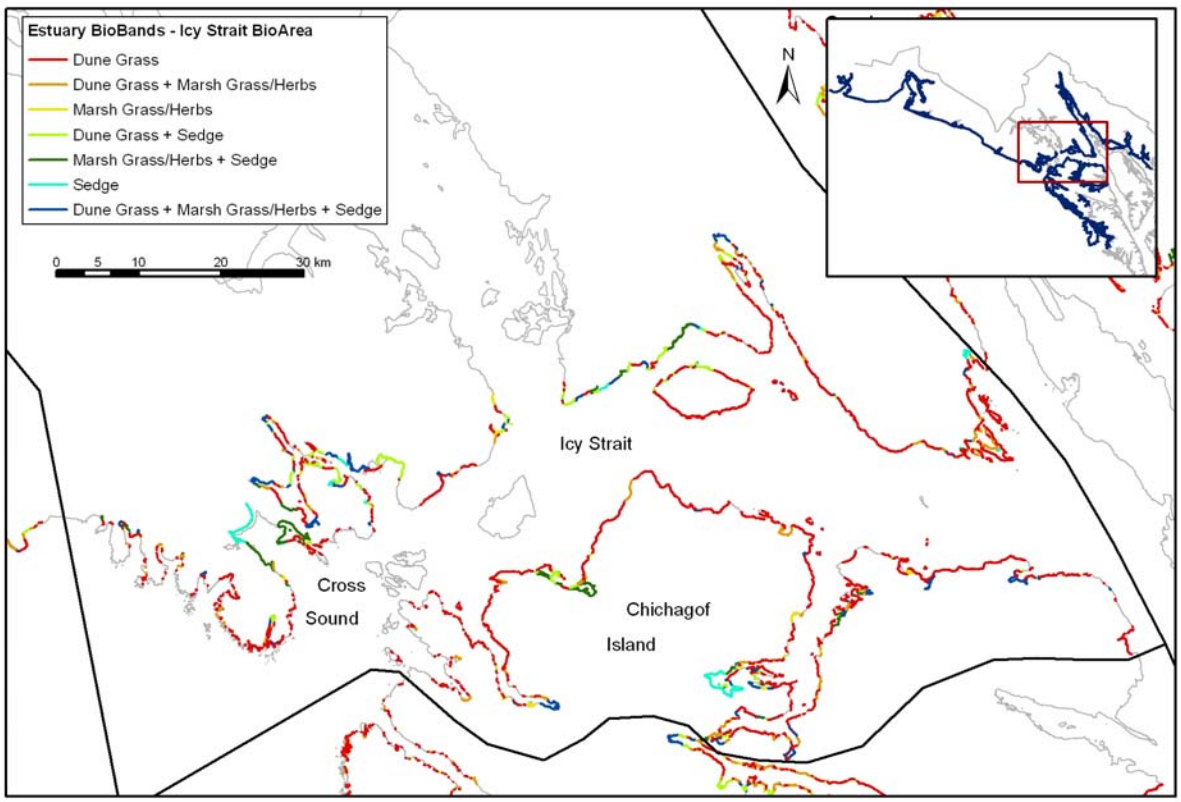
Combinations of these three biobands are examined in the four bioareas of Southeast Alaska, shown in the distribution maps on the following pages. Biological illustrations of these biobands can be found in Section 3.2.

Saltmarsh biobands and combinations:

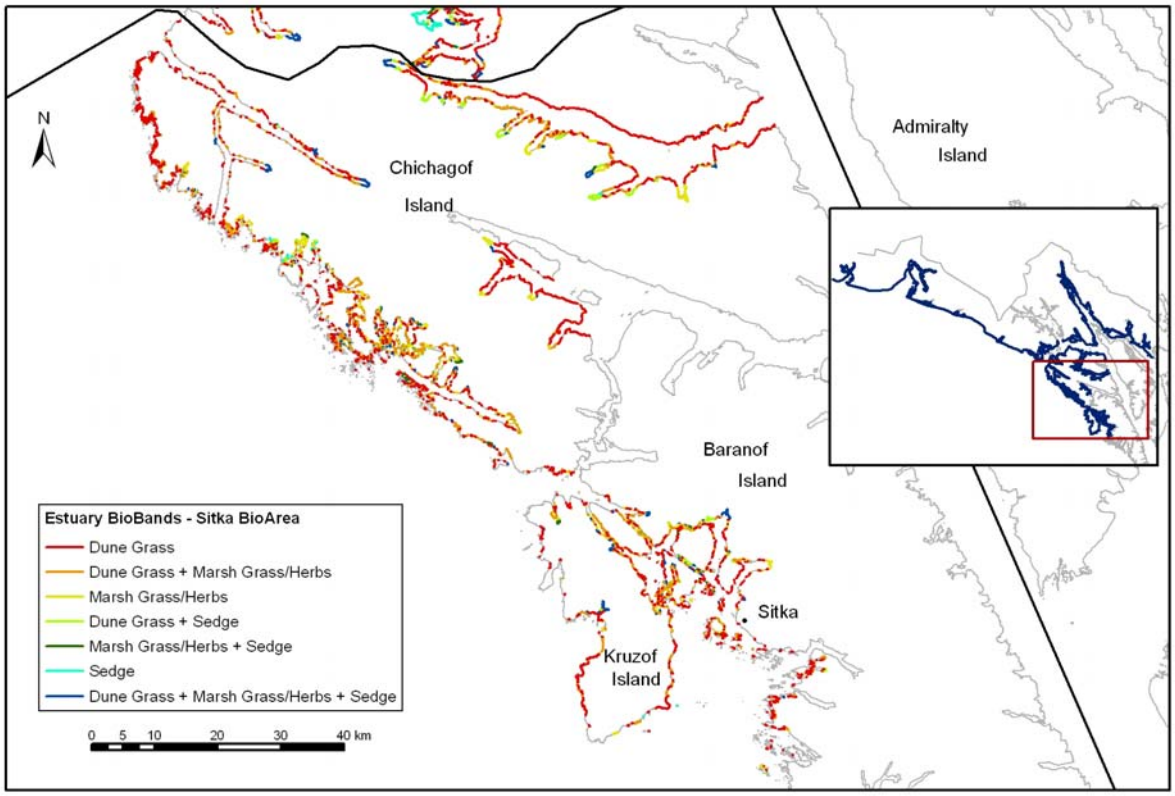
1. GRA – Dune Grass bioband alone – good indicator of dunes on upper beach berms on mobile beaches, or at narrow fringing salt marsh.
2. GRA + PUC – Dune Grass and Marsh Grasses/Herbs – good indicator of fringing salt marsh or smaller salt marsh /estuary areas
3. PUC – Marsh Grasses/Herbs – good indicator of fringing salt marsh or smaller salt marsh /estuary areas
4. GRA + SED – Dune Grass and Sedge – good indicator of smaller salt marsh/estuary areas
5. PUC + SED -- Marsh Grasses/Herbs and Sedge -- good indicator of smaller salt marsh/estuary areas
6. SED – Sedge – good indicator of freshwater input, usually associated with streams
7. GRA + PUC + SED – Dune Grass and Marsh Grasses/Herbs and Sedge biobands – best indicator of contiguous salt marsh /estuary areas



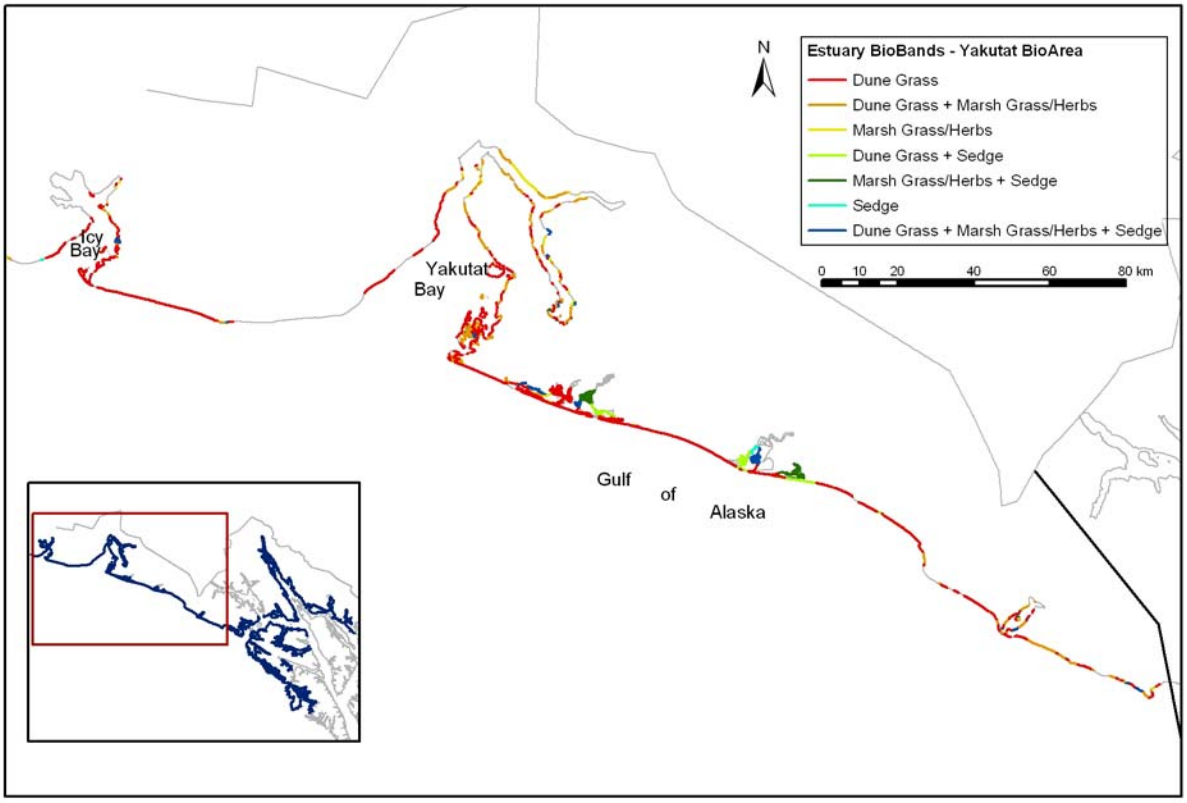
Fjord Bioarea – Salt-tolerant herbs and grasses bioband combinations



Icy Strait Bioarea – Salt-tolerant herbs and grasses bioband combinations



Sitka Bioarea – Salt-tolerant herbs and grasses bioband combinations



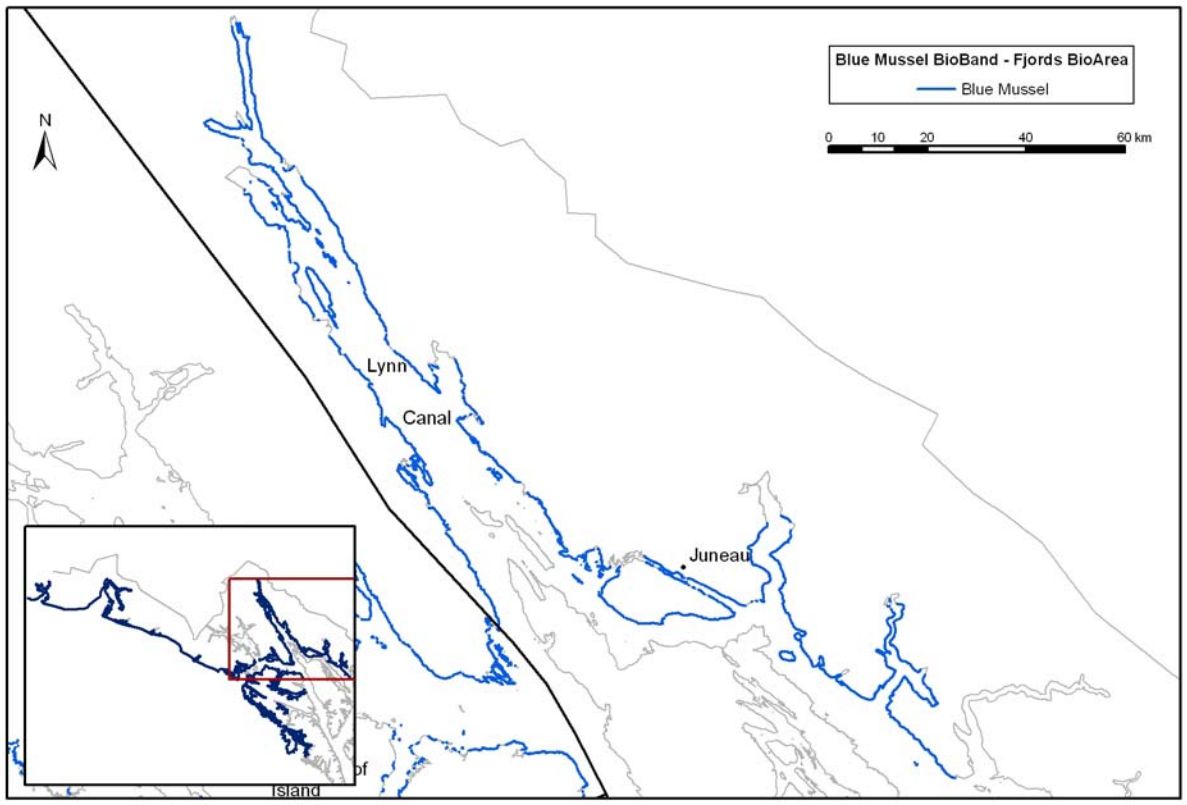
Yakutat Bioarea – Salt-tolerant herbs and grasses bioband combinations

Distribution of the Blue Mussel Bioband by Bioarea

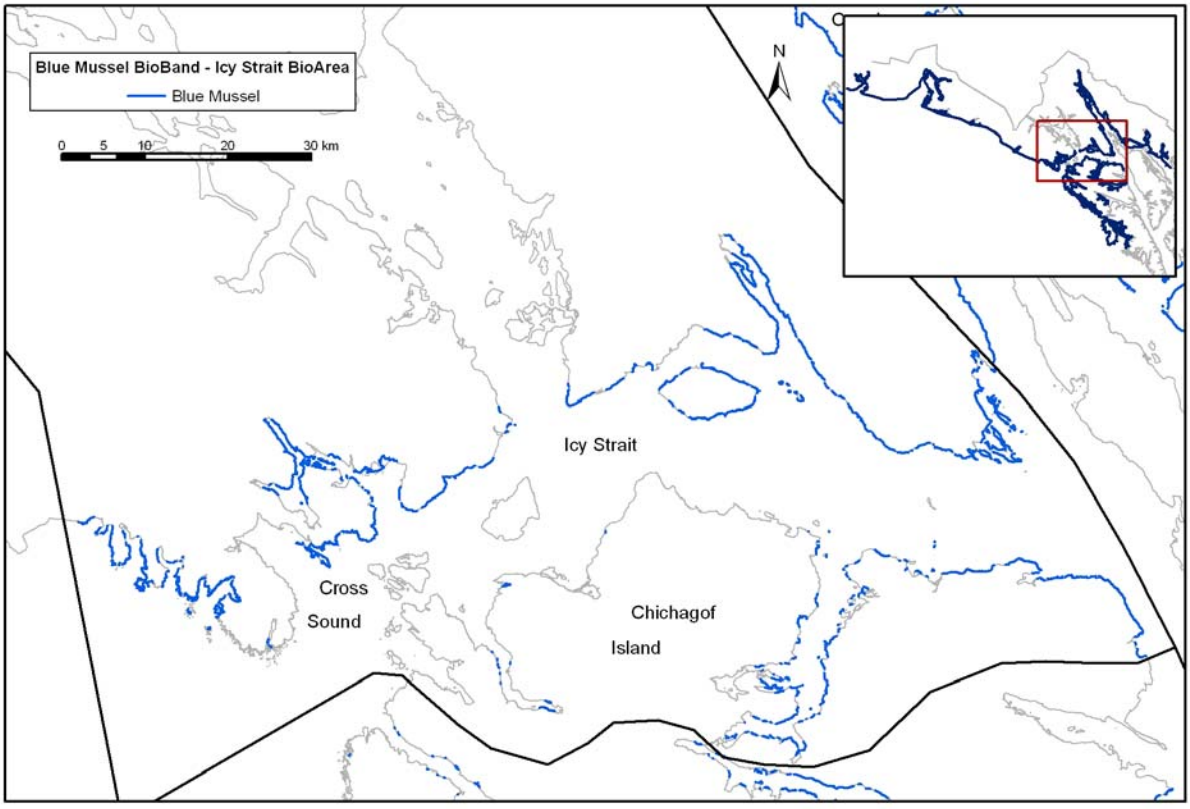
The distribution of the Blue Mussel bioband is shown for each bioarea in the following four maps. The band has been mapped as a single theme to highlight the regional differences. Biological illustrations of this bioband can be found in Section 3.2.

In Lynn Canal, the immobile substrate and the fjord habitat has continuous Blue Mussel, while in Icy Strait, the Blue Mussel is mapped as patchy on the wide sediment shorelines. In the Sitka area, the Blue Mussel band is uncommon, and was mapped only in a few protected shorelines, associated with wetlands and lower wave exposures.

Distribution of the Blue Mussel Bioband by Bioarea

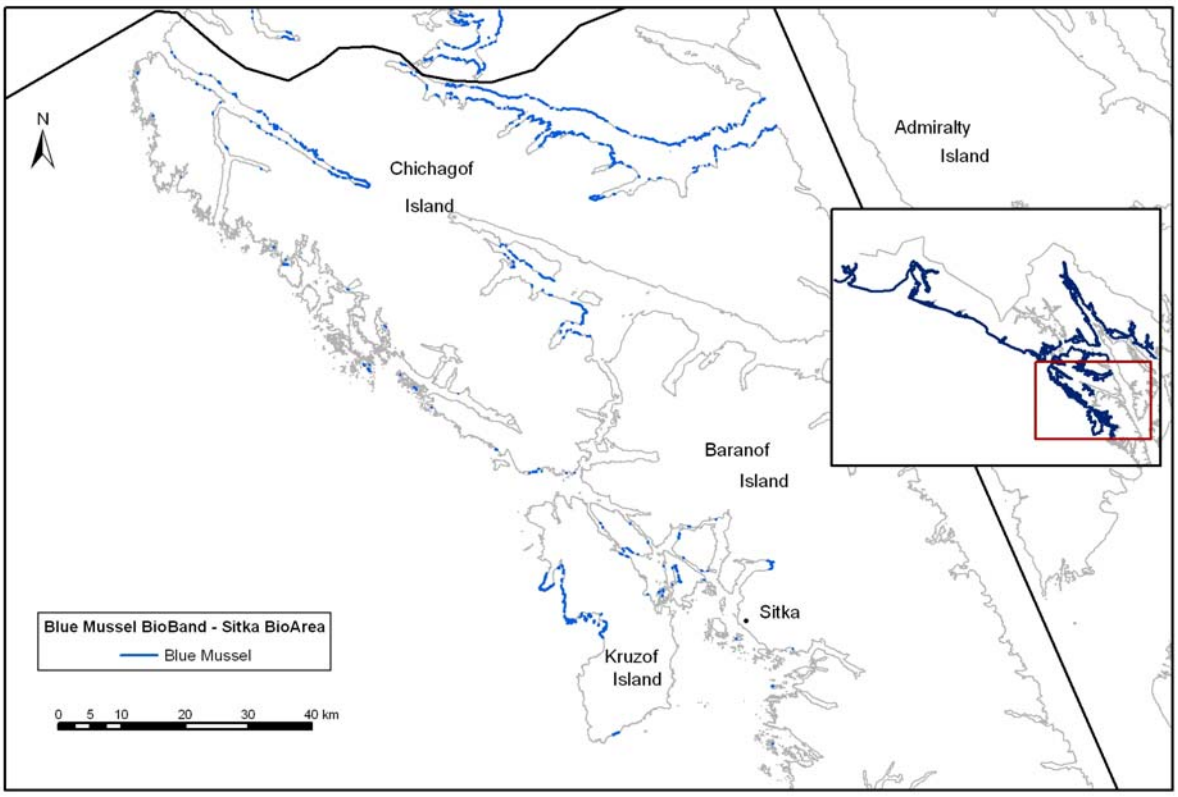


Fjords Bioarea – Blue Mussel Bioband Distribution

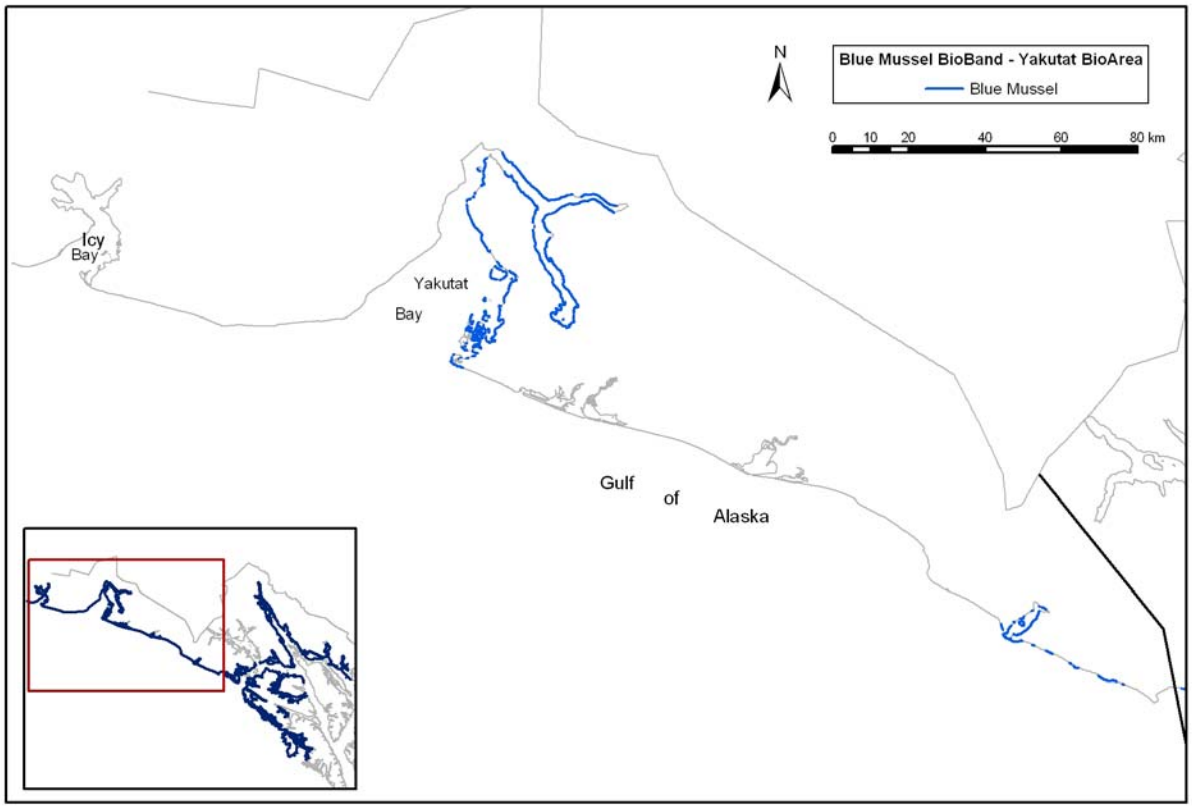


Icy Strait Bioarea -- Blue Mussel Bioband Distribution

Distribution of the Blue Mussel Bioband by Bioarea



Sitka Bioarea -- Blue Mussel Bioband Distribution



Yakutat Bioarea -- Blue Mussel Bioband Distribution

Regional Maps of the Distribution of Combinations of Lower Intertidal Biobands

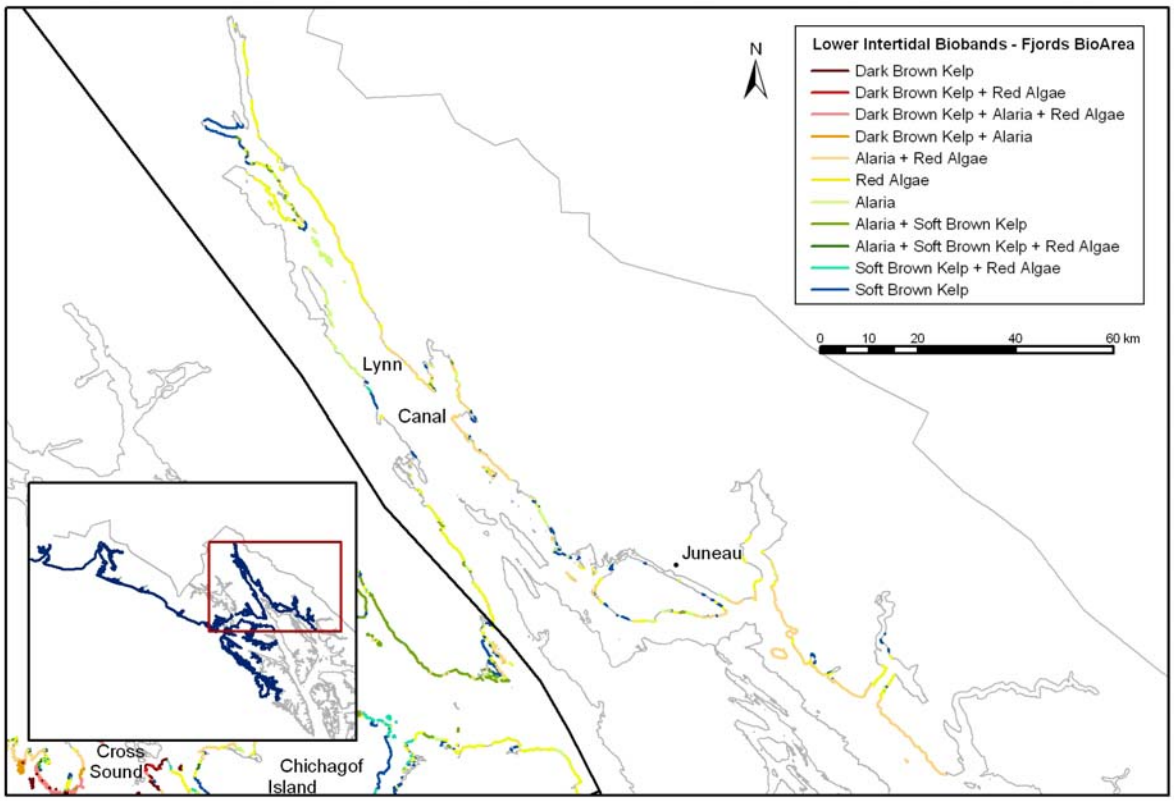
The distribution of the complex of lower intertidal bioband is shown for each bioarea in this section of maps. Four biobands (CHB – Dark Brown Kelps; ALA – Alaria; RED – Red Algae; and SBR – Soft Brown Kelps), and the most common combinations of these have been mapped to show regional differences. Example photos of these four biobands are shown in the biological illustrations in Section 3.2.

The combination of the lower intertidal biobands is the most diagnostic of differences between wave exposures and between regions, and represent the gradation in wave exposure across the area. The Sitka bioarea has most of the higher exposure combinations (which all include the Dark Brown Kelp bioband). The Soft Brown Kelp combinations characterize lower wave exposures.

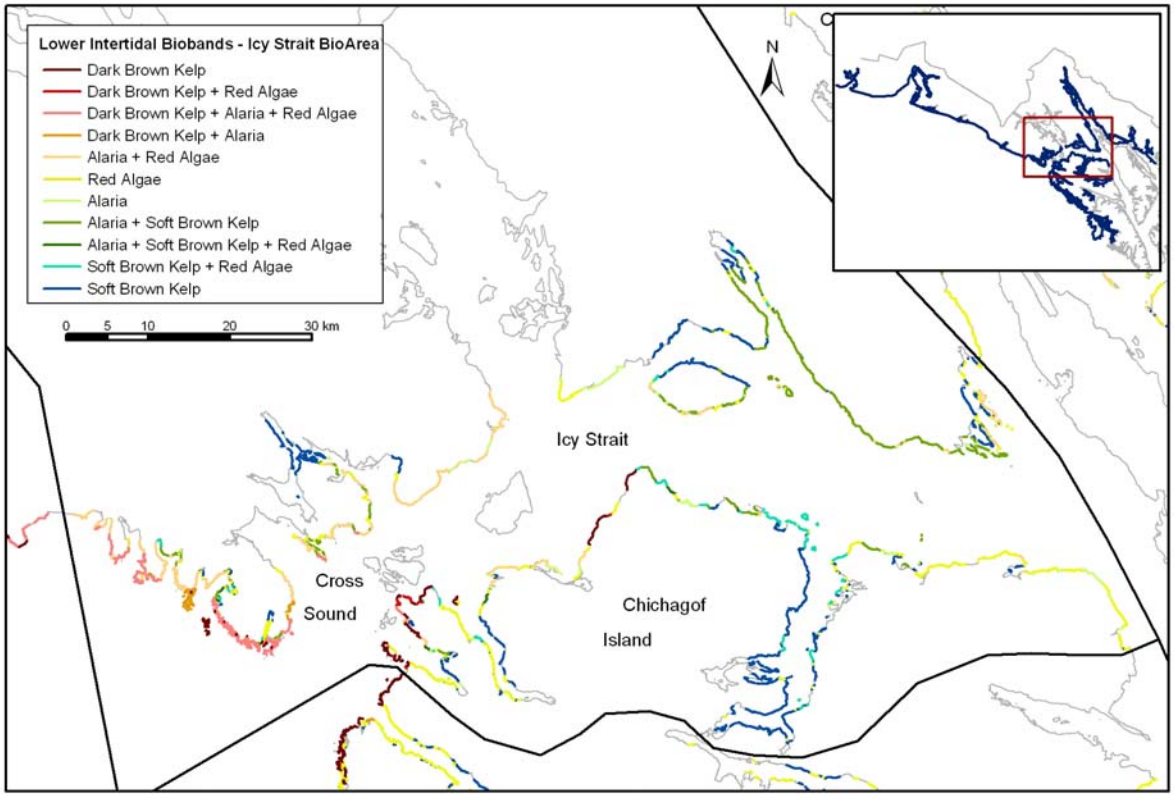
The bioband combinations mapped in these figures are:

1. CHB – Dark Brown Kelps – good indicator of Exposed
2. CHB + RED – Dark Brown Kelps and Red Algae – good indicator of Exposed
3. CHB + ALA + RED – Dark Brown Kelps and Alaria and Red Algae – good indicator of Semi-Exposed to Low Exposed
4. CHB + ALA – Dark Brown Kelps and Alaria – good indicator of Semi-Exposed to Low Exposed
5. ALA + RED – Alaria and Red Algae – good indicator of Semi-Exposed to High Semi-Protected
6. RED – good indicator of Semi-Protected
7. ALA – good indicator of Semi-Exposed to High Semi-Protected
8. ALA + SBR – good indicator of high Semi-Protected
9. ALA + SBR + RED – good indicator of High Semi-Protected to Low Semi - Exposed
10. SBR + RED – good indicator of Semi-Protected
11. SBR – good indicator of Semi-Protected

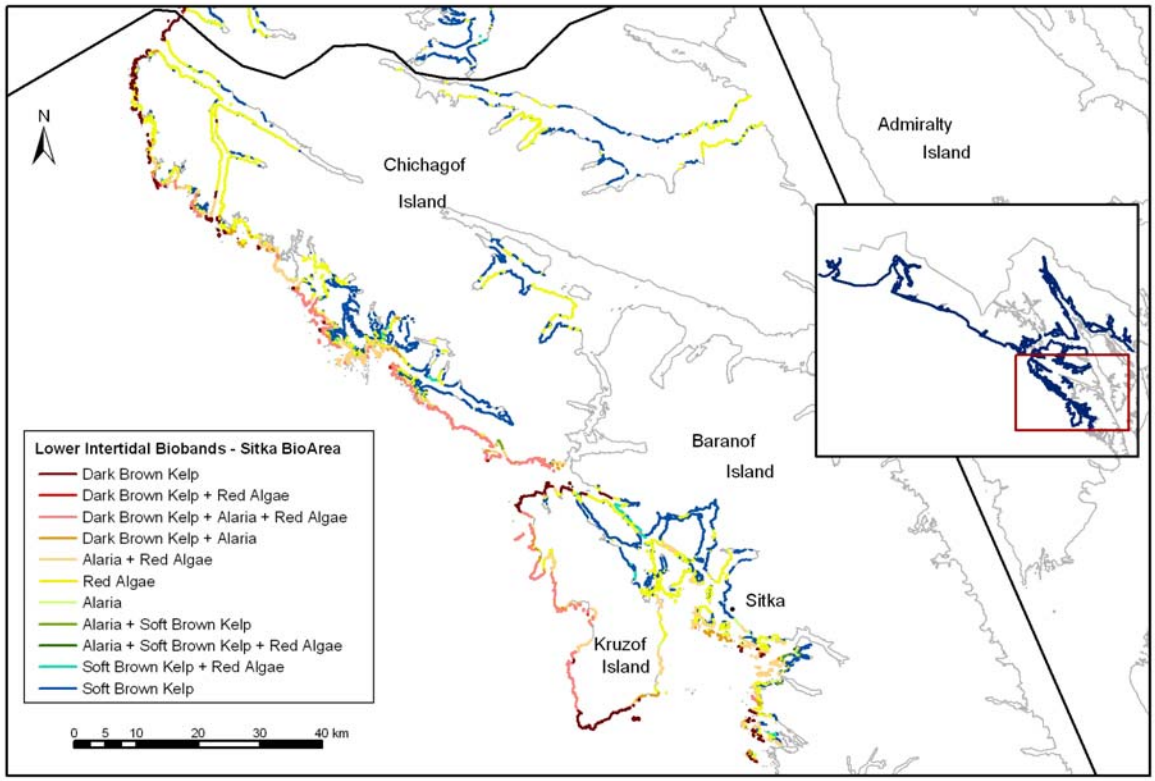
Distribution of Lower Intertidal Bioband Combinations by Bioarea



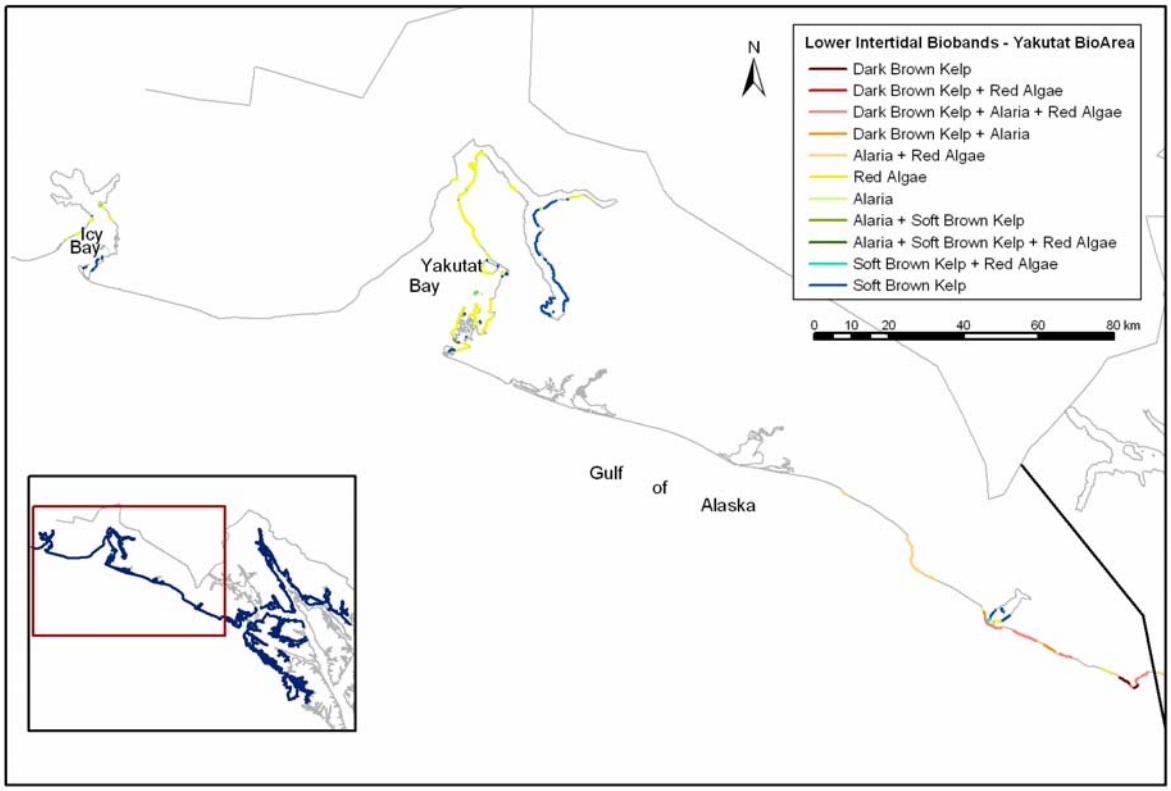
Fjords Bioarea – Lower Intertidal Bioband Combinations



Icy Strait Bioarea -- Lower Intertidal Bioband Combinations



Sitka Bioarea -- Lower Intertidal Bioband Combinations



Yakutat Bioarea -- Lower Intertidal Bioband Combinations

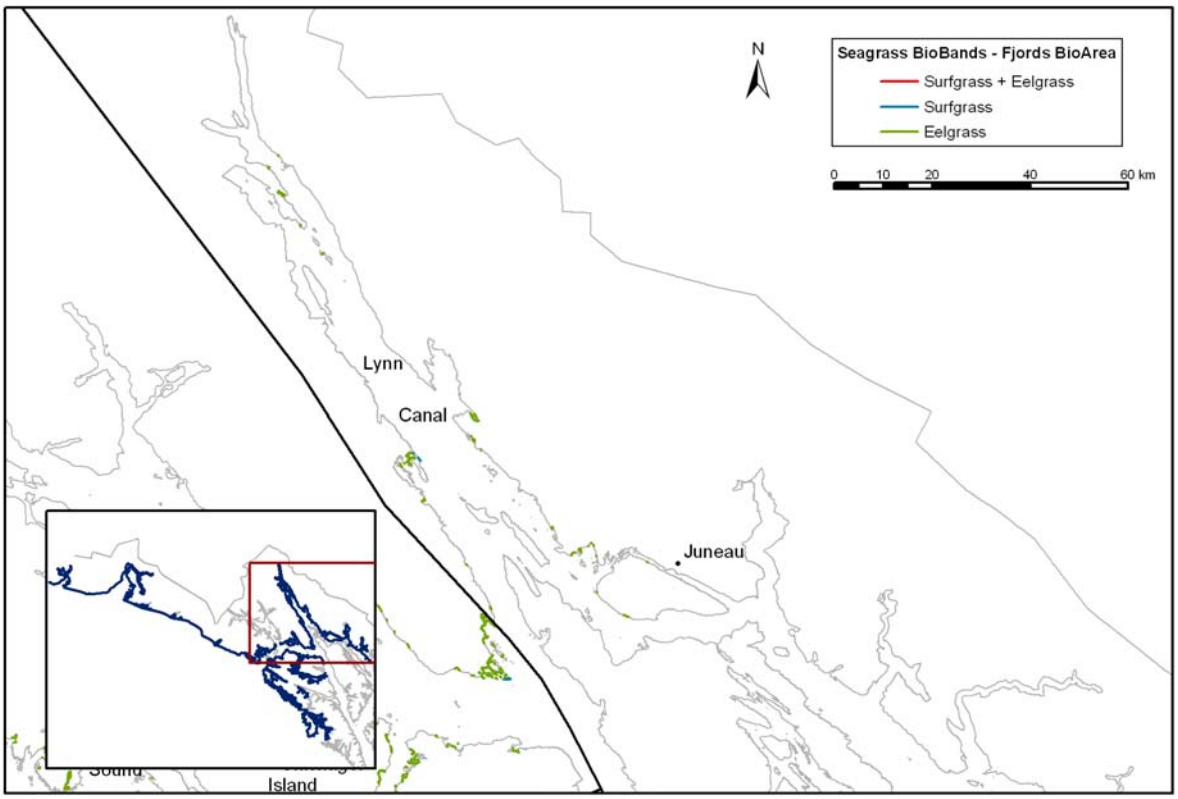
Regional Maps of the Distribution of Seagrass Biobands

The distribution of the lower intertidal seagrass biobands is shown for each bioarea in the maps in this section. Two biobands (SUR – Surfgrass and ZOS – Zostera) have been mapped to show regional differences. Example photos of these two biobands are shown in the biological illustratations in Section 3.2.

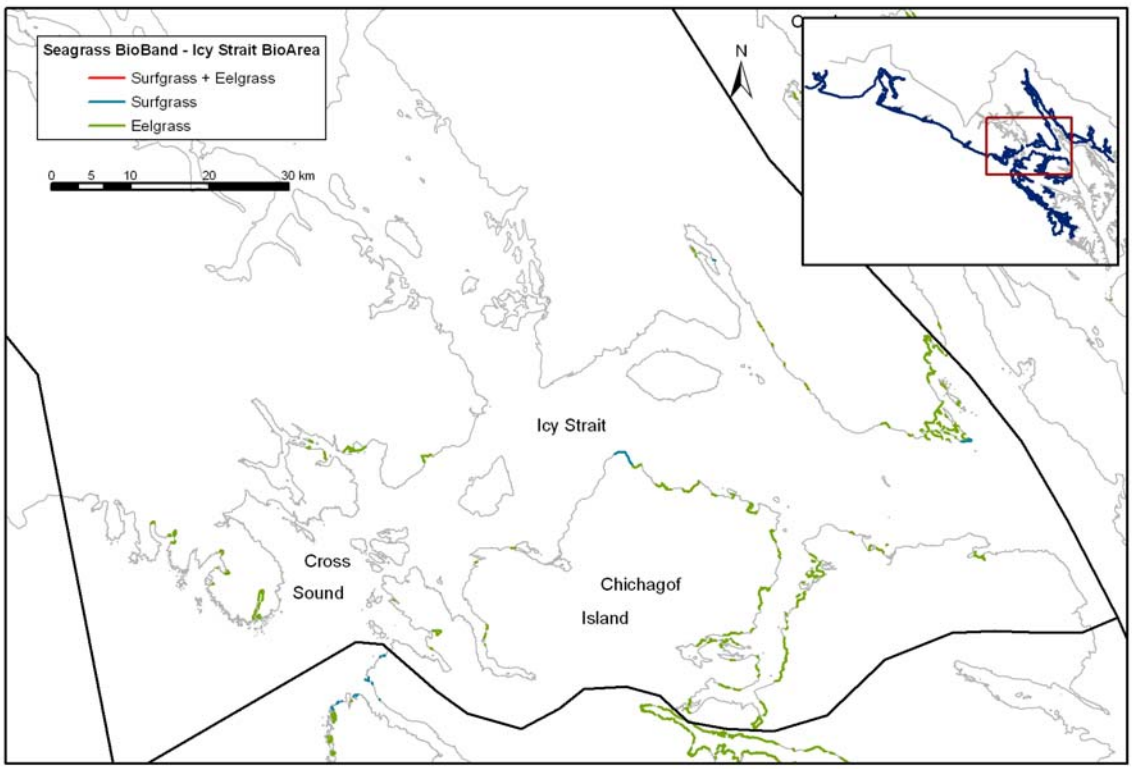
The regional differences in seagrass distribution are striking. Eelgrass was observed in only a few bays in the Lynn Canal area, whereas it is widely distributed in the protected waters of Icy Strait.

The majority of the surfgrass is found in the Sitka area, largely a reflection of the coastal habitat types in that region. Only a few units had co-occurrence of both of the seagrass bands (eelgrass and surfgrass), and those were observed near Sitka.

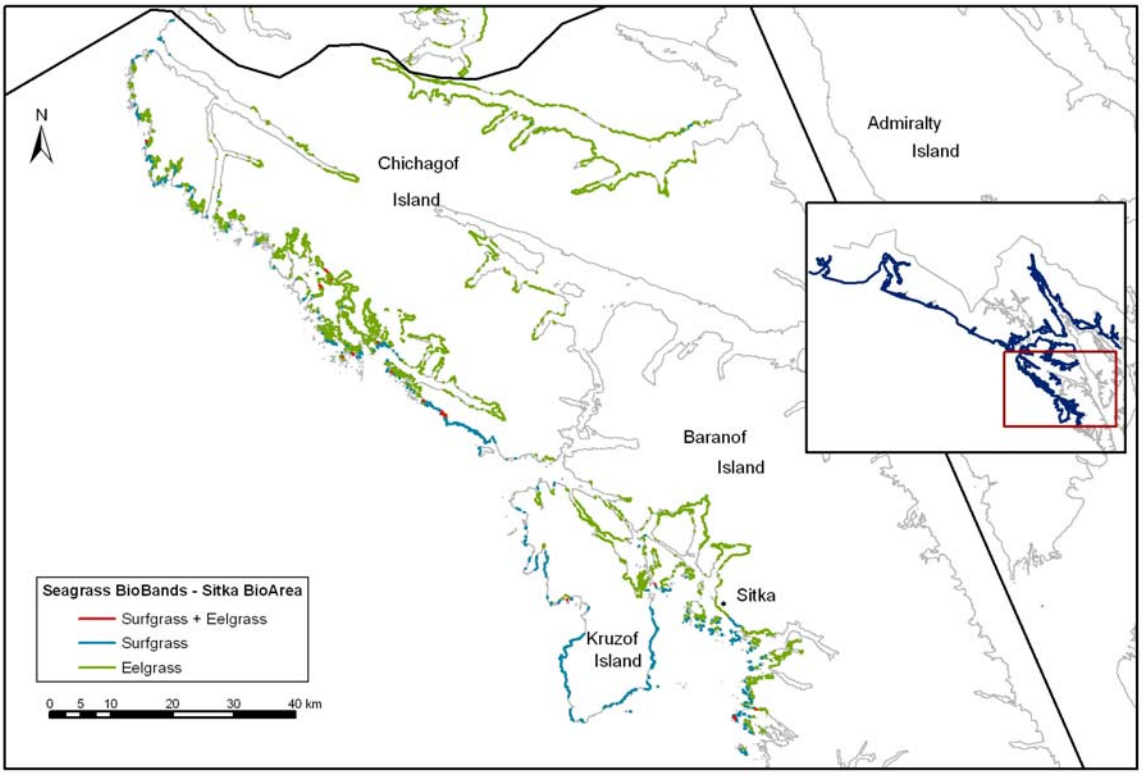
Distribution of Seagrass Biobands by Bioarea



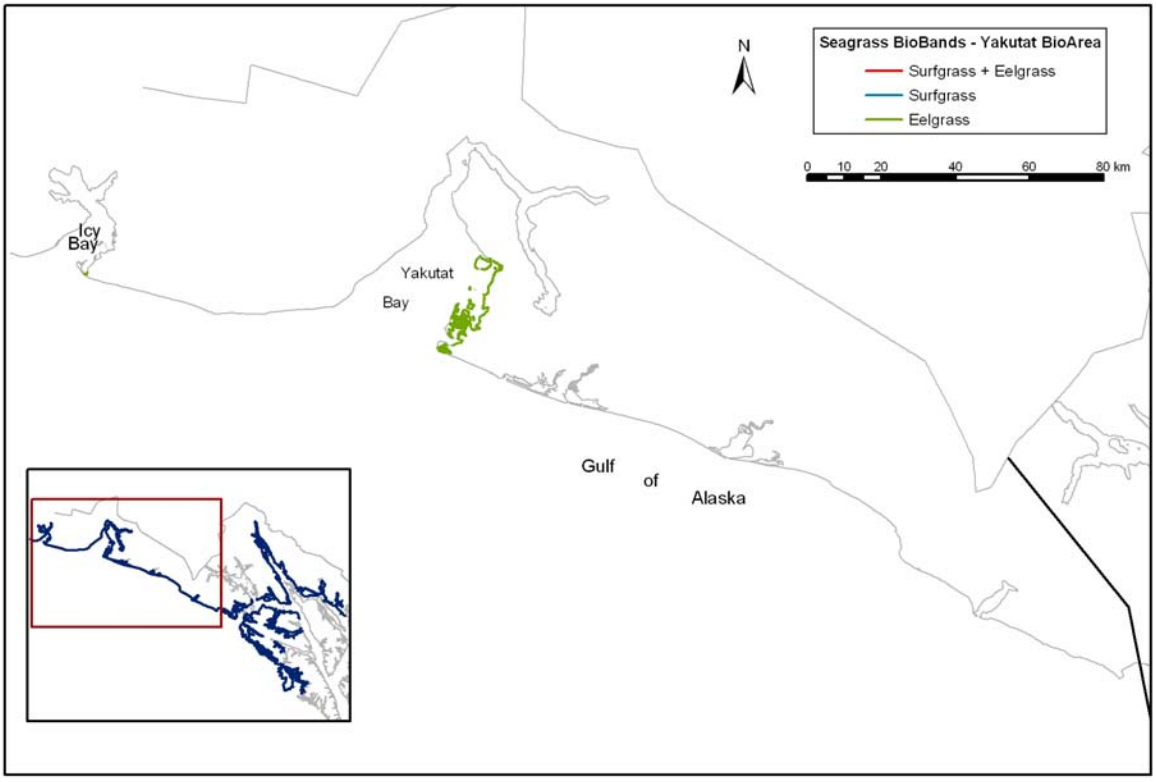
Fjords Bioarea – Lower Intertidal Seagrass Distribution



Icy Strait Bioarea – Lower Intertidal Seagrass Distribution



Sitka Bioarea – Lower Intertidal Seagrass Distribution



Yakutat Bioarea – Lower Intertidal Seagrass Distribution

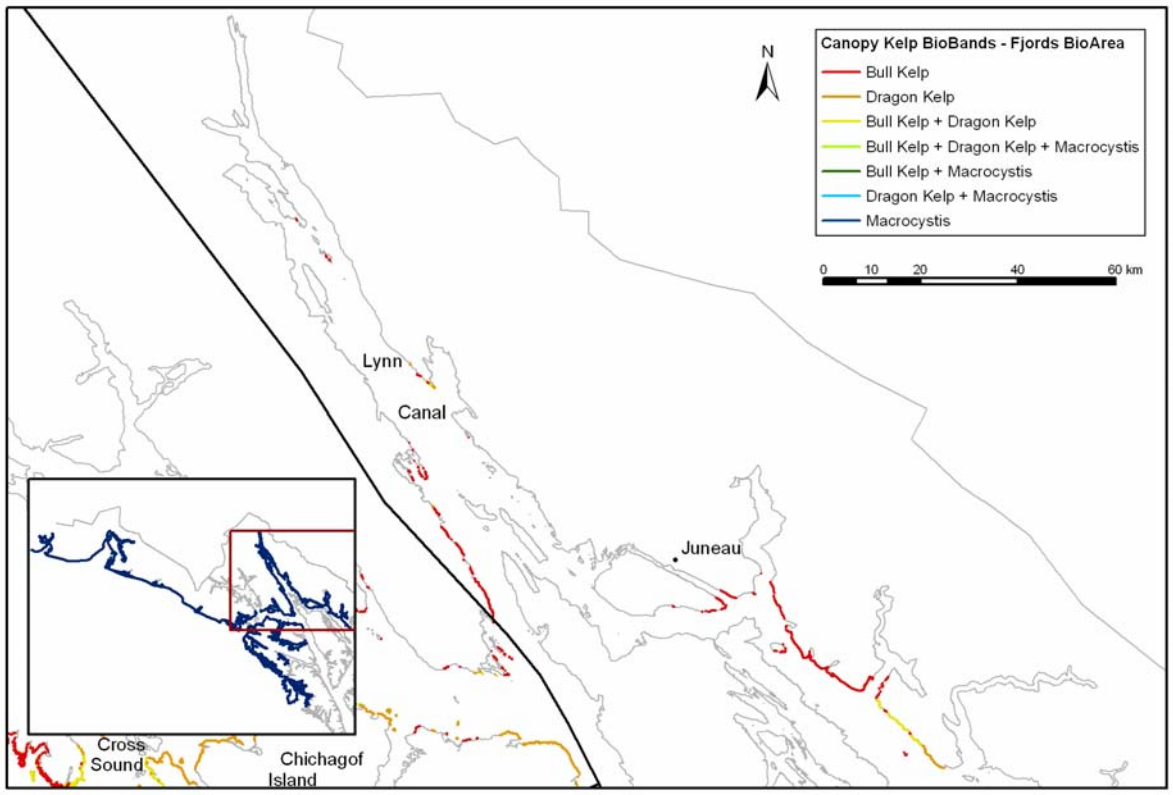
Regional Maps of the Distribution of Nearshore Canopy Kelp Biobands

The distribution of nearshore canopy kelp biobands is shown for each bioarea in the maps in the section. Three biobands (NER – Bull Kelp, ALF – Dragon Kelp and MAC – Giant Kelp *Macrocystis*) have been mapped to show regional differences. Example photos of these three biobands are shown in the biological illustrations of Section 3.2.

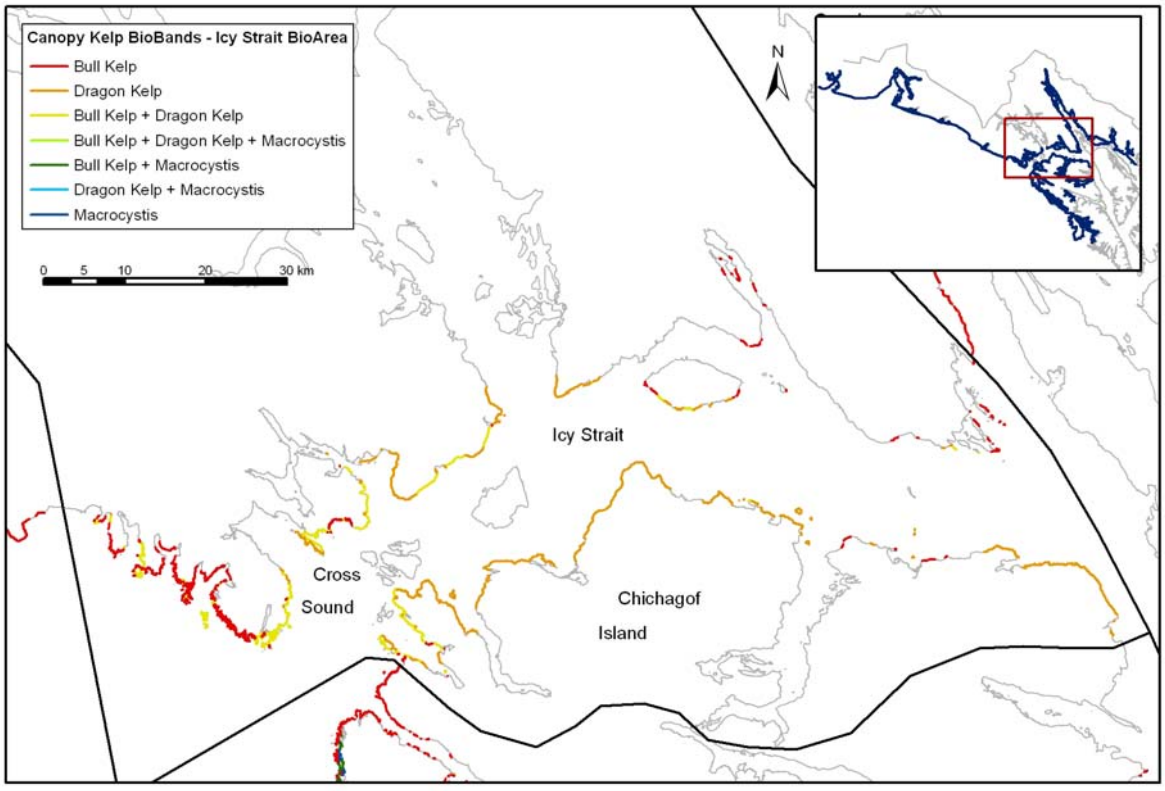
The regional differences in the canopy kelp distribution are striking, with only Bull Kelp observed in Lynn Canal, Dragon Kelp dominating in Icy Strait, and *Macrocystis* dominant in Sitka Sound. The Yakutat bioarea has almost no canopy kelps. The three species co-occurred in only a few units, at the north end of Kruzof Island.

The three species of canopy kelps have different energy tolerances. The Bull Kelp band in found in the highest-energy areas on stable substrates and also in current-affected areas. The Dragon Kelp band is observed in moderate exposures and in milky glacial water. The *Macrocystis* kelp band is found in moderate to lower wave exposures.

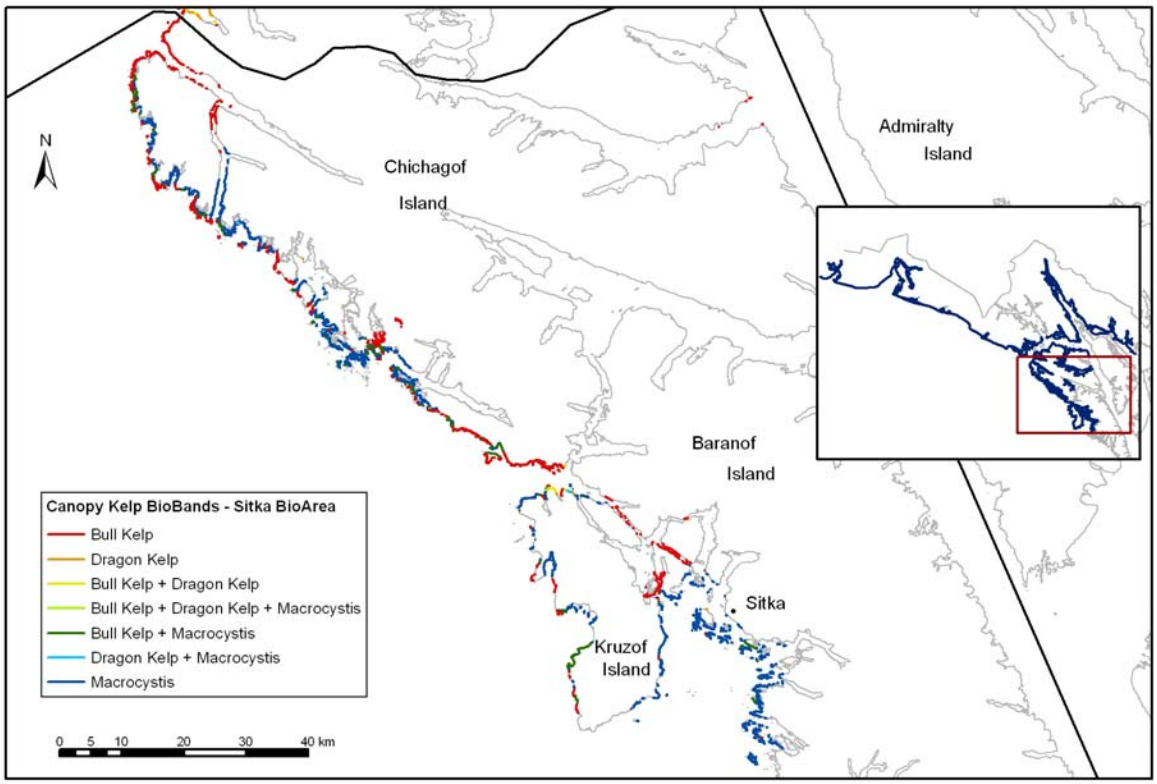
Distribution of Nearshore Canopy Kelp Biobands by Bioarea



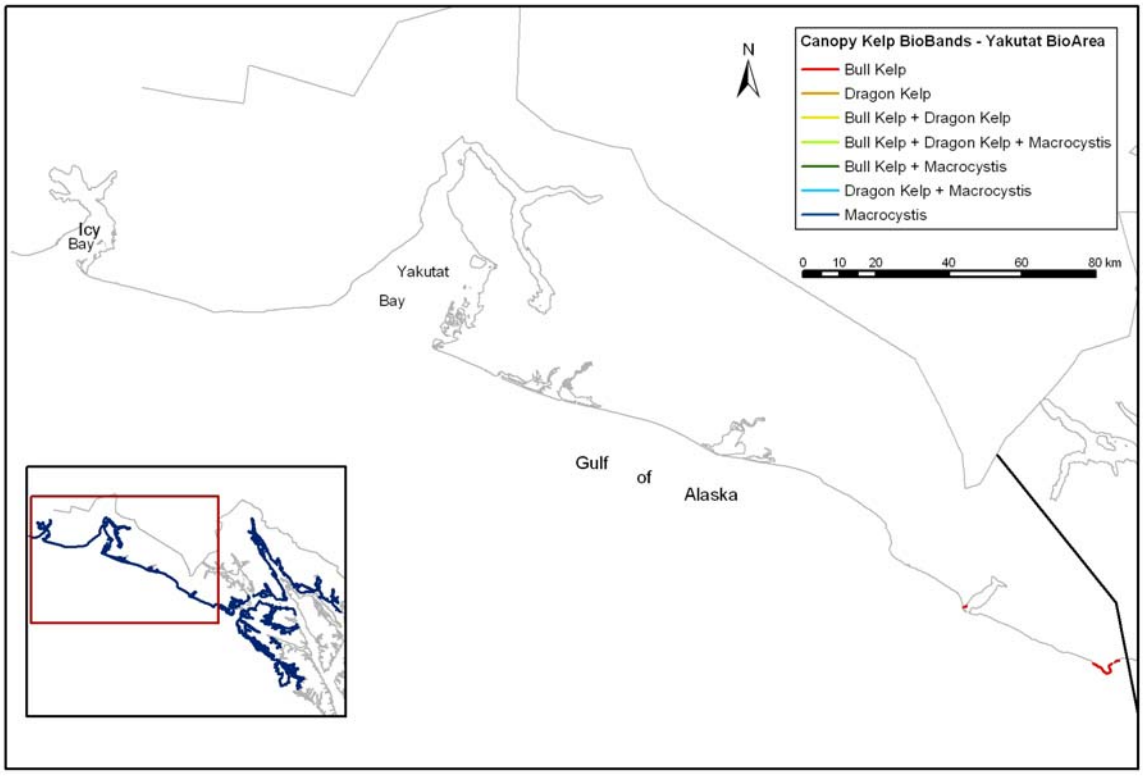
Fjords Bioarea – Nearshore Canopy Kelp Bioband Combinations



Icy Strait Bioarea – Nearshore Canopy Kelp Bioband Combinations



Sitka Bioarea -- Nearshore Canopy Kelp Bioband Combinations



Yakutat Bioarea -- Nearshore Canopy Kelp Bioband Combinations

3.4 Biological Wave Exposure

Biological Wave Exposure is a summary attribute that is interpreted during biological mapping from observations of the presence and abundance of biota in each alongshore unit. It is considered the most representative index of actual wave exposure ("EXP_BIO" in the database; see data dictionary in Section 5 for other database references). For this attribute, wave exposure categories from Very Protected (VP) to Very Exposed (VE) are defined on the basis of a set of indicator species and a "typical" set of biobands. The six categories and codes are the same as those used during 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 database).

Energy tolerances of species assemblages are known from scientific literature and from expert knowledge, and these characteristics of coastal species are used to define wave exposure categories. Some biobands are observed in all wave exposure categories and are considered "associated species" bands (e.g. the Barnacle bioband), while other biobands are considered "indicators" because they are closely associated with particular wave exposures. For example, the Dark Brown Kelps bioband (CHB) is consistently associated with higher wave exposures). Typical indicator and associated species and biobands are summarized with illustrations for each **Biological Wave Exposure** category from mapped bioareas in Southeast Alaska (Tables 3.3-3.6).

Note that the "Very Exposed" category has not been applied in biological mapping of Southeast Alaska but has been mapped on the Outer Kenai coast, in Kenai Fjords National Park, and on the southwest coast of Moresby Island, British Columbia. Some units have been assigned this "Very Exposed" class during *physical* mapping on the basis of fetch estimates (such as in parts of Icy Bay and around the capes of Kruzof Island).

Also note that 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.

Shore station species lists are generally used to add qualitative descriptions to bioband definitions and to augment the list of species associated with each bioband. However, in Southeast Alaska, only a few ground station sites exist; thus species lists are compiled using the existing data as well as our experience in other coastal Alaska surveys.

Table 3.3. Typical and associated species of biobands
Exposure Category: Exposed (E)**

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	Coralline red algae		Red Algae	RED
	Alaria 'nana' morph		Alaria	ALA
	Lessoniopsis littoralis		Choc Brown Kelps	CHB
	Laminaria setchellii		Choc Brown Kelps	CHB
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches
**"Very Exposed" habitats are not distinguished in terms of biobands in SE Alaska

Table 3.4. Typical and associated species of biobands
Exposure Category: Semi-Exposed (SE)

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 Mussels	BMU
Lower Intertidal and Nearshore Subtidal	diverse mixed red algae, including *Odonthalia, Palmaria* and others.		Red Algae	RED
	Neoptilota		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Phyllospadix sp.		Surfgrass	SUR
	Laminaria setchellii		Choc Brown Kelps	CHB
	Laminaria yezoensis		Choc Brown Kelps	CHB
	Laminaria bongardiana morph		Choc Brown Kelps	CHB
	Hedophyllum smooth morph		Choc Brown Kelps	CHB
	Alaria fistulosa		Dragon Kelp	ALF
		Macrocystis integrifolia	Macrocystis	MAC
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches

Table 3.5. Typical and associated species of biobands
Exposure Category: Semi-Protected (SP)

Zone	Indicator species	Associated Species	Bioband Name	Bioband Code
Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp *	Sedges	SED
		Puccinellia *	Marsh grasses, herbs and sedges	PUC
		Triglochin *	Marsh grasses, herbs and sedges	PUC
		Plantago maritima *	Marsh grasses, herbs and sedges	PUC
	Verrucaria		Splash Zone	VER
Lower Intertidal and Nearshore Subtidal		*Balanus glandula* *Semibalanus balanoides*	Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussels	BMU
		Ulva and other foliose green algae	Green Algae	ULV
	Palmeria spp (bleached)		Bleached Red Algae	HAL
	Mixed red algae including *Odonthalia*		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Zostera marina		Eelgrass	ZOS
	Cystoseira		Soft brown Kelps	SBR
	Cymathere		Soft brown Kelps	SBR
	Laminaria saccharina morph		Soft brown Kelps	SBR
	Nereocystis luetkeana		Bull Kelp	NER

*associated with Wetland/ Estuary areas at this wave exposure

Table 3.6. Typical and associated species of biobands
Exposure Category: Protected (P) and Very Protected (VP)

	Indicator species	Associated Species	Bioband Name	Bioband Code
Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp *	Sedges	SED
		Puccinellia *	Marsh grasses, herbs and sedges	PUC
		Triglochin *	Marsh grasses, herbs and sedges	PUC
		Plantago maritima *	Marsh grasses, herbs and sedges	PUC
	Verrucaria		Splash Zone	VER
		Balanus glandula/ Semibalanus balanoides	Barnacle	BAR
		Fucus with epiphyte *Pilayella*	Rockweed	FUC
	Mytilus trossulus		Blue Mussels	BMU
Lower Intertidal	*Ulva/* foliose green algae		Green Algae	ULV
	Zostera marina		Eelgrass	ZOS
	Laminaria saccharina morph (not in Very Protected)		Soft brown Kelps	SBR

*associated with Wetland/ Estuary areas at this wave exposure

3.5 Habitat Class

Habitat suitability for coastal species and marine organisms 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 along-shore and across-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 shore with a mixture of rock and mobile sediment will be distinct from the species assemblage observed on a shore with a protected wetland complex.

The interaction of the wave exposure and the substrate type determines the **substrate mobility**, which in turn is reflected in the presence and abundance of attached biota. Where the substrate is stable (such as bedrock), well-developed epibenthic bioband assemblages occur. Where the substrate is mobile (such as on sandy beaches), the epibenthic community may be sparse or absent.

Three classes of substrate mobility employed in ShoreZone habitat characterization are:

- **Immobile or stable** substrates such as bedrock, boulders, and cobbles (could even be pebbles on a low-exposure coast).
- **Partially mobile** substrates such as a rock platform with a beach or sediment veneer. The partial mobility of the sediment limits the development of a full bioband assemblage that would likely occur on a stable rock shoreline.
- **Mobile** substrates such as sandy beaches are those in which energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota.

Sixteen generalized **Habitat Classes** are described and their distributions summarized for mapped shorelines in Southeast Alaska (Table 3.7). Biology plays a key role in the determination of BioAreas, as such the Habitat Class photos are organized into BioAreas. Illustrations of the most common Habitat Classes for each of the four BioAreas are provided in Section 3.2.

Nearly half of the mapped regions in Southeast Alaska are classified as Partially Mobile, Protected or Semi-Protected wave exposures (45%). One-fifth of the mapped area was classified as Wetland (19%). Because the study area included the outer coast around Yakutat, higher wave exposures in the Exposed and Semi-exposed categories accounted for 20% of the shoreline.

Table 3.7. Summary of ShoreZone biophysical **Habitat Classes** on the basis of observed biological wave exposure (in italics) in mapped areas of Southeast Alaska. Habitat Class code definitions are provide in the data dictionary in the Appendix.

Exposure	**Biophysical Habitat Description**	**Habitat Classes ***	**Length (km)**	**% of Shoreline**
Exposed (E)	**Stable Substrate:** Rocky shorelines with high wave exposure.	10 20	216.0	3%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	11 21	115.4	2%
	Mobile Substrate: No epibenthic community in intertidal due to dynamic substrate.	12 22	246.5	4%
Semi-Exposed (SE)	**Stable Substrate:** Rocky shorelines with moderate to high wave exposure.	30	287.5	5%
	Partially Mobile Substrate*:* Rocky shorelines with sediments that are sufficiently mobile to limit epibenthos in some portions of the shore.	31	325.3	5%
	Mobile Substrate: Small-size sediment shores generally have no epibenthic community. Cobble/boulder beaches may have biota. Dunes frequent in backshore.	32	77.8	1%
Semi-Protected (SP	**Stable Substrate:** Rocky shorelines with moderate to low wave exposure.	40	303.1	5%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	41	1548.4	25%
	Mobile Substrate: Small-size sediment shores generally have low biotic diversity. Cobble/boulder beaches usually support biota, especially in low intertidal/upper subtidal.	42	201.8	3%
Protected (P)	**Stable Substrate:** Rocky shorelines with low wave exposure.	50 60	157.6	3%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	51 61	1251.4	20%
	Mobile Substrate: Small-size sediment shores generally have low biotic diversity. Cobble/boulder beaches usually support biota, especially in low intertidal/upper subtidal.	52 62	162.4	3%

Table 3.8. Summary of ShoreZone biophysical **Habitat Classes** on the basis of unique coastal types (in italics) in mapped areas of Southeast Alaska.

Coastal Type	**Biophysical Habitat Description**	**Habitat Classes ***	**Length (km)**	**% of Mapping**
Wetland/ Estuary	**Estuary/ lagoon:** Generally low energy sediment shores with wetlands and marsh vegetation. Usually influenced by freshwater.	33 43 53 63	1207.5	19%
Channel	**Current-Dominated Channel:** Channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units.		57.4	<1%
Glacier	**Glacier:** Areas where glacial ice interacts directly with the supra-tidal, intertidal and/or subtidal area of a unit.	35 45 55 65	26.7	<1%
Man-Made	**Anthropogenic Features:** unit modified by shorezone disturbances, such as rip rap, wharves or fill	36, 37 46, 47 56, 57 66, 67	80.7	1%
	TOTALS:		**6270.7**	**100%**

3.6 Biological Illustrations: Habitat Classes in BioAreas

Yakutat BioArea (SEYA)

The most common Habitat Class in the Yakutat BioArea (SEYA) is Semi-Protected Estuary, representing 21% of the shoreline. Salt marsh biobands (GRA/SED/PUC) are visible in the supratidal and there is rarely any biota visible in the intertidal or subtidal.
Photo: SE05_ML_2510.jpg

The Semi-Protected, Partially Mobile habitat class represents 17% of the mapped shoreline. Typical biobands include dune grass (GRA), sedges (SED), some rockweed (FUC), blue mussels (BMU), green algae (ULV), and in the subtidal soft brown kelp (SBR).
Photo: SE05_ML_1986.jpg

Yakutat BioArea (SEYA) (continued)

The outer coast of the Yakutat BioArea is characterized by long stretches of exposed beaches with mobile sediment, representing 17% of the mapped shoreline. Such beaches are generally bare of biota. In this example, not even grasses are present in the supratidal.
Photo: SE05_ML_4143.jpg

The Yakutat BioArea is unique within the mapped area of Southeast Alaska owing to the presence glaciers that extend to the shoreline (although <2% of the mapped shoreline). Like the Yahtse Glacier shown in this image, coastal glaciers lack visible biota.
Photo: SE05_ML_3803.jpg

Icy Strait BioArea (SEIC)

The most common Habitat Class in the Icy Strait BioArea is Semi-Protected, Partially Mobile, representing 33% of the mapped shoreline. Much of this area is comprised of wide platforms of bedrock or mixed rock and sediment. In the supratidal are grasses (GRA/PUC/SED); the mid- and lower- intertidal may have barnacles (BAR), blue mussels (BMU), and green algae (ULV); in the subtidal, soft Brown Kelps (SBR) are often observed.
Photo: SE05_ML_5993.jpg

The second most common Habitat Class in the Icy Strait BioArea is the Protected Estuary, representing 13% of the mapped shoreline. Such environments typically have a mixture of salt marsh grasses (GRA/PUC/SED) in the backshore and large delta fans with rockweed (FUC), blue mussels (BMU), and green algae (ULV) in the intertidal.
Photo: SE05_ML_1503.jpg

Icy Strait BioArea (SEIC) (continued)

Bedrock (immobile) outcrops are common in the Icy Strait BioArea, representing 13% of the mapped shoreline. In the intertidal zone, Blue Mussels (BMU), Red algae (RED) and *Alaria marginata* (ALA) are observed as shown in this image. In the subtidal, *Alaria fistulosa* (ALF) mixed with *Nereocystis luetkeana* (NER) is often observed.
Photo: SE05_ML_1631.jpg

Southeast Alaska Fjords BioArea (SEFJ)

The most common Habitat Class in Southeast Alaska fjords is Semi-Protected, Partially Mobile, representing 38% of the mapped shoreline. Commonly observed biobands are visible in this image: fringing dune grass (GRA) in the supratidal, with rockweed (FUC), barnacles (BAR), and blue mussels (BMU) in the intertidal. Algae is generally not discernible in the subtidal, owing to high suspended sediment that reduces water clarity.
Photo: SE05_ML_0760.jpg

The second most common Habitat Class is Protected, Partially Mobile, representing 14% of the mapped shoreline. Typical biobands are shown in this image: blue mussel (BMU) dominates the intertidal with scattered barnacle (BAR) and rockweed (FUC).
Photo: SE05_ML_9353.jpg

Estuaries are common in the fjords of Southeast Alaska, representing 20% of the mapped shoreline. Semi-Protected Estuaries such as the one shown in this image typically exhibit a mixture of salt marsh grasses (GRA/PUC/SED) in the backshore and large delta fans with rockweed (FUC), green algae (ULV), and blue mussels (BMU) in the intertidal zone. In the subtidal, soft brown kelps (SBR) are observed.
Photo: SE05_ML_0810.jpg

Sitka BioArea (SESI)

The most common Habitat Class in the Sitka BioArea is Protected, Partially Mobile, representing 28% of the mapped shoreline. There is often a fringe of wetland biobands, typically marsh grasses (PUC) in these units, with rockweed (FUC) providing most of the intertidal seaweed cover; barnacles (BAR) may also be present. Lush eelgrass (ZOS) is often observed in the subtidal, or replaced by soft brown kelps (SBR).
Photo: SE05_MM_1099.jpg

The second most common Habitat Class in the Sitka BioArea is Semi-Protected, Partially Mobile, representing 20% of the mapped shoreline. Typical biobands are shown here: fringing dune grass (GRA) in the supratidal; barnacles (BAR), mixed red (RED) and green (ULV) algae in the lower intertidal; *Alaria marginata* (ALA) and soft brown kelps (SBR) in the subtidal.
Photo: SE05_ML_8497.jpg

Sitka BioArea (SESI) (continued)

Areas dominated by tidal currents represent 2% of the mapped shoreline in the Sitka BioArea. These channels, often found between islands, have greater observed exposures and richer biota than the adjacent coast. The Semi-Protected Current Channel shown in this image illustrates typical biobands: barnacles (BAR), rockweed (FUC), green algae (ULV), and red algae (RED) in the intertidal, and the giant kelp *Macrocystis* (MAC) in the subtidal.
Photo: SE05_MM_3765.jpg

Semi-Exposed areas, such as this rocky islet with immobile substrate, represent 15% of the mapped shoreline in the Sitka BioArea. In this image, a wide band of the black lichen *Verrucaria* (VER) is obvious in the supratidal; intertidal biobands include barnacles (BAR), blue mussels (BMU), and red algae (RED); subtidal bands include *Alaria marginata* (ALA), dark brown kelps (CHB), and *Nereocyctis leutkeana* (NER).
Photo: SE05_MM_5819.jpg

APPENDIX A DATA DICTIONARY

Table A-1. Data dictionary for UNIT table

Field Names	Type	Description
UnitRecID	N	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
REGION	T	coastal region number
AREAS	T	coastal area number
PHY_UNIT	T	physical shore unit number; the unit is the primary alongshore subdivision during the mapping
SUBUNIT	T	subunit number: "0" for main Unit and "1,2,3…" for variants or point features
TYPE	T	a description of Unit type: a (**L**)line-type unit, or a (**P**)oint variant
BC_CLASS	N	a number indicating the BC "coastal class" or "shoreline type" (see Table A-2)
ESI	T	a number code for the ESI coastal classification system (see Table A-3)
LENGTH_M	N	the unit alongshore length in M, calculated using GIS software
GEO_MAPPER	T	last name of geology mapper
GEO_EDITOR	T	last name of individual responsible for reviewing and editing
GEO_MAP_DATE	D/T	date of original geological mapping
GEO_SOURCE	T	data sources for geological interpretation: (V)ideotape, (P)hoto-aerial, (T)opo maps, (C)harts, (O)ther
SCALE	T	scale of base maps used to delineate units
VIDEOTAPE	T	the videotape identifier number
HR	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available
MIN	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available
SEC	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available
MAP_NO	I	page number from the DeLorme Alaska Atlas where the Unit is plotted
CHART	T	NOAA chart number(s) for the Unit
EXP_OBSER	T	an estimate of the wave exposure as observed by geomorphologist during mapping based on Table A-4
EXP_CLASS	T	a numeric code for best exposure estimate where EXP_BIO is better than ESP_OBS (see Table A-4)
ORI	I	a code indicating the potential oil residence index, see Tables A-5 and A-6
SED_SOURCE	T	a code indicating the estimated sediment source for the unit, (B)ackshore, (A)longshore, (F)luvial, (O)ffshore
SED_ABUND	T	a code indicating the relative sediment abundance within the shore-unit, (A)bundant, (M)oderate, (S)carce
SED_DIR	T	one of the eight cardinal points of the compass indicating dominant sediment transport direction
CHNG_TYPE	T	a code indicating the stability of the shore unit, (A)ccretional, (E)rosional, (S)table
CHNG_RATE	N	the rate of change of the shoreline within the unit in m/yr

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

SHORENAME	T	the name of a prominent geographic feature near the unit; used to facilitate searches
UNIT_COMMENTS	T	a text field used for miscellaneous comments and notes during the mapping
SHORE_PROB	T	comment on nature of the shore problem, usually the difference between electronic shoreline and observed shoreline
SM1_TYPE	T	the *primary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM%	N	the estimated % occurrence of the *primary* seawall type in tenths (i.e., "2" = 20% occurrence within the unit)
SM1_M	N	the calculated length in meters of the *primary* seawall type
SM2_TYPE	T	the *secondary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP = sheet pile; RR = rip rap and WB = wooden bulkhead
SM2%	N	the estimated % occurrence of the *secondary* seawall type in tenths (i.e., "2" = 20% occurrence within the unit)
SM2_M	N	the calculated length in meters of the *secondary* seawall type
SM3_TYPE	T	the *tertiary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; RR = rip rap and WB = wooden bulkhead
SM3%	N	the estimated % occurrence of the *tertiary* seawall type in tenths (i.e., "2" = 20% occurrence within the unit)
SM3_M	N	the calculated length in meters of the *tertiary* seawall type
SMOD_TOTAL	N	the total % occurrence of seawall in the unit, in tenths
RAMPS	N	the number of boat ramps that occur within the shore zone of the unit or subunit. Ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate. Public boat ramps are shown as variants
PIERS_DOCK	N	the number of piers or wharves that occur within the unit. Piers or docks must extend at least 10m into the shore zone. Category does not include anchored floats
REC_SLIPS	N	the estimated number of recreational (or small) slips associated with the piers/docks of the unit based on small boat length (~<50')
DEEPSEA_SLIP	N	the estimated number of slips for ocean-going vessels (~>100')
ITZ	N	the sum of the across-shore width of all the intertidal components (B-Zone) within the unit

Table A-2. Shore Type classification employed in the ShoreZone mapping methodology in Alaska (after Howes et al. 1994 for British Columbia "BC Class")

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

Table A-3 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	Rip rap; Gravel Beaches (cobbles and boulders)
6C	Rip rap
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; Mangroves
10E	Inundated low-lying tundra

Table A-4 Exposure matrix used for estimating observed physical exposure (EXP_OBS)

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 definition and component look-up matrix

ORI Definition

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**

ORI Look-up matrix

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-6. Look-up table of calculated ORI defined by shore type and exposure

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

Table A-7. Data dictionary for BIOUNIT table

Field Names	Type	Description
UnitRecID	N	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
EXP_BIO	T	An estimate of the exposure based on observed indicator species (see detailed definitions in Table B - 2).
HAB_CLASS	T	Habitat Classification determined by the BIO mapper, that combines the EXP_BIO and the Physical features of the shoreline (see Table A-8).
HAB_OBS	N	the observed biotic assemblage from the imagery (not used in SE project, kept for backward compatible with earlier AK projects)
BIO_SOURCE	T	the source that was used to interpret shore-zone biota, (V)ideotape, (S)lide, (I)nferred
RIPARIAN% *	N	estimate of the percentage of alongshore length of the intertidal zone, where the shoreline is shaded by overhanging riparian vegetation, all substrate types (see additional note below)
RIPARIAN_M	N	length, in meters, of the unit shaded by overhanging riparian vegetation, all substrate types
BIO_UNIT_COMMENT	T	comment field
BIO_MAPPER	T	the last name of the biologist that provided the biological interpretation of the imagery
BIO_MAP_DATE	D/T	date of biological mapping
Photo	Y/N	marks if there is a photo (digital or slide) or a ground station associated with the unit

*** 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.

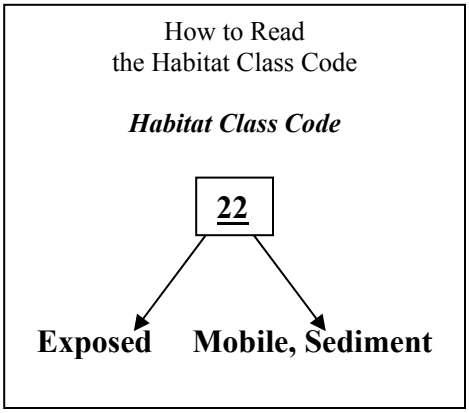
The value recorded in the 'Riparian%' field is an estimate of the percentage of the unit's total alongshore length where riparian vegetation of trees and shrubs is shading the upper intertidal zone. Shading of the last higher high water line is a good estimate of riparian shading. Therefore, shading of wetland herbs and grasses is not included in the estimate, nor is any shading of the splashzone 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, where the splashzone is narrow. Shading may be on sediment-dominated or on rocky intertidal.

Table A-8. Habitat Class codes

Habitat Class is used to describe a summary of the biophysical characteristics of an entire unit, and it is useful to provide a single attribute that describes the typical intertidal biota together with the geomorphology. That is, a 'typical' example of a Habitat Class would include a combination of biobands, and their associated indicator species (which determine the Biological Exposure category) and the geomorphological features of the Habitat Class.

The biomapper observes and records the biobands in the unit, if any, and determines the Biological Exposure Category. From the presence/absence of the biobands, the Exposure Category, the geomorphology and the spatial distribution of the biota within the unit, the Habitat Class is determined.



The codes used in the Habitat Class categories (see Text Box, left) are alphanumeric.

The first digit represents the code for the Biological Exposure and the second digit represents the inferred mobility category.

First Digit in Code

Biological Exposure Categories

1 – Very Exposed
2 – Exposed
3 – Semi-exposed
4 – Semi-protected
5 – Protected
6 – Very protected

Second Digit in Code

Inferred Mobility Categories

0 – Immobile, Bedrock or Sediment & Bedrock, or Sediment (can have lush epibenthic biota)
1 – Partially mobile, Sediment or Rock and Sediment
2 – Mobile, Sediment (bare beach)
3 – Estuary (wetland vegetation associated with freshwater stream, often with delta form)
4 – Current-dominated Saltwater Channel
5 – Glacier Ice
6 – Man-made – Impermeable Substrate
7 – Man-made – Permeable Substrate

Table A-9. Habitat Class definitions (shaded boxes in the Habitat Class matrix are 'Not Applicable' in most regions)

Dominant Structuring Process	Substrate Mobility	Sediment	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	20	30	40	50	60
	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	21	31	41	51	61
	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	22	32	42	52	62
Fluvial/Estuarine Processes		***Estuary/Wetland***	Units classified as the 'estuary' types always include wetland biobands 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	23	33	43	53	63
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	24	34	44	54	64
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	25	35	45	55	65
Man-modified		***Anthropogenic – Impermeable***	Impermeable man-made Habitats are intended to specifically note units classified as Coastal Class 32.	16	26	36	46	56	66
		Anthropogenic – Permeable	Permeable man-made Habitats are intended to specifically note shore units classified as Coastal Class 33.	17	27	37	47	57	67

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

Field Names	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT fields
ZONE	T1	a text code indicating the across-shore position of the component: (A) supratidal, (B) intertidal or (C) subtidal zone
COMPONENT	Is	further subdivision of Zones, numbered from highest elevation in across-shore profile within Zone to lowest.
Form1	T20	describes primary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix1	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat1	T20	describes substrate associated with primary form (see Table A-12 for codes)
FormMat1Txt	T50	translation of Form and Material codes into a sentence descriptor
Form2	T20	describes secondary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix2	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat2	T20	describes substrate associated with secondary form (see Table A-12 for codes)
FormMat2Txt	T50	translation of Form and Material codes into a sentence descriptor
Form3	T20	describes tertiary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix3	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat3	T20	describes substrate associated with tertiary form (see Table A-12 for codes)
FormMat3Txt	T50	translation of Form and Material codes into a sentence descriptor
Form4	T20	describes forth most common physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix4	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat4	T20	describes substrate associated with forth-order form (see Table A-12 for codes)
FormMat4Txt	T50	translation of Form and Material codes into a sentence descriptor
WIDTH	N	the mean across-shore width of the component in meters
SLOPE	N	the estimated across-shore slope of the component in degrees; not coded in Carr Inlet
PROCESS	T4	the dominant coastal process affecting the morphology of the component (F)luvial, (M)asswasting, (W)aves, (C)urrents, (O)ther, (E)olean
COMPONENT_ORI	N	a numeric index between 1 and 5 that indicates the potential oil residency based on Table A-13

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

A = Anthropogenic
- a dolphin
- b breakwater
- c log dump
- d derelict shipwreck
- f float
- 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
- c washover channel
- f face
- i inclined (no berm)
- m multiple bars&troughs
- n relic ridges, raised
- p plain
- r ridge (single intertidal bar)
- s storm ridge
- t low tide terrace
- w washover fan
- v veneer (modifier)

C = Cliff
- a eroding
- p passive

slope
- i inclined (20to35°)
- s steep (>35°)

Cliff cont.

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

modifiers
- f fan, apron
- 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
- f horizontal
- i irregular
- r ramp
- s smooth

I = Ice
- g glacier

L = Lagoon
- o open
- c closed

M = Marsh
- f drowned forest
- h high
- l mid to low (discontinuous)
- c tidal creek
- e levee
- o pond
- s brackish – supratidal

O = Offshore Island
- b barrier
- c chain of islets
- t table shaped
- p pillar/stack
- w whaleback

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

P = Platform
- f horizontal
- g surge channel
- h high tide platform
- i irregular
- l low tide platform
- r ramp
- t terraced
- s smooth
- p tidepool

R = River Channel
- a perennial
- t intermittent
- m multiple channels
- s single channel

T = Tidal Flat
- b bar, ridge
- c tidal channel
- e ebb tidal delta
- f flood tidal delta
- l levee
- s multiple tidal channels
- t flats
- p tidepool
- w plunge pool

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	trees, fallen not cut, dead
o	organic litter
p	peat
t	trees (alive)

C = Clastic

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

v **sediment veneer**

R = Bedrock

rock type:

I	igneous
m	metamorphic
s	sedimentary
v	volcanic

rock structure:

1	bedding
2	jointing
3	massive

U = Undefined

DESCRIPTION OF SUBSTRATE
Simplified from Wentworth scale

GRAVELS		
	boulder	> 25cm
	cobble	6 to 25 cm
	pebble	0.5 to 6 cm
	granule	0.2 to 0.5 cm
SAND		
	from very coarse to very fine: all between .5mm to 2 mm	
FINES (MUD)		
	from silt to clay: smaller than .5mm	

The 'material' descriptor consists of one primary term code and associated modifiers (e.g. 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

	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
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, coded by width **N**arrow (<1m), **M**edium (1-5m) or **W**ide (>5m). See Table B-1 for details.		
VER	T1	bioband for 'VERrucaria' black lichen in supratidal splash zone
PUC	T1	bioband for PUCcinellia and other salt tolerant grasses and herbs
GRA	T1	bioband code for dune GRAsses of supratidal
SED	T1	bioband for mixed sedge of supratidal
BAR	T1	bioband for continuous *Balanus/Semibalanus* BARnacle in upper intertidal
FUC	T1	bioband for FUCus-/barnacle of upper intertidal
ULV	T1	bioband for mixed filamentous and foliose green algae band, mid intertidal
HAL	T1	bioband for bleached mixed filamentous and foliose red algae
BMU	T1	bioband for blue mussels (*Mytilus trossulus)* of mid-intertidal, protected areas
RED	T1	bioband for mixed filamentous and foliose RED algae of lower intertidal
ALA	T1	bioband for stand of large or small morph of *Alaria spp*.
SBR	T1	bioband for unstalked large-bladed laminarins; in the lower intertidal and nearshore subtidal
CHB	T1	bioband for stalked bladed dark chocolate-brown kelps of lower intertidal/nearshore subtidal
SUR	T1	bioband for green SURfgrass of lower intertidal
ZOS	T1	bioband for *ZOStera* (eelgrass) of sheltered areas, lower intertidal and subtidal
ALF	T1	nearshore dragon kelp bioband
MAC	T1	Nearshore canopy kelp *Macrocystis* bioband
NER	T1	bioband for nearshore subtidal *NEReocystis* bull kelp

Note: Refer to Table 6 for brief definitions of Biobands or to Appendix B, Table B-1 for full detailed and illustrated definitions of Biobands.

Table A-14. Data dictionary for the BIOSLIDE table

Field Names	Type	Description
SlideID	N	A unique numeric ID given to each slide
UnitRecID	N	unique record number that relates across-shore records to a unit record
SlideName	T50	A unique alphanumeric name assigned to each slide or photo
ImageName	T75	Full image acronym and .jpg for photolink
TapeTime	D/T	Exact time during flight when jpg collected. Used to link photo to digital trackline and position.
SlideDescription	T255	a text field used for comments made by the biomapper to describe each slide
Good Example?	Y/N	Marks good example photos of shorezone features
ImageType	T10	Media type of original image “Digital” or “Slide"
FolderName	T50	name of the folder where the images are stored - required for hyperlink to digital image
PhotoLink	Hyper-link	clicking this link will open the photos related to each unit

Table A-15. Data dictionary for the GroundStationNumber table

Field Names	Type	Description
StationID	N	A unique numeric ID given to each ground station
UnitRecID	N	The unique ID from Unit Table to link data tables
Station	T50	Unique alphanumeric name assigned to each ground station
StationDescription	T255	a text field used for comments made by the biomapper to describe each ground station
Location	T50	General location of each ground station