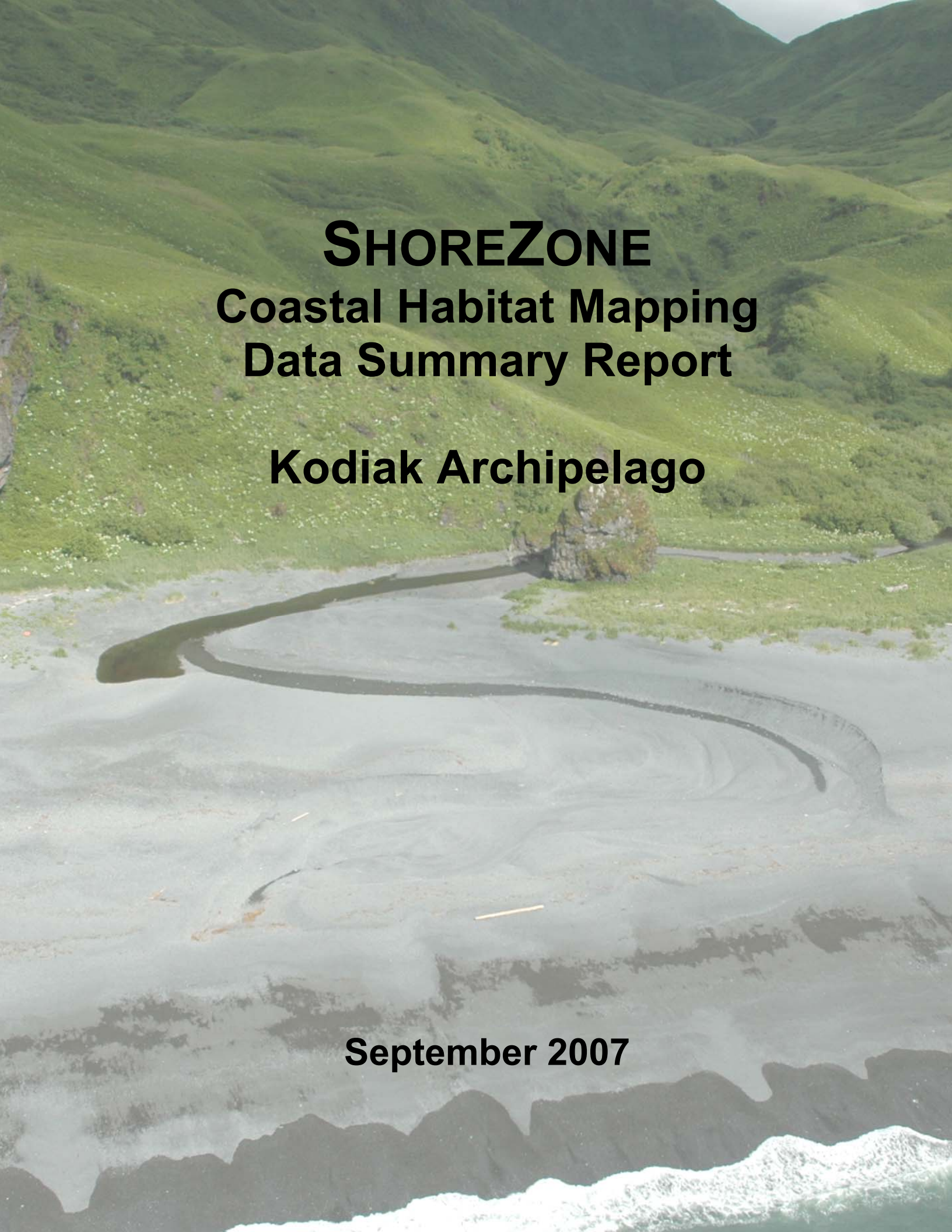

SHOREZONE
Coastal Habitat Mapping Data Summary Report

Kodiak Archipelago

September 2007

CORI Project: 06-21 28 September 2007

ShoreZone Mapping Data Summary
Kodiak Island
(2002 and 2005 Imagery)

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1 INTRODUCTION

1.1 ShoreZone Coastal Habitat Mapping

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 of Archipelago Marine Research Ltd. (Victoria BC). The processing, mapping, integration, and analysis of physical and biological data takes place in both organizations by 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).

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 mapping system provides a spatial framework for coastal habitat assessment on local and regional scales. State-wide between 2001 and 2007, imagery has been collected for a total of **39,575 km** of shoreline in the Gulf of Alaska and Southeast (Figure 1.1). In the Pacific Northwest, the ShoreZone Coastal Mapping Program also includes more than 45,000 km of coastline in British Columbia and Washington state (from the Columbia River to the Alaska/BC border).

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.

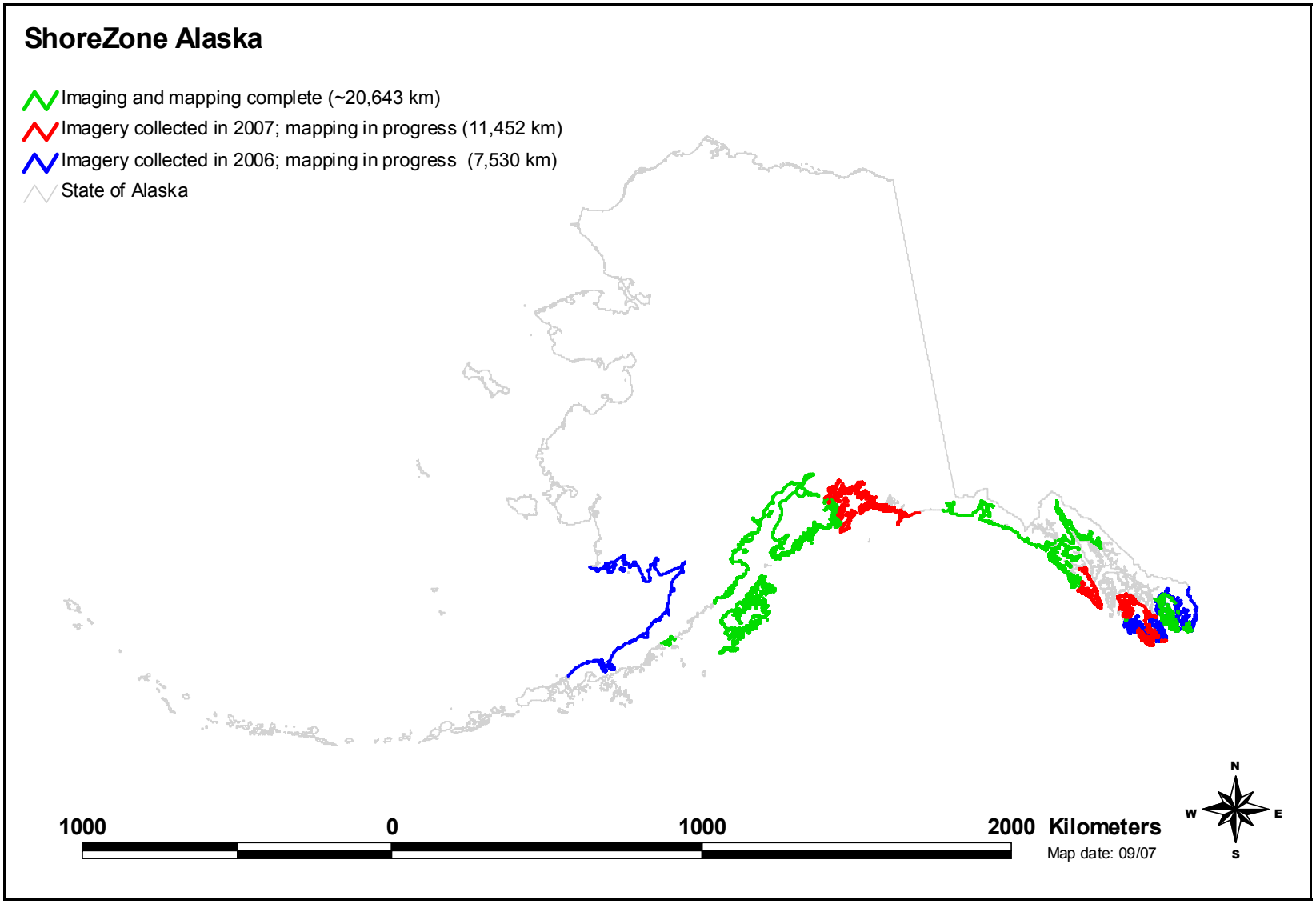


Figure 1.1. Extent of ShoreZone imagery (39,625 km) and coastal habitat mapping in the State of Alaska.

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 1.2). 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 and http://mapping.fakr.noaa.gov/Website/ShoreZone for Alaska and www.shim.bc.ca/gulfislands/atlas.htm for the Gulf Islands in British Columbia, Canada).

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, each with a unique physical identifier (PHY_IDENT) that links the data to the digital shoreline in GIS. Point features (also called "variants") are small features such as streams that are better represented as a point rather than a line. Such point features are also mapped as "forms" within the unit that contains them.

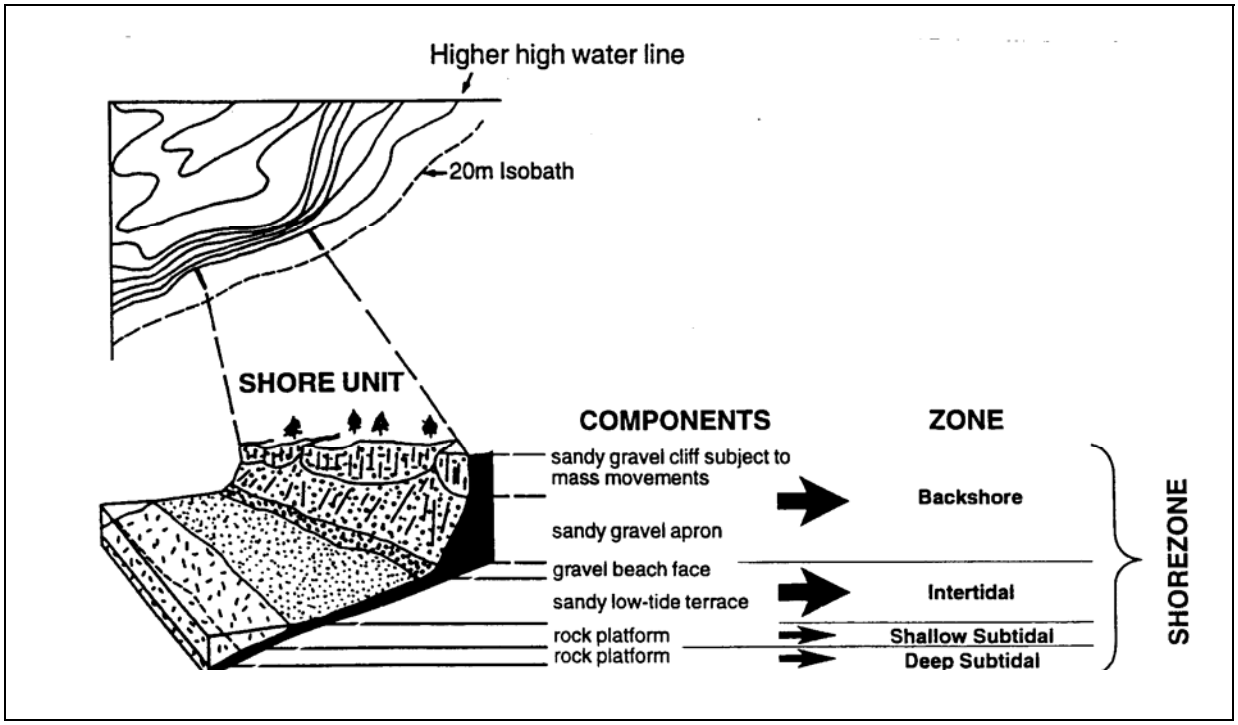


Figure 1.2. Schematic to illustrate how digital shorelines are segmented into alongshore units and across-shore components in the ShoreZone mapping system.

1.2 ShoreZone Coastal Habitat Mapping in the Kodiak Archipelago

Field surveys on Kodiak Island in 2002 and 2005 collected aerial video and digital still photographs of the coastal and nearshore zone at zero-tides and lower. The imagery was used to map the geological and biological features of the shoreline (**4,981 km**, shown in Figure 1.3). The purpose of this report is to provide a summary of that data.

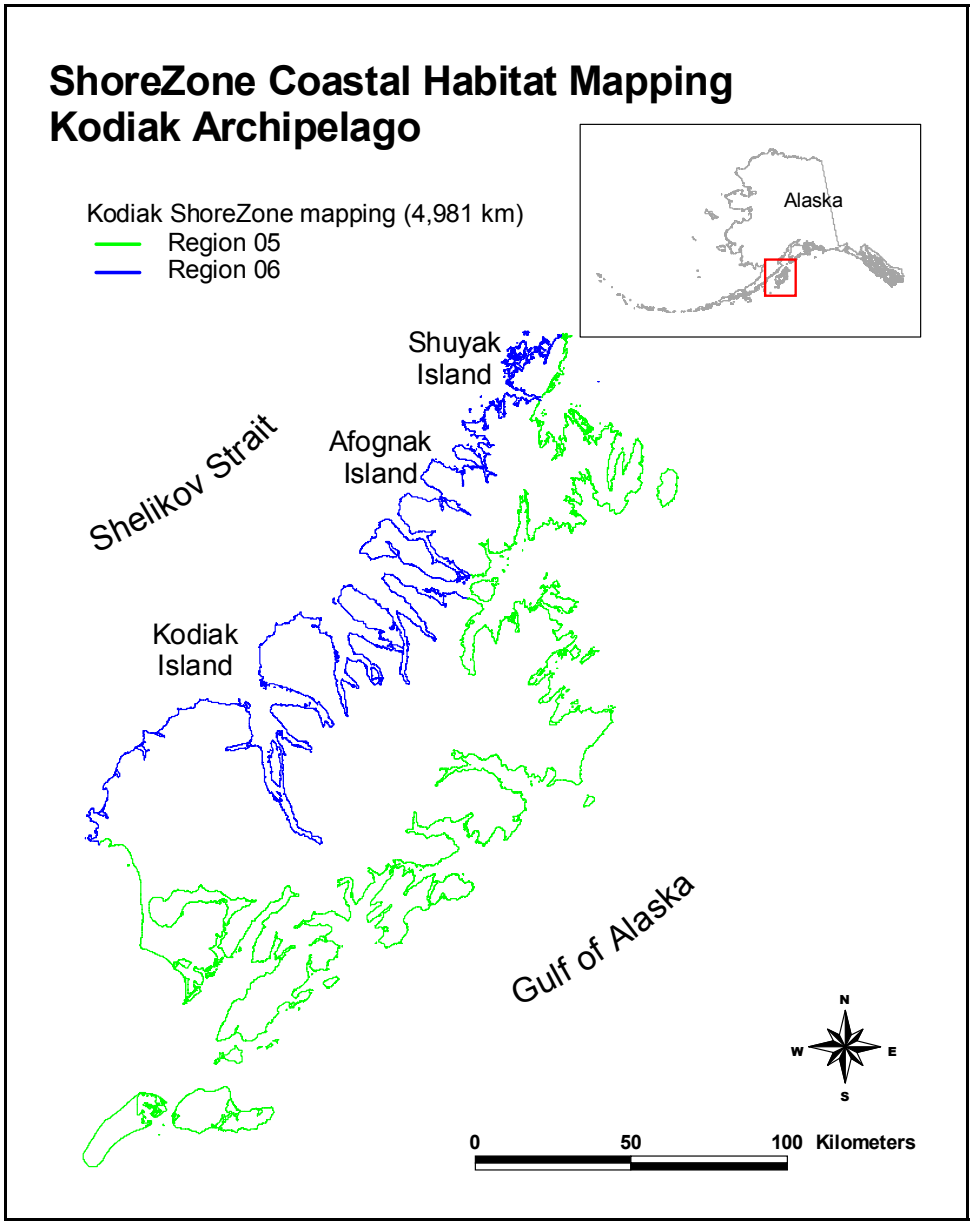


Figure 1.3. Shoreline of the Kodiak Archipelago mapped using the ShoreZone technique (4,981 km).

2 PHYSICAL SHOREZONE DATA SUMMARY

2.1 Shore Types

The principal characteristics of each along-shore segment are used to assign an overall unit classification or “shore type” that represents the unit as a whole. ShoreZone mapping employs two 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 also characterize units dominated by: organic shorelines such as marshes and estuaries (BC Class 31), man-made features (BC Classes 32 and 33), high-current channels (BC Class 34), and glaciers (BC Class 35). The distribution of BC shore types in the Kodiak Archipelago is shown in Figures 2.1 and 2.3. Glacial shorelines are absent.

Mixed rock and sediment shorelines (BC Classes 6-20) comprise 42% of the coastal environment. These shore types are further distinguished on the basic of geomorphology and sediment texture, shown in Figures 2.2 and 2.3). Wide rock ramps and platforms are typical of more exposed areas, while cliffs with pocket beaches and talus slopes are more widely-distributed.

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 the 4,981 km of mapped shoreline of the Kodiak archipelago.

Substrate Type	Shore Type (BC Class)	Sum of Unit Length (km)	# of Units	% Occurrence	Cumulative Occurrence (%, km)
Rock	1	5.8	25	0.1%	**6.1%**
	2	32.3	139	0.6%	**302 km**
	3	174.3	828	3.5%	
	4	72.0	358	1.4%	
	5	17.8	71	0.4%	
Rock+Sediment	6	78.5	303	1.6%	**42.4%**
	7	125.6	459	2.5%	**2,114 km**
	8	331.7	1397	6.7%	
	9	280.9	1322	5.6%	
	10	71.5	298	1.4%	
	11	142.0	614	2.9%	
	12	291.2	1167	5.8%	
	13	426.5	2219	8.6%	
	14	215.6	1107	4.3%	
	15	73.3	315	1.5%	
	16	2.7	6	0.1%	
	17	14.0	56	0.3%	
	18	55.8	150	1.1%	
	19	1.1	7	0.0%	
	20	3.2	16	0.1%	
Sediment	21	75.0	296	1.5%	**42.2%**
	22	97.1	412	1.9%	**2,100 km**
	23	15.5	71	0.3%	
	24	930.3	4179	18.7%	
	25	512.0	2530	10.3%	
	26	79.3	404	1.6%	
	27	44.4	150	0.9%	
	28	243.6	504	4.9%	
	29	66.5	201	1.3%	
	30	36.5	105	0.7%	
Organics/Marsh	31	415.0	1402	8.3%	**8% (415 km)**
Man-made	32	22.8	102	0.5%	**0.5% (25 km)**
	33	1.7	11	0.0%	
Channel	34	25.6	95	0.5%	**0.5% (25 km)**
Glacier/Ice	35	0	25	0.1%	**0%**

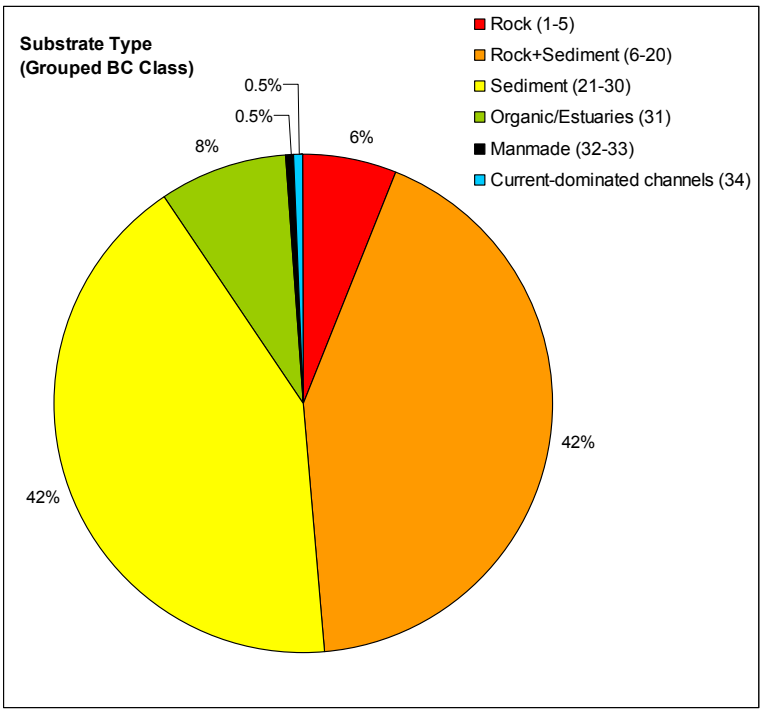


Figure 2.1. Abundance of principal substrate types (on the basis of grouped BC Classes) in the Kodiak archipelago. Photographic illustrations of shore types are provided in Section 2.5.

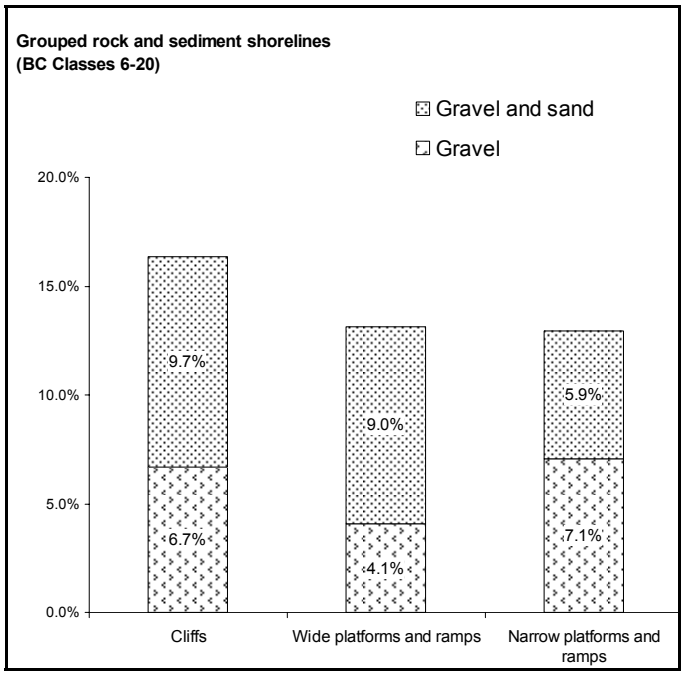


Figure 2.2. Geomorphology and sediment texture of mixed rock and sediment shorelines (BC classes 6-20) in the Kodiak archipelago.

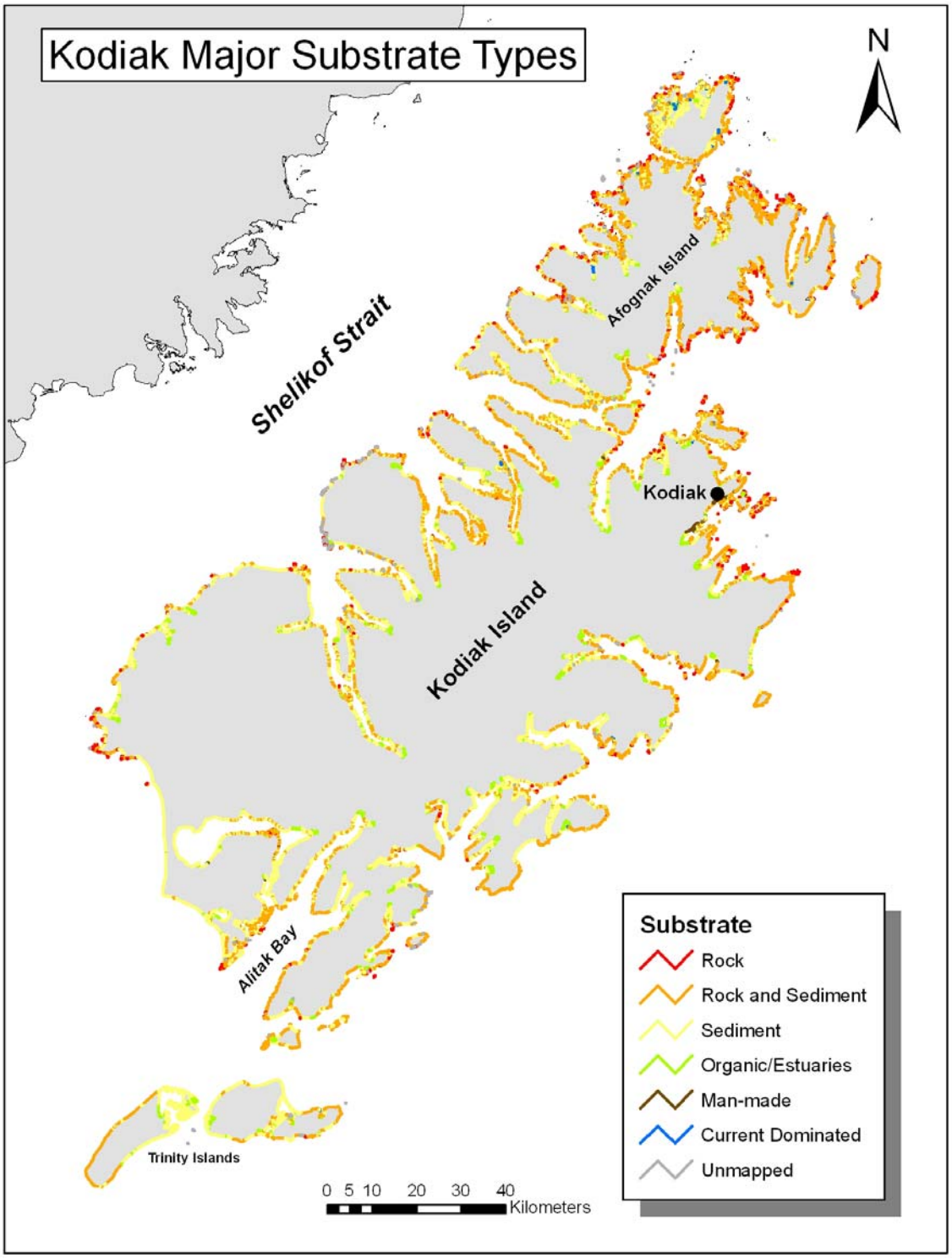


Figure 2.3. Map of the distribution of principal substrate types (on the basis of grouped BC Classes) in the Kodiak archipelago.

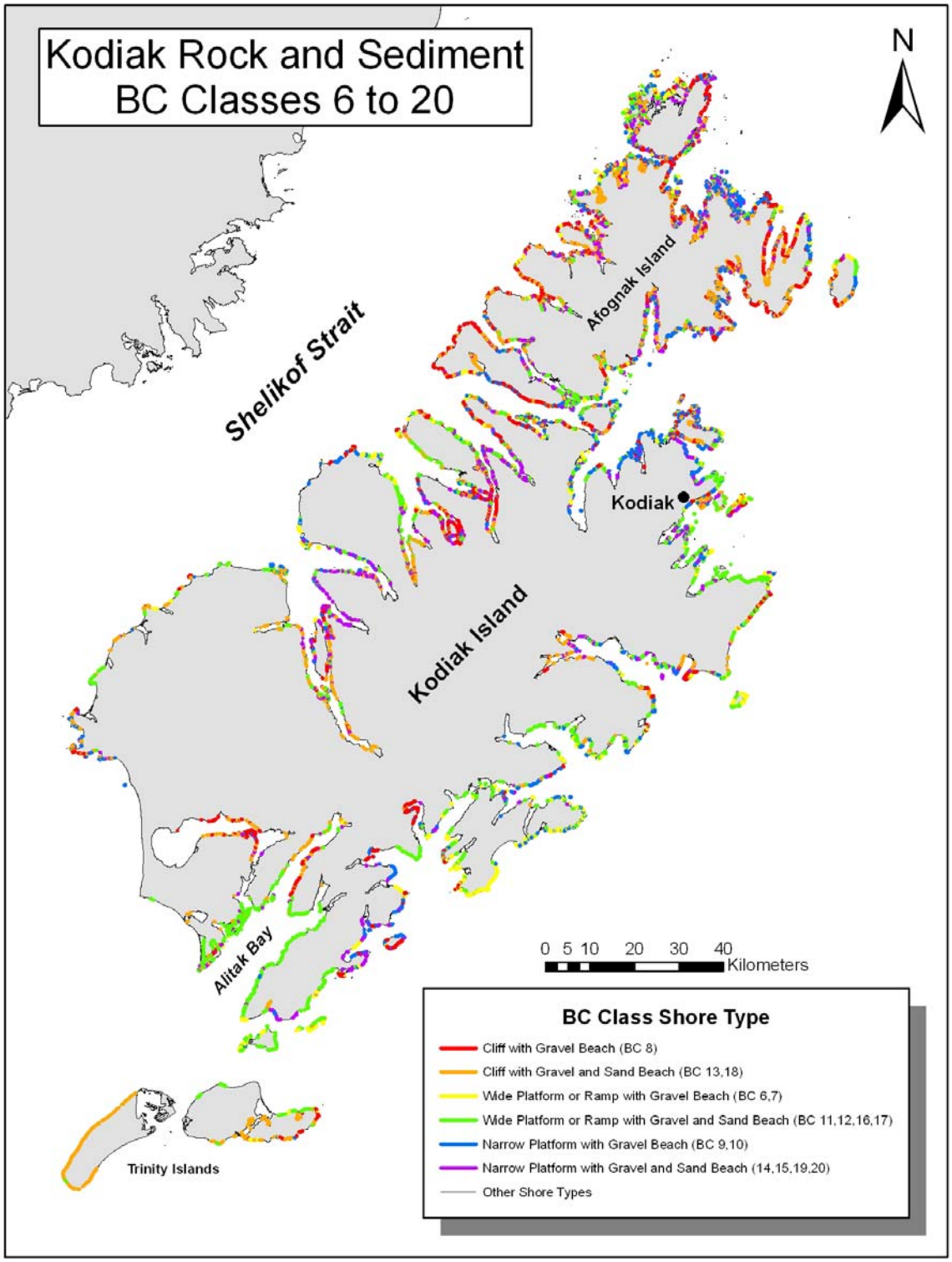


Figure 2.4. Map of the distribution of geomorphology and sediment texture of mixed rock and sediment shorelines (BC classes 6-20) in the Kodiak archipelago.

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, influencing physical processes as well as the biotic character of the intertidal and nearshore zones. **Physical wave exposure** is estimated by geologic mappers on the basis of incident wave energy, which is generally related to fetch distance (Table 2.4) and coastal geomorphology. Physical exposure is recorded as “EXP_OBSER” in the database (see data dictionary in Appendix for other database references). Figure 2.5 illustrates the distribution of physical wave exposures mapped in the Kodiak archipelago.

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.

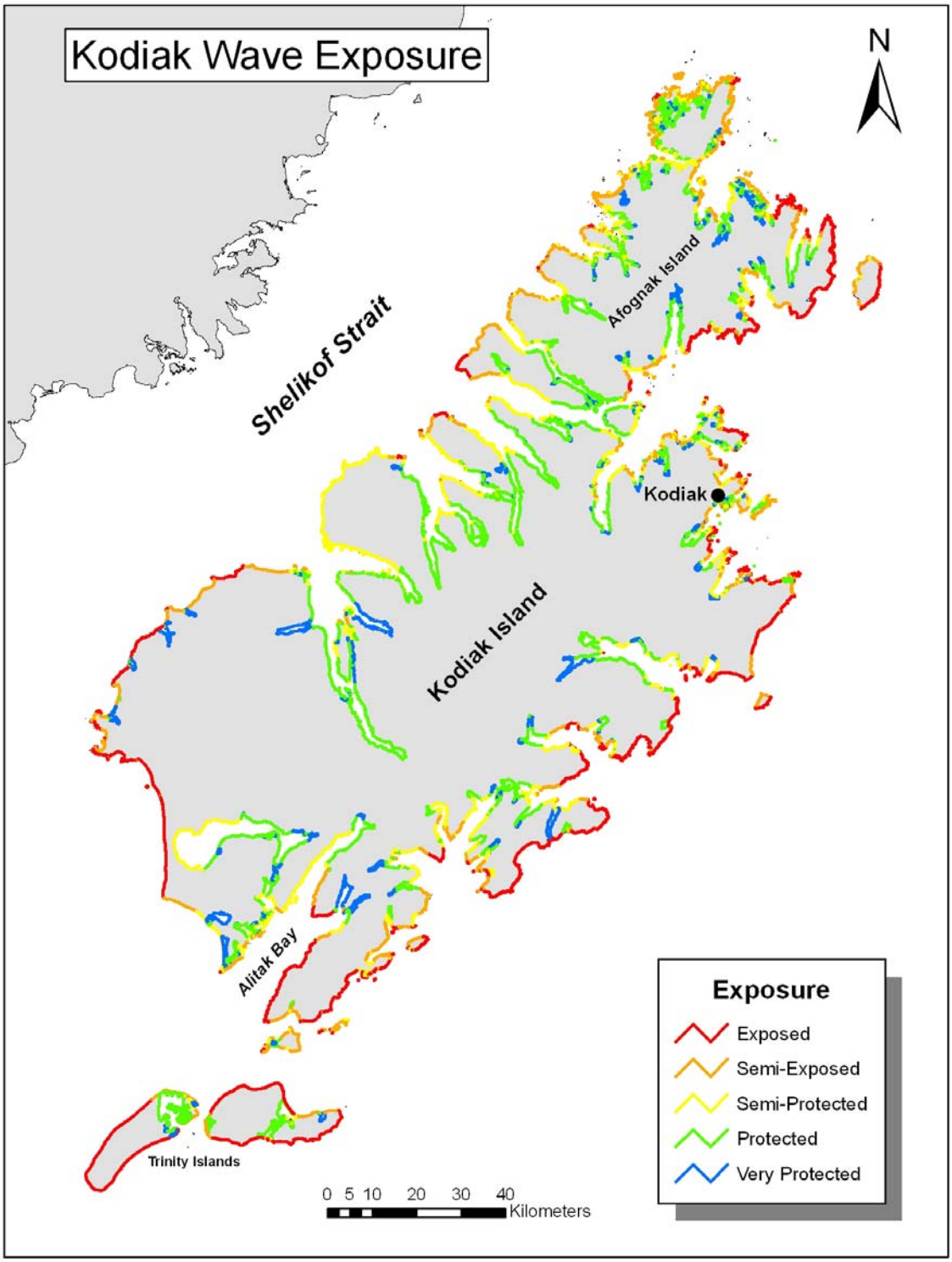


Figure 2.5. Map of the distribution of physical wave exposure categories in the Kodiak archipelago.

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. Very few areas with shore modifications are mapped in the Kodiak Archipelago (25 km of shoreline total, or 0.5% of the coastal environment).

The coastal communities of Larsen Bay and Kodiak are areas in which many units are classified as man-modified (having more than 50% of the unit altered by human activities). The type of shore modification (such as boat ramps, bulkheads, and rip rap) is mapped into the database using a two-letter code in the UNIT table, entered in three fields entitled “SHORE_MOD”. The relative proportion of the intertidal zone that is affected by the modification is entered in adjacent data fields in the UNIT table as well. Table 2.5 lists the shore modification codes used in ShoreZone physical mapping.

The distribution of units with more than 50% human-altered shoreline features in the Kodiak archipelago is shown in Figure 2.6. The inset boxes provide detail on the type of modification found in the communities of Larsen Bay and Kodiak.

Table 2.5. Definition of shore modification types used in ShoreZone physical mapping.

Code	Shore Modification Type
BR	boat ramp
CB	concrete bulkhead
LF	landfill
SP	sheet pile
RR	rip rap
WB	wooden bulkhead

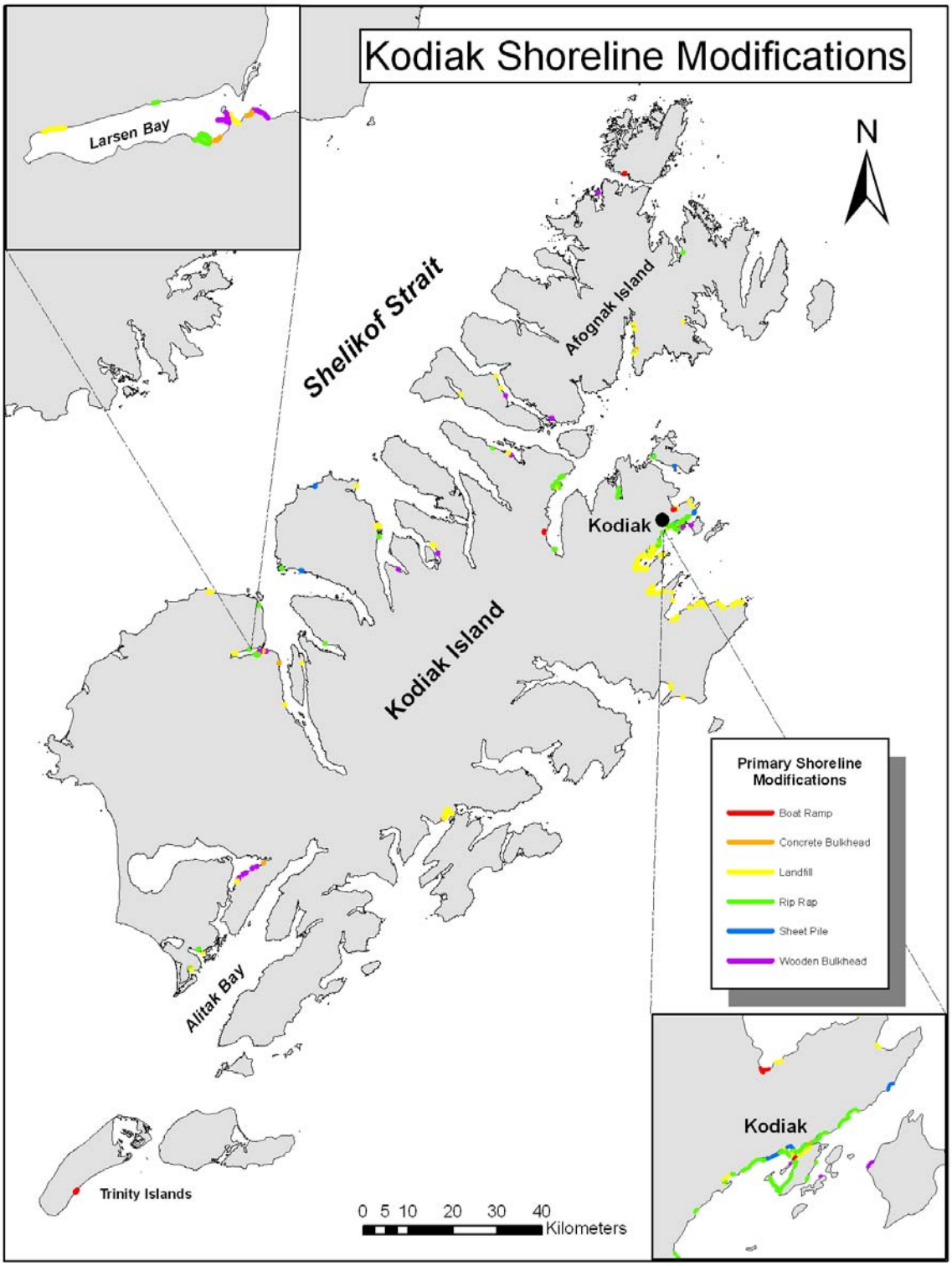


Figure 2.6. Map of the distribution of units with more than 50% human-altered shoreline features in the Kodiak archipelago.

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 2.6 and 2.7). Figure 2.7 illustrates the distribution of units with an ORI of 5, where persistence of oil on the shoreline is estimated to be months to years.

Table 2.6. 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 2.7. 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

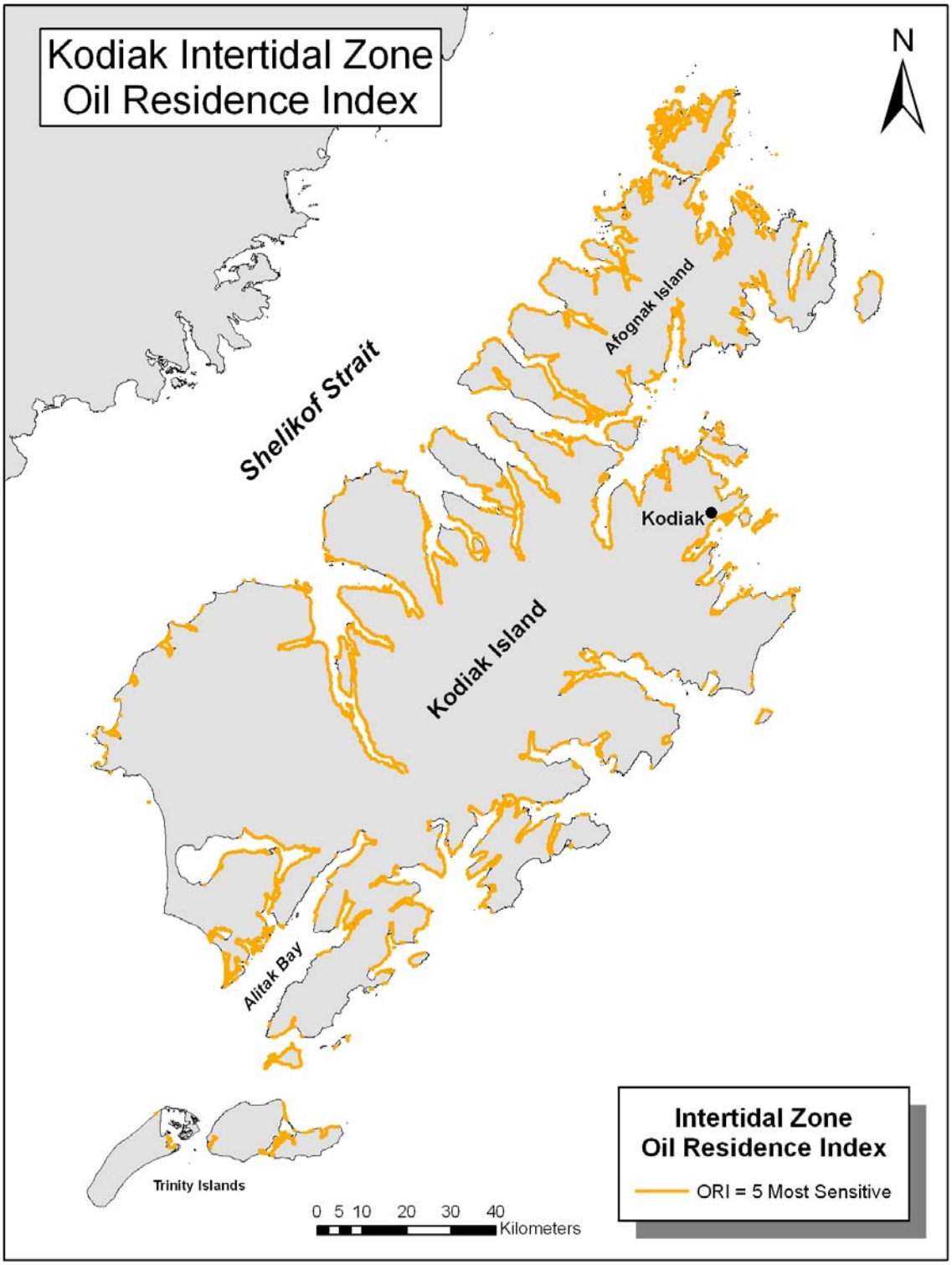


Figure 2.7. Map of the distribution of units with an Oil Residence Index (ORI) of 5, where persistence of oil on the shoreline is estimated to be months to years.

2.5 Physical Illustrations: Shore Types and Geomorphic Features

The following pages provide illustrated examples of shore types and geomorphic features mapped in the Kodiak Archipelago.

Shore Type: Rock (BC Classes 1-5)
Shore Type: Rock and Sediment (BC Classes 6-20)
Shore Type: Sediment (BC Classes 21-30)
Shore Type: Organic Shorelines, Marshes, and Estuaries (BC Class 31)
Shore Type: Human-Altered Shorelines (BC Classes 32-33)
Shore Type: Current-Dominated Channels (BC Class 34)
Geomorphic Features: Deltas, Mudflats, and Tidal Flats
Geomorphic Features: Lagoons
Anthropogenic Features: Coastal Structures and Seawalls
Other Interesting Features: Fish Traps and Drowned Forests

Shore Type: Rock (BC Classes 1-5)

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

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

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

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

Steep cliff (>20°) with narrow (<30 m) gravel beach (BC Class 8). Geomorphic features mapped in this unit include a steep, low cliff (Form “Casl”) with rubble and angular boulders at the base (Materials “Cra/R”), as well as offshore rocky reefs (Form “Fir,” Materials “R”).	Wide rock ramp (>30 m, 5-20° slope) with gravel beach (BC Class 11). Geomorphic features mapped in this unit include the ramp with tidepools covered by a veneer of cobbles and boulders (Form “Pirp,” Materials “Ccb/R”) and a beach face of cobbles overlying pebbles and sand (Form “Bf,” Materials “Cc/Cps”).
Twoheaded Island (Unit 05/04/8153)	Village Islands (Unit 06/03/7032)
KDKavi05_08504.jpg	KDKavi05_3528.jpg

Shore Type: Sediment (BC Classes 21-30)

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

Shore Type: Sediment (BC Classes 21-30)

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

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

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

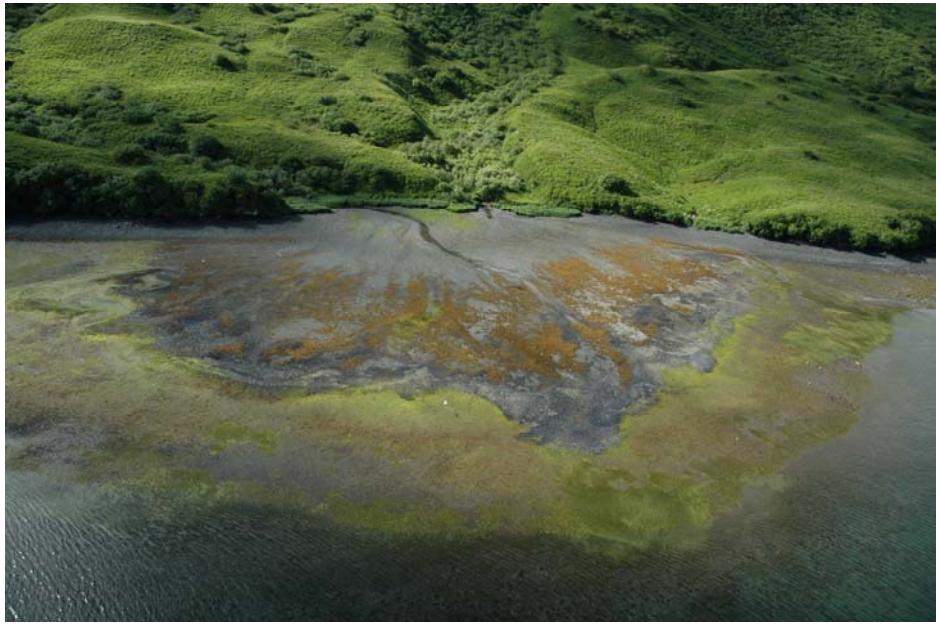
Shore Type: Human-Altered Shorelines (BC Classes 32-33)

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

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

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

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

	
Delta fan (Form “Df”) and tidal flat (Form “Tt”).	Flood tide delta with tide pools (Form “Tfp”) composed of sand (Material “Cs”).
Shuyak Island (Unit 06/01/3733)	Low Cape (Unit 05/01/0121)
KDKavi05_10125.jpg	KDKavi05_5695.jpg

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

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

Geomorphic Features: Beach berms and ridges

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

Geomorphic Features: Lagoons

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

Anthropogenic Features: Coastal Structures and Shore Modifications

Coastal structures mapped in the unit include a wharf (Aw), seawall (As), and pilings (Aa). Buildings such as this cannery are generally mapped as Form Aw.	This home is mapped as Form “Aw” (wharf) with Materials “Awda” (wood, debris, and metal).
Larsen Bay (Units 06/03/0942 and 0943)	Spiridon Bay (Unit 06/03/5156 and 5157)
KDKavi05_4634.jpg	KDKavi05_3993.jpg

Anthropogenic Features: Fish Traps and Village Sites

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

Other Interesting Features: Drowned Forests

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

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, which grows in a typical across-shore elevation, and at characteristic wave energies and substrate conditions. Bands are spatially distinct, with alongshore and cross-shore patterns of color and texture that are visible in aerial imagery (Figure 3.1). Biobands are described across the shore, from the high supratidal to the shallow nearshore subtidal elevations; and are named for the dominant species or group that best represents the entire band (Table 3.1). Some biobands are characterized by a single indicator species (such as the Blue Mussel band (BMU), while others represent an assemblage of co-occurring species (such as the Red Algae band (RED)).

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. Alongshore biobands of color and texture formed by biological assemblages of species in the intertidal zone. Shown is a steep, rocky shoreline in a semi-exposed area of Deadman Bay, Kodiak Island. (Photo: KDKavi05_06780.jpg)

Table 3.1. Bioband definitions for aerial video interpretation of the Kodiak Archipelago.

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 Mussel	**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 *Palmaria* sp. *Odonthalia* sp.	P to SE
	Red Algae	**RED**	Dark to bright red or pink (corallines)	*Odonthalia* sp. *Neorhodomela* sp. *Palmaria* sp. Other foliose red algae, and other coralline algae	P to E
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.	*Saccharina subsimplex* *Cystoseira* sp.	VP to SE
	Stalked Dark Brown Kelps	**CHB**	Dark chocolate brown	Stalked *Laminaria* sp. *Cymathere* sp. 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 SE
	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

** Macrocystis was observed in limited distribution in northwestern Shuyak Island

Upper intertidal biota tend to be consistent between different wave exposure categories and geographic areas, so are considered weak indicators of exposure. An example is the ubiquitous Barnacle band (BAR), which is found across all exposure categories. Lower intertidal biobands are often diagnostic of particular wave exposures. For example, the Surfgrass band (SUR) is indicative of semi-exposed settings, while the Eelgrass band (ZOS) is indicative of semi-protected and protected environments.

As mapping has been completed in different geographic areas, differences in the species assemblages that characterize the lower intertidal biobands have become apparent. These biobands are: Bleached Red Algae (HAL), Red Algae (RED), Soft Brown Kelps (SBR) and Dark Brown Kelps (CHB). These four biobands are also particularly important as biological indicators of wave exposure. To accommodate the region-specific definitions, geographic **bioareas** with unique indicator and associated species definitions for have been defined for those biobands.

The combined 2002 and 2005 biomapping for the Kodiak archipelago has been assigned to two bioareas: Shelikof Strait (KATM) along the northwestern coast and Kodiak Island (KODI) along the southeastern Gulf of Alaska coast. The Shelikof Strait bioarea also includes the Katmai National Park area as well as the Aniakchak National Monument and Preserve coast. In the database, the four lower intertidal biobands in the Kodiak bioarea are identified by the suffix '10' in the bioband name, while Shelikof biobands are designated by the suffix '11'. See Appendix A, Table A-7 for a list of other bioareas defined to date in Alaska ShoreZone mapping.

Descriptions of Kodiak archipelago biobands, including species assemblages and photographic illustrations, are provided in this section. The occurrence of biobands mapped in Kodiak is summarized in Table 3.2 and Figure 3.2.

The Splash Zone (VER) Bioband

Zone	Bioband 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. This band is recorded by width: Narrow (N) = less than 1m Medium (M) = 1m to 5m Wide (W) = more than 5m	Width varies with exposure. N=VP-SP M=SP-SE W=SE-VE	*Littorina* sp.

A wide *Verrucaria* band representing the Splash Zone above Barnacle, Rockweed and Blue Mussel bands in a Semi-Exposed area of Uyak Bay.

KDKavi05_4183.jpg

The *Verrucaria* shows in this partially mobile, semi-protected area of Three Saints Bay as a narrow black band above a band of Barnacle and Green Algae bands at the waterline.

KDKavi05_08862.jpg

The Saltmarsh Biobands: Dune Grass (GRA), Sedges (SED), and Marsh Grasses, Herbs and Sedges (PUC) Biobands

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Dune Grass**	**GRA**	Pale blue-green	*Leymus mollis*	Found in the upper intertidal zone, on dunes or beach berms. This band is often the only band present on high-energy beaches.	P-E	
A	**Sedges**	**SED**	Bright green, yellow-green to red-brown. 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	
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.

Shorter, bright green Marsh Grasses border a band of tall blue-green Dune Grass in a Protected area of Three Saints Bay.

KDKavi05_08949.jpg

The reticulated pattern of Sedges in this Protected portion of Rolling Bay is commonly found in river estuaries and is often mixed within other Marsh Grasses and Dune Grass.

KDKavi05_09464.jpg

The Barnacle (BAR) Bioband

Zone	Bioband 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.

A creamy white Barnacle band in the high intertidal zone of Alitak Bay divides the Splash Zone from the lush algal biobands of the mid to lower intertidal zones.

KDKavi05_06980.jpg

Below this distinct *Verrucaria* band, Barnacles, Rockweed and Blue Mussels form the bands in the high intertidal range of this Semi-Exposed portion of Uyak Bay.

KDKavi05_4740.jpg

The Rockweed (FUC) Bioband

Zone	Bioband 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.

A lush band of Rockweed extends to the waterline in a Protected area of Three Saints Bay.

KDKavi05_08890.jpg

Rockweed forms a golden band in the upper intertidal of this Protected beach in Jap Bay.

KDKavi05_08365.jpg

The Green Algae (ULV) Bioband

Zone	Bioband 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 Green Algae band forms a pale haze of colour at the waterline on a Semi-Protected island in Uyak Bay.

KDKavi05_4509.jpg

The Green Algae band occurs as a bright green band below Rockweed, Barnacle and Blue Mussel bands in a Protected area of Uyak Bay.

KDKavi05_4500.jpg

The Blue Mussel (BMU) Bioband

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

This wide band of Blue Mussels is attached to gravel on this partially mobile semi-protected beach in Portage Bay.

KDKavi05_06922.jpg

Blue Mussels form a narrow black band amidst the Rockweed and Barnacle biobands in Three Saints Bay. Note that the black band above the blue mussels is *Verrucaria*.

KDKavi05_08861.jpg

The Bleached Red Algae (HAL) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Bleached Red Algae**	**HAL10 ***	Olive, golden or yellow-brown	Bleached foliose red algae *Palmaria* sp. *Odonthalia* sp.	Common on bedrock platforms, and cobble or gravel beaches. Distinguished from the 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

An olive coloured band of Bleached Red Algae can be seen in the lower intertidal forming a continuous band on this Protected beach on Hepburn Peninsula.

KDKavi05_06742.jpg

This thick mat of continuous Bleached Red Algae at Cape Hepburn in Alitak Bay is *Odonthalia* sp. with bleached tips and dark roots. This colour pattern was observed throughout both bioareas on the Kodiak archipelago.

KDK05_071_SCL_0216.jpg

*The suffix '10' denotes bioarea KODI (Kodiak Island).

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Bleached Red Algae**	**HAL11** *	Olive, golden or yellow-brown	Bleached foliose red algae including: *Palmaria* sp. *Halosaccion glandiforme*	Occurs on most substrates except fine sediments. Distinguished from the RED band by colour. Bleaching may be caused by a nutrient deficiency.	SP-SE	*Cryptosiphonia woodii* *Pterosiphonia bipinnata* *Neorhodomela* sp *Ulva* sp.

Bleached Red Algae can be seen in the lower intertidal forming a continuous band around this Semi-Protected island in Spiridon Bay.

KDKavi05_3812.jpg

These boulders on a beach on Chief Point in Suyak Bay are covered in Bleached Red Algae mixed with Green Algae.

KDK05_031_RLF_0616.jpg

*The suffix '11' denotes bioarea KATM (Shelikof Strait).

The Red Algae (RED) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Red Algae**	**RED10 ***	**Corallines*:*** pink or white **Foliose or filamentous*:*** Dark red, bright red, or red-brown.	*Corallina* sp. *Lithothamnion* sp. *Neoptilota* sp. *Odonthalia* sp. *Neorhodomela* sp. *Palmaria* sp. *Mazzaella* sp.	Appears on most substrates except fine sediments. Lush coralline algae indicates highest exposures; diversity of foliose red algae indicates medium to high exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures. In Kodiak, often mixed in lower B and upper C zone with lush large browns. *Neoptilota* is particularly abundant.	P-E	*Pisaster* sp. *Nucella* sp. *Katharina tunicate* mixed large browns of the CHB bioband

This Exposed area of Shuyak Island has a wide band of Red Algae at the waterline. Note the wide Verrucaria band stretching up the cliff face.

KDKavi05_0460.jpg

Red Algae forms a thick, dark brick red band in the lower intertidal of this Exposed immobile beach on Shuyak Island.

KDKavi05_0485.jpg

*The suffix '10' denotes bioarea KODI (Kodiak Island).

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Red Algae**	**RED11 ***	**Coralline*:*** pink or white **Foliose or filamentous*:*** Dark red, bright red or red-brown.	*Lithothamnion* sp. *Cryptosiphonia woodii* *Pterosiphonia bipinnata* *Odonthalia floccosa* *Palmaria* sp. *Porphyra* sp. *Mazzaella* sp.	Occurs on most substrates except fine sediments. Lush coralline algae indicate high exposures; foliose red algae indicate moderate exposures, and filamentous species, often mixed with green algae, indicate moderate to low wave exposures.	SP-E	*Alaria* sp. *Fucus* sp. *Semibalanus cariosus* *Katharina tunicata* *Littorina sitkana*

Red Algae form a thicker band on this immobile Semi-exposed rock platform than on the more mobile beach face behind the point, on Uganik Island.

KDKavi05_2811.jpg

Lush Red Algae forms a narrow band below a thick Barnacle band in an exposed area of Bear Island.

KDKavi05_4824.jpg

*The suffix '11' denotes bioarea KATM (Shelikof Strait).

The Surfgrass (SUR) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Surfgrass**	**SUR**	Bright green	*Phyllospadix* sp.	Appears in tidepools on rock platforms, often forming extensive beds. This species has a clearly defined upper exposure limit of semi-exposed and its presence in units of Exposed wave energy indicates a wide across-shore profile, where wave energy is dissipated by wave run-up across the broad intertidal zone.	SP-SE	Foliose and coralline red algae

This Semi-exposed rock and gravel platform below a mobile beach face on Sitkinak Island has a lush covering of Surfgrass mixed with *Alaria* and Green Algae.

KDKavi05_07188.jpg

Semi-Exposed partially mobile beach in Jap Bay, showing Surfgrass in tidepools with Soft Brown Kelps bioband surrounding.

KDKavi05_08407.jpg

The *Alaria* (ALA) Bioband

Zone	Bioband 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.

A Semi-Exposed bay on Aiaktalik Island, with a thick, continuous, mono-specific bed of *Alaria*.

KDKavi05_07971.jpg

Alaria draped over lower intertidal rocks and attached to boulders in an otherwise sandy subtidal on a Semi-exposed partially mobile beach in Portage Bay.

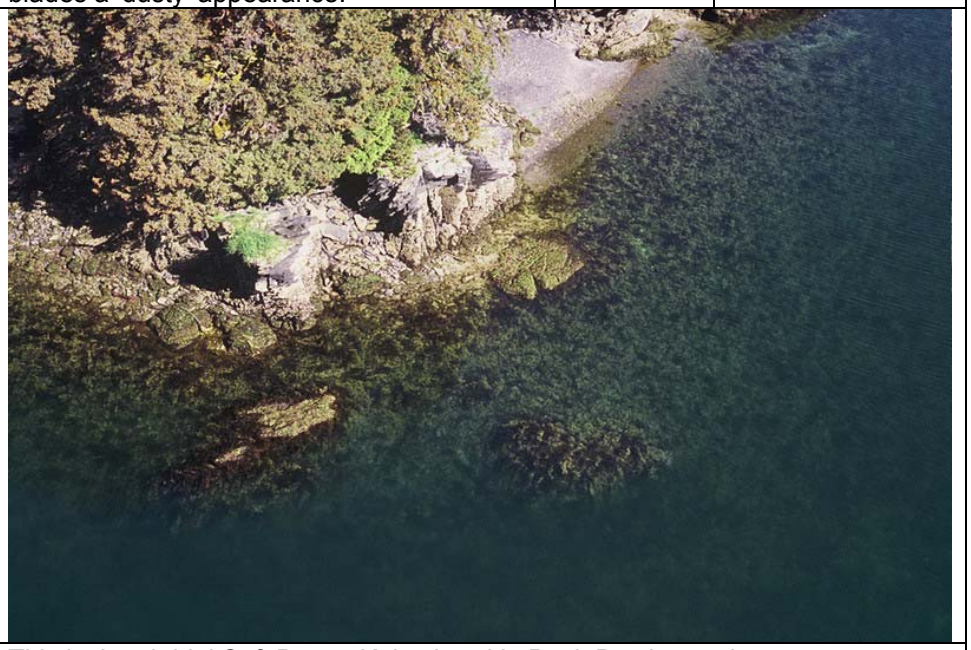
KDKavi05_06955.jpg

The Soft Brown Kelps (SBR) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Soft Brown Kelps**	**SBR10 ***	Yellow-brown, olive brown or brown.	*Saccharina subsimplex* *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. *Saccharina sessile* (bullate)

Soft Brown Kelps mixed with Green Algae, Red Algae, and *Alaria* forma a band spanning the lower intertidal and subtidal on this Semi-Protected, partially mobile beach on Shuyak Island.

KDKavi05_0337.jpg



This lush subtidal Soft Brown Kelps band in Back Bay has a dusty appearance due to accumulated silt and diatoms, possibly due to the influence of the nearby Afognak River.

KDK02-24-22.jpg

*The suffix '10' denotes bioarea KODI (Kodiak Island).

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Soft Brown Kelps**	**SBR11 ***	Olive-brown or brown	*Saccharina subsimplex* *Cystoseira* sp.	This band includes large brown algae characteristic of lower wave energy shores. Blades often have epiphytic diatoms and bryozoans, giving them a 'dusty' appearance.	P-SE	*Alaria* sp. *Cymathere* sp. *Costaria costata* *Zostera marina* Coralline red algae *Tonicella* sp.

A Semi-Protected rock and gravel platform on Shuyak Island has a band of Soft Brown Kelps in the low intertidal and subtidal.	A continuous subtidal band of Soft Brown Kelps off a Protected partially mobile beach in Larsen Bay.
KDKavi05_0713.jpg	KDKavi05_4685.jpg

*The suffix '11' denotes bioarea KATM (Shelikof Strait).

The Stalked Dark Brown Kelps (CHB) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Stalked Dark Brown Kelps**	**CHB10 ***	Dark chocolate brown	*Laminaria setchelli* *Saccharina subsimplex* *Laminaria yezoensis* *Lessoniopsis littoralis* *Saccharina 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. The southwestern coast of Kodiak island seems to be lacking most of the CHB species.	SE-E	*Cymathere* sp. *Pleurophycus* sp. *Costaria* sp. *Alaria* sp. *Neoptilota* sp.

Three Pillar Point has a thick band of Stalked Dark Brown Kelps at the waterline with Barnacle and Green Algae biobands on the beach above.

KDK02-11-31.jpg

This high Semi-Exposed platform near Cape Kostromitinof has a lush band of Stalked Dark Brown Kelps mixed with *Alaria* in the lower intertidal. A dense band of Bull Kelp is visible in the nearshore.

KDK02-26-15.jpg

*The suffix '10' denotes bioarea KODI (Kodiak Island).

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Stalked Dark Brown Kelps**	**CHB11 ***	Dark chocolate brown	*Cymathere triplicata* *Saccharina subsimplex* *Alaria marginata* morph *Laminaria longipes*	Kelps in this band occur in the lower intertidal and upper subtidal zones in higher wave exposures. Blades are leathery and shiny. Limited distribution of this bioband in Katmai, as the primary indicator species for this band do not occur in this region. RED band more common than CHB at high exposures in Shelikof Strait.	SE-E	*Costaria costata* *Odonthalia floccosa* *Palmaria* sp. Coralline algae *Semibalanus* sp.

A rocky Semi-Exposed point on Shyuak Island is covered with Stalked Dark Brown Kelps at the waterline and extending into the subtidal.

KDKavi05_1611.jpg

A band of Stalked Dark Brown Kelps occurs in the lower intertidal, below the Barnacle band, and subtidal of this immobile Semi-Exposed cliff on Cape Newland, Shuyak Island.

KDKavi05_1642.jpg

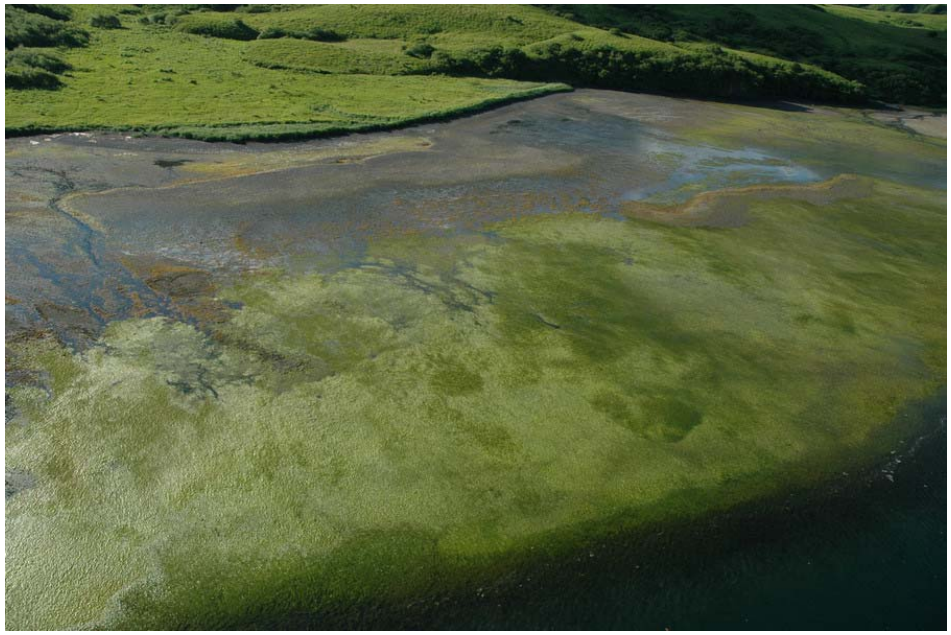
*The suffix '11' denotes bioarea KATM (Shelikof Strait).

The Eelgrass (ZOS) Bioband

Zone	Bioband 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. *Ulva* spp.

An Eelgrass bed extending up onto the delta fan of this estuary in Jap Bay. Rockweed and Blue Mussel bands also occur on this Protected beach.

KDKavi05_08371.jpg



A lush Eelgrass band located on a Protected partially mobile beach in Sitkalidak Lagoon.

KDKavi05_09376.jpg

The Dragon Kelp (ALF) Bioband

Zone	Bioband 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 Dragon Kelp forms a large dense canopy off this Semi-Exposed point in Wonder Bay, Shuyak Island.

KDKavi05_1261.jpg

The long, floating fronds of Dragon Kelp can be seen here in the nearshore subtidal of Wonder Bay on Shuyak Island.

KDKavi05_1264.jpg

The *Macrocystis* (MAC) Bioband

Zone	Bioband 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.	SP-SE	*Nereocystis luetkeana* *Alaria fistulosa*

A large, dense bed of *Macrocystis* off a Semi-Protected partially mobile beach on Shuyak Island.

KDKavi05_1421.jpg

A small bed of *Macrocystis* off a Semi-Protected partially mobile beach on Shuyak Island.

KDKavi05_1422.jpg

*Note: *Macrocystis* is of very limited distribution in the Kodiak archipelago and most was observed in one bay on the southwest side of Shuyak Island, where these example photos were taken.

The Bull Kelp (NER) Bioband

Zone	Bioband 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*. Often indicates current areas if observed at lower wave exposures.	SP-E	*Alaria fistulosa* *Macrocystis integrifolia*

This Exposed point of Cape Liakik has Bull Kelp visible streaming in the current offshore.

KDKavi05_08986.jpg

A lush bed of Bull Kelp forms a dense canopy on Sitkalidak Island.

KDKavi05_09879.jpg

Table 3.2. Bioband occurrence and abundance in the Kodiak archipelago.

Bioband Name	Bioband Code	Continuous (km)	Continuous %	Patchy (km)	Patchy %	Total (km)	% of Mapped
Dune Grass	GRA	1304	26%	664	13%	1968	40%
Sedges	SED	346	7%	175	4%	521	10%
Marsh Grasses, Herbs and Sedges	PUC	579	12%	502	10%	1081	22%
Barnacle	BAR	1818	36%	1069	21%	2887	58%
Rockweed	FUC	1277	26%	1374	28%	2651	53%
Green Algae	ULV	907	18%	1264	25%	2171	44%
Bleached Red Algae	HAL	151	3%	327	7%	478	10%
Blue Mussels	BMU	377	8%	1169	23%	1546	31%
Red Algae	RED	1397	28%	920	18%	2317	47%
Alaria	ALA	939	19%	637	13%	1576	32%
Soft Brown Kelps	SBR	1415	28%	921	18%	2336	47%
Stalked Dark Brown Kelps	CHB	539	11%	362	7%	901	18%
Surfgrass	SUR	219	4%	153	3%	372	7%
Eelgrass	ZOS	775	16%	482	10%	1257	25%
Dragon Kelp	ALF	164	3%	167	3%	331	7%
Macrocystis	MAC	1.3	0%	0.6	0%	2	0%
Bull Kelp	NER	639	13%	409	8%	1048	21%

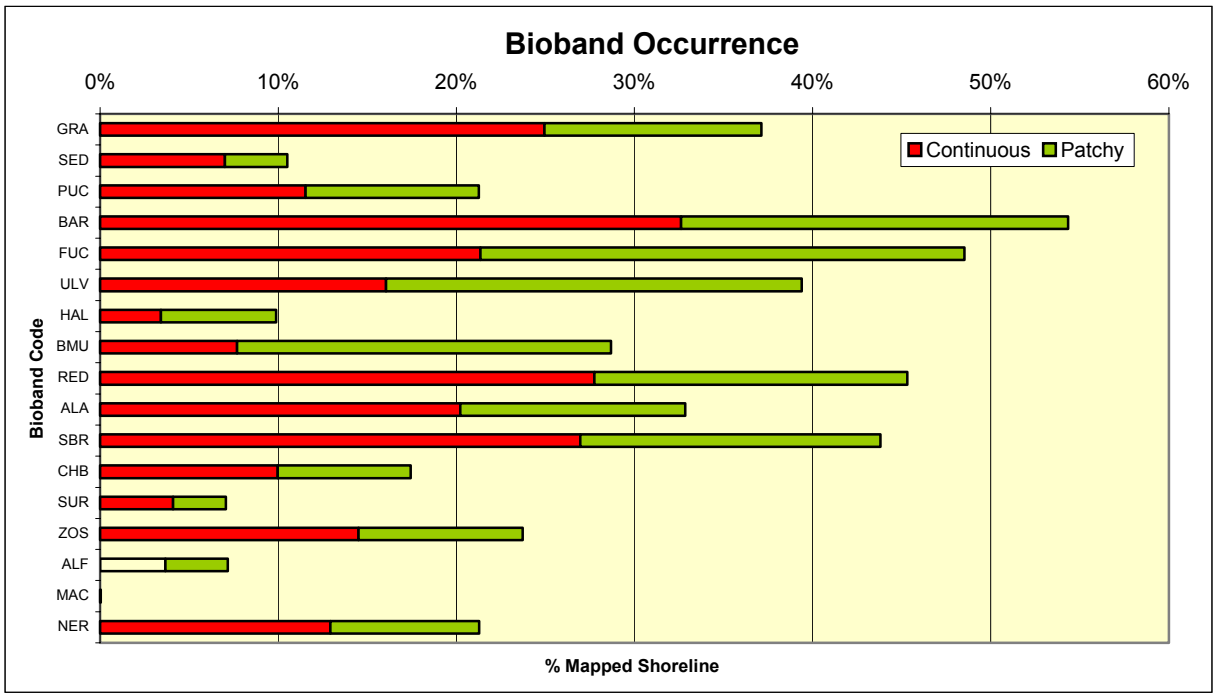


Figure 3.2. Occurrence of biobands in the Kodiak archipelago as a percentage of mapped shoreline length (4,981 km).

Distribution of Biobands

The distributions of select biobands are mapped below in Figures 3.3 – 3.10 to illustrate regional differences observed in the Kodiak Archipelago. Combinations of the various biobands also act as indicators for the different biological wave exposures and habitat classes.

Saltmarsh Biobands

In biological ShoreZone mapping, combinations of the 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.

Saltmarsh biobands and combinations:

1. GRA – Dune Grass 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. GRA + PUC + SED – Dune Grass and Marsh Grasses/Herbs and Sedge – best indicator of contiguous salt marsh /estuary areas
4. PUC – Marsh Grasses/Herbs – good indicator of fringing salt marsh or smaller salt marsh /estuary areas
5. GRA + SED – Dune Grass and Sedge – good indicator of smaller salt marsh/estuary areas
6. PUC + SED – Marsh Grasses/Herbs and Sedge – good indicator of smaller salt marsh/estuary areas
7. SED – Sedge alone – good indicator of freshwater input, usually associated with streams

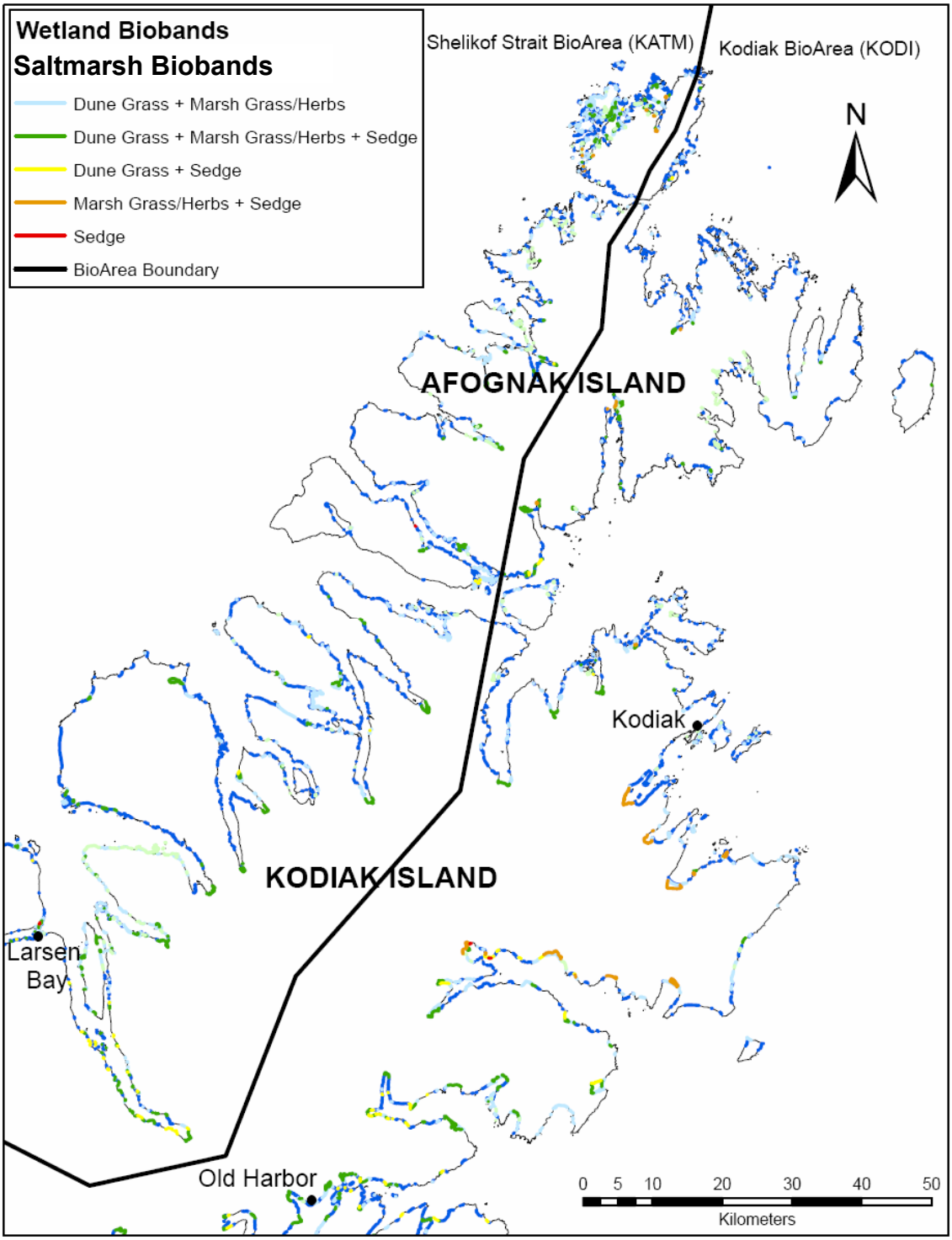


Figure 3.3. Distribution of Saltmarsh Biobands at the northern end of the Kodiak archipelago.

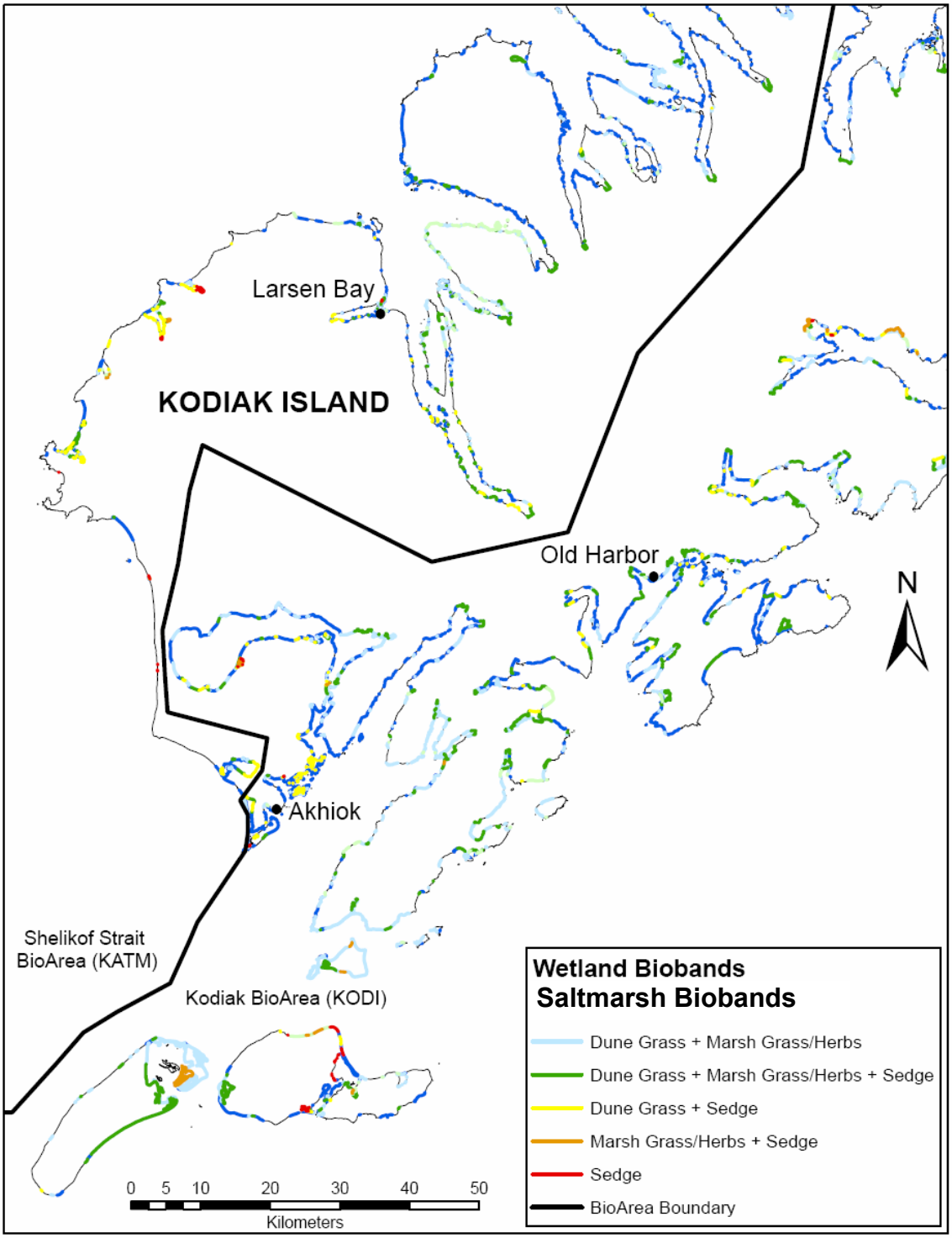


Figure 3.4. Distribution of Saltmarsh Biobands at the southern end of the Kodiak archipelago.

Combinations of Lower Intertidal Biobands

The combination of the lower intertidal biobands (RED – Red Algae; ALA – Alaria; SBR – Soft Brown Kelps; and CHB – Stalked Dark Brown Kelps) is the most diagnostic of differences between wave exposures and between regions, and represent the gradation in wave exposure across the area.

The bioband combinations mapped in these figures are:

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

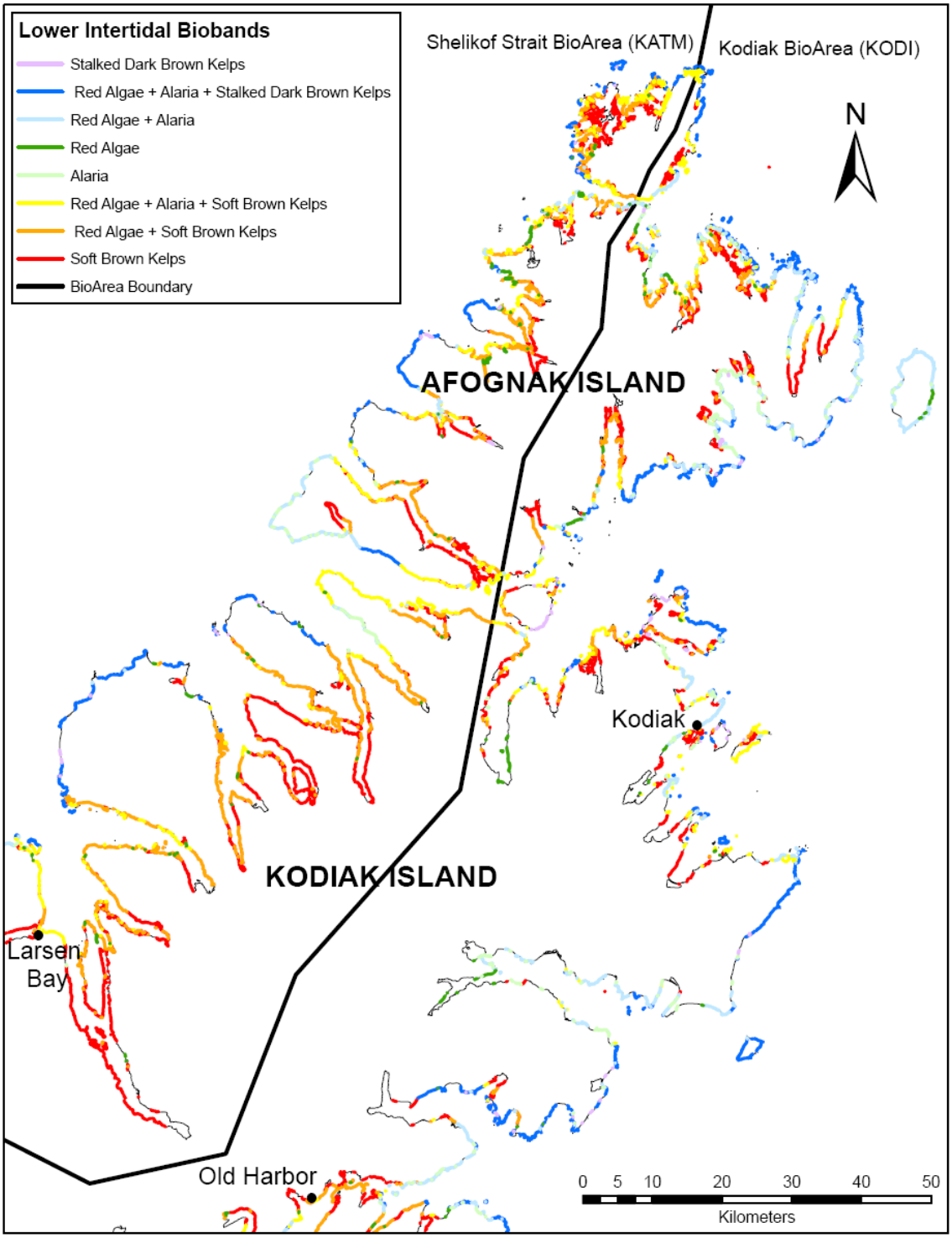


Figure 3.5. Distribution of Lower Intertidal Biobands at the northern end of the Kodiak archipelago.

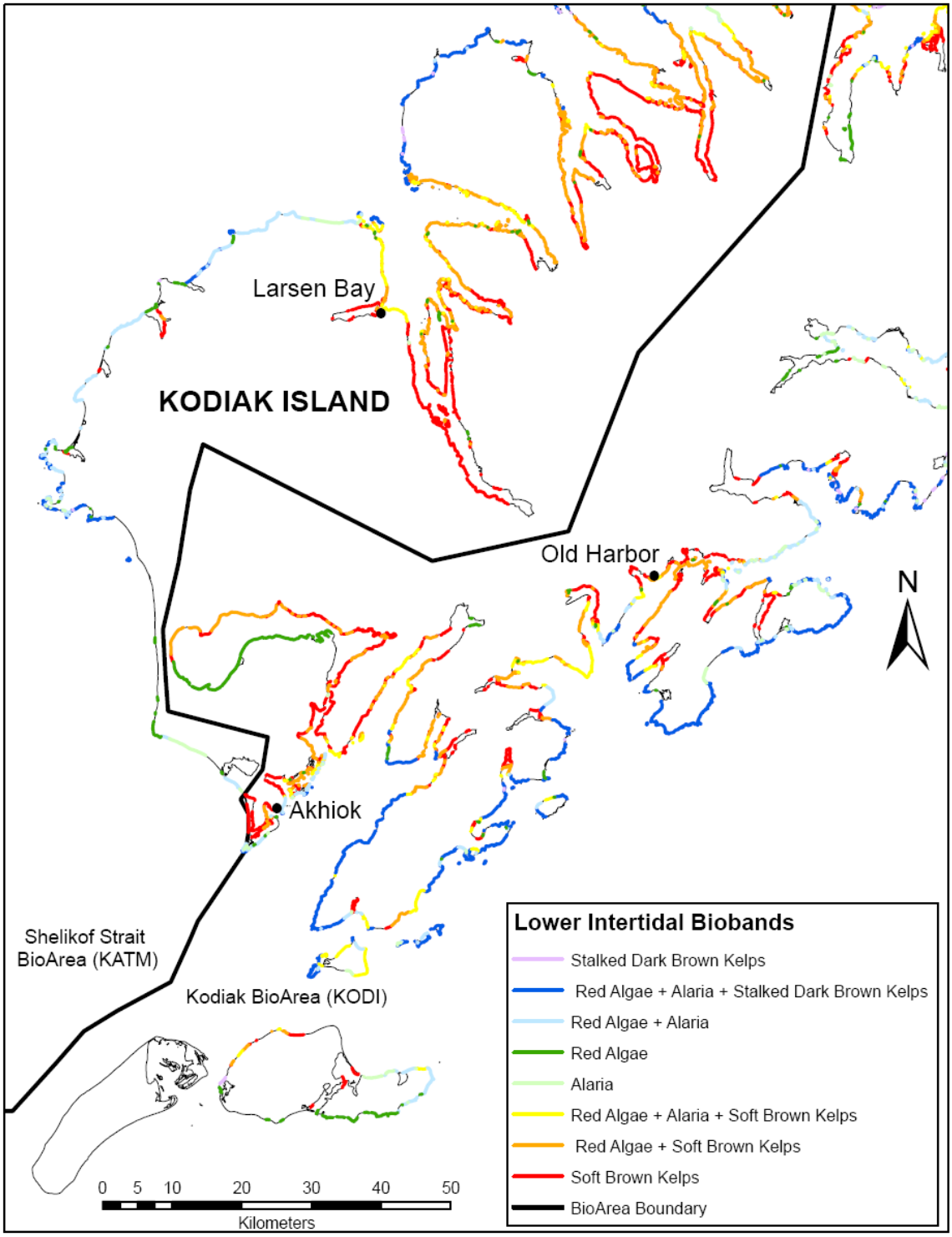


Figure 3.6. Distribution of Lower Intertidal Biobands at the southern end of the Kodiak archipelago.

Seagrass Biobands

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

The regional differences in seagrass distribution in the Kodiak archipelago are striking. While Eelgrass is abundant at lower wave exposures in both bioareas, Surfgrass is only present in the more exposed areas of outer coast in the Kodiak bioareas. Very few units had a co-occurrence of both seagrass bands (Eelgrass and Surfgrass).

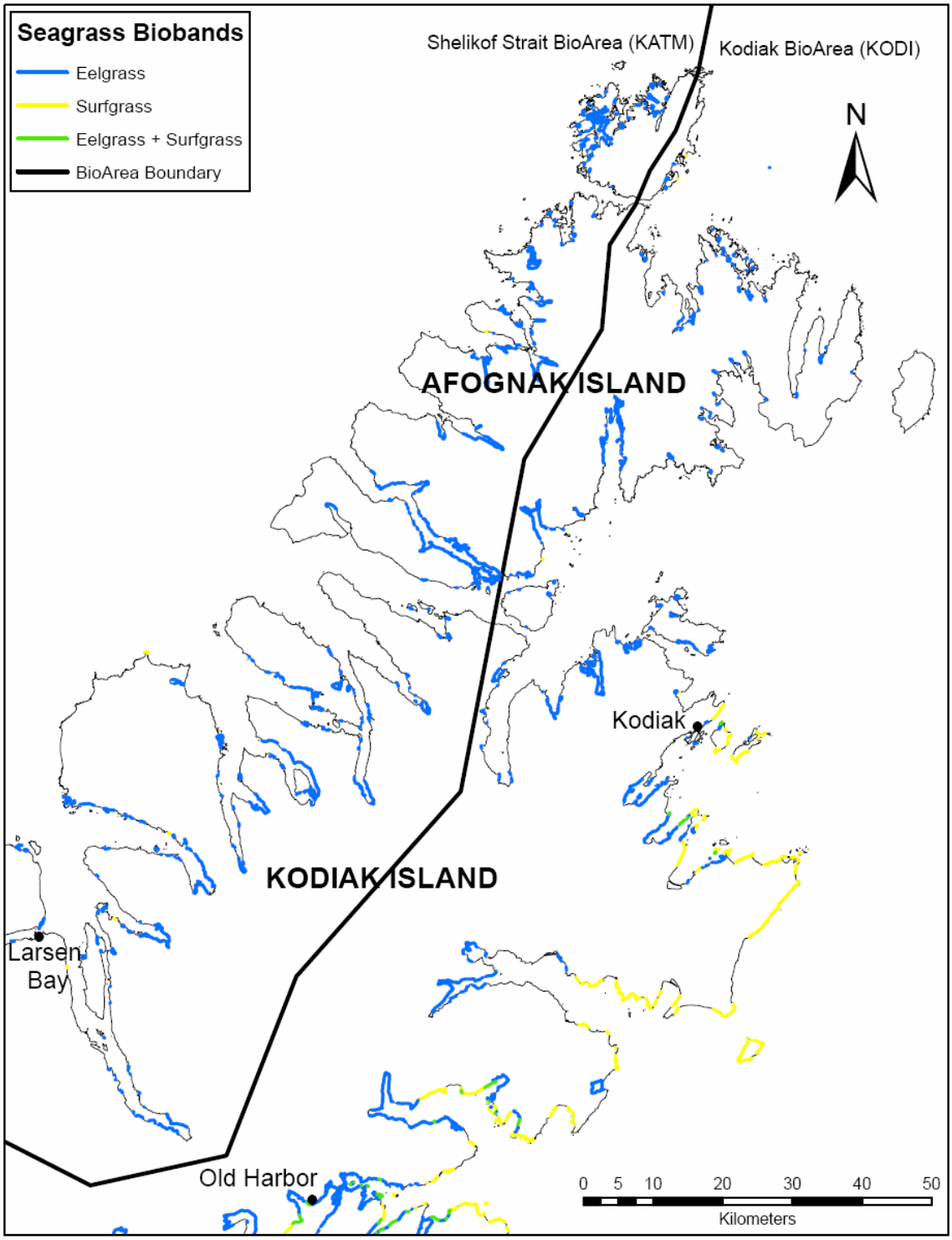


Figure 3.7. Distribution of Seagrass Biobands at the northern end of the Kodiak archipelago.

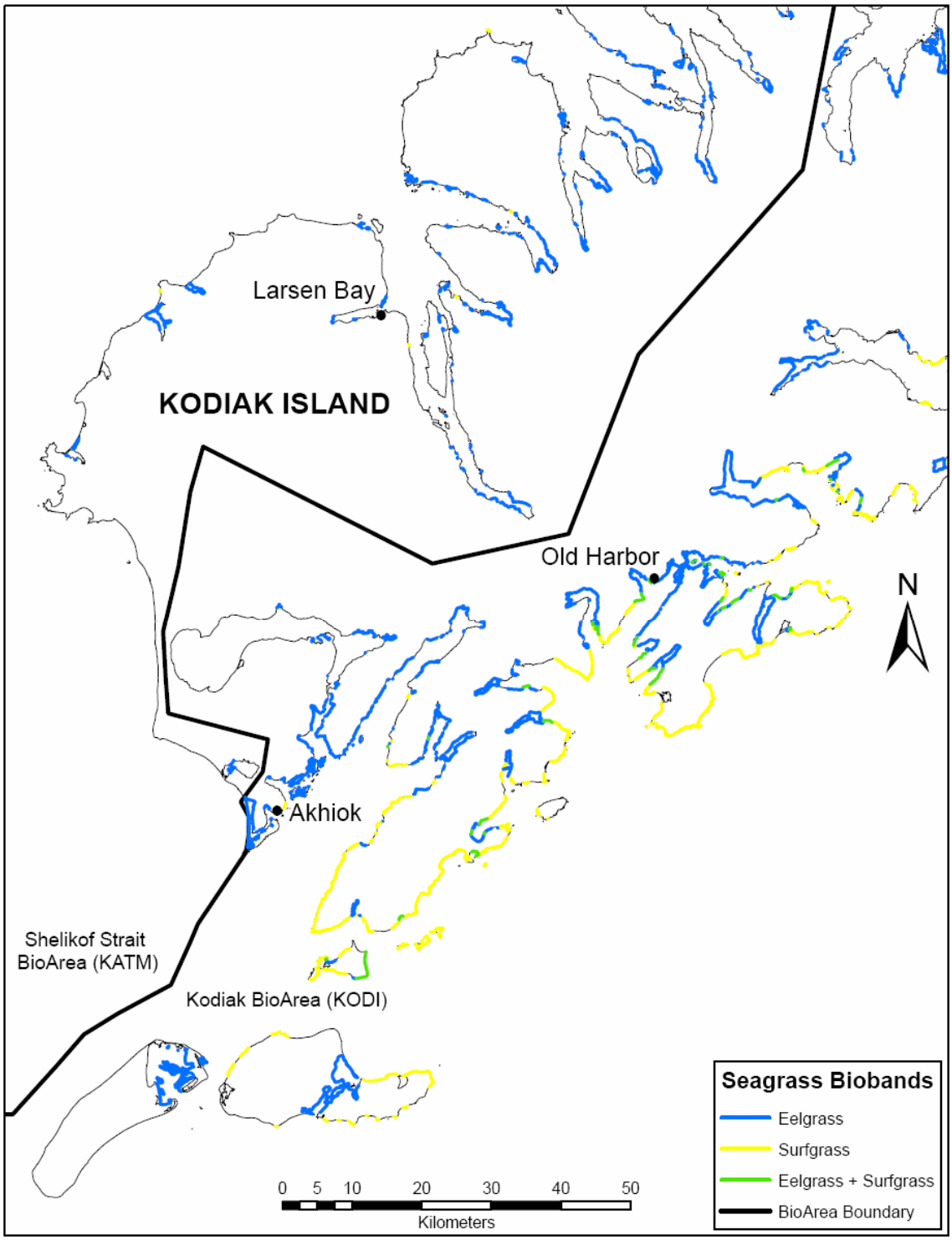


Figure 3.8. Distribution of Seagrass Biobands at the southern end of the Kodiak archipelago.

Nearshore Canopy Kelp Biobands

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

In the Kodiak archipelago, Bull Kelp is widespread along the outer coast in the areas of highest wave exposure. Dragon Kelp is present on both the southern most tip and the northern end of the Kodiak archipelago. It is most prevalent on the coastline around Shuyak Island and the northeast side of Afognak Island. *Macrocystis* is of very limited distribution and most was observed in one bay on the southwest side of Shuyak Island. This was also the only location where the three species were found to co-occur.

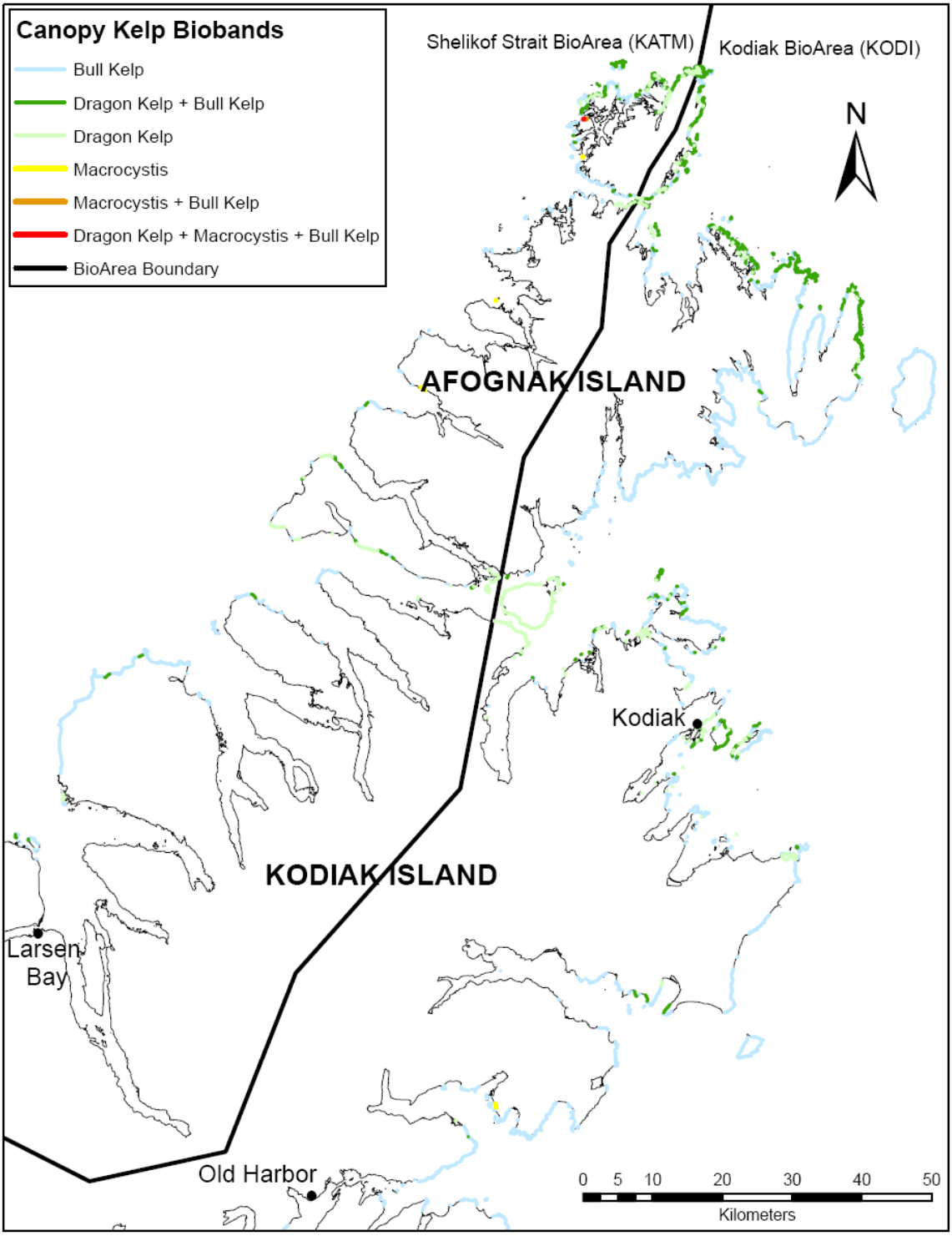


Figure 3.9. Distribution of Canopy Kelp Biobands at the northern end of the Kodiak archipelago.

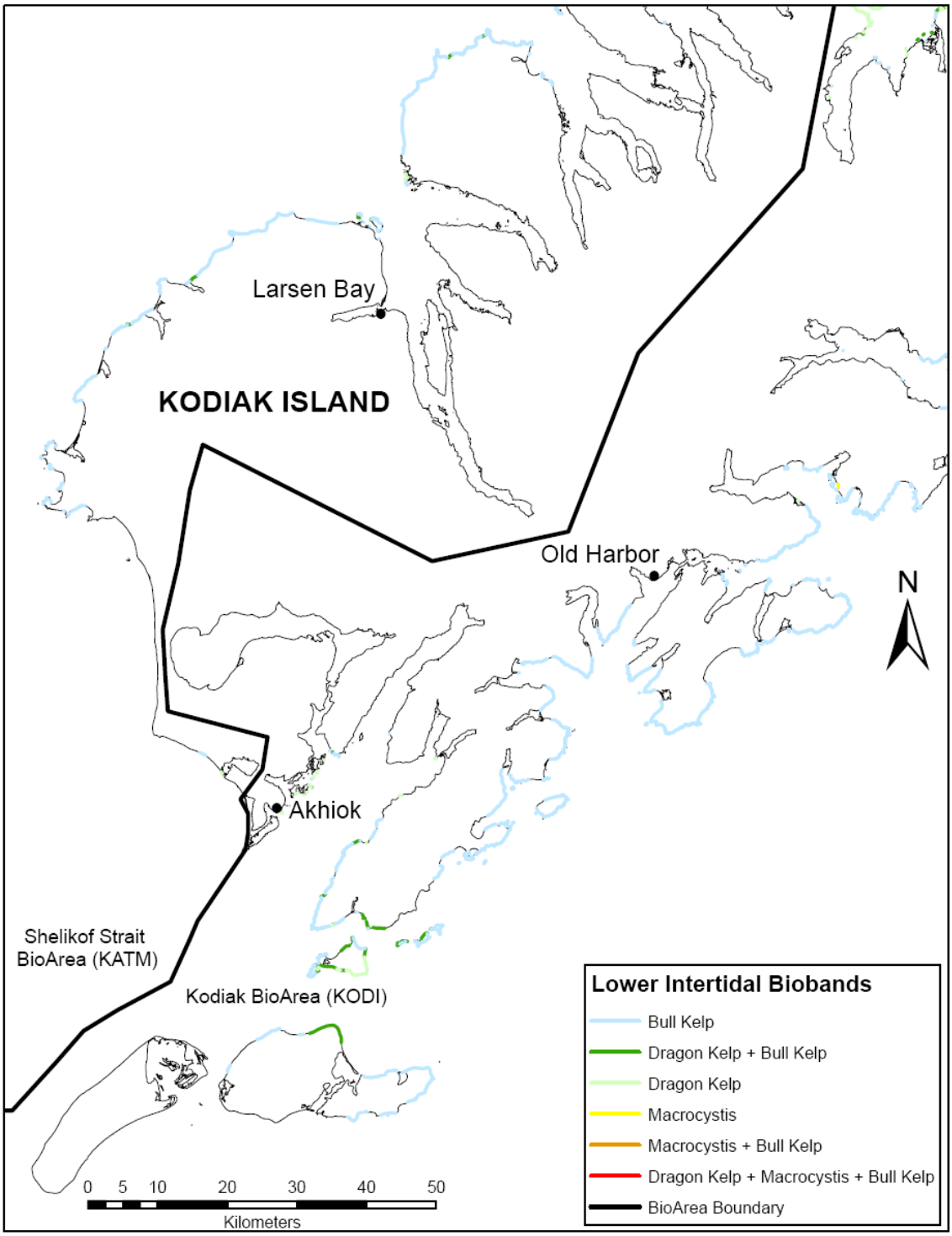


Figure 3.10. Distribution of Canopy Kelp Biobands at the southern end of the Kodiak archipelago.

3.2 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 ("EXP_BIO" in the database). It is considered the most representative index of actual wave exposure. Wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are defined on the basis of a set of indicator species and a "typical" set of biobands. The six categories and codes are the same as those used in the physical ShoreZone mapping to characterize wave exposure of an alongshore unit on the basis of fetch window estimates and coastal geomorphology ("EXP_OBSER" in the UNIT table of the database).

Wave energy tolerances of the species assemblages that comprise the ShoreZone biobands are known from scientific literature and expert knowledge. Some biobands are observed in all wave exposure categories and are considered "associated species" bands (e.g. the Barnacle band (BAR)), while other biobands are considered "indicators" because they are closely associated with particular wave exposures. For example, the Stalked Dark Brown Kelps band (CHB) is consistently associated with higher wave exposures (Semi-Exposed to Exposed). Species and biobands listed for each wave exposure category are considered "typical" but not "obligate." That is, not all species occur in every unit classified with a particular biological wave exposure. The combination of biobands, indicator species, and interpretation by biological mappers determines the wave exposure category for each unit. Typical indicator and associated species and biobands are summarized for each Biological Wave Exposure category from mapped areas in Kodiak with example illustrations in Tables 3.3 through 3.6 and in Figures 3.11 through 3.14.

A summary map of the distribution of biological wave exposure in the 2002 and 2005 mapped areas of Kodiak is shown in Figure 3.15. The "Very Exposed" category has not been applied in biological mapping of Kodiak although it has been mapped on the Outer Kenai coast, in Kenai Fjords National Park, and on the southwest coast of Moresby Island, British Columbia.

An extensive shore station survey was completed in Kodiak in May and June 2005. The information collected from the 113 stations surveyed was used in this report to add qualitative descriptions to bioband definitions and to fill out the list of species associated with each bioband.

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		Stalked Dark Brown Kelps	CHB
	Laminaria setchellii		Stalked Dark Brown Kelps	CHB
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches

Figure 3.11. Exposed bedrock shoreline on Bear Island. The biobands visible here are the Splashzone (VER), Barnacle (BAR), Blue Mussel (BMU), Red Algae (RED) and Bull Kelp (NER). This assemblage of biobands is typical of high exposures, especially in the Shelikof Strait bioarea; Stalked Dark Brown Kelps are not typically seen in this bioarea although they are an indicator band for Exposed areas in the Kodiak Island bioarea on the Gulf of Alaska side of the Kodiak archipelago. (Photo: KDKavi05_4824.jpg)

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 Mussel	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		Stalked Dark Brown Kelps	CHB
	Laminaria yezoensis		Stalked Dark Brown Kelps	CHB
	Laminaria bongardiana morph		Stalked Dark Brown Kelps	CHB
	Hedophyllum smooth morph		Stalked Dark Brown Kelps	CHB
	Alaria fistulosa		Dragon Kelp	ALF
		Macrocystis integrifolia	Macrocystis	MAC
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches

Figure 3.12. Semi-Exposed bedrock cliffs at Kiliuda Bay, Kodiak Island show a typical medium Splash Zone of black *Verrucaria* and distinct bands of mid-intertidal Barnacle (BAR) and Blue Mussel (BMU). Red Algae (RED) and Stalked Dark Brown Kelps (CHB) occur in the lower intertidal. A few *Nereocystis* plants occur offshore (patchy NER band). (Photo: KDKavi_10660.jpg)

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
	Semibalanus carriosus		Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Mytilus trossulus		Blue Mussels	BMU
		Ulva and other foliose green algae	Green Algae	ULV
	Palmeria sp. (bleached)		Bleached Red Algae	HAL
	Mixed red algae including *Odonthalia*		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Zostera marina		Eelgrass	ZOS
	Cystoseira sp.		Soft Brown Kelps	SBR
	Cymathere sp.		Soft Brown Kelps	SBR
	Saccharina latissima		Soft Brown Kelps	SBR
	Nereocystis luetkeana		Bull Kelp	NER

*associated with Wetland/ Estuary areas at this wave exposure

Figure 3.13. Golden brown *Fucus* (Rockweed band (FUC)) mixed with Barnacle (BAR), Bleached Red Algae (HAL), Blue Mussel (BMU) and Soft Brown Kelps (SBR), blankets this platform in Deadman Bay on Moser Peninsula showing a typical lush Semi-Protected area. (Photo: KDKavi05_06591.jpg)

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 Mussel	BMU
Lower Intertidal	*Ulva/* foliose green algae		Green Algae	ULV
	Zostera marina		Eelgrass	ZOS
	Saccharina latissima (not in Very Protected)		Soft Brown Kelps	SBR

*associated with Wetland/ Estuary areas at this wave exposure

Figure 3.14. The combination of a lush eelgrass bed (ZOS band) with Green Algae (ULV) and Rockweed (FUC) bands and patchy fringing Dune Grass (GRA band) in Sitkalidak Strait, Kodiak Island indicates a typical low energy Protected biological wave exposure. (Photo: KDKavi05_10235.jpg)

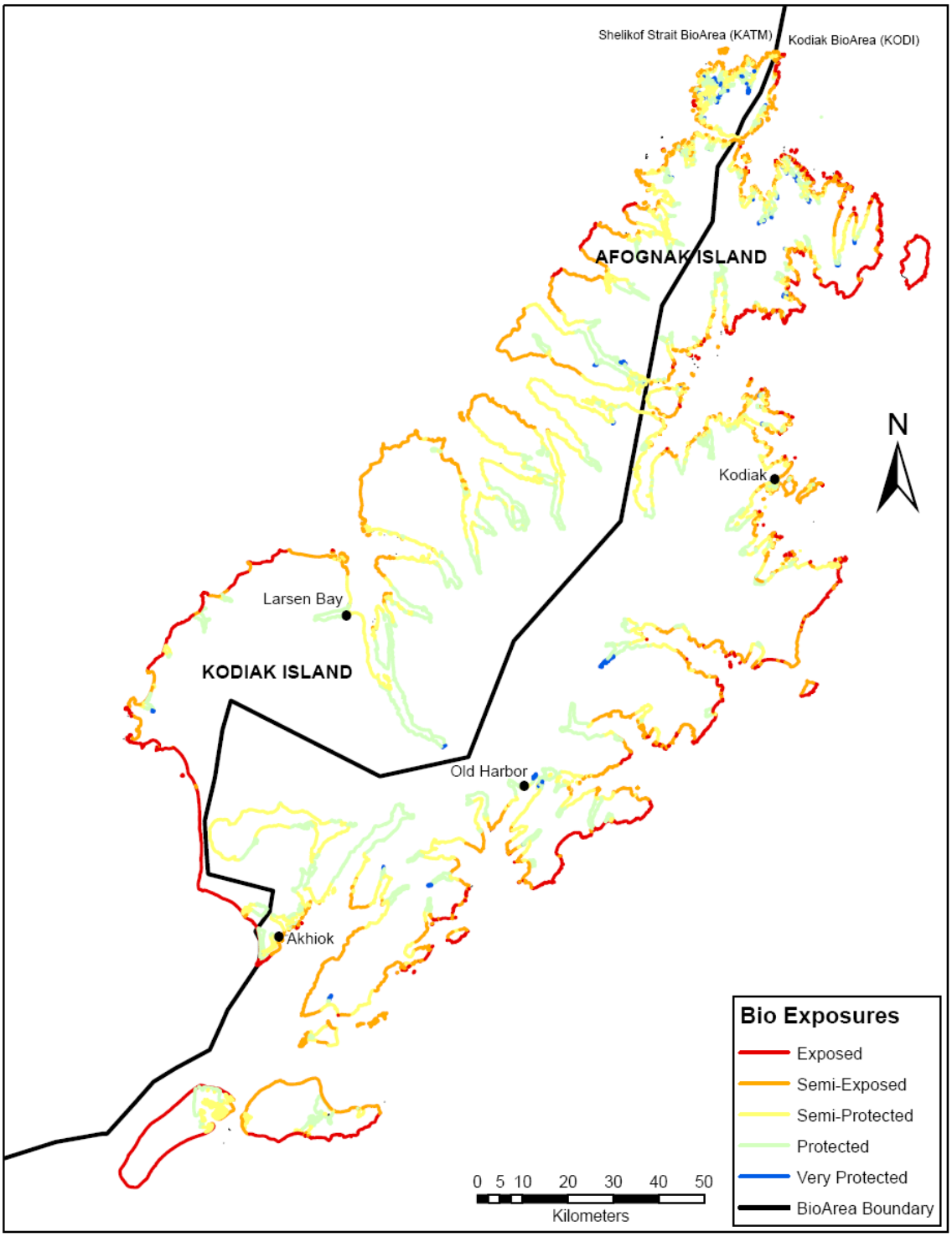


Figure 3.15. Distribution of Biological Wave Exposure categories in the Kodiak archipelago.

3.3 Habitat Class

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

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

The species assemblages observed at a particular location are a reflection of both the physical characteristics of that shore segment as well as the wave exposure. Thus, the species assemblage observed on an Exposed shore with a mixture of rock and mobile sediment will be distinct from the species assemblage observed on a Protected shore with a wetland complex. Further description of the Habitat Class codes and definitions are provided in Appendix A, Tables A-8 and A-9.

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

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

- **Immobile or stable:** substrates such as bedrock, boulders, and cobbles (could even be pebbles on a very protected coast) (Figure 3.16).
- **Partially mobile:** mixed substrates such as a rock platform with a beach or sediment veneer; or units where energy varies across the beach. The partial mobility of the sediment limits the development of a full bioband assemblage that would likely occur on a stable rock shoreline (Figure 3.17).
- **Mobile:** substrates such as sandy beaches where coastal energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota (Figure 3.18).

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

- **Estuary** types with wetlands and marsh vegetation along low energy sediment shores influenced by freshwater (Figure 3.19).
- **Current-Dominated** channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units (Figure 3.20).
- **Anthropogenic Features** where the shoreline has been modified or disturbed. Examples include wharves or areas of rip rap or fill (Figure 3.21).
- **Lagoon** units have enclosed or constricted area of brackish or salty water, often found in the supratidal; however, sometimes large shallow lagoons form the subtidal zone to multiple units (Figure 3.22). Lagoons were mapped only as 'secondary habitat classes'.

The occurrence of fifteen generalized Habitat Classes is summarized for mapped areas of Kodiak archipelago in Table 3.7. Nearly half of the mapped area was Partially Mobile, Protected, or Semi-Protected wave exposures (40%) and nearly one fifth of Kodiak was classified as Mobile (19%). Because Kodiak has a relatively sparse population, less than 1% of the shoreline was mapped with Anthropogenic Features. Higher wave exposure habitats made up about a third of the mapped area (36%).

Summary maps of the distribution of Habitat Classes mapped in Kodiak are shown in Figures 3.23 and 3.24.

Figure 3.16. Example of the **immobile, semi-exposed** habitat class on Bear Island. The bedrock cliff has a dense cover of biobands, including: Barnacles, Blue Mussel, Red Algae, and *Alaria*. (Photo: KDKavi05_4823.jpg)

Figure 3.17. **Partially mobile, semi-exposed** shoreline in Uyak Bay, showing dense cover of biota on the stable bedrock platform, with bare, mobile sediment on adjacent beaches. (Photo: KDKavi05_4603.jpg)

Figure 3.18. **Mobile**, **semi-exposed** beach in Zachar Bay, bare of attached biota. (Photo: KDKavi05_4080.jpg)

Figure 3.19. **Estuary** habitat class in Portage Bay. Wetland grasses cover a large area in the supratidal, while the delta fan has a sparse cover of *Fucus* (rockweed) and *Zostera* (eelgrass) biobands. (Photo: KDKavi05_06914.jpg)

Figure 3.20. **Current-dominated channel** habitat connects a ponded high-tide lagoon to Uyak Bay. (Photo: KDKavi05_4701.jpg)

Figure 3.21. Marina and modified shoreline at Old Harbor, an example of **anthropogenic** habitat classes. (Photo: KDKavi05_09115.jpg)

Figure 3.22. Backshore brackish **lagoon** in Uyak Bay, an example of a shore unit where the lagoon secondary habitat class was mapped. (Photo: KDKavi05_4014.jpg)

Table 3.7. Summary of Biophysical Habitat Classes in the Kodiak archipelago.

	Biophysical Habitat Description	Habitat Classes *	Length (km)	% of Mapping
Exposed	**Stable Substrate:** Rocky shorelines with high wave exposure.	10 20	188.4	4%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	11 21	243.7	5%
	Mobile Substrate: No epibenthic community in intertidal due to dynamic substrate.	12 22	181.2	4%
Semi-Exposed	**Stable Substrate:** Rocky shorelines with moderate to high wave exposure.	30	325.2	6%
	Partially Mobile Substrate*:* Rocky shorelines with sediments that are sufficiently mobile to limit epibenthos in some portions of the shore.	31	632.4	13%
	Mobile Substrate: Small-size sediment shores generally have no epibenthic community. Cobble/boulder beaches may have biota. Dunes frequent in backshore.	32	183.4	4%
Semi-Protected	**Stable Substrate:** Rocky shorelines with moderate to low wave exposure.	40	215.6	4%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	41	1101.3	22%
	Mobile Substrate: Small-size sediment shores generally have low biotic diversity. Cobble/boulder beaches usually support biota, especially in low intertidal/upper subtidal.	42	284.5	6%
Protected	**Stable Substrate:** Rocky shorelines with low wave exposure.	50 60	52.4	1%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	51 61	896.7	18%
	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	264.9	5%
Wetland/ Estuary	**Estuary:** Generally low energy sediment shores with wetlands and marsh vegetation. Usually influenced by freshwater.	23, 33 43, 53 63	334.7	7%
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.	34 44 54	48.0	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	27.1	<1%
	TOTALS:		4980.5	100%
	Summary of Occurrence of Habitat Class 2			
Lagoon	**Lagoon Features:** a unit that encompasses an area of constricted brackish or saltwater with limited drainage, often associated with wetlands.	38, 48 58, 68	420.7	8%

* see Appendix A, Table A – 8 for list of definitions of Habitat Class codes.

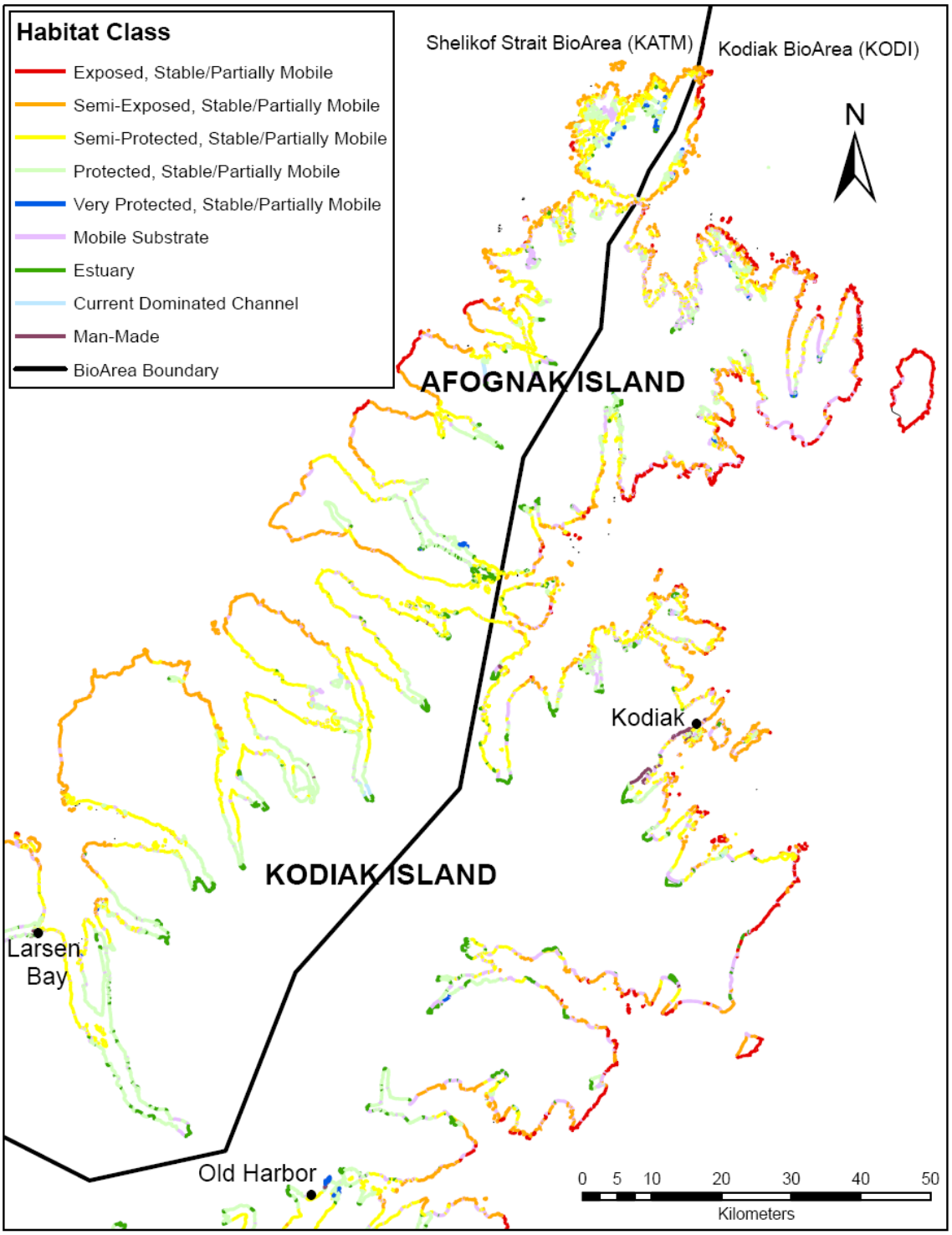


Figure 3.23. Distribution of Habitat Class categories at the northern end of the Kodiak archipelago.

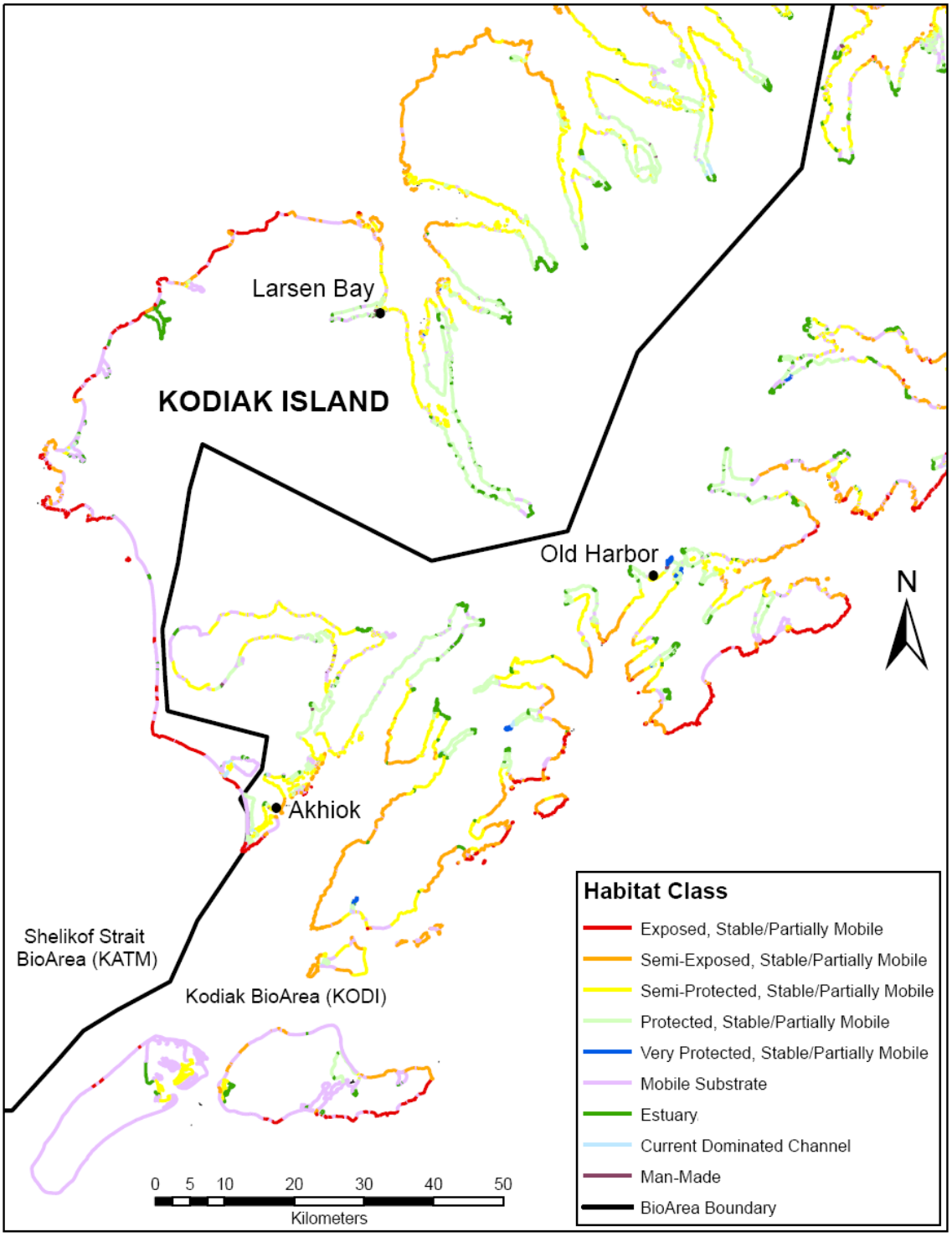


Figure 3.24. Distribution of Habitat Class categories at the southern end of the Kodiak archipelago.

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

(continued on following page)

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

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	-	-	-	3	3	3
organics/vegetation	-	-	-	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)
BioArea*	T	a geographic region used to describe regional differences in biota observed in the lower intertidal biobands.
EXP_BIO	T	estimate of the exposure based on observed indicator species (see Section 3.2 for details).
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 current 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
HAB_CLASS2**	N	Secondary Habitat Classification determined by the BIO mapper used to denote lagoon habitat types
HC2_SOURCE	T	the source that was used to interpret the secondary habitat class (HC2) lagoon, OBS(erved) as viewed from video, L(oo)KUP refering to 'Form' Code (Table A-11) Lo or Lc in Across-Shore Component Table (XSHR)
HC2_Note	T	comment field for Secondary Habitat Class (HC2)
RIPARIAN% ***	N	estimate of the percentage of alongshore length of the intertidal zone, 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 **BIOAREA** attribute:

BIOAREA NAMES in Alaska ShoreZone Mapping To Date	BIOAREA Codes in Alaska SZ Mapping	SUFFIX Used in Database to Identify BioArea
Southeast Alaska -- Lynn Canal	SEFJ	12
Southeast Alaska -- Sitka	SESI	12
Southeast Alaska -- Icy Strait	SEIC	12
Southeast Alaska -- Yakutat	SEYA	12
Southeast Alaska -- Misty Fjords	SEMJ	12
Southeast Alaska -- Craig	SECR	12
Prince William Sound	PRWS	13
Outer Kenai	KENA	8
Cook Inlet	COOK	9
Kodiak Island	KODI	10
Katmai & Shelikof Strait side of Kodiak Island	KATM	11
Aniakchak	ANIA	11

(continued on following page)

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

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

The 'Secondary Habitat Class' was added as an attribute in the BioUnit Table during the Kodiak biomapping to specifically identify *lagoon* habitats because many backshore lagoons were observed in the Kodiak region, and they represent an unusual coastal habitat that differs from estuaries and other areas designated as marshland.

***** 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 a summary attribute that represents the biophysical characteristics of a unit, describing the typical intertidal biota and 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 biological mapper 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.

Within the database, both a numeric code and an alpha code are used. Both codes are listed in Table A-8, where the matrix includes all combinations of 'Dominant Structuring Process' on the vertical axis, and 'Biological Wave Category' on the horizontal axis.

Biological Exposure Categories

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

Dominant Structuring Process Categories

Wave	– Immobile on Bedrock; or Bedrock & Sediment; or Sediment (can have lush epibenthic biota)
	– Partially mobile on Rock & Sediment; or Sediment
	– Mobile on Sediment (bare beach)
Fluvial	– Estuary (saltmarsh vegetation associated with freshwater stream, often with delta form)
Current	– Current-dominated saltwater channel
Glacial	– Glacier ice
Anthropogenic	– Impermeable substrate
	– Permeable substrate
Lagoon	– Backshore lagoon, only recorded as a Secondary Habitat Class

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

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

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

Field 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)olian
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)
k	clay
p	pebbles
r	rubble (boulders>1m)
s	sand
x	angular fragments (mix block & rubble)
v	**sediment veneer**

DESCRIPTION OF SUBSTRATE
Simplified from Wentworth scale

GRAVELS

boulder	> 25 cm
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 0.5 mm to 2 mm

FINES (MUD)
from silt to clay:
finer than 0.5 mm

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 relative abundance. A surface layer can be described by prefix 'v' for veneer (e.g. vCs/R). Veneer is not used for living vegetation (e.g. Bt/R is used without the 'v').

Shore Modifications (ranked 0-10 for 0-100% of alongshore unit length)

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

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 numeric 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 Section 3.1 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 SEDges 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

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

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

The Kodiak archipelago includes two Boreas: the Katmai and Shelikof Strait area (BioArea KATM with bioband suffix 11) and the Gulf of Alaska shore of Kodiak (BioArea KODI, bioband suffix 10).

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 biological mapper to describe each slide
Good Example?	Y/N	Indicated when the photo is representative of a particular coastal class, geomorphic form, or biological feature
ImageType	T10	Media type of original image “Digital” or “Slide"
FolderName	T50	Name of the folder where the images are stored (required if hyperlink to digital images are used)
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