Coastal Habitat Mapping Program

Southeast Alaska
Data Summary Report
October 2011

ShoreZone

Prepared for:
The Nature Conservancy

The Nature Conservancy

Coastal & Ocean Resources Inc.

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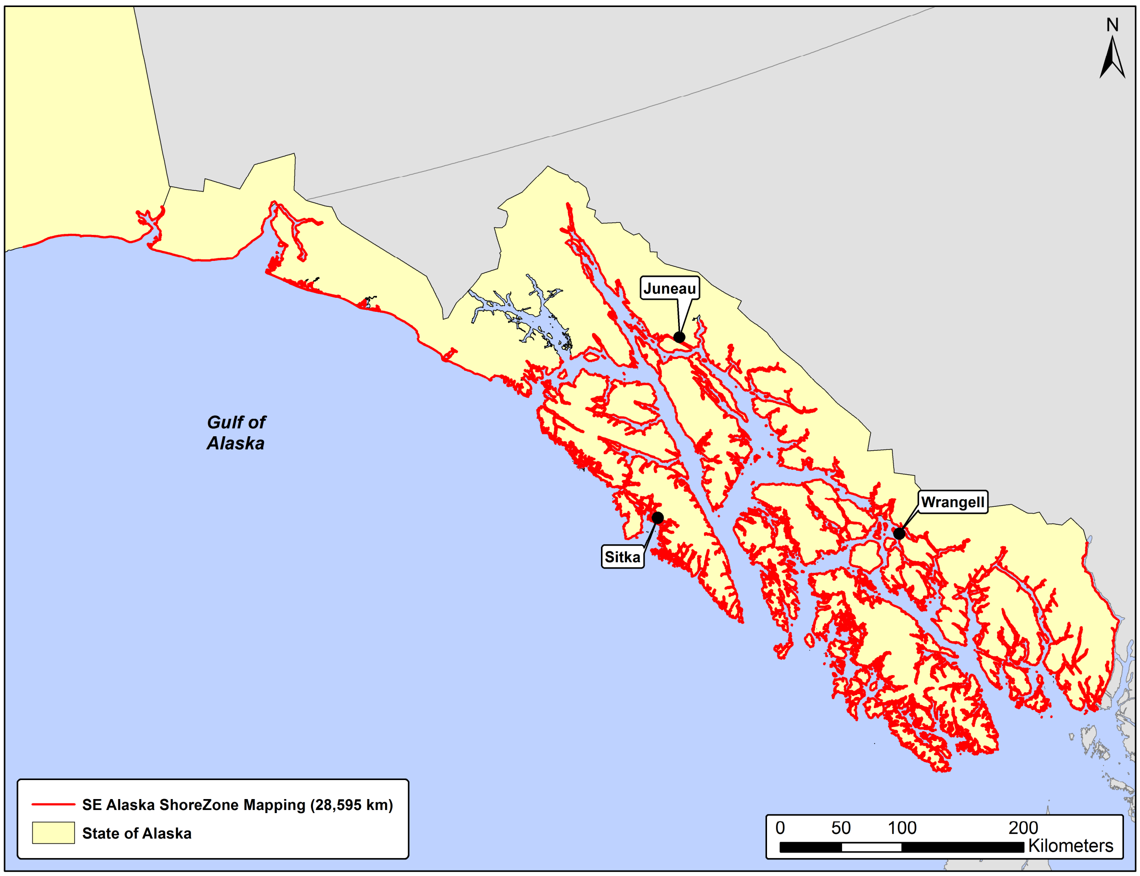
On the Cover:

South Coronation Island
Sawyer Glacier, Tracy Arm
North Zarembo Island
Juneau, AK

CORI Project: 10-17 **Oct 2011**

ShoreZone Coastal Habitat Mapping Data Summary Report

2004-2010 Survey Area, Southeast Alaska



Prepared for:
NOAA National Marine Fisheries Service, Alaska Region
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SUMMARY

ShoreZone is a coastal habitat mapping and classification system in which georeferenced aerial imagery is collected specifically for the interpretation and integration of geological and biological features of the intertidal zone and nearshore environment. The mapping methodology is summarized in Harney *et al* (2008).

This interim data summary report provides information on **geomorphic and biological features** of 28,595 km of shoreline mapped in 2004-2010 surveys of Southeast Alaska. There is approximately 1,100 km of unmapped shoreline in Glacier Bay. The habitat inventory is comprised of 88,704 along-shore segments (units), averaging 322 m in length.

Organic shorelines (such as estuaries) are mapped along 3,388 km (12%) of the study area. Bedrock shorelines (BC Classes 1-5) comprise 4,947 km (17%) of mapped shorelines. Of these, steep rock cliffs are the most common mapped along 3,682 km (13%) of the shoreline. A little less than half of the mapped coastal environment is characterized as combinations of rock and sediment shorelines (BC Classes 6-20): 11,747 km (41%). Sediment-dominated shorelines (BC Classes 21-30) comprise 8,205 km of the study area (29%). Of these, wide sand and gravel flats (BC Class 24) are the most common, mapped along 4,309 km of shoreline (15% of the total study area).

Approximately 85% of all habitat classes mapped are structured by wave energy and another 14% is structured by estuarine processes. Repeatable assemblages of biota that can be recognized from the aerial imagery are termed *biobands*; 19 biobands have been mapped in SE Alaska to date. Fox example, *Saltmarsh* occurs along 46% of the shoreline mapped to date, a surprisingly high percentage of the coast. *Eelgrass*, a designated essential fish habitat (EFH), is mapped along 20% of the coast to date. Canopy kelps, such as *bull kelp*, *giant kelp* and *dragon kelp*, are mapped along 34% of the coast. Assemblages of biobands are used to characterize shoreline wave exposure; most of the coastline mapped to date is low energy with *Semi-Protected* (38%) and *Protected* (44%) shorelines dominating with only 5% characterized as *Exposed*.

Man-modified shorelines are comparatively rare (<1%). The most common type of shore modification observed is riprap (146 km), followed by landfill (122 km) and wooden bulkheads (30 km). Most anthropogenic features occur in the communities of Ketchikan, Sitka, and Juneau.

Mapping data can be accessed via the Alaska ShoreZone Mapping Website at: www.shorezone.org

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1 INTRODUCTION

1.1 Overview of the ShoreZone Coastal Habitat Mapping Program

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

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

The ShoreZone program in Alaska continues to grow through the efforts of a network of partners, including scientists, managers, GIS specialists, and web specialists in federal, state, and local government agencies and in private and nonprofit organizations. The coastal mapping data and imagery are used for oil spill contingency planning, conservation planning, habitat research, development evaluation, mariculture site review, and recreation opportunities. Protocols and standards are updated through technological advancements (e.g. Harney et al 2008), and applications are developed that use ShoreZone data to examine modern questions regarding the coastal environment and nearshore habitats (Harney 2007, 2008). As of October 2011, mapped regions include close to 45,000 km of coastline in the Gulf of Alaska and 40,000 km of coastline in British Columbia and Washington State (Figures 1.1, 1.2 and 1.3).

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

- natural resource and conservation planning
- environmental hazard response
- spill contingency planning
- linking habitat use and life-history strategy of nearshore fish and other intertidal organisms
- habitat suitability modeling (for example, to predict the spread of invasive species or the distribution of beaches appropriate for spawning fish
- development evaluation and mariculture site review

- ground-truthing of aerial data on smaller spatial scales
- public use for recreation, education, outreach, and conservation

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

1.2 ShoreZone Mapping of Southeast Alaska 2004-2010 Imagery

Field surveys in Southeast Alaska conducted from 2004 to 2010 collected aerial video and digital still photographs of the coastal and nearshore zone during zero-meter tide levels and lower. The imagery and associated audio commentary are used to map the geomorphic and biological features of the shoreline according to the ShoreZone Coastal Habitat Mapping Protocol (Harney *et al* 2008).

The purpose of this report is to provide a summary of the physical (geomorphic) and biological data mapped in the study area to date (Southeast Alaska; Figure 1.4).

The along-shore length of shoreline mapped in the SE04-SE10 database is **28,595 kilometers** (1,100 km is still unmapped in Glacier Bay) in 88,704 along-shore segments (units), averaging 322 m in length. Physical and biological data are summarized with illustrations in Sections 2 and 3, respectively.

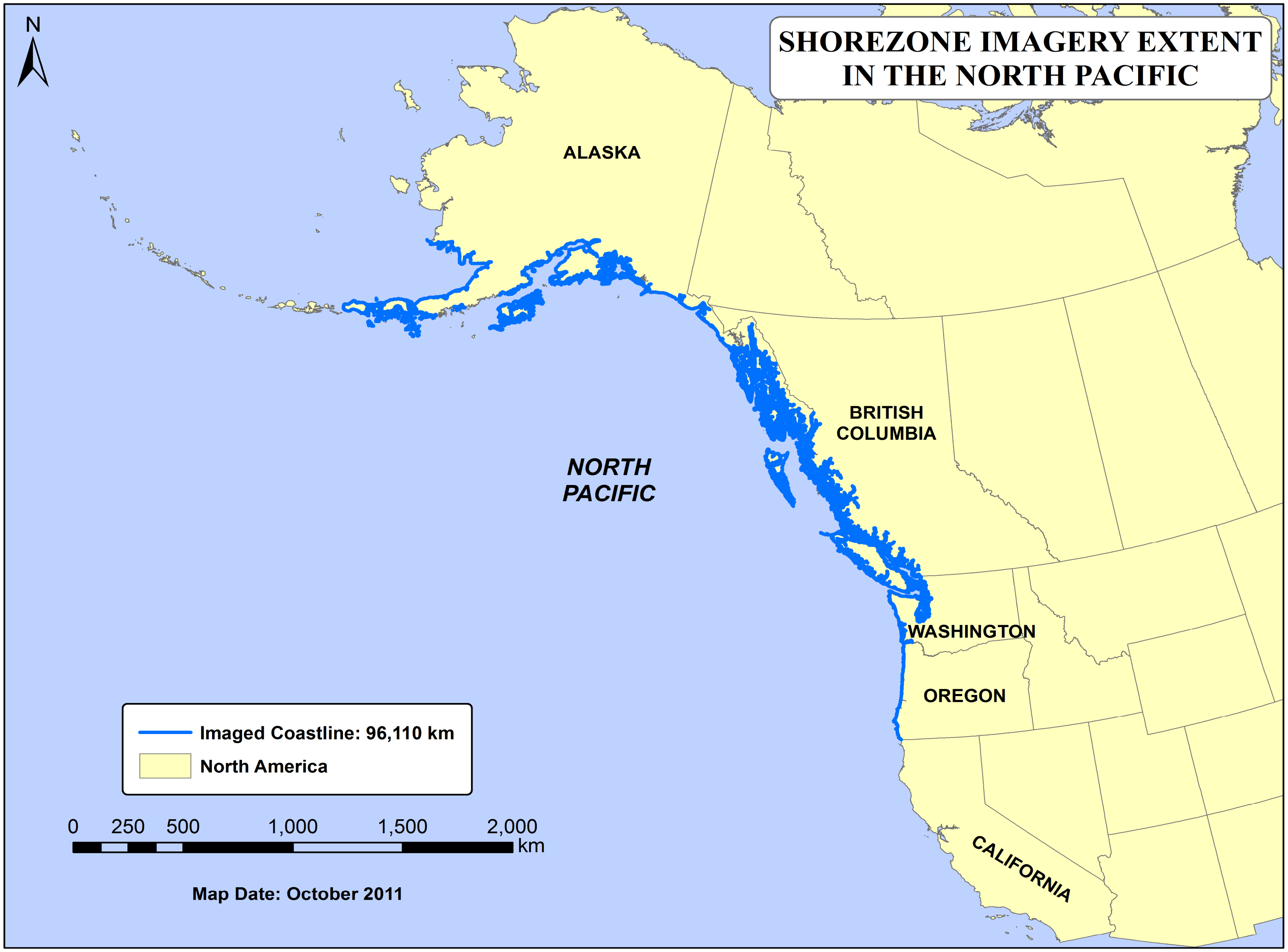

Figure 1.1. Extent of ShoreZone imagery in Alaska, British Columbia, and Washington State and Oregon (96,110 km).

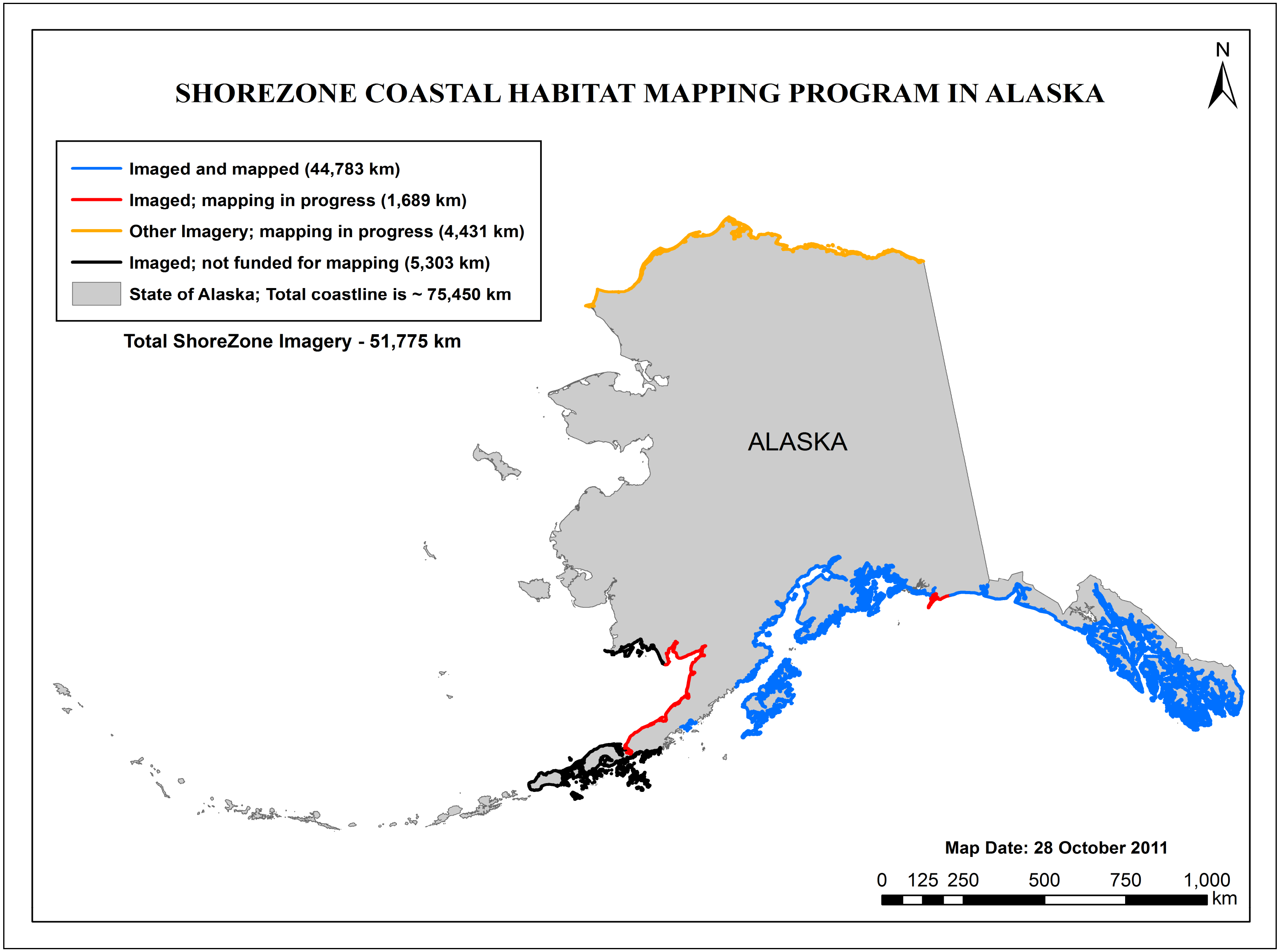

Figure 1.2. Extent of ShoreZone imagery (51,775 km) and coastal habitat mapping in the State of Alaska (as of October 2011).

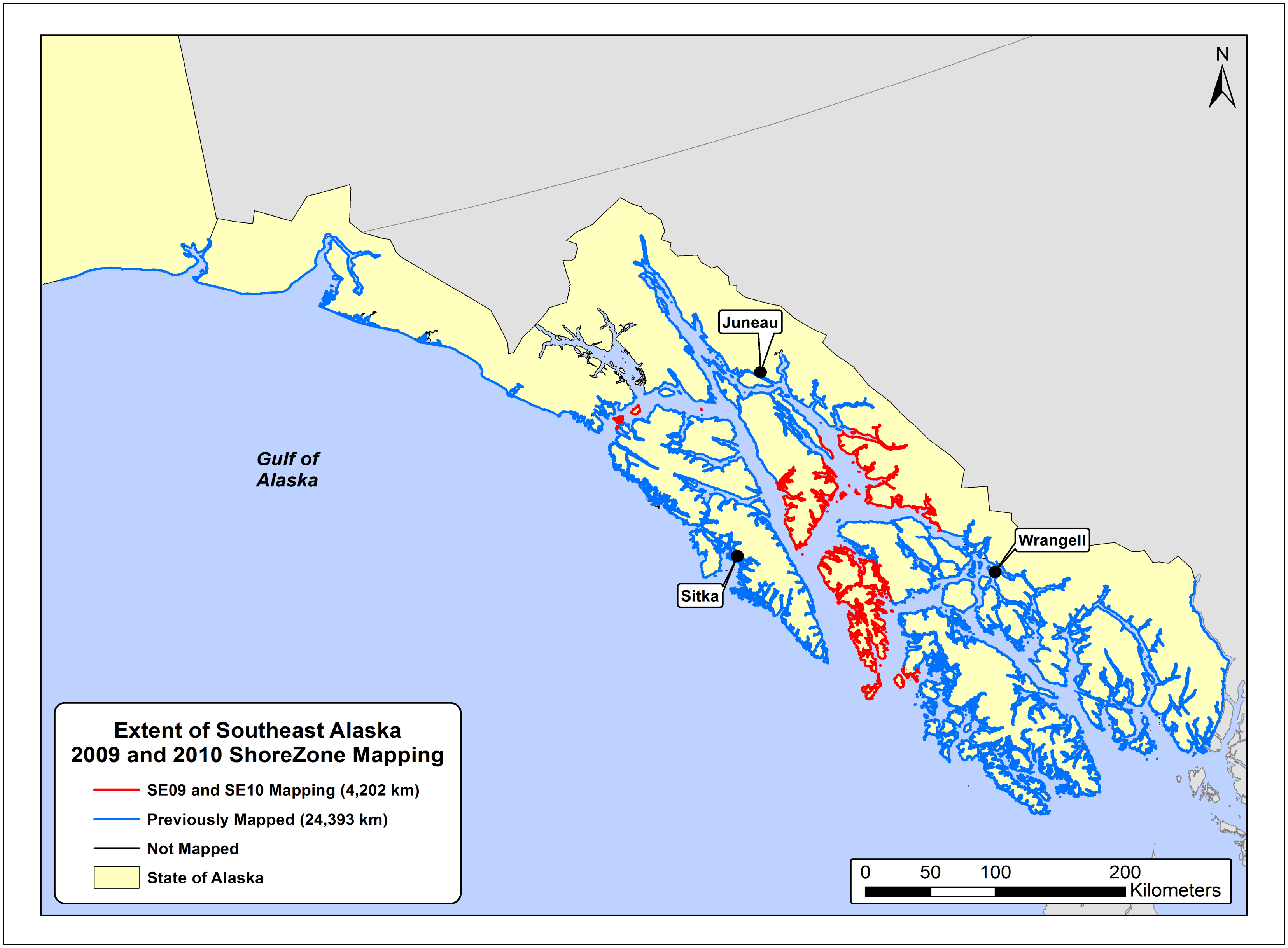

Figure 1.3. Extent of Southeast Alaska 2010 ShoreZone mapping (4,202 km)

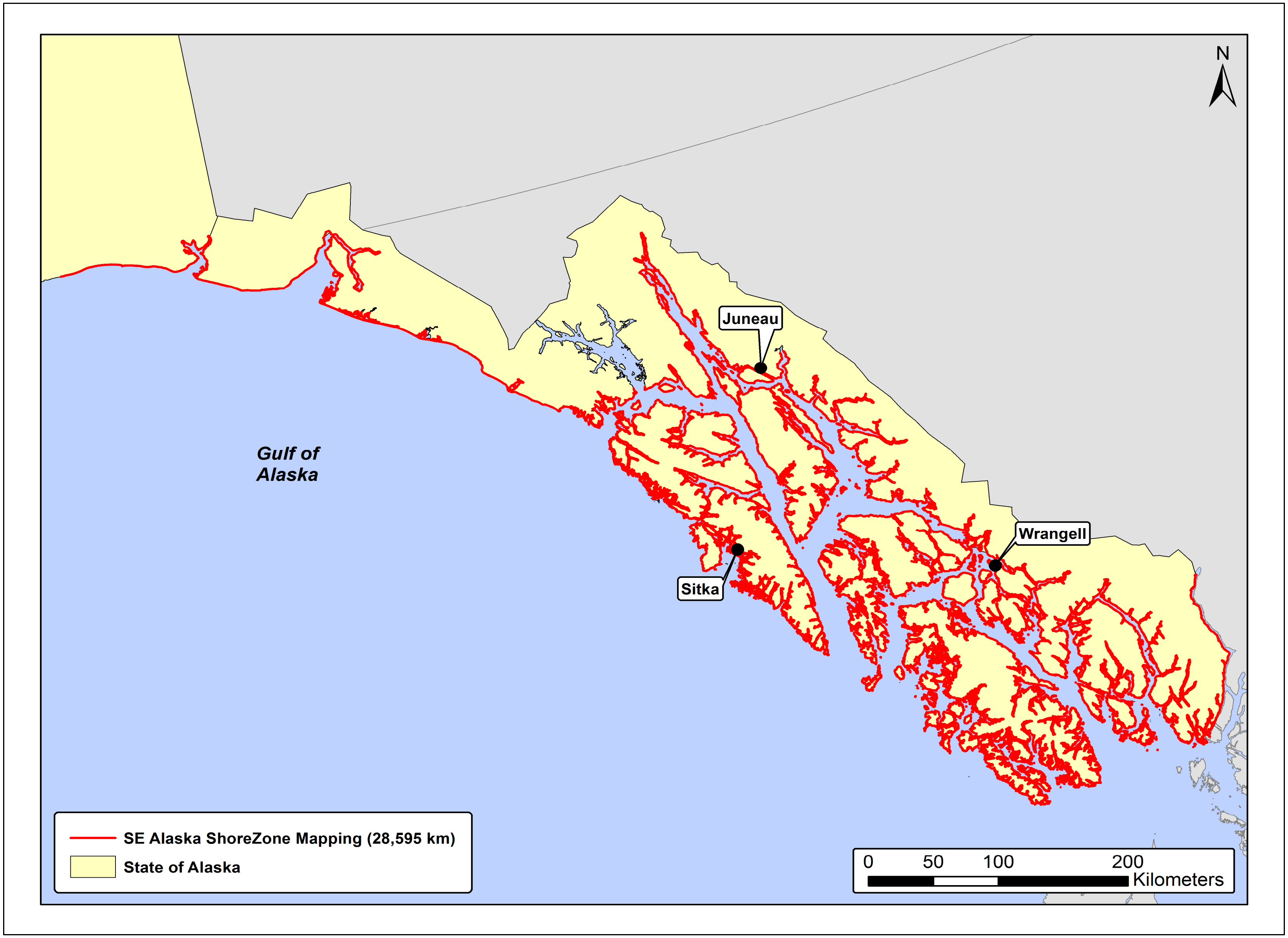

Figure 1.4. Map of the study area imaged in Southeast Alaska from 2004 to 2010, for which physical (geomorphic) and biological ShoreZone data are summarized in this report (28,595 km).

2 PHYSICAL SHOREZONE DATA SUMMARY

2.1 Shore Types

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

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

The occurrence of BC shore types in the study area is listed in Table 1.1. Grouped BC Classes are useful to illustrate mapped distributions (Figure 1.5) and to summarize data in graphic form (Figure 1.6). **Bedrock shorelines** (BC Classes 1-5) comprise 4,946.9 km (17.3%) of mapped shorelines. Slightly less than half of the mapped coastal environment is characterized as **rock and sediment shorelines** (BC Classes 6-20: 11,746.7 km or 41.1%). These shore types are further distinguished on the basis of geomorphology and sediment texture, shown in Figures 1.7 and 1.8). **Sediment-dominated shorelines** (BC Classes 21-30) comprise 8,205.4 km of the study area (28.7%). Of these, wide sand and gravel flats (BC Class 24) are the most common, mapped along 4,308.7 km of shoreline (15.1% of the total study area).

The NOAA Environmental Sensitivity Index (ESI Class) is a shoreline classification system developed to categorize coastal regions on the basis of their oil-spill sensitivity. The ESI system uses wave exposure and principal substrate type to assign alongshore coastal units a ranking of 1-10 to indicate the relative degree of sensitivity to oil spills (1=least sensitive, 10=most sensitive) as well as a general shore type (Peterson *et al* 2002; Appendix A, Table A-3). The ESI system is an integral component of oil-spill contingency planning. Substrate permeability is of principal importance in estimating the residence time of oil on the shoreline, thus sediment texture is a key element in determining the ESI class. The occurrence of ESI shore types in the study area is listed in Table 1.2. The distribution of beaches and tidal flats (on the basis of mapped ESI class referring to sediment texture) is shown in Figure 1.9.

Table 1.1. Summary of Shore Types by BC Class

Substrate Type	Shore Type (BC Class)		Sum of Unit Length (km)	# of Units	% Occurrence (by length)	Cumulative Occurrence (%, km)
	No.	Description				
Rock	1	Rock Ramp, wide	316.0	788	1.1	17.3% 4,946.9km
	2	Rock Platform, wide	163.7	499	0.6	
	3	Rock Cliff	3,682.9	10,968	12.9	
	4	Rock Ramp, narrow	751.6	2,993	2.6	
	5	Rock Platform, narrow	32.6	155	0.1	
Rock & Sediment	6	Ramp with gravel beach, wide	844.1	2,933	3.0	41.1% 11,746.7km
	7	Platform with gravel beach, wide	479.6	1,573	1.7	
	8	Cliff with gravel beach	1,975.7	7,645	6.9	
	9	Ramp with gravel beach	2,388.7	10,179	8.4	
	10	Platform with gravel beach	78.9	378	0.3	
	11	Ramp w gravel & sand beach, wide	1,824.0	6,483	6.4	
	12	Platform with G&S beach, wide	1,603.9	4,580	5.6	
	13	Cliff with gravel/sand beach	526.8	2,337	1.8	
	14	Ramp with gravel/sand beach	1,862.5	7,970	6.5	
	15	Platform with gravel/sand beach	95.8	398	0.3	
	16	Ramp with sand beach, wide	8.7	43	0.0	
	17	Platform with sand beach, wide	15.4	50	0.1	
	18	Cliff with sand beach	30.9	109	0.1	
	19	Ramp with sand beach, narrow	10.8	48	0.0	
	20	Platform with sand beach, narrow	1.0	5	0.0	
Sediment	21	Gravel flat, wide	279.9	1,154	1.0	28.7% 8,205.4km
	22	Gravel beach, narrow	508.9	2,288	1.8	
	23	Gravel flat or fan	8.0	36	0.0	
	24	Sand & gravel flat or fan	4,308.7	11,990	15.1	
	25	Sand & gravel beach, narrow	1,621.6	6,347	5.7	
	26	Sand & gravel flat or fan	109.1	439	0.4	
	27	Sand beach	102.2	110	0.4	
	28	Sand flat	750.2	795	2.6	
	29	Mudflat	464.1	483	1.6	
	30	Sand beach	52.7	76	0.2	
Organics	31	Organics	3,387.8	3,849	11.8	11.8% 3,387.8 km
Man-made	32	Man-made, permeable	135.0	521	0.5	0.5% 140.9 km
	33	Man-made, impermeable	5.9	37	0.0	
Channel	34	Channel	143.7	433	0.5	0.5% (143.7)
Glacier/Ice	35	Glacier	23.5	12	0.1	0.1% (23.5)
		Totals:	***28,595***	***88,704***	***100%***	***100%***

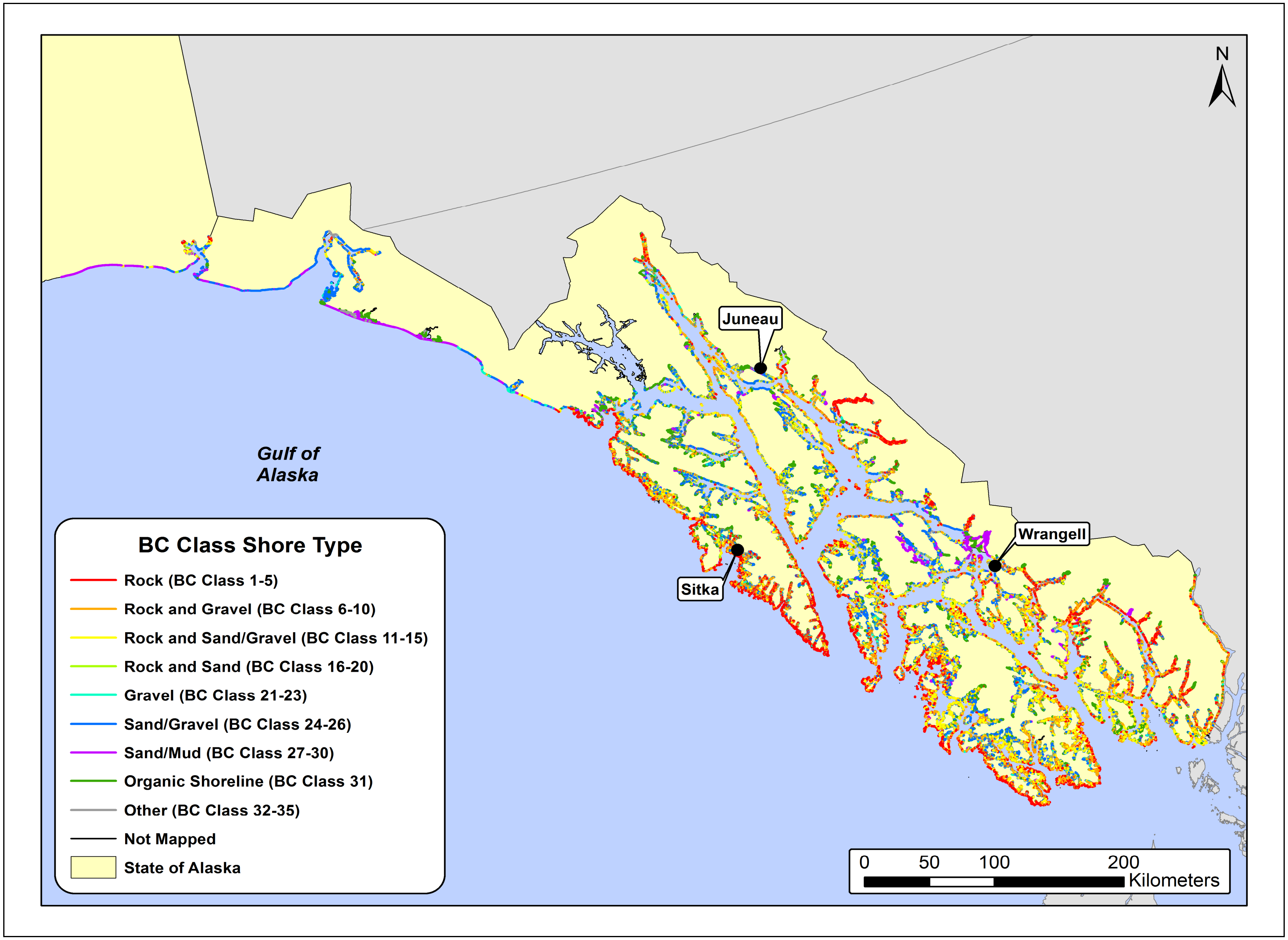

Figure 1.5. Map of the distribution of principal substrate types (on the basis of grouped BC Classes) in the study area. Data are listed by individual class and summarized by grouped classes in Table 1.1.

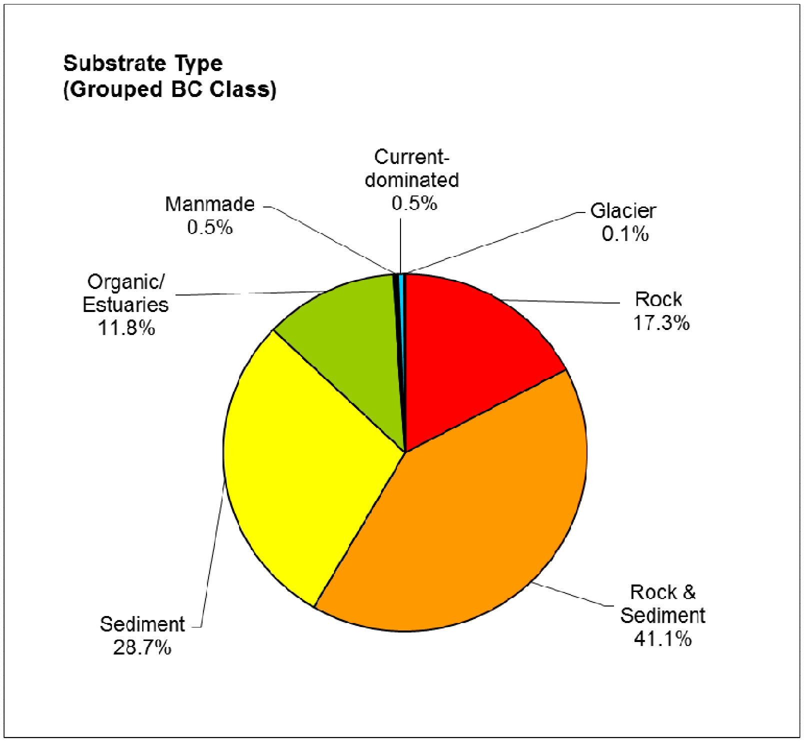

Figure 1.6. Relative abundance of principal substrate types (on the basis of grouped BC Classes) in the study area. Data are summarized in Table 1.1.

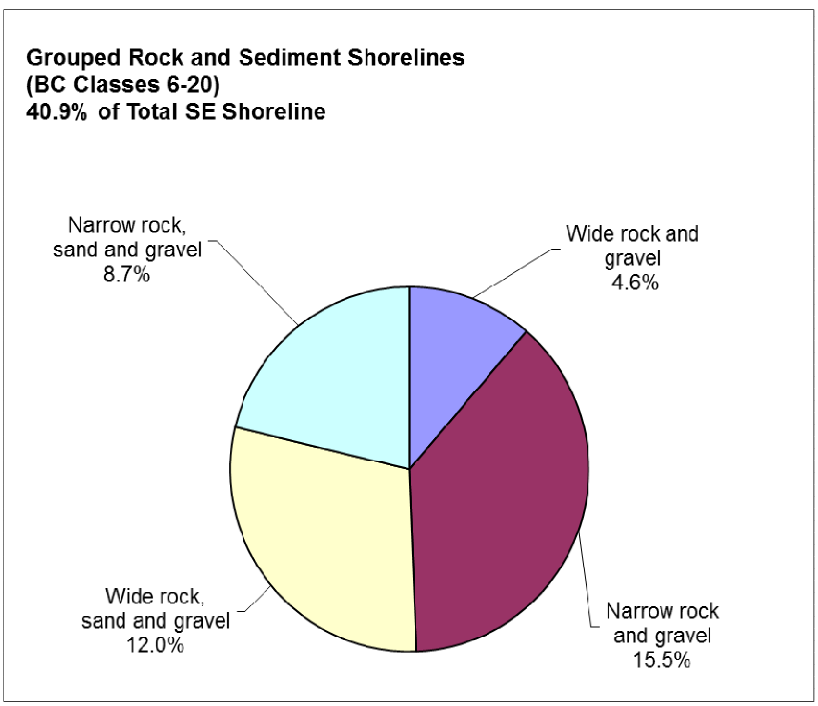

Figure 1.7. Relative abundance of rock and sediment shorelines (BC classes 6-20) in the study area.

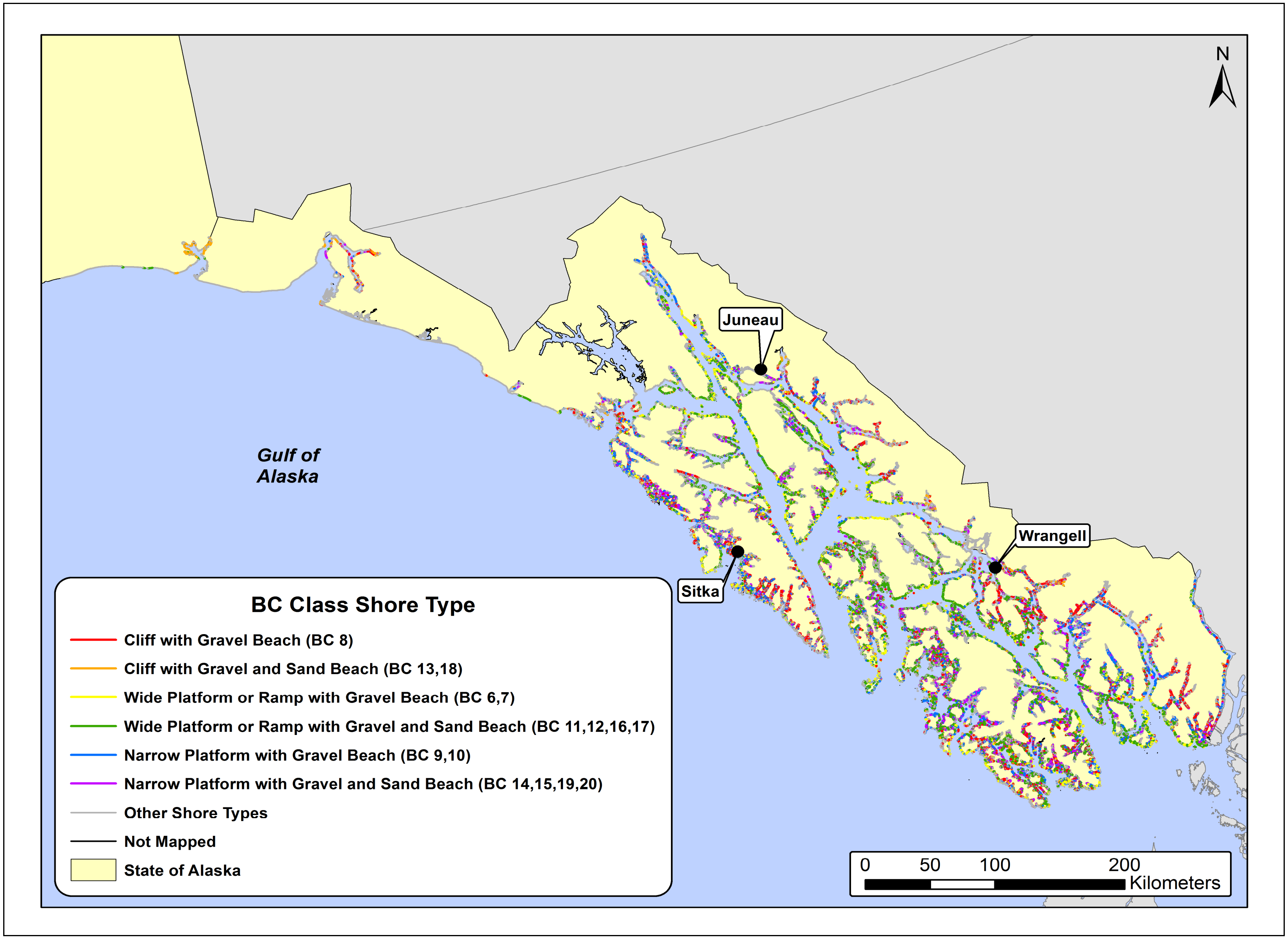

Figure 1.8. Map of the distribution of rock and sediment shorelines (BC Classes 6-20, grouped by geomorphology) in the study area. Data are summarized in Table 1.1.

Table 1.2. Summary of Shore Types by ESI Class

Environmental Sensitivity Index (ESI)		Sum of Unit Length (km)	# of Units	% Occurrence (by length)
No.	**Description**			
1A	Exposed rocky shores and banks	1,633.4	3,970	5.7%
1B	Exposed, solid, man-made structures	0	0	0.0%
1C	Exposed rocky cliffs with boulder talus base	288.1	941	1.0%
2A	Exposed wave-cut platforms in bedrock, mud, or clay	533.9	1,416	1.9%
2B	Exposed scarps and steep slopes in clay	0.1	1	0.0%
3A	Fine- to medium-grained sand beaches	127.6	191	0.4%
3B	Scarps and steep slopes in sand	0.2	1	0.0%
3C	Tundra cliffs	0	0	0.0%
4	Coarse-grained sand beaches	287.5	377	1.0%
5	Mixed sand and gravel beaches	9,194.5	33,705	32.2%
6A	Gravel beaches (granules and pebbles)	226.6	1,006	0.8%
6B	Gravel beaches (cobbles and boulders)	3,005.8	12,097	10.5%
6C	Rip rap (man-made)	8.6	41	0.0%
7	Exposed tidal flats	133.4	286	0.5%
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	2,610.3	9,559	9.1%
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	1,465.4	6,271	5.1%
8C	Sheltered riprap (man-made)	49.0	197	0.2%
8D	Sheltered rocky rubble shores	2,138.1	7,977	7.5%
8E	Peat shorelines	5.8	6	0.0%
9A	Sheltered tidal flats	3,895.2	7,692	13.6%
9B	Vegetated low banks	69.1	77	0.2%
9C	Hypersaline tidal flats	0	0	0.0%
10A	Salt- and brackish-water marshes	2,855.1	2,878	10.0%
10B	Freshwater marshes	67.4	21	0.2%
10C	Swamps	0	0	0.0%
10D	Scrub-shrub wetlands; mangroves	0	0	0.0%
10E	Inundated low-lying tundra	0	0	0.0%
	Totals:	***28,595***	***88,704***	***100.0 %***

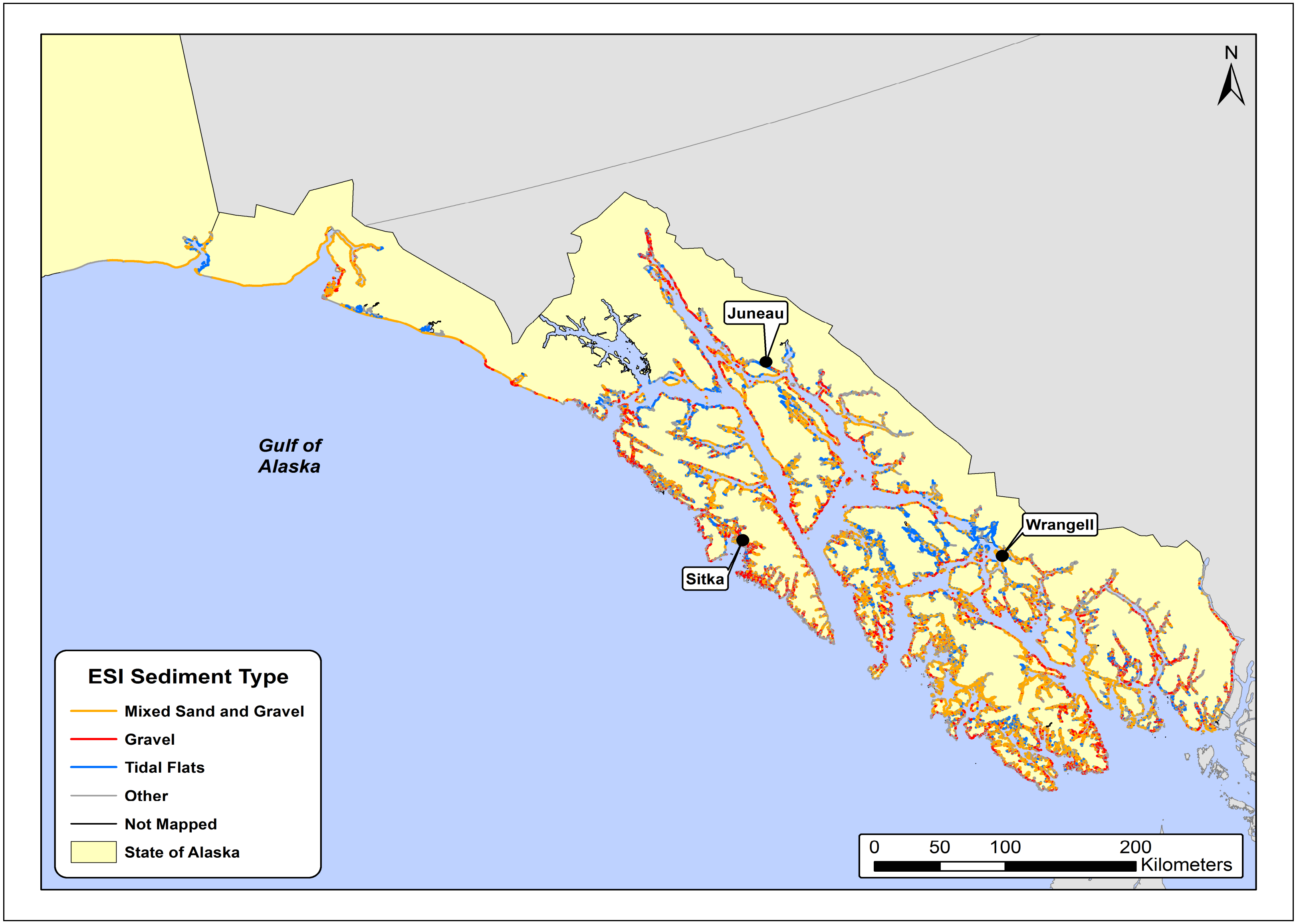

Figure 1.9. Distribution of beaches and tidal flats on the basis of ESI class. Sand and gravel beaches refer to ESI classes 4 & 5. Gravel beaches refer to ESI classes 6A & 6B. Tidal flats refer to ESI class 9A & 7 and are generally confined to relatively protected areas at the heads of inlets.

2.2 Anthropogenic Shore Modifications

Shore-protection features and coastal access constructions such as seawalls, rip rap, docks, dikes, and wharves are enumerated in ShoreZone mapping data. Overall, shorelines classified as man-modified (having more than 50% of the unit altered by human activities, assigned BC Classes 32 and 33) occur along 140.9 km (0.5%) of shoreline in the study area, mostly in the communities of Ketchikan, Sitka, and Juneau. The types of shore modification features (such as boat ramps, bulkheads, and rip rap) and their relative proportions of the intertidal zone are mapped into the database in the “SHORE_MOD” fields of the UNIT table (see Table A-1 for a description of these fields). The distribution of shore modifications mapped in the study area (Table 1.3) is shown in Figure 1.10.

Table 1.3 Summary of Shore Modifications

Shore Modification	# of Occurrences	Shoreline Length (km)	% of Shoreline
Wooden bulkhead	384	29.5	9.1
Boat ramp	262	12.4	3.8
Concrete bulkhead	107	9.7	3.0
Landfill	862	122.1	37.9
Sheet pile	45	2.8	0.9
Riprap	1083	145.7	45.2
Totals:	***2,743***	***322.2***	***100.0***

2.3 Oil Residence Index (ORI)

The Oil Residence Index (ORI) is a rating between 1 and 5 that reflects the estimated persistence of spilled oil on a shoreline. A value of 1 reflects relatively short oil residence (days to weeks), while a value of 5 reflects potentially long oil residence times (months to years). An ORI value is applied to each across-shore component on the basis of sediment texture and wave exposure (Table A-5), as well as to each along-shore unit on the basis of shore type and wave exposure (Table A-6). For more information on the assignment of this attribute, refer to the ShoreZone Protocol (Harney *et al* 2008).

The dominance of lower wave exposures and sand-gravel sediment textures results in high Oil Residence Indices for most shore segments: 76% have an ORI of 4 or 5, indicating oil residence times are on the order of months to years (Table 1.4; Figure 1.11).

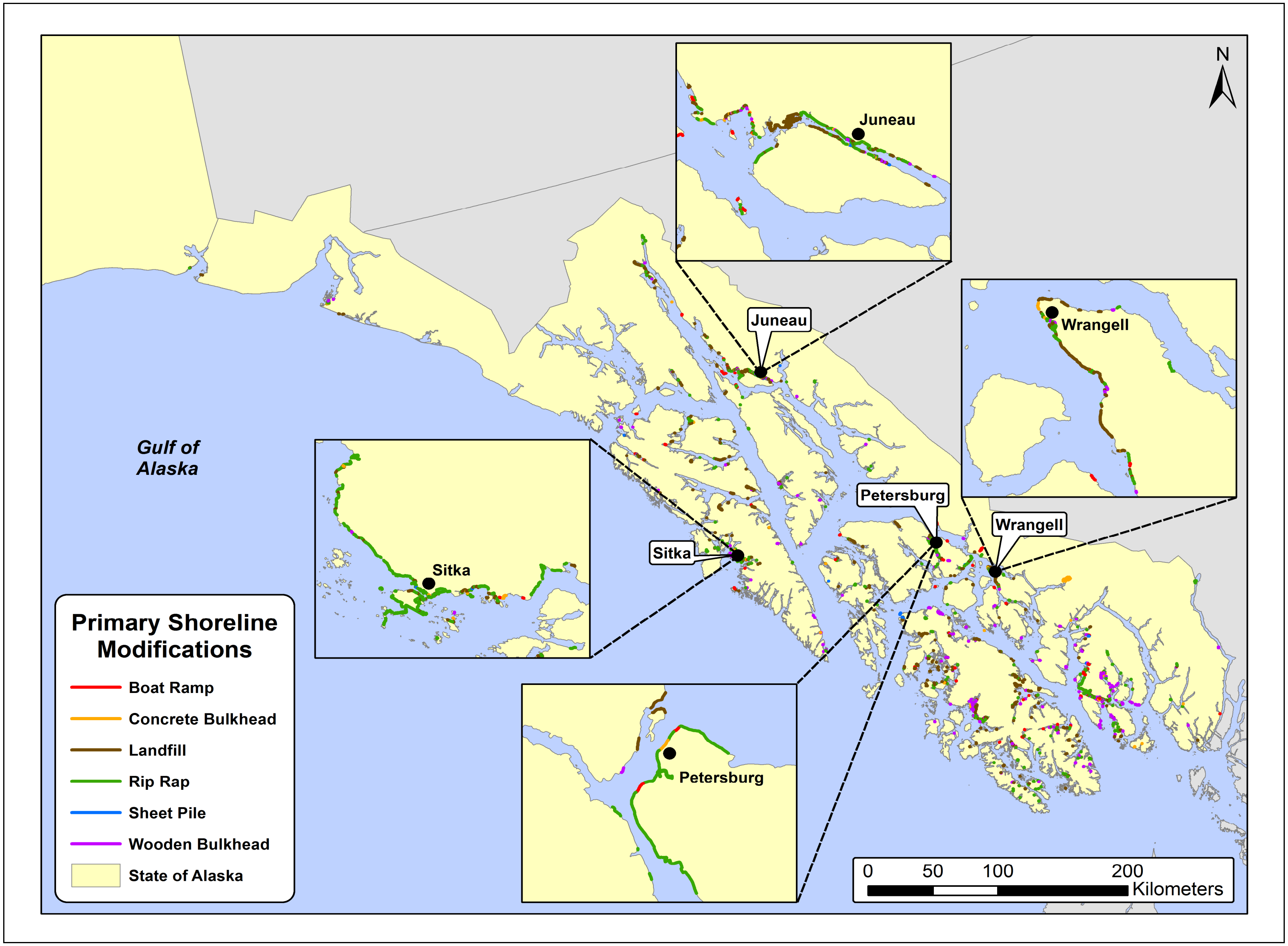

Figure 1.10. Map of the distribution of units in which shore modification features were observed in the study area. Data are summarized in Table 1.3.

Table 1.4. Summary of Oil Residence Index

Relative Persistence	Oil Residence Index (ORI)	Estimated temporal persistence	Shoreline Length (km)	Shoreline Length (%)
Short	1	Days to weeks	2,200.3	7.7%
	2	**Weeks** to months	2,022.0	7.1%
Moderate	3	Weeks to **months**	2,589.8	9.1%
	4	**Months** to years	10,996.7	38.5%
Long	5	Months to **years**	10,786.0	37.7%
		Totals:	***28,595***	***100.0%***

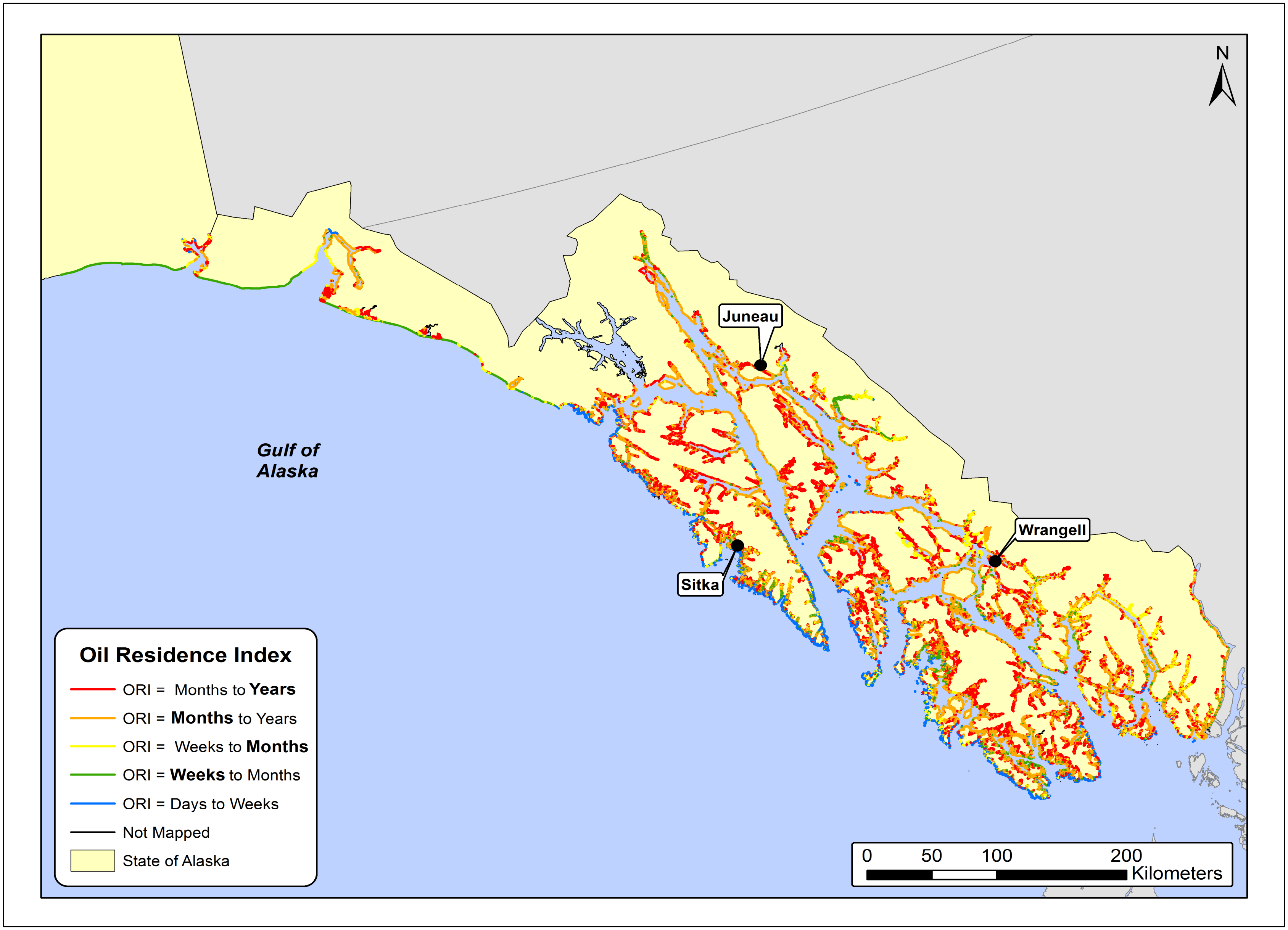

Figure 1.11. Oil Residence Index (ORI) for shorelines in Southeast Alaska, based on substrate type and wave exposure (see Appendix A, Table A-5).

3 BIOLOGICAL SHOREZONE DATA SUMMARY

Biological ShoreZone mapping is based on the observation of patterns of biota in the coastal zone, with data recorded on the occurrence and extent of species assemblages (called **biobands**). The observations of presence, absence and relative distribution of the biobands are recorded in the mapping within each alongshore unit and, based on those observations, an interpreted classification of **biological wave exposure** and **habitat class** is assigned.

3.1 Biobands

A **bioband** is an observed assemblage of coastal biota, found on the shoreline at characteristic wave energies, substrate conditions and typical across-shore elevations. Biobands are spatially distinct, with alongshore and across-shore patterns of color and texture that are visible in aerial imagery (Figure 1.12). Biobands are described across the shore, from the high supratidal to the shallow nearshore subtidal and are named for the dominant species or group that best represents the entire bioband.

Figure 1.12. Example of biobands, which are defined as alongshore bands of color and texture formed by biological assemblages of species along the coast (San Fernando Island, west of Craig, Alaska; photo se06_mm_23079.jpg).

Some biobands are named for a single *indicator* species (such as the Blue Mussel bioband (BMU)), while others represent an assemblage of co-occurring species (such as the Red Algae bioband (RED)). Indicator species are the species that are most commonly observed in the band. Other species that have been observed in the bioband during ground surveys are listed as *associate* species for the bands. Associate species are species that may or may not be observed in the aerial imagery, as they are often small-sized or present in lower percent cover than the indicator species.

For descriptions of all the biobands, including lists of indicator and associate species, refer to Appendix A, Table A-17. Example illustrations of the biobands mapped in Southeast Alaska can be found in Appendix C of the Southeast Alaska data summary report produced in December 2009 (Coastal and Ocean Resources Inc. and Archipelago Marine Research Ltd. 2009).

Bioband occurrence is recorded as *patchy* or *continuous* for all biobands except for the Splash Zone bioband (VER), which is recorded from an estimate of the across-shore width (*narrow, medium* or *wide*). A distribution of *patchy* is defined as 'visible in less than half (approximately 25-50%) of the along-shore unit length' and *continuous* is considered more than half (50-100%). Refer to Appendix A, Table A-18 for complete bioband occurrence definitions.

The abundance of each bioband mapped in the project area of Southeast Alaska is summarized in Figure 1.13 and Table 1.5. Note that the abundances for each bioband are listed by occurrences of patchy or continuous. As a result, the abundance values for the lengths and percentages of shoreline do not translate into the presence of each band along 100% of the values. The values under the 'continuous' column should be interpreted as the band was mapped in approximately 50-100% of the value listed, while the values under the 'patchy' column indicate that the band was mapped in approximately 25-50%.

The Barnacle (BAR) and Rockweed (FUC) biobands were by far the most abundant bands mapped in the project area, with each mapped as patchy or continuous across approximately 23,000 km or 80% of the shoreline. Green Algae was the next most abundant bioband, mapped as patchy or continuous along approximately 21,000 km of shoreline.

Dune Grass (GRA) and Salt Marsh (PUC) were each mapped as continuous along nearly 8,000 km of shoreline and patchy along nearly 6,000 km. Eelgrass (ZOS) was mapped as patchy or continuous along approximately 6,000 km of the shoreline, accounting for 20% of the total mapped shoreline. Giant Kelp (MAC) and Bull Kelp (NER) were mapped as patchy or continuous along approximately 3,100 km (11%) and 4,500 km (16%) respectively, while the Dragon Kelp was less common along 2,000 km (7%) of the coast.

Table 1.5. Bioband Abundances Mapped in Southeast Alaska

Bioband		Continuous		Patchy		Total	% of
Name	Code	(km)	%	(km)	%	(km)	Mapped
Dune Grass	GRA	7,568	26	5,506	19	13,074	45
Sedges	SED	1,888	7	1,154	4	3,041	11
Salt Marsh	PUC	7,715	27	5,367	19	13,082	46
Barnacle	BAR	17,032	60	6,077	21	23,109	81
Rockweed	FUC	18,329	64	5,174	18	23,503	82
Green Algae	ULV	13,542	47	7,547	26	21,090	73
Blue Mussel	BMU	3,080	9	4,436	16	7,516	25
California Mussel	MUS	20	0	284	1	304	1
Bleached Red Algae	HAL	598	2	1,187	4	1,785	6
Red Algae	RED	10,906	38	4,488	16	15,394	54
Alaria	ALA	3,490	12	2,065	7	5,555	19
Soft Brown Kelps	SBR	10,624	37	5,518	19	16,142	56
Dark Brown Kelps	CHB	2,312	10	752	3	3,064	13
Surfgrass	SUR	280	1	840	3	1,120	4
Eelgrass	ZOS	2,814	10	2,820	10	5,634	20
Urchin Barrens	URC	280	1	344	1	625	2
Dragon Kelp	ALF	1,331	5	670	2	2,002	7
Giant Kelp	MAC	2,365	8	757	3	3,123	11
Bull Kelp	NER	2,551	9	1,932	7	4,483	16

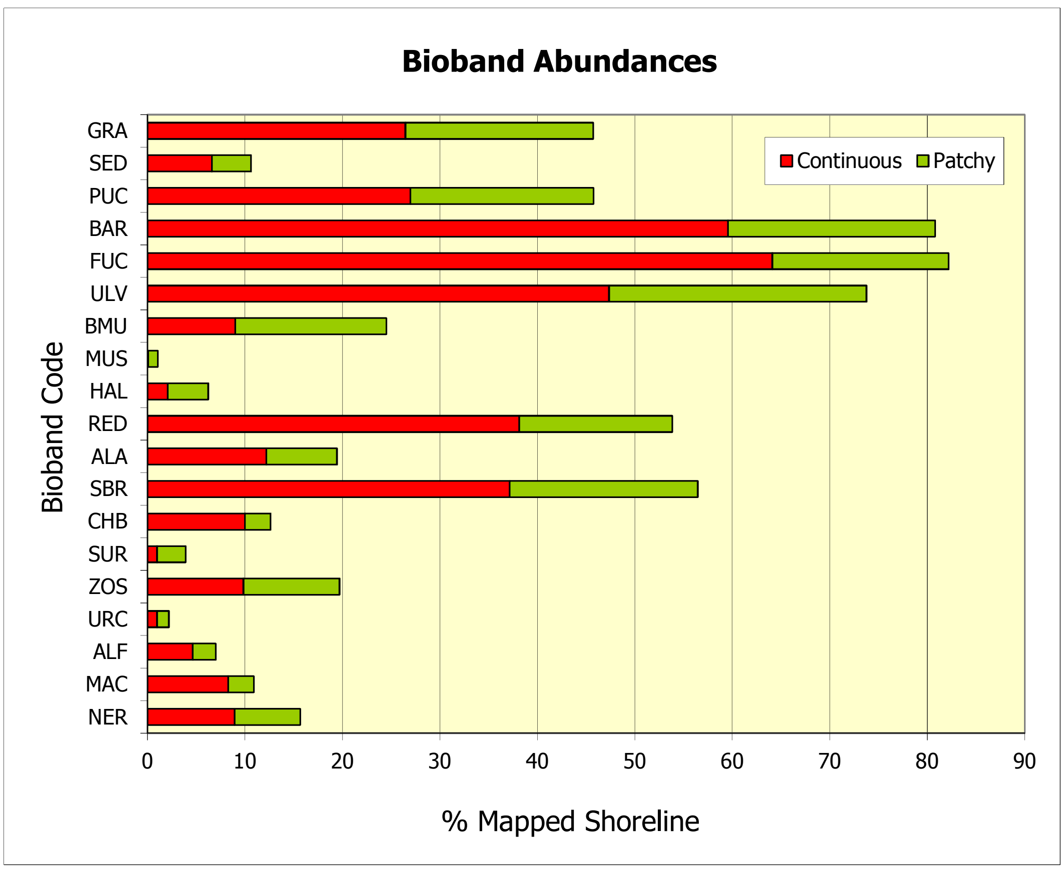

Figure 1.13. Bioband abundances mapped in Southeast Alaska study area.

Bioband Distributions

Combinations of the various biobands act as indicators for the different biological wave exposures and habitat classes. The distributions of select bioband combinations are mapped below in Figures 1.14 – 1.20 to highlight regional differences observed in Southeast Alaska.

Dune Grass, Sedges and Salt Marsh Biobands

The three biobands that can occur in the supratidal (A zone) used to indicate salt marsh and estuarine conditions are the Dune Grass (GRA), Sedges (SED) and Salt Marsh (PUC) biobands. Each of these three bands are dominated by rooted vascular plants, with the Salt Marsh bioband having the most diversity in species composition, including a number of salt-tolerant grasses, herbs and sedges. Further descriptions of the characteristics of these biobands can be found in Appendix A, Table A-17.

Co-occurrence of these three bands, together with the presence of a freshwater stream (year-round flow) and a 'delta' form at the stream mouth, are used to indicate an Estuary habitat class category. Usually, shorelines where all three biobands co-occur are the areas with the largest estuary salt marsh complexes, which are often found at river deltas and at the heads of inlets. Smaller estuarine features are often indicated when the Dune Grass (GRA) and the Salt Marsh (PUC) bands co-occur.

The Dune Grass bioband is often observed growing on its own, in dry beach berms or among driftwood log lines, and occurs at all wave exposures, from high energy bare beaches, to sheltered salt meadows.

The following combinations have been mapped below (Figure 1.14):

- Dune Grass (GRA) alone: showing where fringing grass is present (not necessarily associated with wetlands).
- Dune Grass (GRA) and Salt Marsh (PUC) occurring together: showing locations of smaller areas of estuarine conditions.
- All three bands occurring together, Dune Grass (GRA), Salt Marsh (PUC) and Sedges (SED): showing larger estuarine complexes.

A large portion of the shoreline mapped in the Southeast region has at least one of these three supratidal marsh biobands observed as illustrated in Figure 1.14.

Note that shorelines with Dune Grass alone are mapped along high energy beaches near Yakutat, as well as along sections of Icy Strait. Distribution of the other combinations of estuary biobands can be compared to the 'Estuary' habitat class illustrated in Figure 1.24.

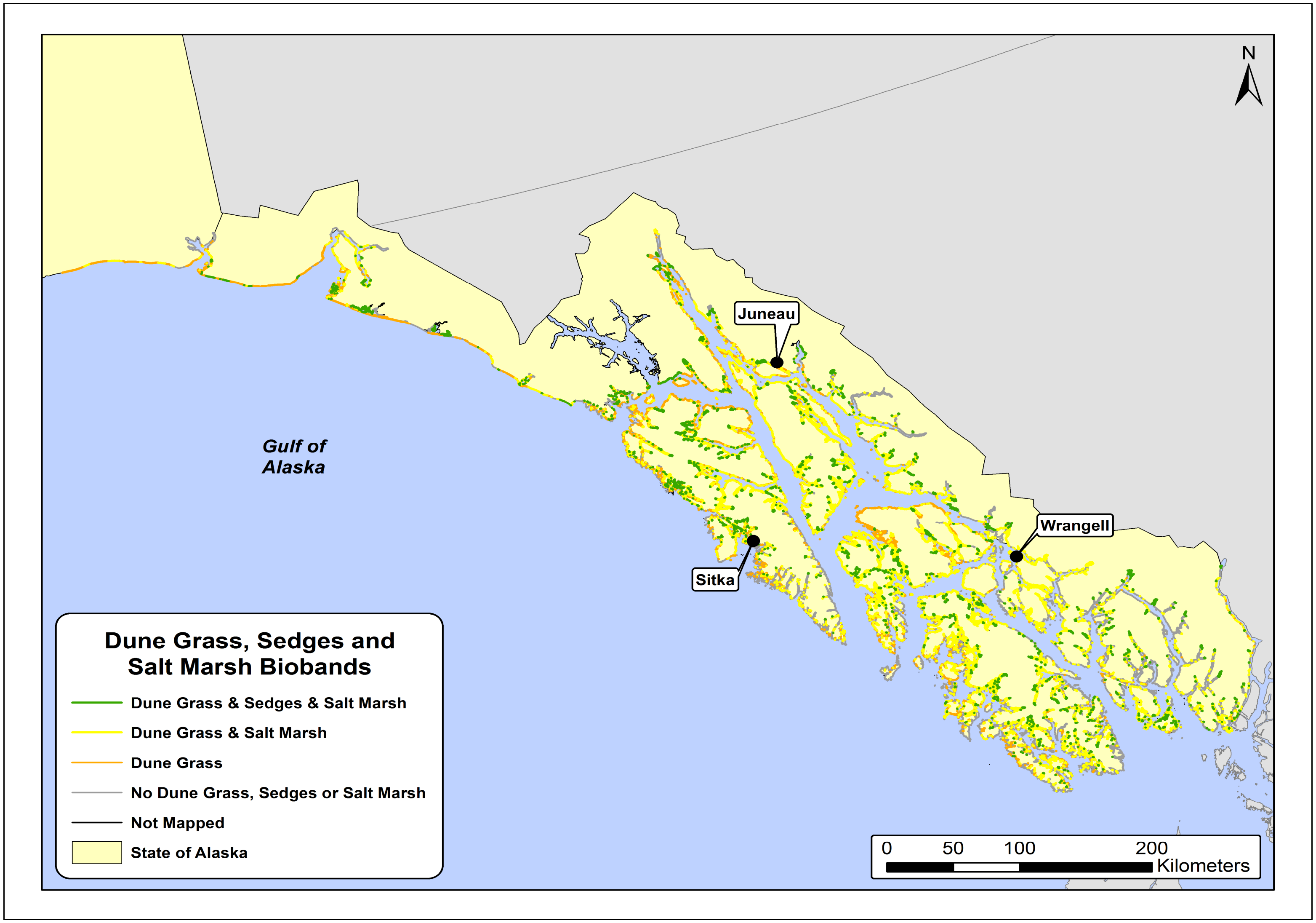

Figure 1.14. Distribution of units in which select combinations of the Dune Grass, Salt Marsh and Sedges biobands were observed in the study area of Southeast Alaska.

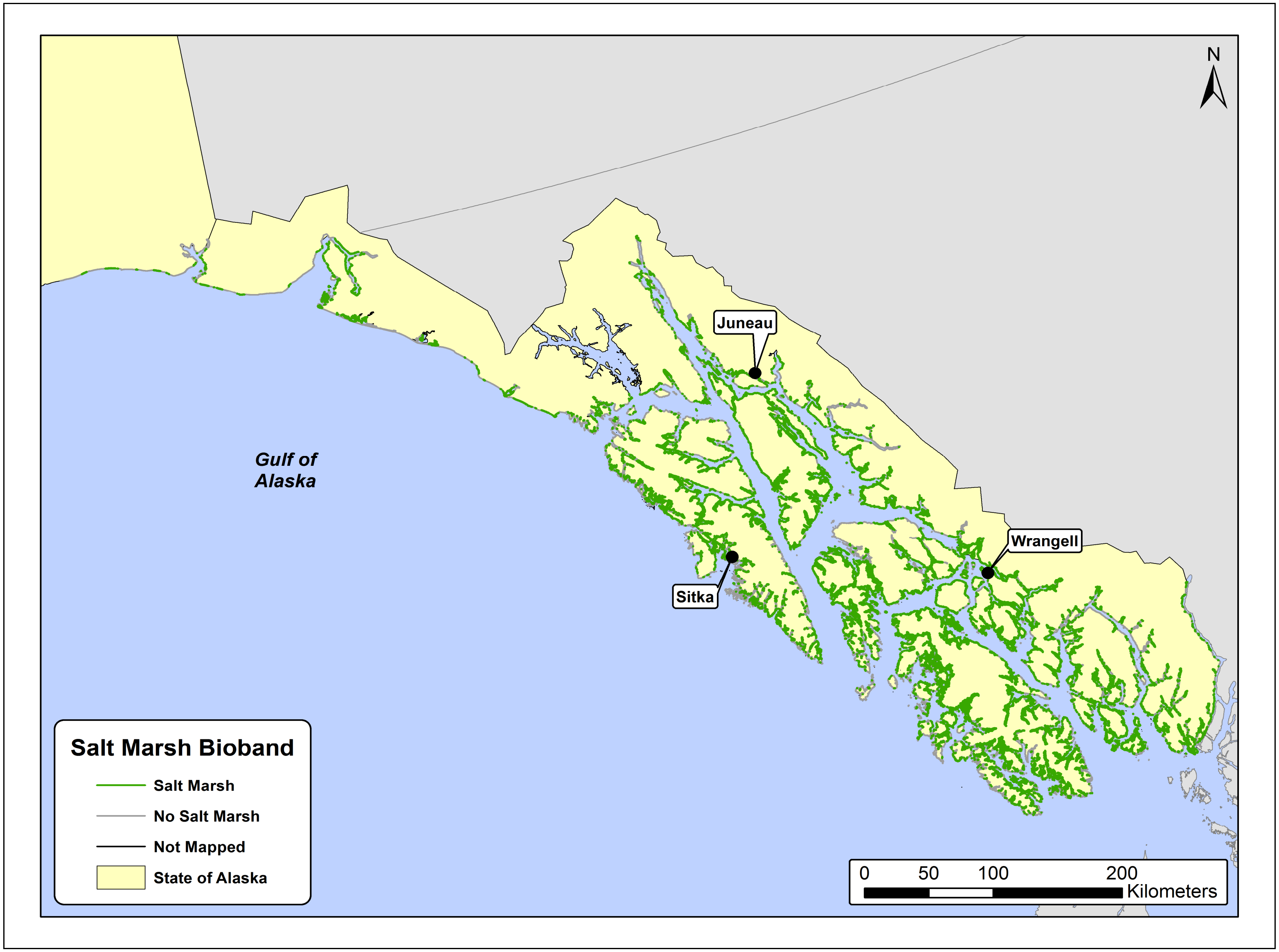

Figure 1.15. Distribution of Salt Marsh in Southeast Alaska observed in the study area

Blue Mussel and California Mussel Biobands

The distribution of the Blue Mussel and the California Mussel biobands is shown in Figure 1.16. In the fjord habitats, where shorelines are dominated by immobile bedrock, continuous Blue Mussel bands were mapped. Other areas have patchy occurrence of Blue Mussel in protected shorelines, usually associated with freshwater streams and lower wave exposures. The California Mussel bioband was only observed in the highest wave exposures on the open west side of islands in southwestern portions of Southeast Alaska. Although a few scattered individuals have been observed on ground station surveys further north in Alaska, the bioband does not occur north of the Sitka area.

Red Algae, Alaria, Soft Brown Kelps & Dark Brown Kelps Biobands

The four main biobands observed in the lower intertidal are Red Algae (RED), Alaria (ALA), Soft Brown Kelps (SBR) and Dark Brown Kelps (CHB). The highest energy coastlines are generally indicated by the co-occurrence of Dark Brown Kelps (CHB) and Red Algae (RED) biobands, while a lush Soft Brown Kelps (SBR) bioband is an indicator of Semi-Protected wave exposures. Combinations of the Red Algae (RED) or Alaria (ALA) biobands with either of the brown kelps bands occur in areas of transition between Semi-Protected and higher wave exposure categories.

Many of the possible combinations of the four lower intertidal biobands occur throughout Southeast Alaska, strongly patterned by the wave exposures. To simplify the map presentation, only the occurrence of Dark Brown Kelps, indicating higher energy, and occurrence Soft Brown Kelps, indicating lower energy, have been presented (Figure 1.17).

Eelgrass and Surfgrass Biobands

The seagrass biobands, Eelgrass (ZOS) and Surfgrass (SUR), have different energy tolerances. The Eelgrass bioband is found in lower to moderate energy wave exposures on sandy substrate and is often associated with estuaries. The Surfgrass bioband is found in moderate to higher energy wave exposures and the rhizomes attach to stable substrate.

The distribution of the two seagrass biobands reflects the wave exposures of the area, with most of the Surfgrass observed on the outer, higher energy shorelines and the Eelgrass observed in the sheltered inlets and protected bays (Figure 1.18).

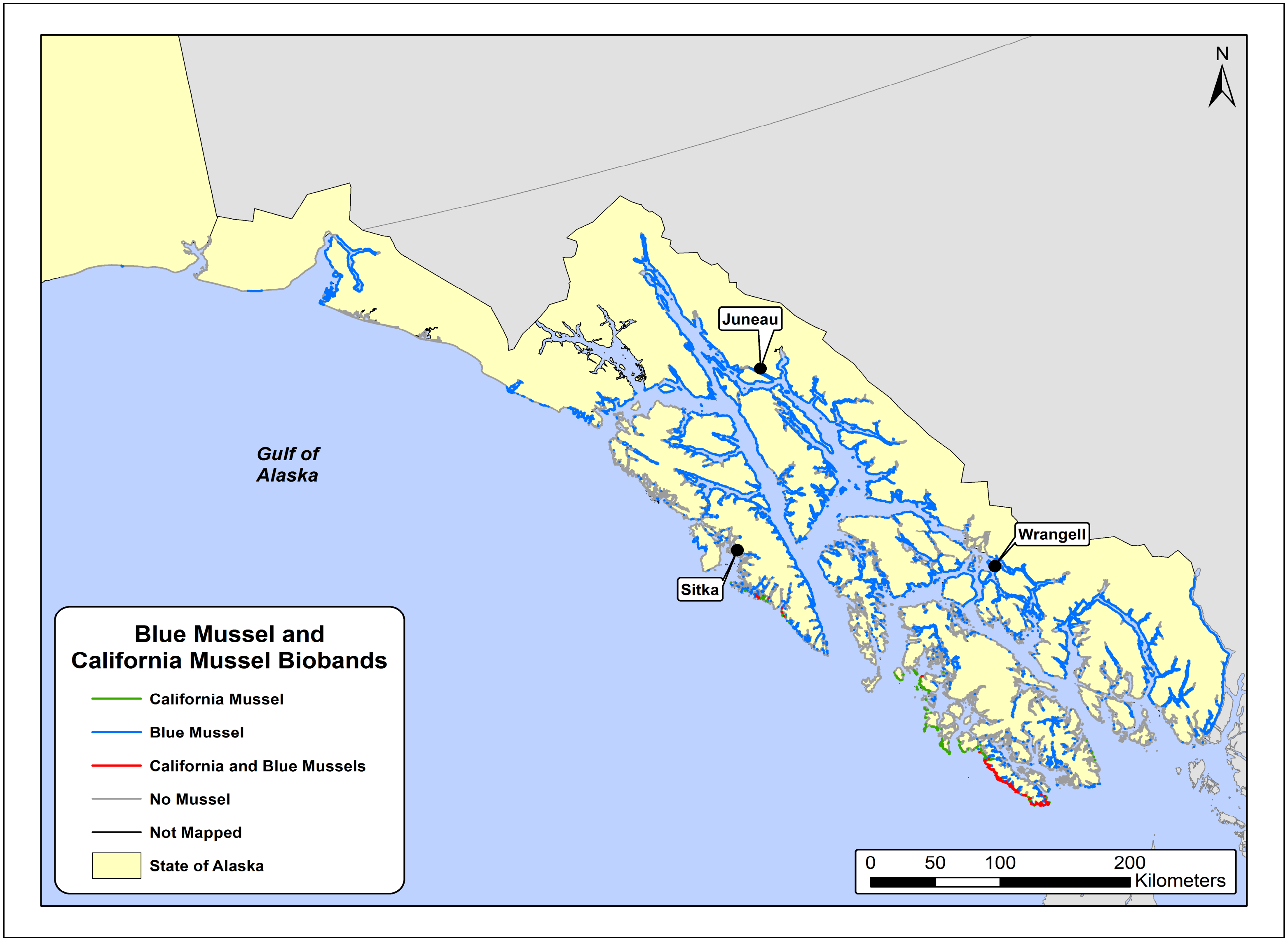

Figure 1.16. Distribution of units in which the Blue Mussel and California Mussel biobands were observed in the study area of Southeast Alaska.

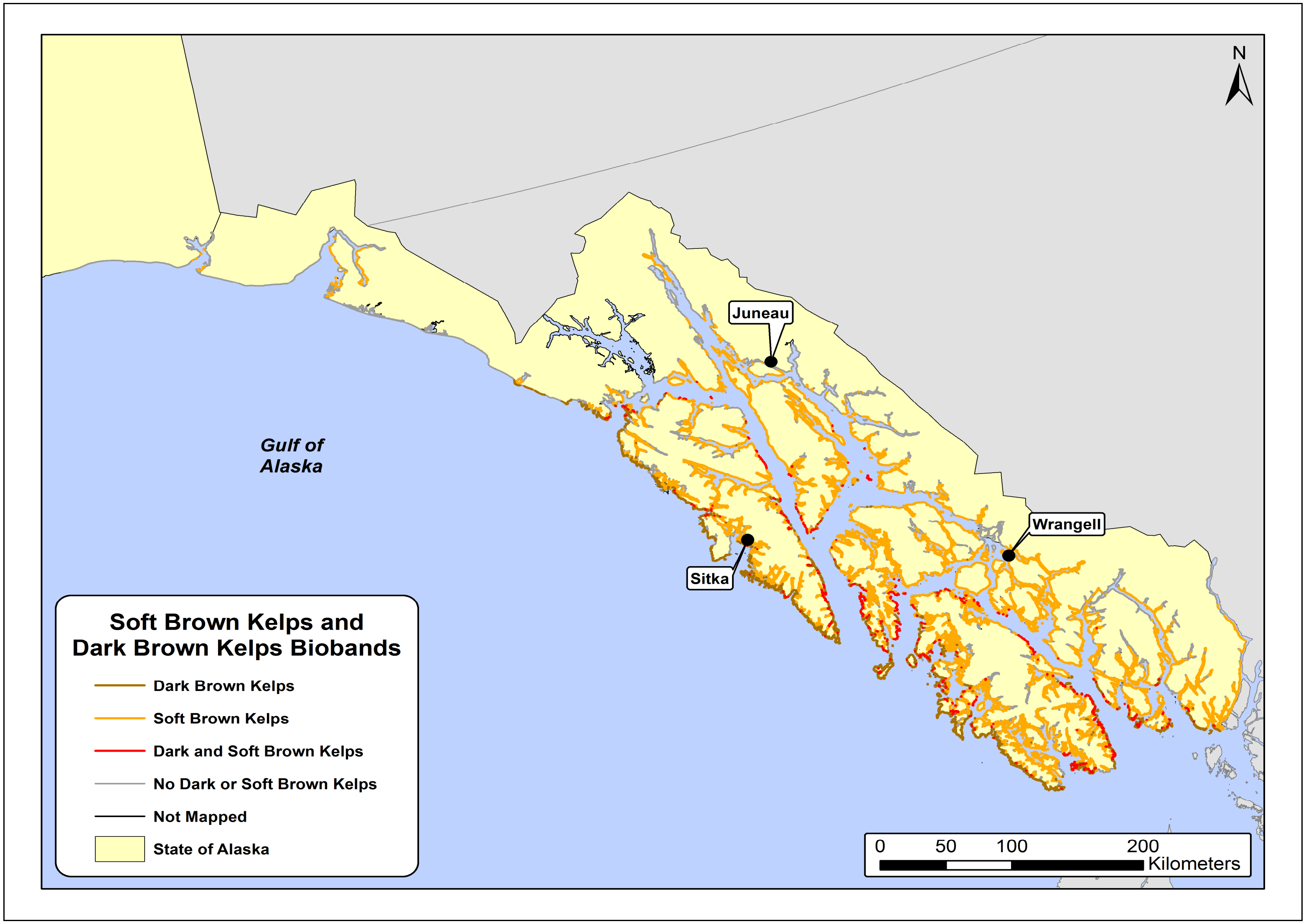

Figure 1.17. Distribution of units in which the Soft Brown Kelps and Dark Brown Kelps biobands were observed in the study area of Southeast Alaska

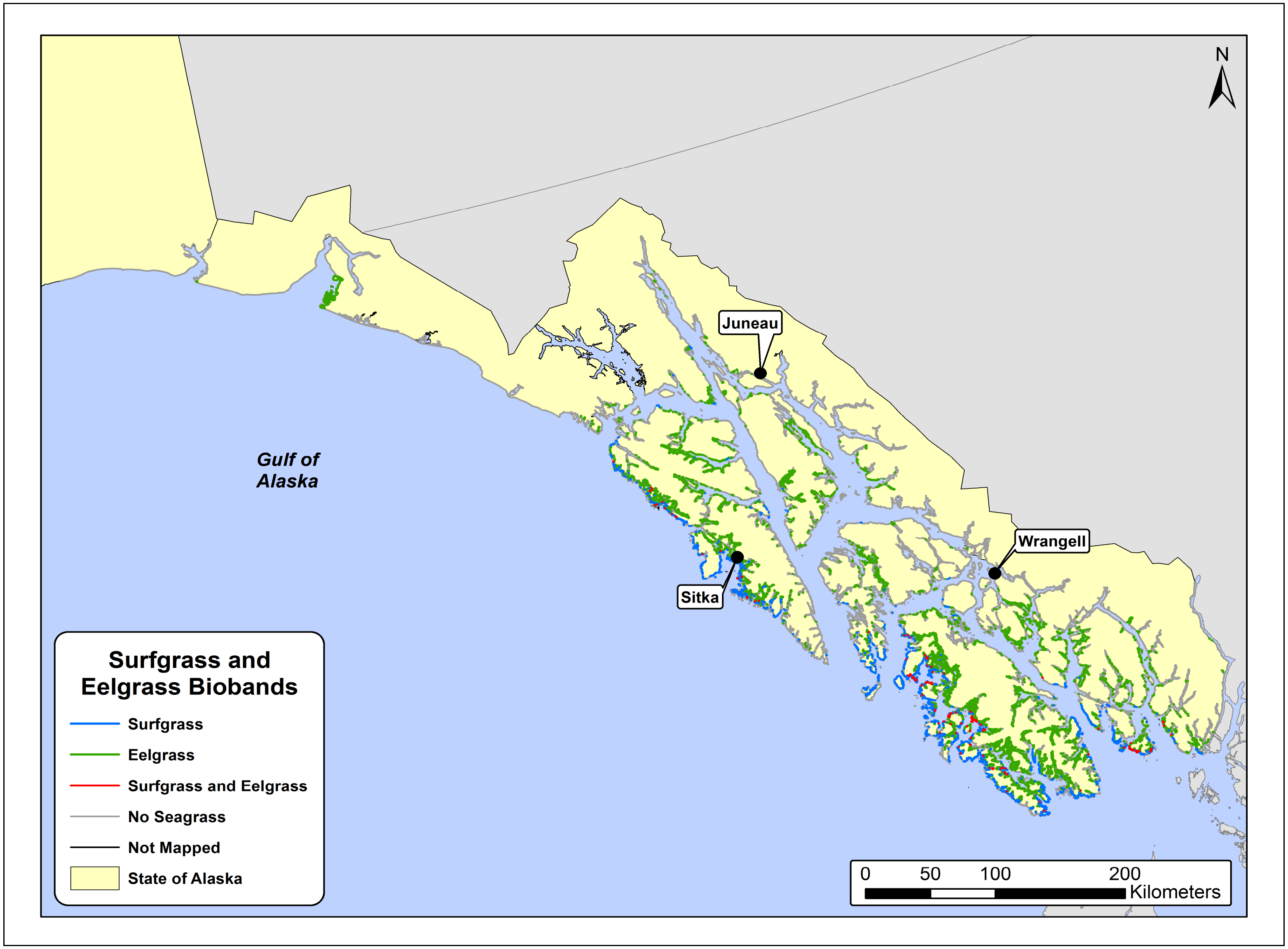

Figure 1.18. Distribution of units in which the Eelgrass and Surfgrass biobands were observed in the study area of Southeast Alaska.

Bull Kelp, Dragon Kelp and Giant Kelp Biobands

The three species of canopy kelps (bull kelp, dragon kelp and giant kelp) show different patterns of occurrence in Southeast Alaska, with different geographic and regional distributions, likely related to wave energy and nearshore water conditions.

Distributions of the three canopy kelp biobands is shown in Figures 1.19 and 1.20. The Bull Kelp bioband (NER) is found throughout Southeast Alaska, and occurs on stable substrates, in moderate to high energy sites, as well as in current-affected areas. Giant Kelp is found in moderate exposures and is the dominant kelp on the open marine west coast of Baranof Island and Prince of Wales Island. Dragon Kelp is also observed in moderate exposures, usually associated with silty glacial melt water, like that in Icy Strait as well as the outflow of the Stikine River.

Dragon Kelp, which is common further north in Alaska, occurs in certain areas of Southeast Alaska and the southern limit of the species is near the northwestern edge of Prince of Wales Island. In the Southeast Alaska coastline surveyed, all three species were observed co-occurring in only a few locations: at the southwest end of Peril Strait, Kuiu and Coronation Islands, and along the northwest edge of Prince of Wales Island.

BioAreas

As ShoreZone biological mapping has been completed throughout Alaska, differences in the species assemblages that characterize the coastal habitats have been observed on a broad geographic scale. Differences in biota are the most obvious in the lower intertidal and nearshore subtidal biobands.

To recognize region-specific species assemblages, as well as to identify broad-scale trends in coastal habitats, a number of **bioareas** have been defined in Alaska (Appendix A, Table A-8). A similar approach was applied in British Columbia to recognize the broad-scale ecoregional differences and seven bioareas have been defined there for the ShoreZone mapping.

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

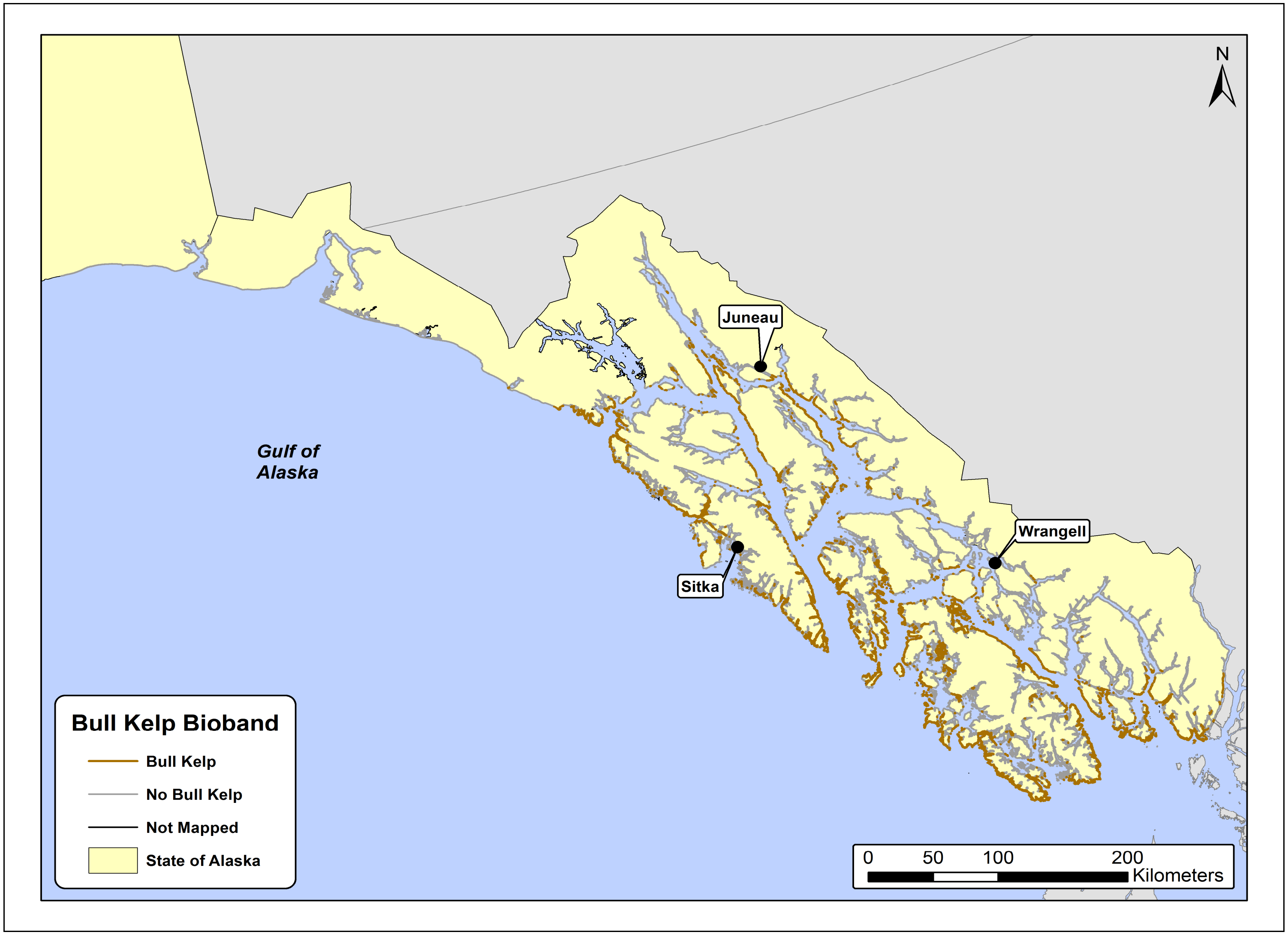

Figure 1.19. Distribution of units in which the Bull Kelp bioband was observed in the study area of Southeast Alaska.

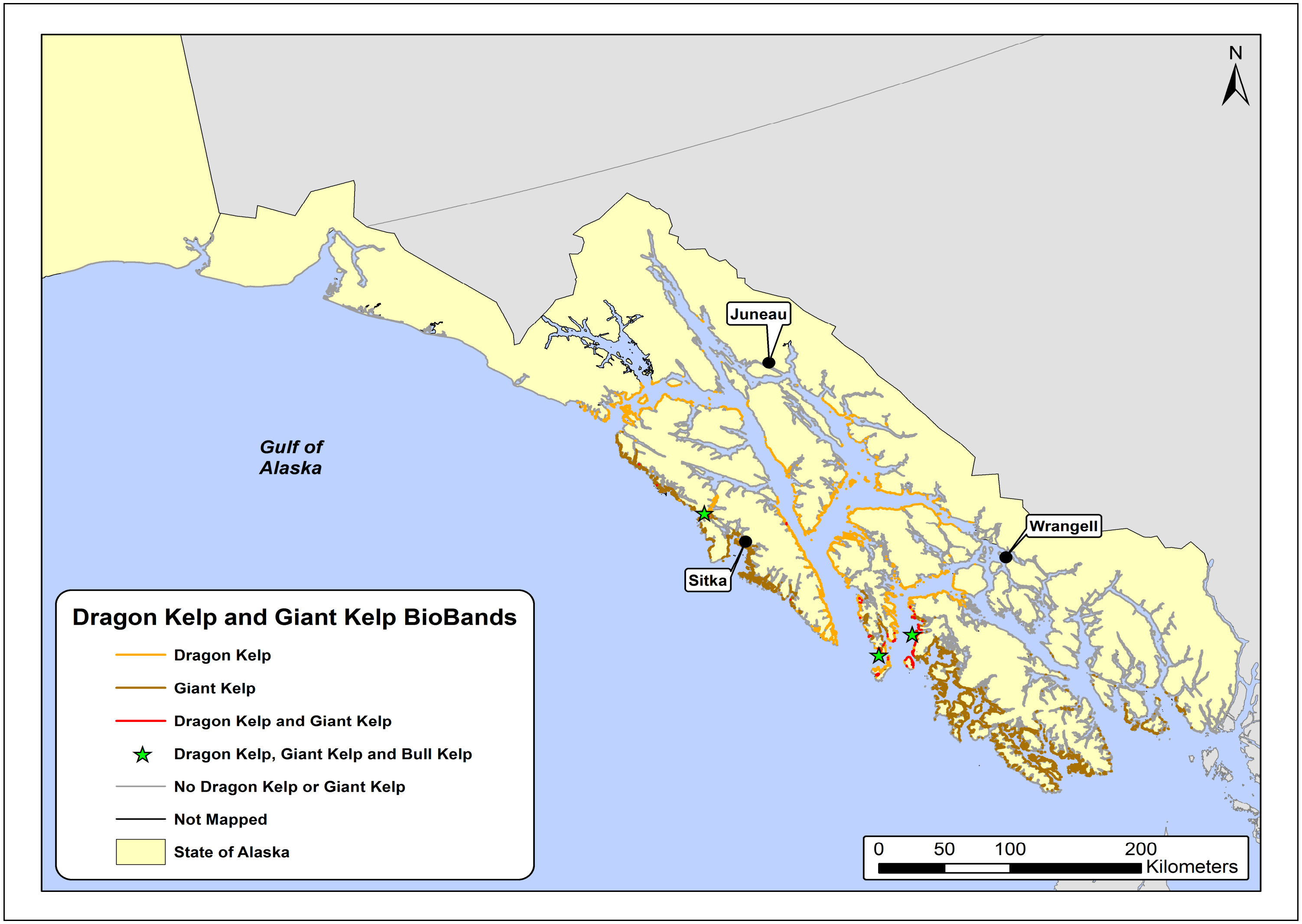

Figure 1.20. Distribution of units in which selected combinations of the Dragon Kelp and Giant Kelp biobands were observed in the study area of Southeast Alaska.

Southeast Alaska bioareas are based on an overview interpretation of biomapping and the distribution of major species (e.g., the canopy kelp species – Dragon Kelp (ALF), Giant Kelp (MAC) and Bull Kelp (NER)) as well as overall coastal habitats (e.g., relief, geomorphology, dominate shoreline characteristics). As ground surveys are completed, detail will be added to the definitions of indicator and associate species for each of the four lower intertidal biobands: Bleached Red Algae (HAL), Red Algae (RED), Soft Brown Kelps (SBR) and Dark Brown Kelps (CHB), as these species will differ according to bioarea.

Each unit where ShoreZone mapping has been completed to date in Alaska has been assigned to a bioarea (Figure 1.21). In Southeast Alaska, seven bioareas have been outlined to broadly represent regional differences observed in coastal biology and geomorphology.

3.2 Biological Wave Exposure

Biological wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are defined on the basis of a typical set of biobands. Biological wave exposure is a classified attribute that is determined from observations of the presence and abundance of biota in each alongshore unit. The assemblages of biota observed are then used as a proxy for the energy conditions at that site.

The six biological wave exposure categories are the same as those used in the physical mapping to characterize wave exposure of an alongshore unit (Appendix A, Tables A-4 and A-9). The physical wave exposure is based on fetch window estimates and coastal geomorphology, whereas the biological wave exposure is based on the presence or absence of indicator species and biobands. Species assemblages observed in each alongshore unit can be used as indicators of wave energy because wave energy tolerances for species assemblages have been assigned from scientific literature and expert knowledge (Table A-10). The biological wave exposure categories are considered a better index of exposure than are scores derived from fetch measurements and are used in the look up matrix for determining the Oil Residence Index (ORI) (Table A-6).

Some biobands are observed in all wave exposure categories and are considered weak indicators in determining the wave exposure (e.g., the Barnacle bioband (BAR)), while other biobands are considered strong indicators because they are closely associated with particular exposures. For example, the Dark Brown Kelps (CHB) bioband is consistently associated with higher wave exposures (Semi-Exposed (SE) to Exposed (E)).

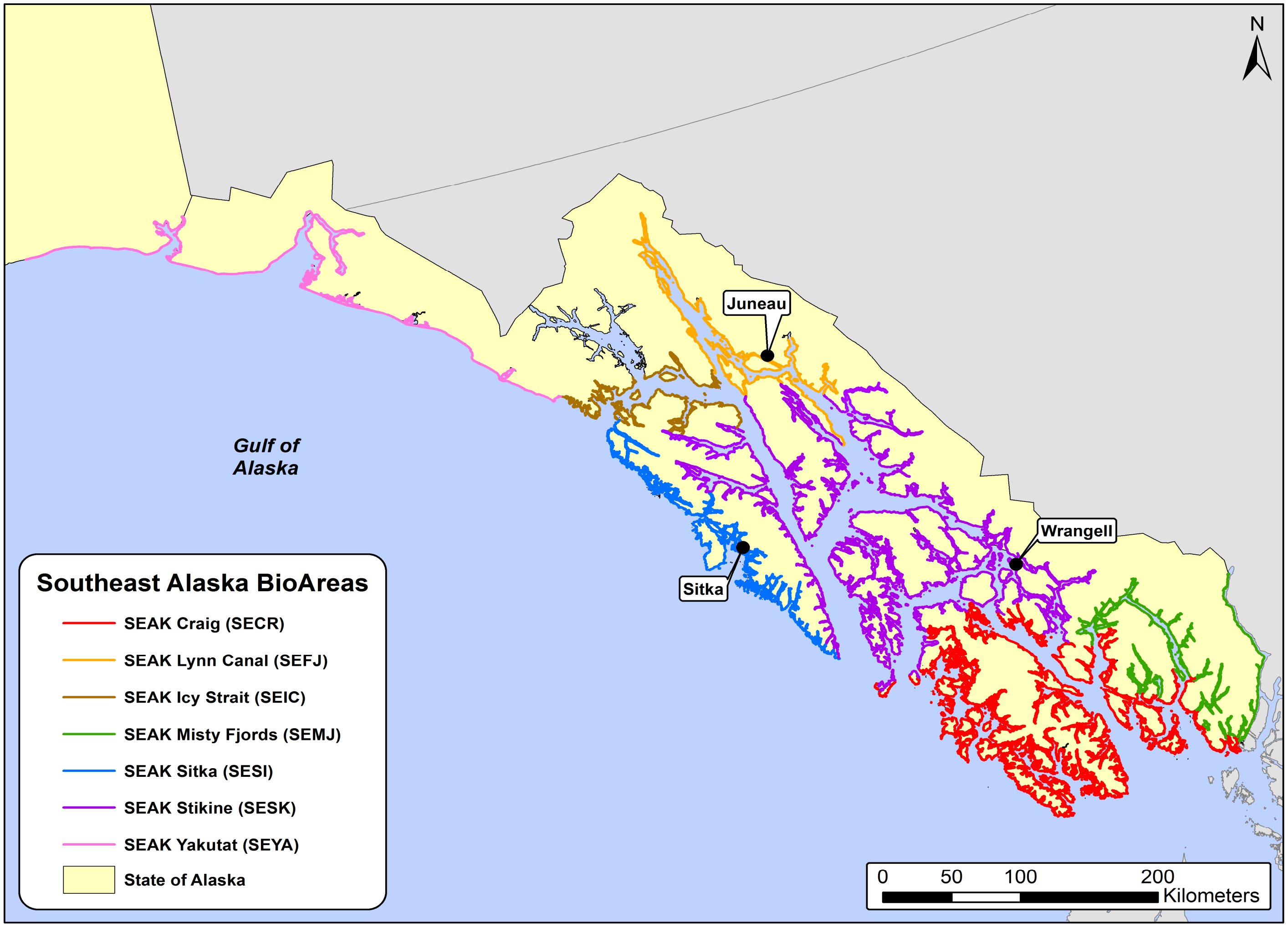

Figure 1.21. Distribution of bioareas identified in Alaska to date. Bioareas are delineated on the basis of observed regional differences in the distribution of biota and coastal geomorphology.

Biobands and indicator species listed for each wave exposure category are considered typical for each category but are not obligate; that is, not all of the indicator biobands (or species) occur in every unit classified with a particular biological wave exposure. The combination of biobands, species and interpretation determines the biological wave exposure category for each unit.

Typical biobands and species are summarized for each biological wave exposure category in Appendix A, Table A-10. Note that the species listed for the exposure categories were not compiled from formal ground survey data in Southeast Alaska, but are instead based on expert knowledge and ground surveys from other regions of Alaska, as well as opportunistic observations and photos collected during the aerial surveys.

Example illustrations of the biological wave exposures mapped in Southeast Alaska can be found in Appendix C of the Southeast Alaska data summary report produced in December 2009 (Coastal and Ocean Resources Inc. and Archipelago Marine Research Ltd. 2009).

Table 1.6. Summary of Biological Wave Exposure

Biological Wave Exposure		Shoreline Length (km)	% of Shoreline
Name	**Code**		
Exposed	E	1,425	5
Semi-Exposed	SE	2,865	10
Semi-Protected	SP	10,906	38
Protected	P	12,665	44
Very Protected	VP	734	3
Totals		***28,595***	***100***

The occurrence of the five biological wave exposure categories mapped in Southeast Alaska is summarized in Table 1.6 and in Figure 1.22. Most of the shoreline in the study area was classified with a wave exposure of Semi-Protected (SP) or lower (85%). Only a small portion was considered Exposed (E) (5% of the mapped shoreline length) and 10% was mapped in the Semi-Exposed (SE) category. A summary map of the biological wave exposure categories distribution is shown in Figure 1.23.

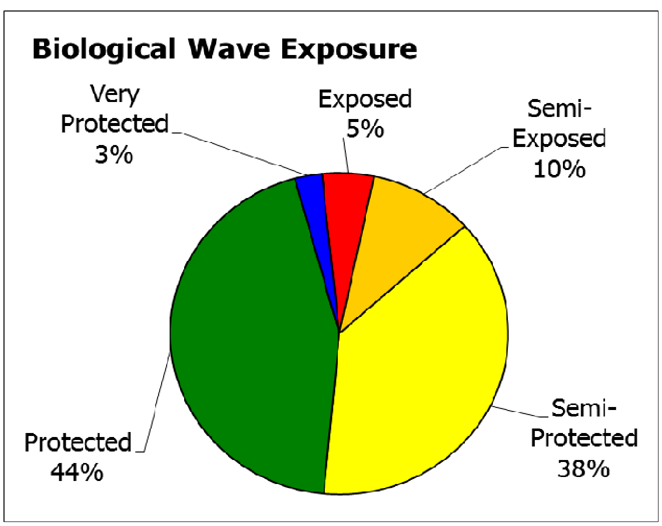

Figure 1.22. Summary of biological wave exposures mapped in the study area of Southeast Alaska.

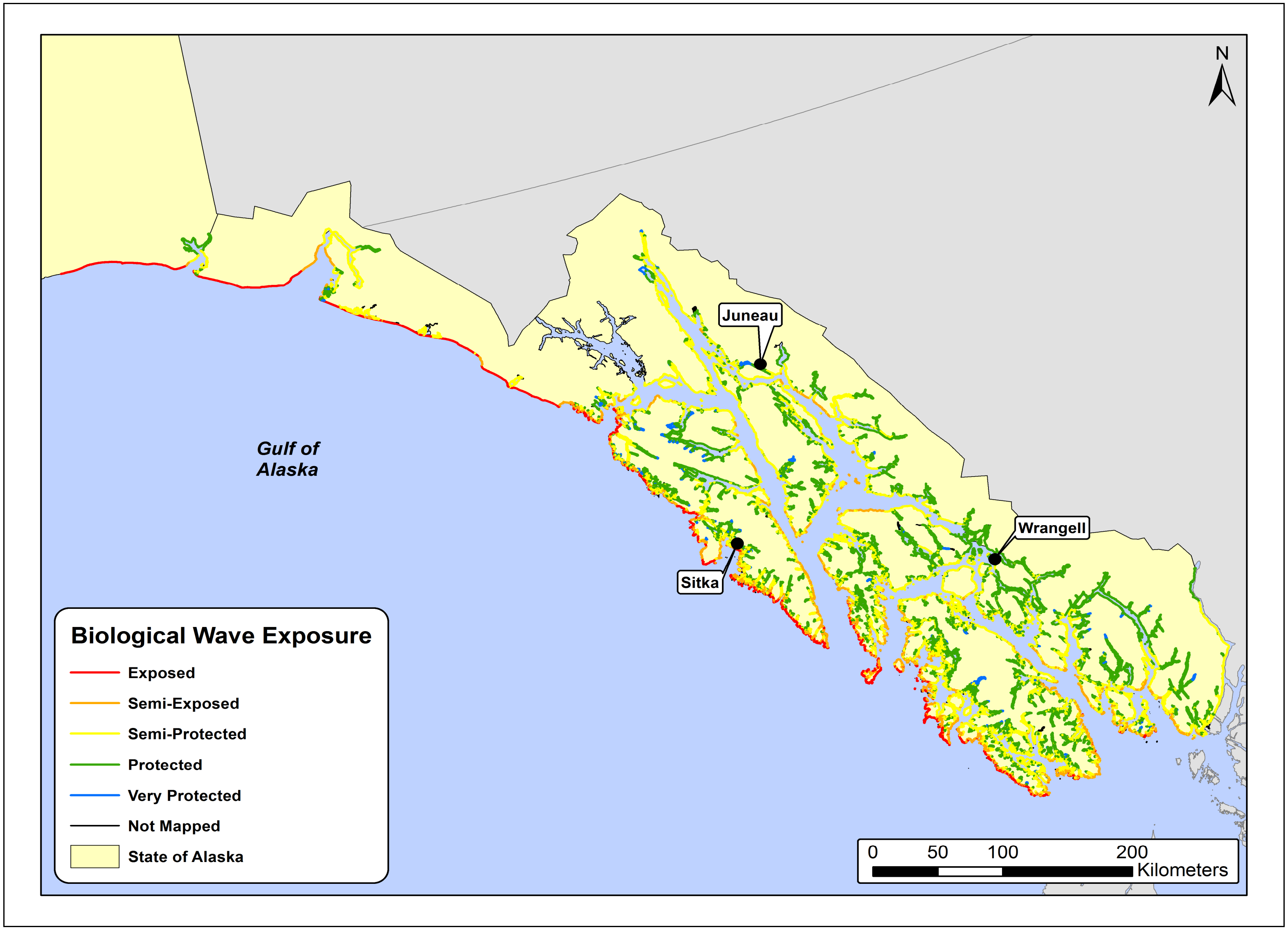

Figure 1.23. Distribution of biological wave exposure categories mapped in the study area of Southeast Alaska.

3.3 Habitat Class

Habitat Class is a summary classification that combines both physical and biological characteristics observed for a particular shoreline unit. The classification is based on biological wave exposure and geomorphic characteristics. The habitat class category is intended to provide a single attribute to summarize the biophysical features of the unit, based on an overall classification made from the detailed attributes that have been mapped.

The habitat class is determined from the biological wave exposure category, as indicated by the species assemblages observed in combination with the 'dominant structuring process' and geomorphic features of the site (Appendix A, Table A-12). Wave energy is the most common structuring process, and less commonly observed habitats are those structured by current, by estuarine/fluvial processes or by anthropogenic structures. See Appendix A, Table A-12 for a complete lookup table for habitat class combinations.

In wave energy-structured habitat classes, the combination of wave exposure and substrate type determined the degree of substrate mobility, and stability of the substrate determines the presence and abundance of attached biota. Where the substrate is mobile, biota is sparse or absent, and where substrates are stable, epibenthic biota can be abundant.

The three categories of wave energy-structured habitat classes, based on substrate mobility, are as follows:

- **Immobile** or stable substrates, such as bedrock or large boulders, enabling a well-developed epibenthic assemblage to form;
- **Partially Mobile** mixed substrates such as a rock platform with a beach or sediment veneer where the development of a full bioband assemblage is limited by the partial mobility of the sediments;
- **Mobile** substrates such as sandy beaches where coastal energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota.

Habitat classes determined by dominant structuring processes other than wave energy have limited occurrence along the coast and, except for the anthropogenic shorelines, are often highly valued habitats. These habitat classes are:

- **Estuary** complexes, with freshwater stream flow, delta form at the stream mouth and fringing wetland biobands including Salt Marsh (PUC), Dune Grass (GRA) and often Sedges (SED);
- **Current-Dominated** channels where high tidal currents support assemblages of biota typical of higher energy sites than would be found at the site if wave energy was the structuring process (these units are usually associated with lower wave exposure conditions in adjacent shore units);

- **Glacier** ice, where saltwater glaciers form the intertidal habitat;
- **Anthropogenic** features where the shoreline has undergone human modification (e.g., areas of rip rap or fill, marinas and landings), excluding archaeological sites;
- **Lagoons**, which have enclosed coastal ponds of brackish or salty water (mapped only as a secondary habitat class, see Table A-11 for further definition of secondary habitat class).

Further descriptions and definitions of the habitat class categories are presented in Appendix A, Tables A-11 and A-12. Example illustrations of the habitat classes mapped in Southeast Alaska can be found in Appendix C of the Southeast Alaska data summary report produced in December 2009 (Coastal and Ocean Resources Inc. and Archipelago Marine Research Ltd. 2009).

The occurrences of habitat class categories are summarized in Figure 1.24 and Table 1.7. Approximately 85% of all habitat class categories mapped are structured by wave energy, with 70% in the Semi-Protected and lower wave energy categories. Of the non-wave energy structured habitats, the Estuary habitat class is the most often observed, and accounts for 14% of the shoreline mapped so far in Southeast Alaska. Fluvial processes are the dominant structuring force in this habitat class. The least common habitat class categories are those that are structured by current energy, glacial processes or are anthropogenic. Each of these classes account for approximately 1% or less of the shoreline mapped. For simplification purposes, summary maps of two habitat class distributions, Estuary and Current-Dominated, are shown in Figures 1.25 and 1.26.

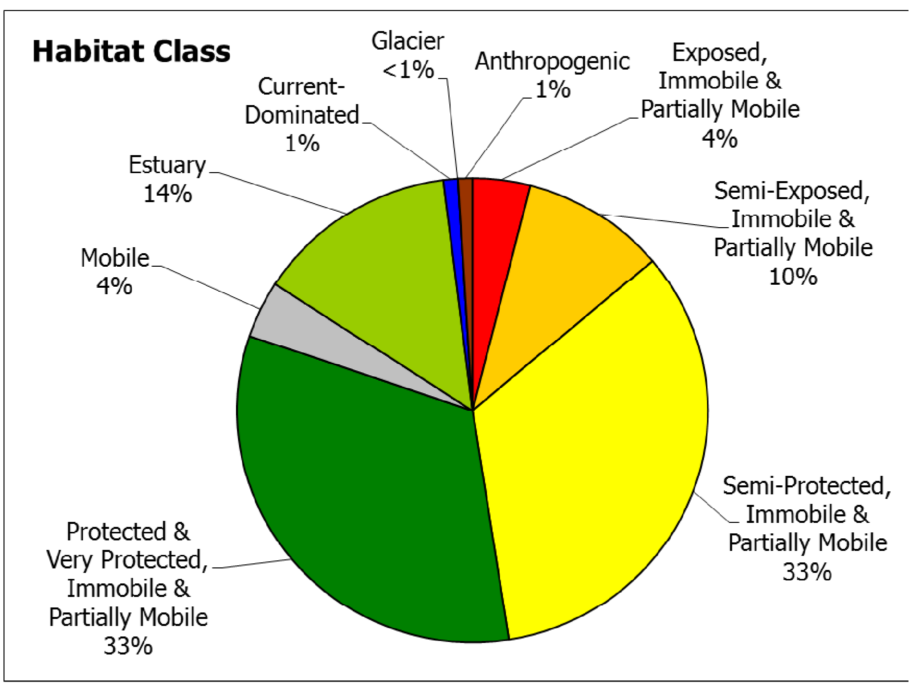

Figure 1.24. Summary of habitat class categories mapped in the study area of Southeast Alaska (2004 to 2010).

Table 1.7. Summary of Habitat Class

Dominant Structuring Process	Habitat Class		Length (km)	% of Mapping
	Exposure Category	Substrate Mobility		
Wave energy	Exposed	Immobile	833	3
		Partially Mobile	254	1
		Mobile	326	1
	Semi-Exposed	Immobile	1,299	5
		Partially Mobile	1,435	5
		Mobile	108	0
	Semi-Protected	Immobile	1,667	6
		Partially Mobile	8,029	28
		Mobile	293	1
	Protected/ Very Protected	Immobile	1,325	5
		Partially Mobile	8,219	29
		Mobile	394	1
Fluvial/Estuarine processes	Estuary		3,991	14
Current energy	Current-Dominated		212	1
Glacial processes	Glacier		29	<1
Man-modified	Anthropogenic		181	1
Lagoon	Lagoon		711	3
		Totals:	***28,595***	***100***

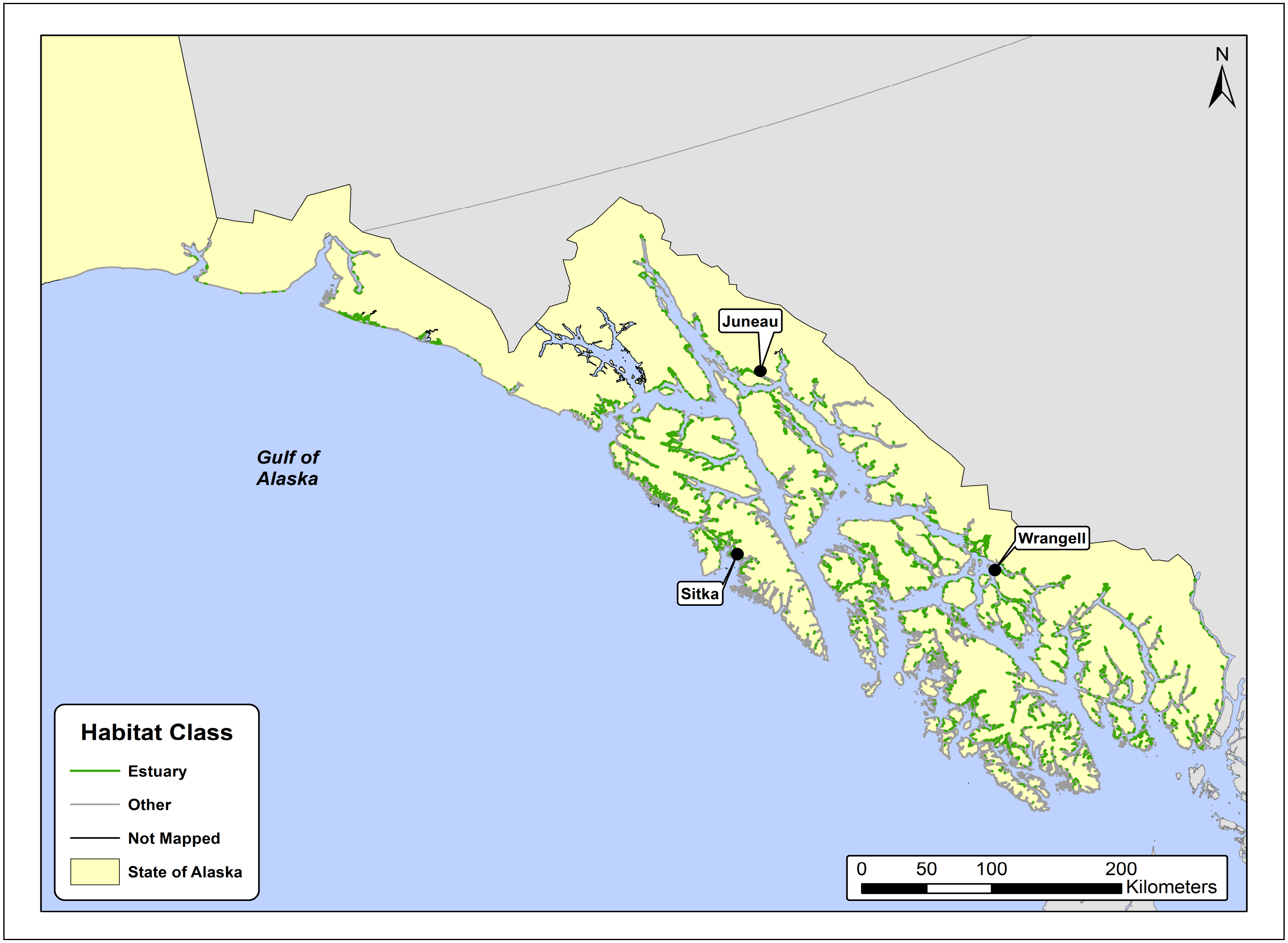

Figure 1.25. Distribution of Estuary habitat class category mapped in the study area of Southeast Alaska.

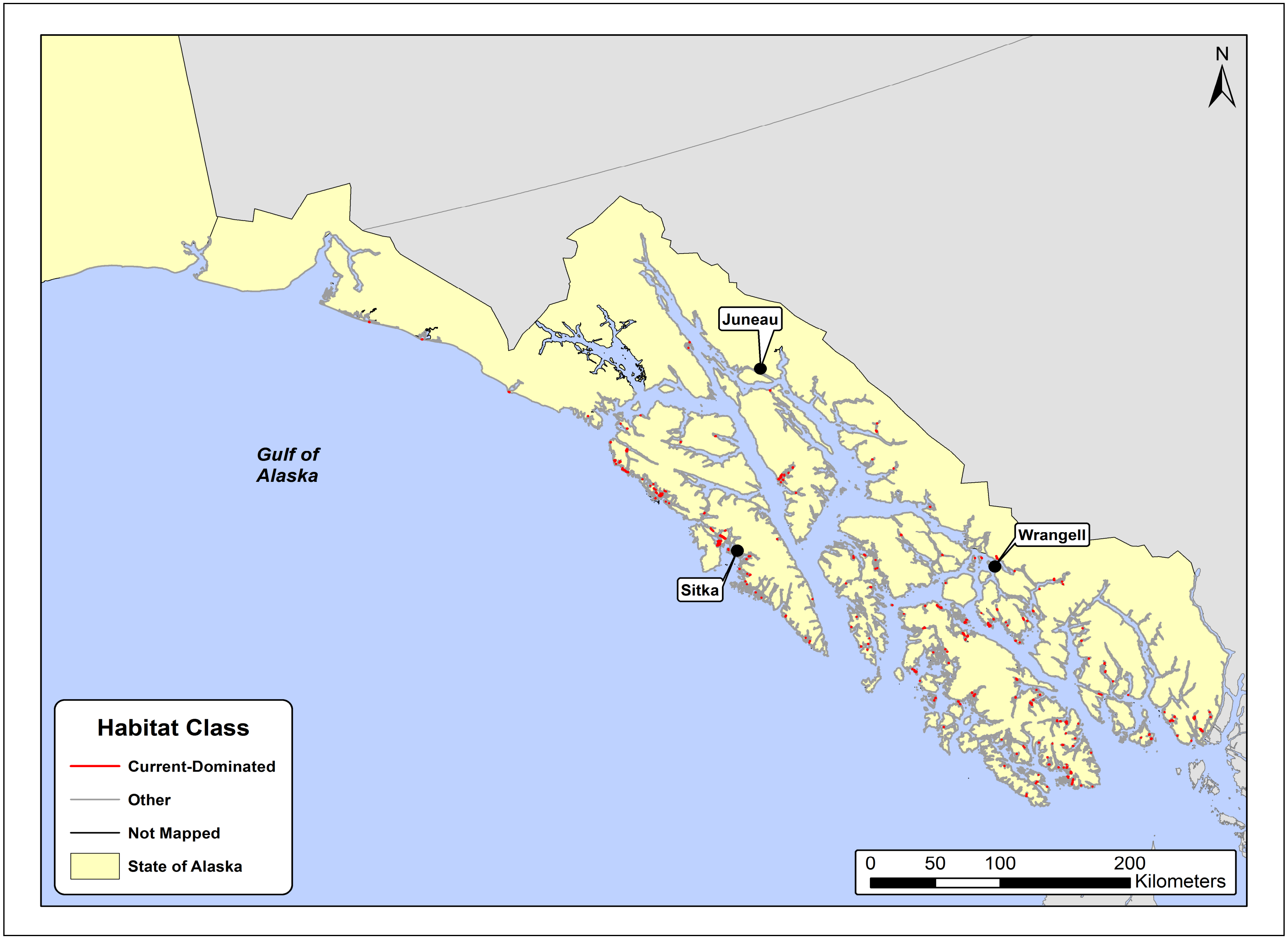

Figure 1.26. Distribution of Current-Dominated habitat class category mapped in the study area of Southeast Alaska.

4 REFERENCES

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5 ACKNOWLEDGMENTS

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

APPENDIX A DATA DICTIONARY

Table	Description
A-1	Definitions for fields and attributes in the UNIT table.
A-2	Definitions of the BC_CLASS attribute, in the UNIT table. (after Howes *et al* [1994] “BC Class” in British Columbia ShoreZone)
A-3	Definitions of the ESI (Environmental Sensitivity Index) attribute, from the UNIT table (after Peterson *et al* [2002]).
A-4	Definitions for estimating the OBSERVED PHYSICAL EXPOSURE attribute, (EXP_OBSER) in the UNIT table.
A-5	Definition of the OIL RESIDENCE INDEX (ORI) attribute in the UNIT table.
A-6	OIL RESIDENCE INDEX (ORI) Component lookup matrix based on exposure (columns) and substrate type (rows).
A-7	Definitions of the attributes in the BIOUNIT table.
A-8	Definitions of the BIOAREA attribute in BIOUNIT table.
A-9	List of the BIOLOGICAL WAVE EXPOSURE codes, in BIOUNIT table.
A-10	Definitions of BIOLOGICAL WAVE EXPOSURES, by bioband, and by indicator and associate species assemblages (EXP_BIO attribute in BIOUNIT table).
A-11	Expanded descriptions for HABITAT CLASS, SECONDARY HABITAT CLASS, and RIPARIAN fields of the BIOUNIT table.
A-12	Codes for HABITAT CLASS and SECONDARY HABITAT CLASS attributes, in the BIOUNIT table.
A-13	Definitions of fields and attributes in the XSHR (Across-shore) component table (after Howes *et al* 1994).
A-14	Definitions of FORM attributes, in XSHR (Across-shore) table (after Howes *et al* 1994).
A-15	Definitions of the MATERIALS attributes, in XSHR (Across-shore) table. (after Howes *et al* 1994).
A-16	Definitions for fields in the BIOBAND table.
A-17	Definitions for BIOBAND attribute for Southeast Alaska, in BIOBAND table.
A-18	Definitions for Occurrences of Biobands, in the BIOBAND table.
A-19	Definitions for fields in the PHOTOS table.

Table A-1. Definitions for Fields and Attributes in the UNIT table.

Field Name	Description
UnitRecID	**Unit Record ID:** An automatically-generated number field; the database "primary key" for unit-level relationships
PHY_IDENT	**Physical Ident** is a unique code to identify each unit, assigned by physical mapper; defined as an alphanumeric string determined by the codes for: Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0), where '12' is Region 12, '03' is Area 3, '0552' is the Unit number, and '0' is the Subunit number.
REGION	**Region:** assigned during mapping, makes up first two digits of the PHY_IDENT. (See PHY_IDENT description for example.)
AREAS	**Area:** assigned during mapping, makes up the third and fourth digits of the PHY_IDENT. (See PHY_IDENT description for example.)
PHY_UNIT	**Unit:** Four digit **along-shore unit number**; assigned during mapping, unique within Region/Area mapping section. (See PHY_IDENT description for example.)
SUBUNIT	**Subunit:** assigned during mapping, is '0' for unit line features. Subunit field is used to identify Point features (if any, also called 'Variants') within Units, and are numbered sequentially (1, 2, 3…) according to the order occurring within the unit. (See PHY_IDENT description for example.)
TYPE	**Unit Type:** A single-letter description for Unit as either: a (L)ine (linear unit) or (P)oint feature (variant). Related to SUBUNIT attribute, where each numbered SUBUNIT 'variant' would be TYPE 'P'
BC_CLASS	**BC Coastal Class:** Code number for Coastal Class classification for the unit. Definitions of codes in Table A-2. Determined by the Physical mapper and based on: overall substrate type, sediment size (if sediment is present), across-shore width, and across-shore slope for the unit; derived from the Howes *et al* (1994)
ESI	**Environmental Sensitivity Index** Classification for the shore unit, using unit-wide interpretation of ESI. Definitions in Table A-3, after Peterson *et al* [2002].
LENGTH_M	**Unit Length**: Along-shore unit high waterline, in meters; calculated in ArcGIS, from digitized shoreline
GEO_MAPPER	**Physical Mapper Name:** Last name of the physical mapper
GEO_EDITOR	**Physical Mapper Reviewer:** Last name of the physical mapper who QA/QCs the work (10% of all units are reviewed by a different Physical mapper than did original mapping)
VIDEOTAPE	**Videotape Name:** Unique code for title of the videotape used for mapping; Naming convention example is SE07_SO_08, where first four characters identify the main survey region and year, (where SE07 is 'Southeast Alaska 2007'), two letter code for survey team (where SO is 'Sockeye') and two digit code '08' is for consecutively numbered tape.
HR	**Hour**: From the first two digits of the 6-digit UTC time burned on video image, identifying video frame at which the unit starts; with the unit start frame at center of viewing screen
MIN	**Minute**: From the third and fourth digits of the 6-digit UTC time burned on video image at which unit starts; with the unit start frame at center of viewing screen
SEC	**Seconds**: From the last two digits of the 6-digit UTC time burned on video image at which unit starts; with the unit start frame at center of viewing screen
EXP_OBSER	**Physical wave exposure:** Estimate of wave exposure as observed by the physical mapper, estimated from observed fetch and coastal processes; categories listed in Table A-4.

[continued]

Table A-1. Definitions for Fields and Attributes in the UNIT table. (continued)

Field Name	Description
ORI	**Oil Residency Index:** Code indicating the potential persistence of oil within the shore unit. Based on unit substrate type and biological wave exposure categories. Definitions and lookup matrix in Tables A-5 and A-6
SED_SOURCE	**Sediment Source:** Code to indicate estimated sediment source for the unit: (A)longshore, (B)ackshore, (F)luvial, (O)ffshore, (X) not identifiable
SED_ABUND	**Sediment Abundance:** Code to indicate the relative sediment abundance within the shore-unit: (A)bundant, (M)oderate, (S)carce
SED_DIR	**Sediment Transport Direction:** One of the eight cardinal points of the compass indicating dominant sediment transport direction (N, NE, E, SE, S, SW, W, NW). (X) Indicates transport direction could not be discerned from imagery.
CHNG_TYPE	**Change Type:** Code indicating the estimated stability of the shore unit, reflecting the relative degree of “measurable change” during a 3-5 year time span: (A)ccretional, (E)rosional, (S)table
SHORENAME	**Shorename:** Name of a prominent geographic feature near the unit (from nautical chart or gazetteer)
UNIT_COMMENTS	**Unit Comments**: Text field for comments and notes during physical mapping
SM1_TYPE	**Primary Shore Modification:** 2-letter code indicating the primary type of shore modification occurring within the unit: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM1_PCT	**Primary Shore Modification Percent Unit Length:** Estimated % occurrence of the primary shore modification type in tenths (i.e. “2” = 20% occurrence with the unit alongshore)
SM2_TYPE	**Secondary Shore Modification:** 2-letter code indicating the secondary type of shore modification occurring within the unit
SM2_PCT	**Secondary Shore Modification Percent Unit Length:** Estimated % occurrence of the secondary type of shore modification occurring within the unit
SM3_TYPE	**Tertiary Shore Modification:** 2-letter code indicating the tertiary type of shore modification occurring within the unit
SM3_PCT	**Tertiary Shore Modification Percent Unit Length:** Estimated % occurrence of the tertiary seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SMOD_TOTAL	**Total Shore Modification % Unit Length:** Total % occurrence of shore modification in the unit in tenths
RAMPS	**Boat Ramps:** Number of boat ramps that occur within the unit; ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate
PIERS_DOCK	**Piers or Wharves:** Number of piers or wharves that occur within the unit; piers or docks must extend at least 10 m into the intertidal zone; does not include anchored floats
REC_SLIPS	**Dock Slips:** Estimated number of recreational slips at docks or marinas within the unit; based on small boat length ~<50’
DEEPSEA_SLIP	**Ship Dock Slips:** Estimated number of slips for ocean-going vessels within the unit; based on ship length ~>100’
ITZ	**Intertidal Zone Width:** Sum of the across-shore width of all the intertidal (B Zone) components within the unit
SLIDE	Still Photo in Unit: **Yes/No tick box** to indicate if high resolution photo is available for the Unit.
EntryDate ModifiedDate	**Date/Time Mapped or Modified:** Date and time the unit was physically mapped (or modified)

Table A-2. Definitions of the BC_CLASS attribute, in the UNIT table.
(after Howes *et al* [1994] "BC Class" in British Columbia ShoreZone)

Substrate	Sediment	Width	Slope	BC_CLASS	
				Description	CODE
Rock	n/a	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	Rock Ramp, wide	1
			Flat (<5°)	Rock Platform, wide	2
		Narrow (<30 m)	Steep	Rock Cliff	3
			Inclined (5-	Rock Ramp, narrow	4
			Flat (<5°)	Rock Platform, narrow	5
Rock & Sediment	Gravel	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	Ramp with gravel beach,	6
			Flat (<5°)	Platform with gravel beach,	7
		Narrow (<30 m)	Steep	Cliff with gravel beach	8
			Inclined (5-	Ramp with gravel beach	9
			Flat (<5°)	Platform with gravel beach	10
	Sand & Gravel	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	Ramp w gravel & sand	11
			Flat (<5°)	Platform with G&S beach,	12
		Narrow (<30 m)	Steep	Cliff with gravel/sand beach	13
			Inclined (5-	Ramp with gravel/sand	14
			Flat (<5°)	Platform with gravel/sand	15
	Sand	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	Ramp with sand beach,	16
			Flat (<5°)	Platform with sand beach,	17
		Narrow (<30 m)	Steep	Cliff with sand beach	18
			Inclined (5-	Ramp with sand beach,	19
			Flat (<5°)	Platform with sand beach,	20
Sediment	Gravel	Wide (>30	Flat (<5°)	Gravel flat, wide	21
		Narrow (<30 m)	Steep	n/a	-
			Inclined (5-	Gravel beach, narrow	22
			Flat (<5°)	Gravel flat or fan	23
	Sand & Gravel	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	n/a	-
			Flat (<5°)	Sand & gravel flat or fan	24
		Narrow (<30 m)	Steep	n/a	-
			Inclined (5-	Sand & gravel beach,	25
			Flat (<5°)	Sand & gravel flat or fan	26
	Sand/Mud	Wide (>30 m)	Steep	n/a	-
			Inclined (5-	Sand beach	27
			Flat (<5°)	Sand flat	28
			Flat (<5°)	Mudflat	29
		Narrow (<30 m)	Steep	n/a	-
			Inclined (5-	Sand beach	30
			Flat (<5°)	n/a	-
	Organics	n/a	n/a	Organics	31
Anthropogenic	Man-made	n/a	n/a	Man-made, permeable	32
			n/a	Man-made, impermeable	33
Channel	Current	n/a	n/a	Channel	34
Glacier	Ice	n/a	n/a	Glacier	35

Table A-3. Definitions of the ESI (Environmental Sensitivity Index) attribute, from the UNIT table. (after Peterson *et al* [2002])

Environmental Sensitivity Index (ESI)	
CODE	**Description**
1A	Exposed rocky shores; exposed rocky banks
1B	Exposed, solid man-made structures
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave-cut platforms in bedrock, mud, or clay
2B	Exposed scarps and steep slopes in clay
3A	Fine- to medium-grained sand beaches
3B	Scarps and steep slopes in sand
3C	Tundra cliffs
4	Coarse-grained sand beaches
5	Mixed sand and gravel beaches
6A	Gravel beaches; Gravel Beaches (granules and pebbles
6B	Gravel Beaches (cobbles and boulders)
6C	Rip rap (man-made)
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud, or clay; Sheltered rocky shores (impermeable)
8B	Sheltered, solid man-made structures; Sheltered rocky shores (permeable)
8C	Sheltered rip rap
8D	Sheltered rocky rubble shores
8E	Peat shorelines
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10A	Salt- and brackish-water marshes
10B	Freshwater marshes
10C	Swamps
10D	Scrub-shrub wetlands; mangroves
10E	Inundated low-lying tundra

Table A-4. Definitions for estimating the OBSERVED PHYSICAL EXPOSURE attribute, (EXP_OBSER) in the UNIT table.

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. Definition of the OIL RESIDENCE INDEX (ORI) attribute in the UNIT table.

Persistence	Oil Residence Index (ORI)	Estimated Persistence
Short	1	Days to weeks
Short to Moderate	2	**Weeks** to Months
Moderate	3	Weeks to **Months**
Moderate to Long	4	**Months** to Years
Long	5	Months to **Years**

Table A-6. OIL RESIDENCE INDEX (ORI) Component lookup matrix based on exposure (columns) and substrate type (rows).

Component Substrate	VE	E	SE	SP	P	VP
rock	1	1	1	2	3	3
man-made, impermeable	1	1	1	2	2	2
boulder	2	3	5	4	4	4
cobble	2	3	5	4	4	4
pebble	2	3	5	4	4	4
sand with pebble, cobble or boulder	1	2	3	4	5	5
sand without pebble, cobble or boulder	2	2	3	3	4	4
mud	999	999	999	3	3	3
organics/vegetation	999	999	999	5	5	5
man-made, permeable	2	2	3	3	5	5

Table A-7. Definitions of the attributes in the BIOUNIT table.

Field Name Code	Description
UnitRecID	**Unit Record ID:** Automatically-generated number field; the database "primary key" required for relationships between tables
PHY_IDENT	**Physical_Ident** is a unique code to identify each unit, assigned by physical mapper; defined as an alphanumeric string determined by the codes for: Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0), where '12' is Region 12, '03' is Area 3, '0552' is the Unit number, and '0' is the Subunit number.
BIOAREA	**Bioarea:** Geographic division used to describe regional differences in observed biota and coastal habitats (Bioarea codes and descriptions listed in Table A-8)
EXP_BIO	**Biological Wave Exposure:** A classification of the wave exposure category within the Unit, assigned by the Biological mapper, based on observed indicator species and biobands (Table A-9 and Table A-10)
HAB_CLASS	**Habitat Class**: Code for a classification of overall habitat category within the Unit, assigned by the biological mapper. Based on the Biological Exposure (EXP_BIO) and the geomorphic features of the shoreline (Table A-11 and A-12).
HAB_CLASS_LTRS	**Habitat Class** in alphabetic code: translation from number codes in the HAB CLASS lookup table (Table A-12)
HAB_OBS	**Habitat Observed**: Original Habitat code categories used to classify Habitat Type; not used in current protocol but kept for backward-compatibility with earlier projects; replaced by HAB_CLASS
BIO_SOURCE	**Biomapping Source:** The source data used to interpret coastal zone biota: (V)ideotape, (V2) - lower quality video imagery, (S)lide, (I)nferred
HAB_CLASS2	**Secondary Habitat Class**: Code for a classification of secondary Lagoon-type habitat within the Unit, assigned by the biological mapper. Based on the Biological Exposure (EXP_BIO) and lagoon habitat types (Table A-11 and A-12)
HC2_SOURCE	**Secondary Habitat Class Source:** Source used to interpret the Secondary Habitat Class (HAB_CLASS2) "lagoon": OBServed as viewed from video, LooKUP referring to 'Form' Code (Table A-11 and Table A-12) Lo or Lc in across-shore physical component table (Table A-13 and A-14)
HC2_Note	**Secondary Habitat Class Comment:** comment field for Secondary Habitat Class ((HAB_CLASS2))
RIPARIAN_PERCENT	**Riparian Percent Overhang:** Estimate of the percentage of alongshore length of the intertidal zone, in which the shoreline is shaded by overhanging riparian vegetation; all substrate types (Expanded definition in Table A-11)
RIPARIAN_M	**Riparian Overhang Meters:** Calculated portion of the unit length, in meters, of riparian overhang in the intertidal (B) zone, using LENGTH_M field of UNIT table, and RIPARIAN_PERCENT of BIOUNIT table; all substrate types;
BIO_UNIT_COMMENT	**Biological Comments**: regarding the along-shore unit as a whole. Included as deliverable data, as note format.
BIO_MAPPER	**Biological Mapper:** The initials of the biological mapper that provided the biological interpretation of the imagery
PHOTO	Still Photo in Unit: **Yes**/**No tick box** to indicate if high resolution photo is available for the Unit. (see BIOSLIDE table)
DateAdded DateModified	**Date**/**Time Mapped or Modified:** Date and time the unit was physically mapped (or modified)

Table A-8. Definitions of the BIOAREA attribute in BIOUNIT table.

Bioarea Name	Bioarea Code	Bioarea Suffix *	Geographic Extent	Characteristics
Outer Kenai	KENA	8	Kenai Coast, Alaska, including Kenai Fjords National Park, from Cape Elizabeth at the east entrance of Cook Inlet to Port Bainbridge at the west entrance of Prince William Sound.	Rugged coastline, dominated by extremely steep shores and Very Exposed wave energy. Fjord heads with tidewater glaciers. Absence of Dragon Kelp and Giant Kelp biobands.
Cook Inlet	COOK	9	Cook Inlet, Alaska, from Cape Douglas on the southwest entrance Cook Inlet, north to Anchorage, including Turnagain Arm and Kachemak Bay, to Cape Elizabeth at the southeast entrance of Cook Inlet.	Sediment-dominated, wide, low-slope shorelines, moderate to lower wave exposures. Affected by silt-laden freshwater input, absence of Giant Kelp and Dragon Kelp. Very wide complexes of salt marshes and estuaries.
Kodiak Island	KODI	10	Kodiak archipelago, Gulf of Alaska side, from Tugidak Island and Akhiok at the southwest end of the archipelago, to Shuyak Island at the northeast end of the islands.	Diversity of habitats and wave exposures, from Very Protected estuaries to Exposed rock cliffs. Fully marine and open to Gulf of Alaska. Lush lower intertidal brown algae, red algae and canopy kelps, in particular at north end. Southwest coast has wide rock platforms with surfgrass beds and sediment dominated offshore islands.
Katmai / Shelikof Strait side of Kodiak Island	KATM	11	Katmai National Park and Preserve, Alaska Peninsula, Shelikof Strait, includes the northwest side of the Kodiak archipelago.	Moderate to high wave exposures, affected by outflow from Cook Inlet, and separated from open Gulf of Alaska by Kodiak archipelago. Limited diversity of lower intertidal browns and canopy kelps, with diversity of red algae characterizing higher exposure sites. Includes both coasts of Shelikof Strait.
Aniakchak	ANIA	11	Aniakchak National Monument and Preserve, Alaska Peninsula, Shelikof Strait, southwest of Katmai National Park.	High wave exposure, wide bedrock platforms and mobile sediment beaches. Included in KATM bioareas for species descriptions, pending further delineation of bioarea boundaries. Likely transitional to Aleutian bioareas.
Southeast Alaska -- Yakutat	SEYA	12	The Yakutat region, on the Gulf of Alaska coast. Extends from the outer edge of the Copper River delta, near Cordova, south through Yakutat Bay, to Icy Point, just north of Cross Sound.	Exposed west-facing coast, open to Gulf of Alaska. Mobile, high-energy sediment beaches dominant. Limited canopy kelp distribution.
Southeast Alaska – Lynn Canal (fjord)	SEFJ	12	Lynn Canal from Point Howard at the southwest edge, at SEIC boundary, north to Skagway, and the east side of Lynn Canal south. Includes Juneau, Douglas Island, Taku Inlet and Port Snettisham with the southeast edge to the south tip of Glass Peninsula, Hugh Point on Admiralty Island.	Fjord landscape, bedrock dominated, moderate to low wave exposures, glacial silty waters. Low species diversity in intertidal, dense Blue Mussel bioband, absence of Dragon Kelp and Giant Kelp biobands.

* Suffix applied to four lower intertidal biobands (HAL, RED, SBR, CHB) to distinguish between regional differences in species composition of these bands in different bioareas.

[continued]

Table A-8. Definitions of the BIOAREA attribute in BIOUNIT table. (continued)

Bioarea Name	Bioarea Code	Bioarea Suffix *	Geographic Extent	Characteristics
Southeast Alaska – Icy Strait	SEIC	12	The Icy Strait region, of northern SE Alaska. The north extend is at Icy Point, at SEYA boundary, south to Cape Spencer and the north shore Cross Sound, east to the southwest entrance of Lynn Canal at Point Howard. Includes entire south shore Icy Strait, from Point Lucan at west to False Bay, northeast Chichagof Island.	Glacial silty water, wide, sediment-dominated beaches common, fringing salt marsh common, moderate and lower wave exposures, wide estuary flats common. Dragon Kelp dominant canopy kelp.
Southeast Alaska – Sitka	SESI	12	The Sitka area includes the northwest sides of Chichagof and Baranof Islands. The northern boundary is at Point Lucan in Icy Strait, including Yakobi and Kruzof Islands with the southern boundary at the southern tip of Baranof Island at Cape Ommaney.	Fully marine, west coast, includes diversity of species, exposure and habitat categories, from Exposed to Very Protected. Giant Kelp abundant, Dragon Kelp limited distribution.
Southeast Alaska – Misty Fjords	SEMJ	12	Misty Fjords area includes all fjords in the southeast region of Southeast Alaska, including Behm Canal, George Inlet, Carroll Inlet, Thorne Arm, Boca de Quadra and the western side of Portland Inlet.	Fjord landscape, bedrock-dominated, low wave exposures. Low species diversity. Absence of Giant Kelp and Dragon Kelp.
Southeast Alaska – Craig	SECR	12	The Craig area includes islands in the southwest region of Southeast Alaska, including areas around Ketchikan as well as Prince of Wales Island, Dall Island and all surrounding archipelagos, from southern Coronation Island, south to Dixon Entrance.	Fully marine, west coast. High species diversity and habitat heterogeneity. Northern limit of California Mussel and Urchin Barrens biobands and certain species of other lower intertidal kelps. Southern limit of Dragon Kelp.
Southeast Alaska -- Stikine	SESK	12	The Stikine area encompasses central Southeast Alaska. Northern extent includes east Chichagof Island from False Bay, west Admiralty Island and south from Tracy and Endicott Arms. Includes east Baranof, Kuiu and Kupreanof Islands as well as the Stikine River and surrounding Islands, Etolin and Wrangell. Southern boundary crosses Coronation and Warren Islands and northwest Prince of Wales Island	Glacial silty water affected, diversity of shoreline habitats and substrate types, moderate and lower wave exposures. Dragon Kelp dominant canopy kelp.
Prince William Sound	PRWS	13	All of Prince William Sound from Orca Inlet at Cordova on the east, to the south end of Montague Island, and across to Port Bainbridge on the west.	Diverse habitat, with high Semi-Exposed to Very Protected wave exposures. Differences between conditions in eastern and western Sound, with interaction of circulation complexities. Numerous tidewater glaciers and affects of Copper River. Absence of Giant Kelp and Dragon Kelp.

* Suffix applied to four lower intertidal biobands (HAL, RED, SBR, CHB) to distinguish between regional differences in species composition of these bands in different bioareas.

Table A-9. List of the BIOLOGICAL WAVE EXPOSURE codes, in BIOUNIT table.

Biological Wave Exposure	
Name	**Code**
Very Exposed	VE
Exposed	E
Semi-Exposed	SE
Semi-Protected	SP
Protected	P
Very Protected	VP

Table A-10. Definitions of BIOLOGICAL WAVE EXPOSURES, by bioband, and by indicator and associate species assemblages (EXP_BIO attribute in BIOUNIT table).

Exposure	Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
Very Exposed (VE) & Exposed (E)	Upper Intertidal		*Leymus mollis*	Dune Grass	GRA
		Verrucaria		Splash Zone	VER
			Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
		Semibalanus cariosus		Barnacle	BAR
		Mytilus trossulus		Blue Mussel	BMU
	Lower Intertidal & Nearshore Subtidal		*Mytilus californianus*	California Mussel	MUS
		Coralline red algae		Red Algae	RED
		Alaria 'nana' morph		Alaria	ALA
		Lessoniopsis littoralis		Dark Brown Kelps	CHB
		Laminaria setchellii		Dark Brown Kelps	CHB
		Nereocystis luetkeana		Bull Kelp	NER
Semi-Exposed (SE)	Upper Intertidal		*Leymus mollis*	Dune Grass	GRA
		Verrucaria		Splash Zone	VER
			Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
			Fucus distichus	Rockweed	FUC
		Semibalanus cariosus		Barnacle	BAR
		Mytilus trossulus		Blue Mussel	BMU
	Lower Intertidal & Nearshore Subtidal	mixed filamentous and foliose red algae		Red Algae	RED
		Alaria 'marginata' morph		Alaria	ALA
		Phyllospadix sp.		Surfgrass	SUR
		Laminaria setchellii		Dark Brown Kelps	CHB
		Saccharina subsimplex		Dark Brown Kelps	CHB
		Saccharina sessile smooth morph		Dark Brown Kelps	CHB
		Alaria fistulosa		Dragon Kelp	ALF
			Strongylocentrous fransciscanus	Urchin Barrens	URC
			Macrocystis integrifolia	Giant Kelp	MAC
		Nereocystis luetkeana		Bull Kelp	NER

[continued]

Table A-10. Definitions of BIOLOGICAL WAVE EXPOSURES, by bioband, and by indicator and associate species assemblages (EXP_BIO attribute in BIOUNIT table).(continued)

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

Table A-11. Expanded descriptions for HABITAT CLASS, SECONDARY HABITAT CLASS, and RIPARIAN fields of the BIOUNIT table.

Attribute	Description
HAB_CLASS	**Habitat Class** attribute is a classification of the biophysical characteristics of an entire unit, and provides a single attribute that describes the typical intertidal biota and the associated biological wave exposure together with the geomorphology. That is, a typical example of a Habitat Class includes a combination of biobands, and their associated indicator species (which determine the Biological Exposure category) and the geomorphological features of the Habitat Class. The biological mapper observes and records the biobands in the unit, if any, and determines the Biological Exposure Category (EXP_BIO). The Habitat Class is determined on the basis of presence/absence of biobands, exposure category, geomorphology, and spatial distribution of biota within the unit. Within the database, both a numeric code and an alpha code are used. Both codes for Habitat Class are listed in Table A-12, in which the matrix includes all combinations of Dominant Structuring Process, with associated substrate mobility and general geomorphic type on the vertical axis, and Biological Exposure on the horizontal axis.
HAB_CLASS2	The '**Secondary Habitat Class**' was added as an attribute in the BioUnit Table during biological mapping of the Kodiak Archipelago in order to specifically identify lagoon habitats. Many backshore lagoons were observed in the Kodiak region, and they represent an unusual coastal habitat that differs from other estuaries and marshes. Units classified as lagoons contain brackish or salt water contained in a basin with limited drainage. They are often associated with wetlands and may include wetland biobands in the upper intertidal. Single units classified as lagoons often have the lagoon form in the A zone; however, some lagoons are large and may encompass several units when the lagoon form is mapped as the C zone.
RIPARIAN_PERCENT	As an attribute in the BIOUNIT table, the **Riparian_Percent** value is intended to be an index for the potential habitat for upper beach spawning fishes. The value recorded in the **Riparian_Percent** field is an estimate of the percentage of the unit's total alongshore length in which riparian vegetation (trees and shrubs) shades the upper intertidal zone. Shading of the highest high water line is a good estimate of riparian shading; therefore, shading of wetland herbs and grasses is not included in the estimate, nor is any shading of the splash zone alone. Shading must be visible in the upper intertidal zone, and the shading vegetation must be woody trees or shrubs. Riparian overhanging vegetation is also an indicator of lower wave exposures, in which the splash zone is narrow. Shading may occur in on sediment-dominated or in rocky intertidal settings.

Table A-12. Codes for HABITAT CLASS and SECONDARY HABITAT CLASS attributes, in the BIOUNIT table.

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

Shaded boxes are not applicable in most regions

Table A-13. Definitions of fields and attributes in the XSHR (Across-shore) component table. (after Howes *et al* 1994)

Field Name	Description
UnitRecID	**Unit Record ID:** An automatically-generated number field; the database "primary key" for unit-level relationships
XshrRecID	**Across-shore Record ID:** Automatically-generated number field; the database "primary key" for across-shore relationships
PHY_IDENT	**Physical Ident** is a unique code to identify each unit, assigned by physical mapper; defined as an alphanumeric string determined by the codes for: Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0
CROSS_LINK	**Crosslink code:** Unique identifier for each across-shore record, consisting of an alphanumeric string comprised of the PHY_IDENT followed by the Zone and Component separated by slashes (e.g. 12/03/0552/0/A/1)
ZONE	Across-shore **Zone:** Code indicating the across-shore position (tidal elevation) of the Component: (A) supratidal, (B) intertidal, (C) subtidal
COMPONENT	Across-shore **Component:** a subdivision of Zones, numbered from highest to lowest elevation in across-shore profile (e.g. A1 is the highest supratidal component; B1 is the highest intertidal; B2 is lower intertidal)
Form1	**Form1:** The principal geomorphic feature within across-shore Component, described by a specific set of codes (Table A-11)
MatPrefix1	**Material Prefix:** Veneer indicator field; blank = no veneer; "v" = veneer
Mat1	**Material** (substrate and/or sediment type) that best characterizes Form1, described by a specific set of codes (Table A-12)
FormMat1Txt	**Form/Material Text:** Automatically-generated field that is the translation of codes used in Form1 and Mat1 into text
Form2	**Form2:** Secondary geomorphic feature within across-shore Component, described by a specific set of codes (Table A-11)
MatPrefix2	**Material Prefix:** Veneer indicator field; blank = no veneer; "v" = veneer
Mat2	**Material** (substrate and/or sediment type) that best characterizes Form2, described by a specific set of codes (Table A-12)
FormMat2Txt	**Form/Material Text:** Automatically-generated field that is the translation of codes used in Form2 and Mat3 into text
Form3	**Form3:** Tertiary geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix3	**Material Prefix:** Veneer indicator field; blank = no veneer; "v" = veneer
Mat3	**Material** (substrate and/or sediment type) that best characterizes Form3, described by a specific set of codes (Table A-12)
FormMat3Txt	**Form/Material Text:** Automatically-generated field that is the translation of codes used in Form3 and Mat3 into text
Form4	**Form4:** Fourth-order geomorphic feature within each across-shore component, described by a specific set of codes (Table A-11)
MatPrefix4	**Material Prefix:** Veneer indicator field; blank = no veneer; "v" = veneer
Mat4	**Material** (substrate and/or sediment type) that best characterizes Form4, described by a specific set of codes (Table A-12)
FormMat4Txt	**Form/Material Text:** Automatically-generated field that is the translation of codes used in Form4 and Mat4 into text
WIDTH	**Width:** Estimated mean across-shore width of the component (e.g. A1) in meters
SLOPE	**Slope:** Estimated across-shore slope of the mapped geomorphic Form in degrees; must be consistent with Form codes (Table A-11)
PROCESS	**Coastal Process** dominant in affecting the morphology: (F)luvial, (M)ass wasting (landslides), (W)aves, (C)urrents, (E)olian (wind, as with dunes) (O)ther
COMPONENT_ORI	**Component Oil Residence Index** on the basis of substrate type; 1 is least persistent, 5 is most persistent (Tables A-5 and A-6)

Table A-14. Definitions of FORM attributes, in XSHR (Across-shore) table. (after Howes *et al* 1994)

A = Anthropogenic

a	pilings, dolphin
b	breakwater
c	log dump
d	derelict shipwreck
f	float
g	groin
i	cable/ pipeline
j	jetty
k	dyke
m	marina
n	ferry terminal
o	log booms
p	port facility
q	aquaculture
r	boat ramp
s	seawall
t	landfill, tailings
w	wharf
x	outfall or intake
y	intake

B = Beach

b	berm (intertidal or supratidal)
c	washover channel
f	face
i	inclined (no berm)
m	multiple bars / troughs
n	relic ridges, raised
p	plain
r	ridge (single bar; low to mid intertidal)
s	storm ridge (occas marine influence; supratidal)
t	low tide terrace
v	thin veneer over rock (also use as modifier)
w	washover fan

C = Cliff

stability/geomorphology

a	active/eroding
p	passive (vegetated)
c	cave

slope

i	inclined (20°-35°)
s	steep (>35°)

[continued]

Cliff continued

height

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

modifiers (optional)

f	fan, apron, talus
g	surge channel
t	terraced
r	ramp

D = Delta

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

E = Dune

b	blowouts
i	irregular
n	relic
o	ponds
r	ridge/swale
p	parabolic
v	veneer
w	vegetated

F = Reef

(no vegetation)

f	horizontal (<2°)
i	irregular
r	ramp
s	smooth

I = Ice

g	glacier

L = Lagoon

o	open
c	closed

M = Marsh

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

O = Offshore Island

(not reefs)

b	barrier
c	chain of islets
t	table shaped
p	pillar/stack
w	whaleback

elevation

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

P = Platform

(slope <20°)

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

R = River Channel

a	perennial
i	intermittent
m	multiple channels
s	single channel

T = Tidal Flat

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

Table A-15. Definitions of the MATERIALS attributes, in XSHR (Across-shore) table. (after Howes *et al* 1994)

A = Anthropogenic

a	metal (structural)
c	concrete (loose blocks)
d	debris (man-made)
f	fill, undifferentiated mixed
o	concrete (solid cement blocks)
r	rubble, rip rap
t	logs (cut trees)
w	wood (structural)

B = Biogenic

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

C = Clastic

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

R = Bedrock

rock type:

i	igneous
m	metamorphic
s	sedimentary
v	volcanic

rock structure:

1	bedding
2	jointing
3	massive

SEDIMENT TEXTURE

(Simplified from Wentworth grain size scale)

GRAVELS

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

SAND

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

FINES ("MUD")

includes silt and clay

silt	0.0039 to 0.063 mm
clay	<0.0039 mm

TEXTURE CLASS BREAKS

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

SHORE MODIFICATIONS

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

% are 0-10 (default value 0)

Note: The 'Material' descriptor consists of one primary term code, followed by codes for associated modifiers (e.g. Cbc). If only one modifier is used, indicated material comprises 75% of the volume of the layer (e.g. Cb), if more than one modifier, they are ranked in order of volume. A surface layer can be described by prefix *v* for veneer (e.g. vCs/R).

Table A-16. Definitions for fields in the BIOBAND table. *

Field	Description
UnitRecID	Automatically-generated number field; the database "primary key" required for relationships between tables
XshrRecID	Automatically-generated number field; the database "primary key" required for relationships between tables
PHY_IDENT	Unique physical identifier; an alphanumeric string comprised of the Region, Area, Unit, and Subunit separated by slashes (e.g. 12/03/0552/0)
CROSS_LINK	Unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT fields
VER	Bioband for Splash Zone (black lichen **VER***ucaria*) in supratidal (Table A-17)
GRA	Bioband code for Dune **GRA**ss in supratidal (Table A-17)
SED	Bioband for **SED**ges in supratidal (Table A-17)
PUC	Bioband for Salt Marsh grasses, including **PUC***cinellia* and other salt tolerant grasses, herbs and sedges, in supratidal (Table A-17)
BAR	Bioband for **BAR**nacle (*Balanus/Semibalanus*) in upper intertidal (Table A-17)
FUC	Bioband for Rockweed, the **FUC***us*/barnacle in upper intertidal (Table A-17)
ULV	Bioband for Green Algae, including mixed filamentous and foliose greens (**ULV***a* sp., *Cladophora, Acrosiphonia*) in mid-intertidal (Table A-17)
BMU	Bioband for **B**lue **MU**ssel (*Mytilus trossulus*) in mid-intertidal (Table A-17)
MUS	Bioband for California **MUS**sel/gooseneck barnacle assemblage (*Mytilus californianus/Pollicipes polymerus*) in mid-intertidal (Table A-17)
HAL	Bioband for Bleached Red Algae, including mixed filamentous and foliose reds (*Palmaria, Odonthalia*, **HAL***osaccion*) in mid-intertidal (Table A-17)
RED	Bioband for **RED** Algae, including mixed filamentous and foliose reds (*Odonthalia, Neorhodomela, Palmaria*) in lower intertidal (Table A-17)
ALA	Bioband for ribbon kelp, ALA*ria* spp. (Table A-17)
SBR	Bioband for **S**oft **BR**own Kelps, including unstalked large-bladed laminarians, in lower intertidal and nearshore subtidal (Table A-17)
CHB	Bioband for Dark Brown Kelps, including stalked bladed dark **CH**ocolate-**B**rown kelps in lower intertidal and nearshore subtidal (Table A-17)
SUR	Bioband for **SUR**fgrass (*Phyllospadix*) in lower intertidal and nearshore subtidal (Table A-17)
ZOS	Bioband for **ZOS***tera* (Eelgrass) in lower intertidal and subtidal (Table A-17)
URC	Bioband for **URC**hin Barrens (*Strongylocentrotus fransicanus*) in nearshore subtidal (Table A-17)
ALF	Bioband for Dragon Kelp (**AL***aria* **F***istulosa*) in nearshore subtidal (Table A-17)
MAC	Bioband for Giant Kelp (**MAC***rocystis integrifolia*) in nearshore subtidal (Table A-17)
NER	Bioband for Bull Kelp (**NER***eocystis luetkeana*) in nearshore subtidal (Table A-17)

* Distribution code for biobands observed are listed in Table A-18.

Table A-17. Definitions for BIOBAND attribute for Southeast Alaska, in BIOBAND table. *

Zone	Bioband		Color	Indicator Species	Physical Description	Biological Wave Exposure	Associate Species
	Name	Code					
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), Medium (M) or Wide (W)	VP to VE	*Littorina* sp.
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 to E	
A	Sedges	SED	Bright green, yellow-green to red-brown.	*Carex lynbyei*	Appears in wetlands around lagoons and estuaries. Usually associated with freshwater. This band can exist as a wide flat pure stand or be intermingled with dune grass. Often the PUC band forms a fringe below.	VP to SP	*Carex* spp.
A	Salt Marsh	PUC	Light, bright, or dark green, with red-brown	*Puccinellia* sp. *Plantago maritima* *Glaux maritima*	Appears around estuaries, marshes, and lagoons. Usually associated with freshwater. Often fringing the edges of GRA and SED bands. PUC can be sparse *Puccinellia* and *Plantago* on coarse sediment or a wetter, peaty meadow with assemblage of herbs and sedges (including *Potentilla, Spergularia, Achillea, Dodecatheon* and other associated species*)*.	VP to SE	*Carex* spp. *Potentilla anserine* *Honckenya peploides* *Salicornia virginica* *Triglochin maritima*
upper B	Barnacle	BAR	Grey-white to pale yellow	*Balanus glandula* *Semibalanus cariosus*	Visible on bedrock or large boulders. Can form an extensive band in higher exposures where algae have been grazed away.	P to E	*Endocladia muricata* *Gloiopeltis furcata* *Porphyra* sp. *Fucus distichus*
upper B	Rockweed	FUC	Golden-brown	*Fucus distichus*	Appears on bedrock cliffs and boulder, cobble or gravel beaches. Commonly occurs at the same elevation as the barnacle band.	P to SE	*Balanus glandula* *Semibalanus cariosus* *Ulva* sp. *Pilayella* sp.
B	Green Algae	ULV	Green	*Ulva sp.* *Monostroma 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 to E	*Filamentous red algae*

*Note that four lower intertidal biobands (Red Algae, Bleached Red Algae, Soft Brown Kelps, Dark Brown Kelps) may have slightly different species compositions in different bioareas.

[continued]

Table A-17. Definitions for BIOBAND attribute for Southeast Alaska, in BIOBAND table. *

Zone	Bioband		Color	Indicator Species	Physical Description	Exposure	Associate Species
	Name	**Code**					
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 to VE	*Fucus distichus* *Balanus glandula* *Semibalanus cariosus* Filamentous red algae
B	**California Mussel**	**MUS**	Grey-blue	*Mytilus californianus*	Dominated by a complex of California mussels (*Mytilus californianus*) and thatched barnacles (*Semibalanus cariosus*) with gooseneck barnacles (*Pollicipes polymerus*) seen at higher exposures.	SE to VE	*Semibalanus cariosus* *Pollicipes polymerus*
B	**Bleached Red Algae**	**HAL**	Olive, golden or yellow-brown	*Bleached foliose red algae* *Palmaria* sp. *Odonthalia* sp.	Common on bedrock platforms, and cobble or gravel beaches. Distinguished from the RED band by color. The bleached color usually indicates lower wave exposure than where the RED band is observed, and may be caused by nutrient deficiency.	P to SE	*Halosaccion glandiforme* *Mazzaella* sp. Filamentous green algae
B	**Red Algae**	**RED**	Corallines: pink or white Foliose or filamentous: Dark red, bright red, or red-brown.	*Corallina* sp. *Lithothamnion* sp. *Neoptilota* sp. *Odonthalia* sp. *Neorhodomela* sp. *Palmaria* sp. *Mazzaella* sp.	Appears on most substrates except fine sediments. Lush coralline algae indicates highest exposures; diversity of foliose red algae indicates medium to high exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures.	P to VE	*Pisaster* sp. *Nucella* sp. *Katharina tunicata* Large brown kelps of the CHB bioband
B & C	**Alaria**	**ALA**	Dark brown or red-brown	*Alaria marginata*	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 to E	Foliose red algae *Saccharina* sp. *Laminaria* sp.
B & C	**Soft Brown Kelps**	**SBR**	Yellow-brown, olive brown or brown.	*Saccharina latissima* *Cystoseira sp.* *Sargassum muticum*	This band is defined by non-floating large browns and can form lush bands in semi-protected areas. The kelp fronds have a ruffled appearance and can be encrusted with diatoms and bryozoans giving the blades a 'dusty' appearance.	VP to SE	*Alaria sp.* *Cymathere sp.* *Saccharina sessile* (bullate)

*Note that four lower intertidal biobands (Red Algae, Bleached Red Algae, Soft Brown Kelps, Dark Brown Kelps) may have slightly different species compositions in different bioareas.

[continued]

Table A-17. Definitions for BIOBAND attribute for Southeast Alaska, in BIOBAND table. *(continued)

Zone	Bioband Name	Bioband Code	Color	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Dark Brown Kelps**	**CHB**	Dark chocolate brown	*Laminaria setchelli* *Saccharina subsimplex* *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.	SE to VE	*Cymathere sp.* *Pleurophycus sp.* *Costaria sp.* *Alaria sp.* *Egregia menziesii* Filamentous and foliose red algae
B & C	**Surfgrass**	**SUR**	Bright green	*Phyllospadix* sp.	Appears in tide pools 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 to SE	Foliose and coralline red algae
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 to SP	*Pilayella* sp.
C	**Urchin Barrens**	**URC**	Coralline white, underwater	*Strongylocentrotus franciscanus*	Shows rocky substrate clear of macroalgae. Often has a pink-white color of encrusting coralline red algae. May or may not see urchins.	SP to SE	Encrusting invertebrates
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming kelp, with winged blades on gas-filled center midrib. Usually associated with silty, cold waters near glacial outflow rivers	SP to SE	*Nereocystis luetkeana*
C	**Giant Kelp**	**MAC**	Golden-brown	*Macrocystis integrifolia*	Canopy-forming giant kelp, long stipes with multiple floats and fronds. If associated with NER, it occurs inshore of the bull kelp.	P to SE	*Nereocystis luetkeana* *Alaria fistulosa*
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	Distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa* and *Macrocystis*. Often indicates higher current areas if observed at lower wave exposures.	SP to VE	*Alaria fistulosa* *Macrocystis integrifolia*

*Note that four lower intertidal biobands (Red Algae, Bleached Red Algae, Soft Brown Kelps, Dark Brown Kelps) may have slightly different species compositions in different bioareas.

Table A-18. Definitions for Occurrences of Biobands, in the BIOBAND table. *

Value		Applicable Bioband	Definition
Name	**Code**		
Patchy	P	All biobands *except* VER	Bioband visible in less than half (approximately 25 – 50%) of the along-shore unit length
Continuous	C	All biobands *except* VER	Bioband visible in more than half (approximately 50-100%) of the along-shore unit length
Narrow	N	VER *only*	Bioband visible at an across-shore width of up to 2 meters
Medium	M	VER *only*	Bioband visible at an across-shore width of between 2 and 5 meters
Wide	W	VER *only*	Bioband visible at an across-shore width of greater than 5 meters

* Note that a Blank or Null value for the bioband indicates that band was not observed within the unit.

Table A-19. Definitions for fields in the PHOTOS table.

Field Name	Description
SlideID	**SlideID**: A unique numeric ID assigned to each slide or photo
UnitRecID	**Unit Record ID**: Automatically-generated number field; the database "primary key" required for relationships between tables, links to Unit table
SlideName	**Photo Name:** A unique alphanumeric name assigned to each slide or photo
ImageName	**Full Photo Name:** Full image name with .jpg extension (required to enable "PhotoLink")
TapeTime	**Photo Time:** Exact time during aerial video imaging (AVI) survey when digital image was collected; used to link photo to digital trackline and position
SlideDescription	**Photo Comment:** Text field for biological comments regarding the digital photo or slide
Good Example?	**Yes/No** field, which when set to "Yes," indicates the photo is good representative of a particular biological feature or classification type
ImageType	**Photo Image Type:** Media type of original image: "Digital" or "Slide"
FolderName	**Photo Folder Name:** Name of the folder in which digital images are stored (required to enable "PhotoLink")
PhotoLink	**Photo Hyperlink:** Enables linkage to photos placed in directories near the database
PHY Good Example?	**Yes/No** field, which when set to "Yes," indicates the photo is representative of a particular geomorphic feature or classification
PHY SlideComment	**Physical Photo Comment:** Text field for geomorphological comments regarding the digital photo or slide