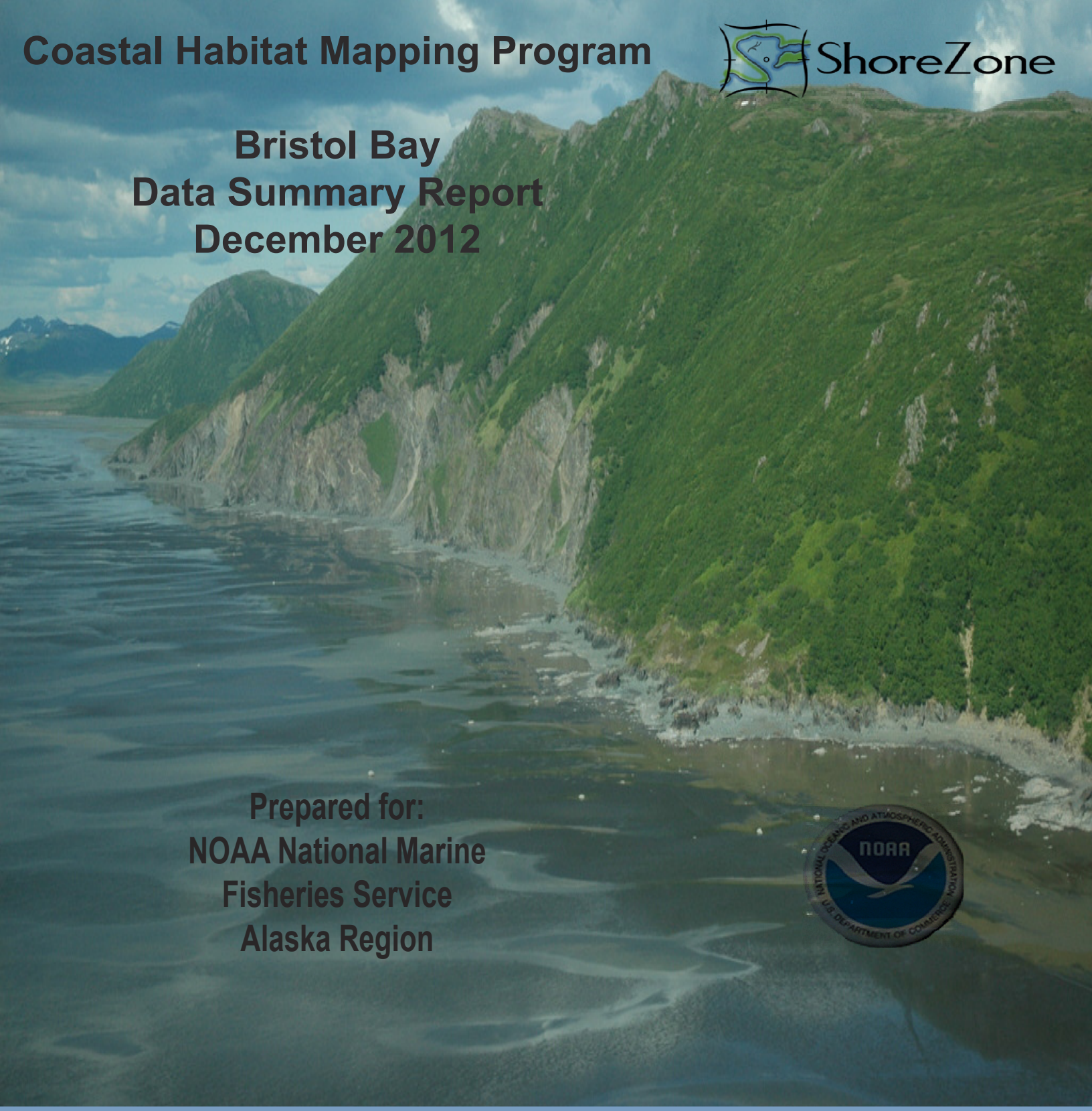
Coastal Habitat Mapping Program

ShoreZone

Bristol Bay
Data Summary Report
December 2012



Prepared for:
NOAA National Marine
Fisheries Service
Alaska Region

Coastal & Ocean Resources Inc.

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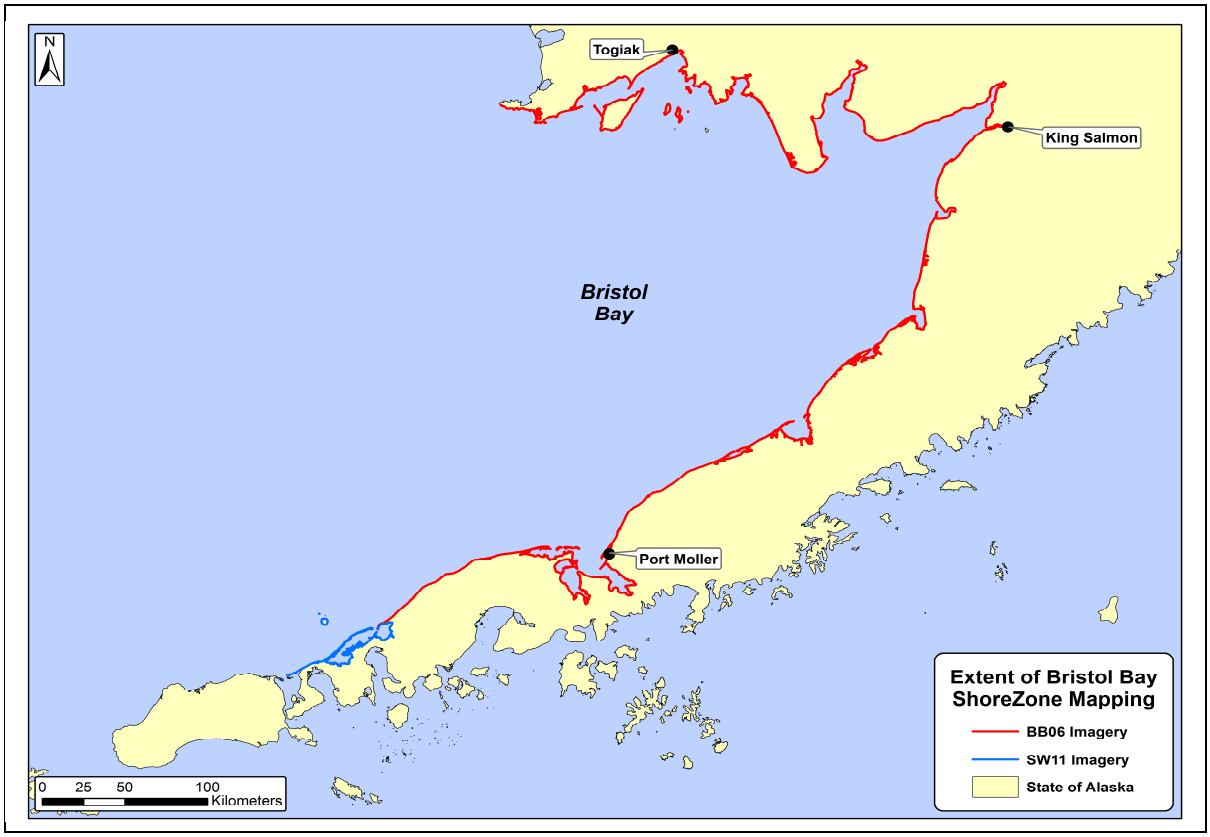
On the Cover:

Kulukak Bay
Nunavachak Bay
Port Moller
Hagemeister Island

CORI Project: 12-27 **December 2012**

ShoreZone Coastal Habitat Mapping
Data Summary Report

Bristol Bay Survey Area



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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 data summary report provides information on **geomorphic and biological features** of 3,224 km of shoreline mapped for the 2006 survey of Bristol Bay and the 2011 survey of Southwest Alaska. The habitat inventory is comprised of 3002 along-shore segments (units), averaging 1,074 m in length (note that the AK Coast 1:63,360 digital shoreline shows this mapping area encompassing 2,624 km, but mapping data based on better digital shorelines represent the same area with 3,224km stretching along the coast). New mapping in Bristol Bay includes 719km in Togiak Bay.

Organic shorelines (such as estuaries) are mapped along 768.4 km (23.8%) of the study area. Bedrock shorelines (Shore Types 1-5) are extremely limited along the shoreline with only 1.2% mapped. A little less than two thirds (61%) of the mapped coastal environment is characterized as sediment-dominated shorelines (Shore Types 21-30). Of these, wide sand and gravel flats (Shore Type 24) are the most common, mapped along 818 km of shoreline (25.4% of the total study area).

Approximately 80% of all habitat classes mapped are structured by wave energy and another 20% is structured by estuarine processes. Repeatable assemblages of biota that can be recognized from the aerial imagery are termed *biobands*; 16 biobands have been mapped in Bristol Bay and southwest Alaska to date. Salt marshes, as represented by the PUC bioband are mapped along 50% of the shoreline. Eelgrass, as indexed by the ZOS bioband is not common and mapped along 12% of the shoreline in this mapping area (9% of the shoreline has “continuous”eelgrass).

Man-modified shorelines (Shore Types 32 and 33) are comparatively rare (0.1%). The most common types of shore modification observed are landfill and boat ramps (16.3km and 14.4km respectively). Most anthropogenic features occur near the communities of Port Moller, King Salmon and Togiak.

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 December 2012, mapped regions include close to 54,000 km of coastline Alaska and 40,000 km of coastline in British Columbia and Washington State (Figures1, 2 and 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 Bristol Bay & Southwest Alaska Imagery

The field surveys conducted in Bristol Bay and Southwest Alaska in 2006 and 2011 respectively, 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) with some updates for periglacial shorelines included in the DRAFT revision (Harper and Morris 2011).

The purpose of this report is to provide a summary of the physical (geomorphic) and biological data mapped in Bristol Bay (Figure 3).

The along-shore length of shoreline mapped in the database is **3,224 kilometers** in 3002 along-shore segments (units), averaging 1,074 m in length. New mapping data for Bristol Bay includes 719km. Physical and biological data are summarized with illustrations in Sections 2 and 3, respectively.

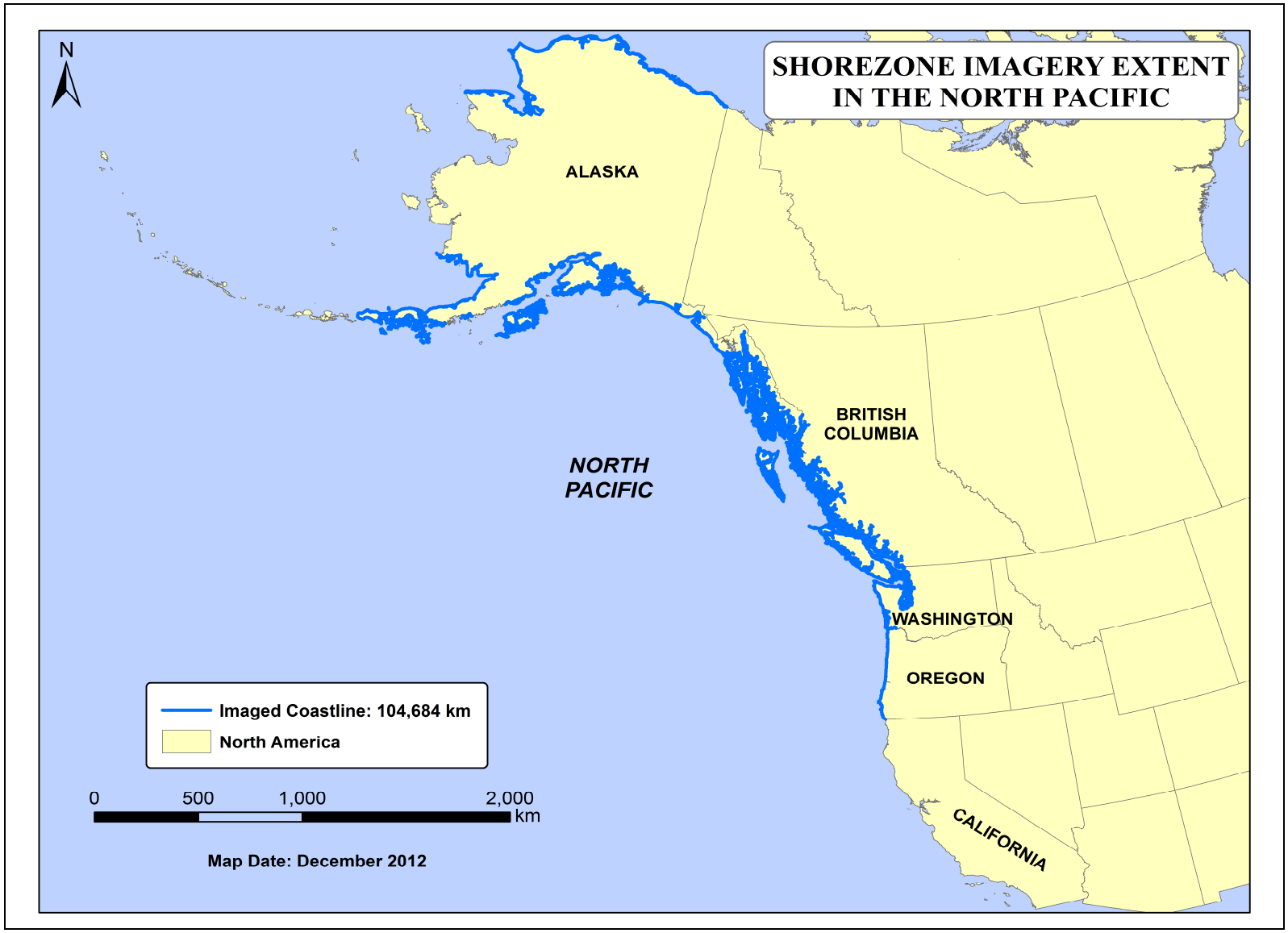

Figure 1. Extent of ShoreZone imagery in Alaska, British Columbia, and Washington State and Oregon (104,684 km).

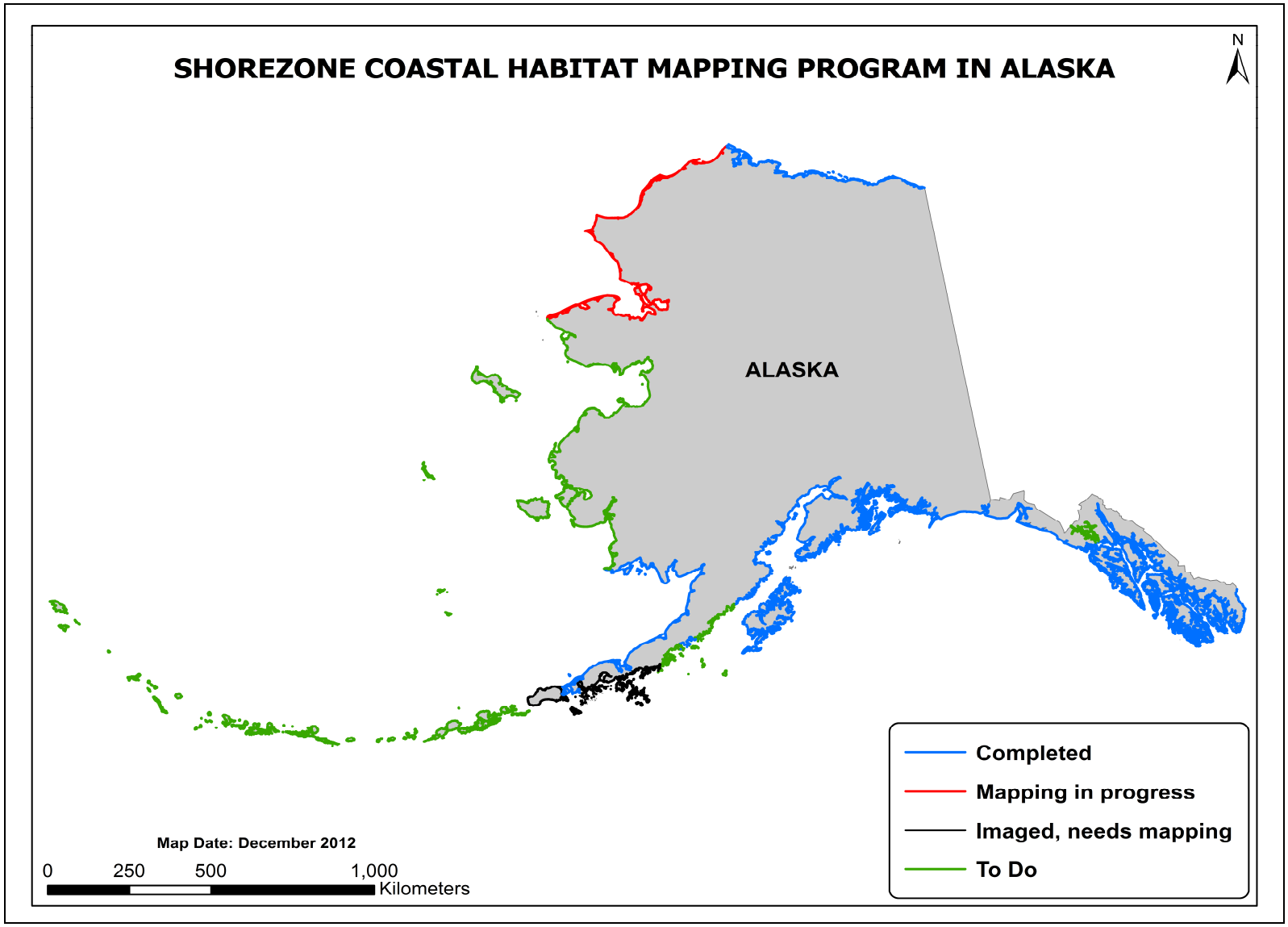

Figure 2. Extent of ShoreZone imagery and coastal habitat mapping in the State of Alaska (as of December 2012).

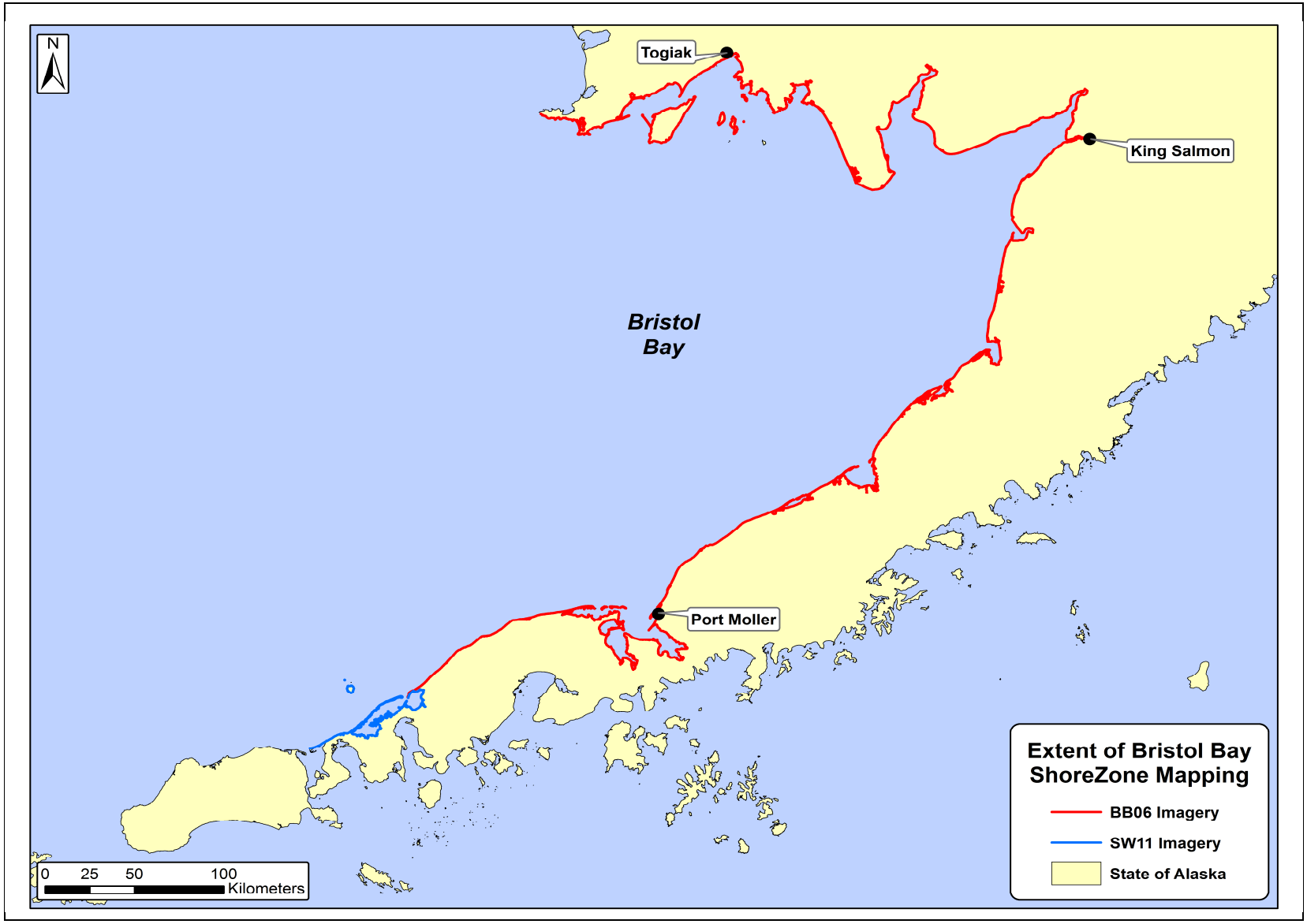

Figure 3. Map of study area in Bristol Bay (2,895 km) & Southwest Alaska (329 km)

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 ("Shore Types") 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 3.4.

The BC Class system is used to describe along-shore coastal units as one of 39 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 & Table A-3). Coastal classes also characterize units dominated by organic shorelines such as marshes and estuaries (Shore Type 31), man-made features (Shore Types 32 and 33), high-current channels (Shore Type 34), glaciers (Shore Type 35), lagoons (Shore Type 36), inundated tundra (Shore Type 37), ground ice slumps (Shore Type 38) and low vegetated peat (Shore Type 39).

The occurrence of shore types in the study area is listed in Table 1. Grouped Shore Types are useful to illustrate mapped distributions (Figure 4) and to summarize data in graphic form (Figure 5). **Bedrock shorelines** (Shore Types 1-5) comprise 37km (1.2%) of mapped shorelines. **Rock and sediment shorelines** (Shore Types 6-20) comprise of 6% of the shoreline (192.5km). **Sediment-dominated shorelines** (Shore Types 21-30) comprise approximately two thirds of the entire area (61%) along 1956km of the coast (Figures 6 & 7). Of these, wide sand and gravel flats (Shore Type 24) are the most common, mapped along 818km of shoreline (25.4% of the total study area). Organic and Lagoon shorelines constitute the remaining coast with 23.8% and 7.5% respectively.

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-4). 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 are listed in Table 2.

Table 1. Summary of Shore Types

Substrate Type	Shore Type		Sum of Unit Length (km)	# of Units	% Occurrence (by length)	Cumulative Occurrence (%, km)
	No.	Description				
Rock	1	Rock Ra p, wide	1.1	6	0.0	
	2	Rock Platfor , wide	3.0	11	0.1	**1.2%**
	3	Rock Cliff	30.6	86	1.0	**37.0km**
	4	Rock Ra p, narrow	2.4	11	0.1	
Rock & Sediment	6	Ra p w gravel beach, narrow	20.9	46	0.6	
	7	Platfor w gravel beach, wide	14.6	40	0.6	
	8	Cliff with gravel beach	31.9	92	1.0	
	9	Ra p with gravel beach	26.4	4	0.8	
	10	Platfor with gravel beach	0.6	2	0.0	**6.0%**
	11	Ra p w gravel & sand beach, wide	16.4	49	0.6	**192.5km**
	12	Platfor with G&S beach, wide	3.9	136	2.0	
	13	Cliff with gravel/sand beach	.9	26	0.2	
	14	Ra p with gravel/sand beach	4.6	13	0.1	
	16	Ra p w sand beach, wide	.0		0.2	
	17	Platfor w sand beach, wide	3.0		0.1	
	18	Cliff with sand beach	0.3	1	0.0	
Sediment	21	Gravel flat, wide	46.6	8	1.6	
	22	Gravel beach, narrow	13.6	44	0.4	
	24	Sand & gravel flat or fan	818.1	861	26.4	
	25	Sand & gravel beach, narrow	9.3	183	2.6	
	26	Sand & gravel flat or fan	13.2	28	0.4	**60.7%**
	27	Sand beach	9.3		2.1	**1955.9km**
	28	Sand flat	43.3		20.0	
	29	Mudflat	269.9	246	8.1	
	30	Sand beach	11.8	30	0.4	
Organics	31	Organics/Estuarine	768.4	195	23.8	**24.2%**
	39	Low Vegetated Peat	11.5	21	0.4	**779.9km**
Man-made	32	Man- ade, per eable	2.6	7	0.1	**0.1%**
	33	Man- ade, i per eable	1.5	6	0.0	**4.1km**
Currents	34	Channel	14.1	10	0.4	**0.4%** **14.1km**
Lagoon	36	Lagoon	240.6	58	7.5	**7.5%** **240.6km**
Totals:			***3,224.0***	***3,002***	***100.0***	***100%***

*Note: Other Shore Types not observed.

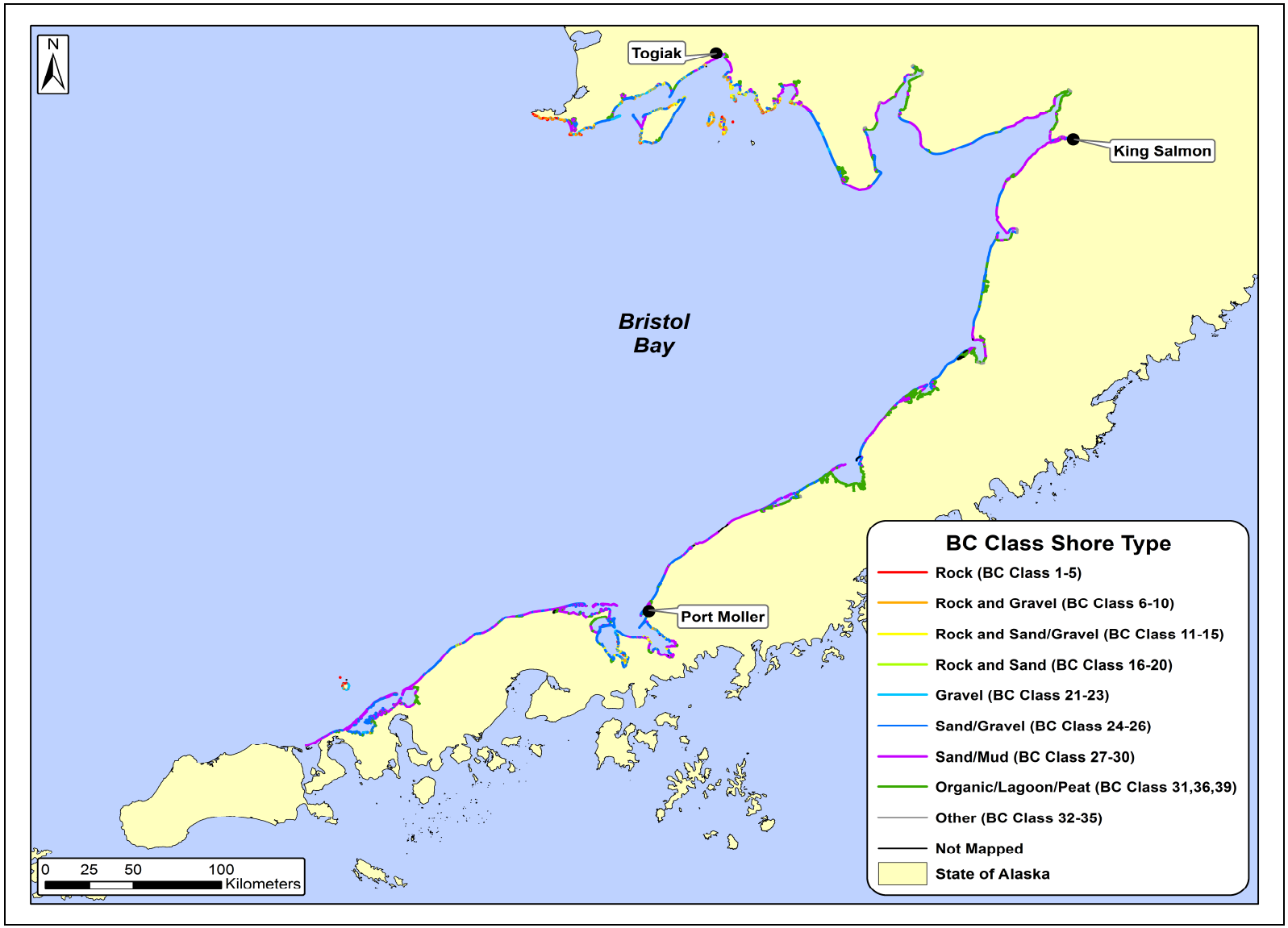

Figure 4. Map of the distribution of principal substrate types (on the basis of grouped Shore Types) in the study area. Data are listed by individual class and summarized by grouped classes in Table 1.

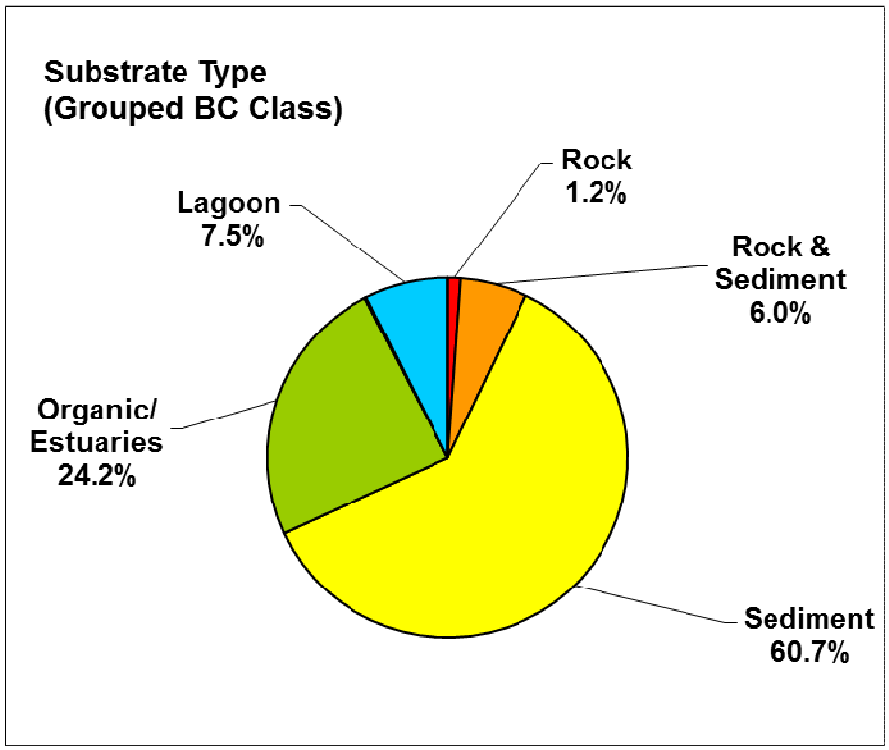

Figure 5. Relative abundance of principal substrate types (on the basis of grouped Shore Types) in the study area. Data are summarized in Table 1.

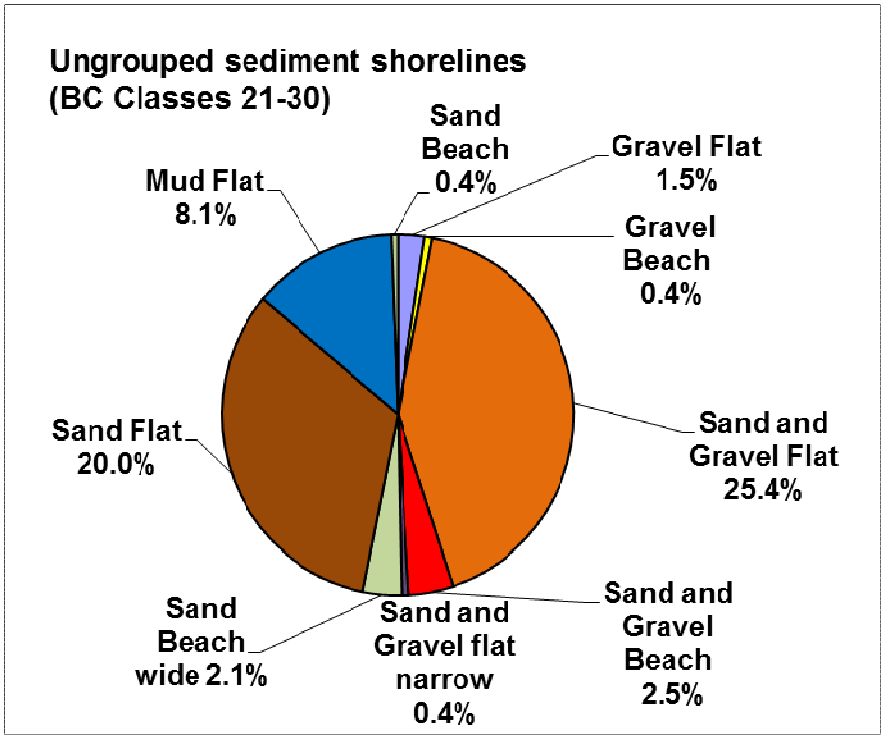

Figure 6. Relative abundance of sediment shorelines (Shore Types 21-30) in the study area.

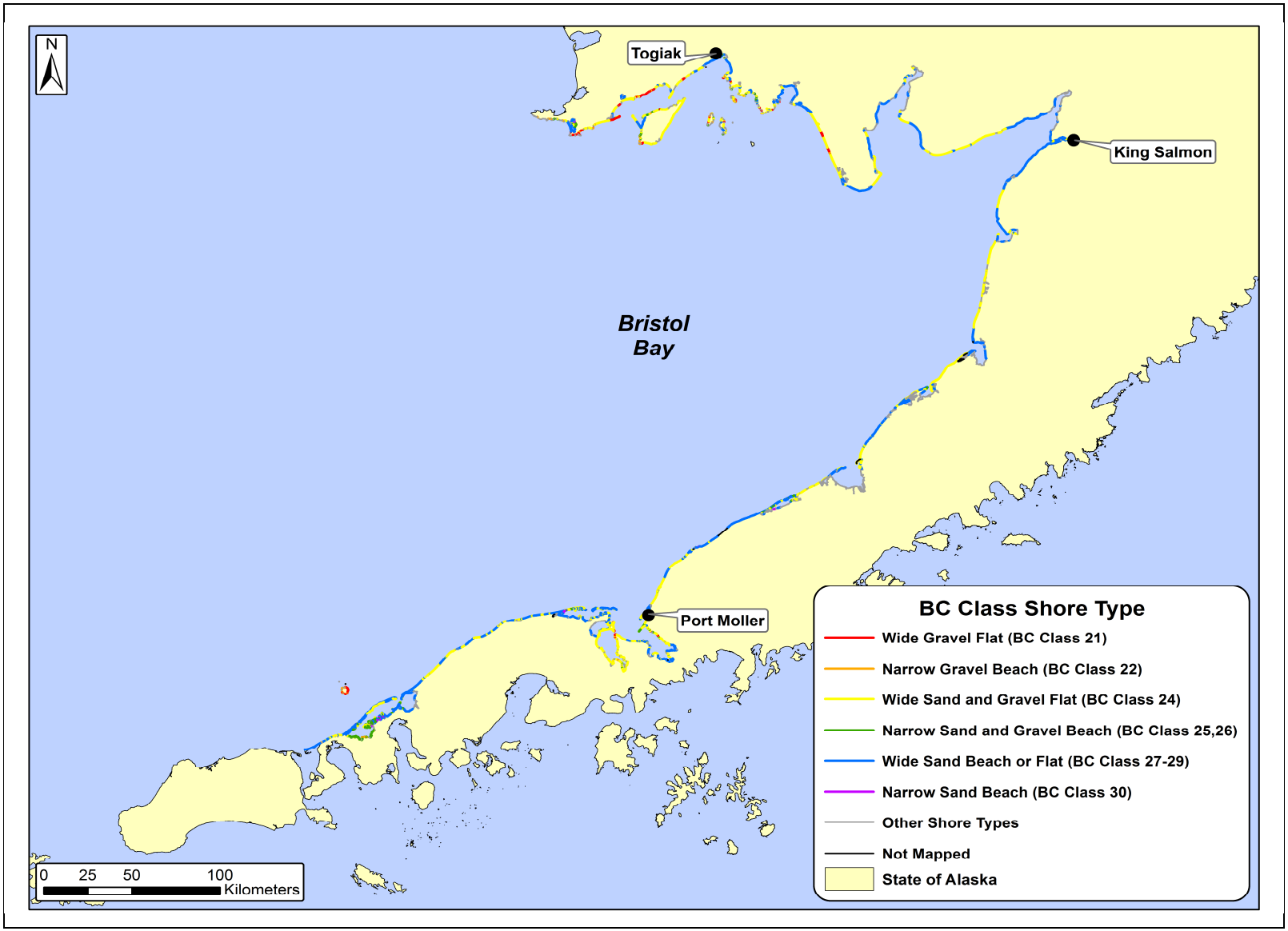

Figure 7. Map of the distribution of sediment shorelines (Shore Types, grouped by geomorphology) in the study area. Data are summarized in Table 1.

Table 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; Exposed rocky banks	30.0 6	84 6	0.9 6
1C	Exposed rocky cliffs with boulder talus base	31.6 6	81 6	1.0 6
2A	Exposed wave-cut platforms in bedrock, mud, or clay	.6 6	18 6	0.2 6
3A	Fine- to medium-grained sand beaches	146.6 6	186 6	4.6 6
3B	Scarps and steep slopes in sand	23.6 6	20 6	0.6 6
4	Coarse-grained sand beaches	84.6 6	83 6	2.6 6
5	Mixed sand and gravel beaches	00.8 6	869 6	16.6 6
6A	Gravel beaches (granules and pebbles)	34.9 6	3 6	1.1 6
6B	Gravel beaches (cobbles and boulders)	80.6 6	190 6	2.6 6
6C	Rip Rap (man-made)	0.1 6	1 6	0.0 6
7	Exposed tidal flats	46.6 6	361 6	16.9 6
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	.2 6	20 6	0.2 6
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	.3 6	26 6	0.2 6
8D	Sheltered rocky rubble shores	2.2 6	9 6	0.1 6
8E	Peat shorelines	24.6 6	26 6	0.8 6
9A	Sheltered tidal flats	828.1 6	49 6	26.6 6
9B	Vegetated low banks	41.6 6	22 6	1.3 6
10A	Salt- and brackish-water marshes	806.2	183	25.0
10B	Freshwater marshes	25.1	9	0.8
	Totals:	***3,224.0***	***3,002***	***100.0%***

*Note: Other ESI Classes not observed.

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 Shore Types 32 and 33) occur along 4.1 km (0.1%) of shoreline in the study area, mostly near the communities of Port Moller, Togiak and King Salmon. 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 3) is shown in Figure 8.

Table 3. Summary of Shore Modifications

Shore Modification	# of Occurrences	Shoreline Length (km)	% of Shoreline
Wooden bulkhead	30	11.6	19.2%
Boat ramp	22	14.4	23.8%
Concrete bulkhead	15	6.9	11.4%
Landfill	28	16.3	27.0%
Sheet pile	22	8.4	13.8%
Riprap	9	2.9	4.8%
Totals:	***126***	***60.4***	***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-6), as well as to each along-shore unit on the basis of shore type and wave exposure (Table A-7). 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: 58% have an ORI of 4 or 5, indicating oil residence times are on the order of months to years (Table 4; Figure 9).

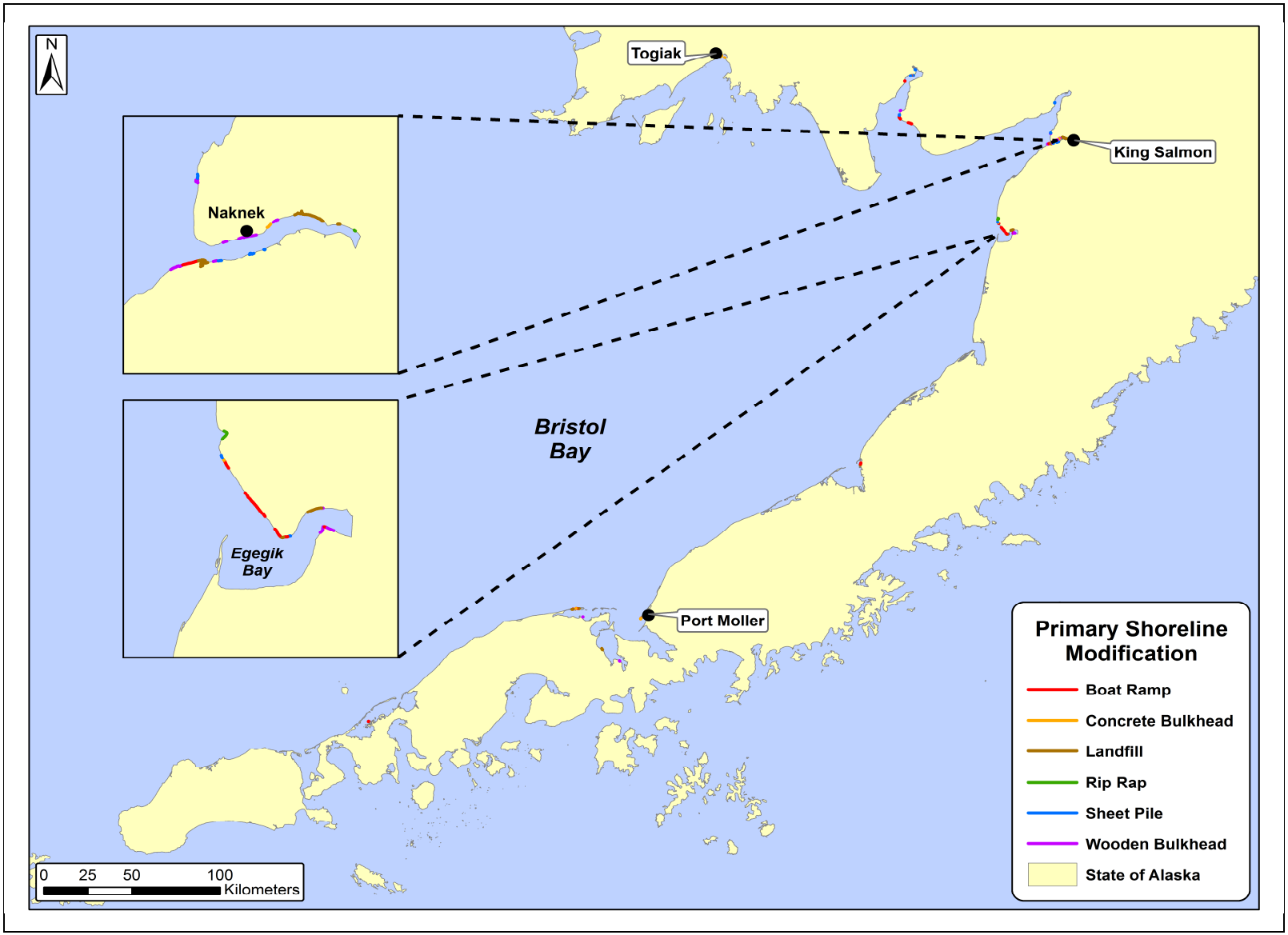

Figure 8. Map of the distribution of units in which shore modification features were observed in the study area. Data are summarized in Table 3.

Table 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	33.0	1.0%
	2	**Weeks** to months	39.6	16.7%
Moderate	3	Weeks to **months**	92.6	24.6%
	4	**Months** to years	3.2	17.8%
Long	5	Months to **years**	1286.8	39.9%
		Totals:	***3,224.0***	***100.0%***

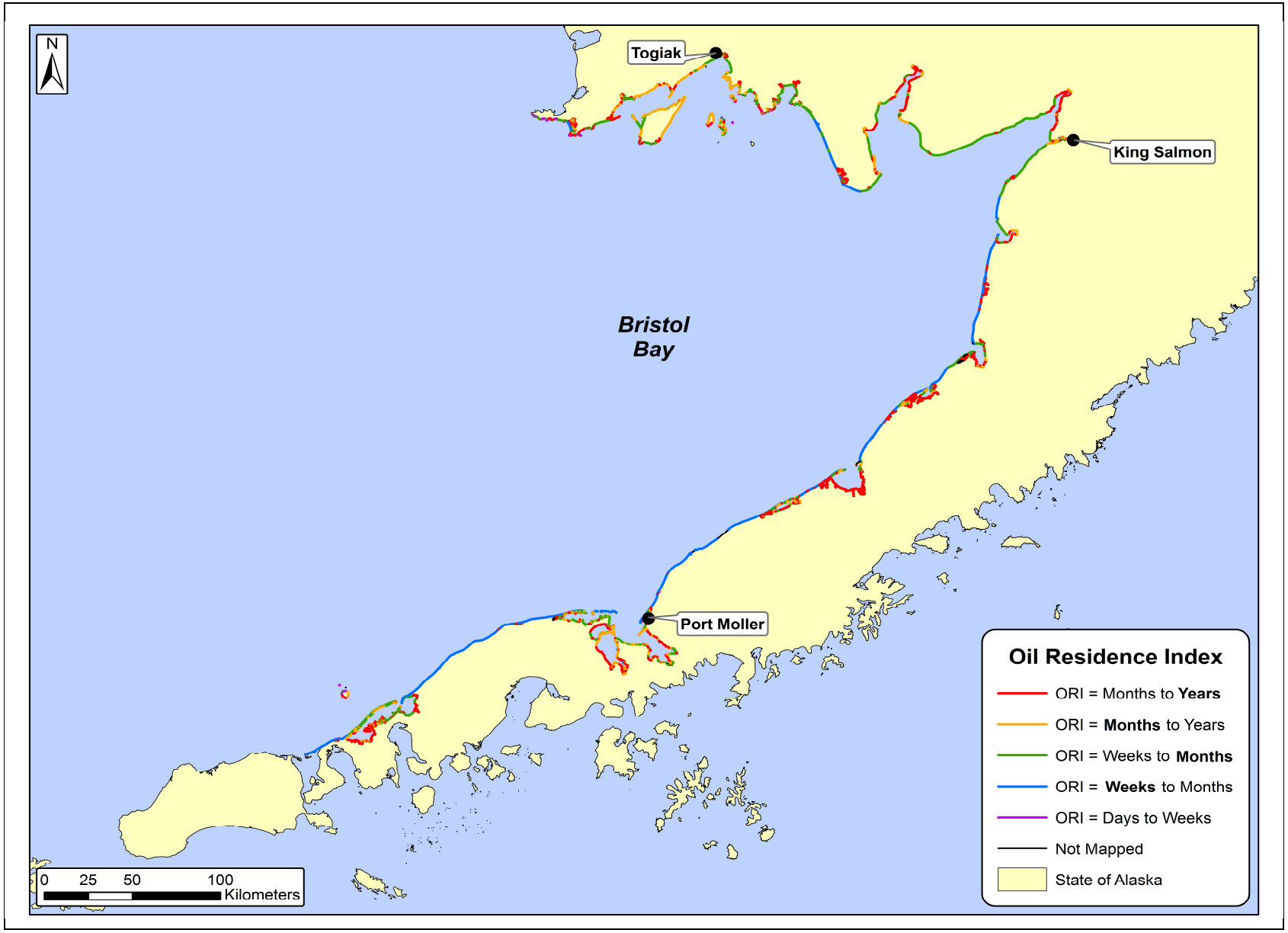

Figure 9. Oil Residence Index (ORI) for shorelines in Bristol Bay, based on substrate type and wave exposure (Appendix A, Table A-7).

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. Based on those observations, an interpreted classification of **biological wave exposure** and **habitat class** is assigned.

In the Bristol Bay project area, most of the shoreline is composed of mobile sediment beaches and there are not many intertidal biobands to use to indicate exposure categories. For units which are bare of biobands, the biological mappers used the wave exposure category which had been classified by the physical Mappers (EXP_OBSER) to assign the 'biological' exposure.

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 (Figures 10 and 11). 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 10. Example of supratidal Dune Grass bioband (GRA), with Salt Marsh (PUC) and Eelgrass (ZOS) in the subtidal, in Cold Bay, near Blue Bill Creek, Applegate Cove (photo SW11_CB_02440.jpg).

Figure 11. Example of supratidal *Verrucaria* in the splashzone (VER bioband), with Barnacles (BAR), Rockweed (FUC), Green Algae (ULV), and Red Algae (RED) in the nearshore subtidal, in Bristol Bay, near Right Hand Point, west of Metervik Bay (photo BB06_HA_2916.jpg).

Some biobands are named for a single *indicator* species (such as the Eelgrass bioband (ZOS)), 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.

For descriptions of all the biobands in mapping throughout Alaska, including lists of indicator and associate species, refer to Appendix A, Table A-18.

The distribution of each bioband observed in every unit is recorded in the database. 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 defined as 'visible in more than half (50-100%) of the unit's along-shore length'.

Refer to Appendix A, Table A-19 for definitions for bioband occurrence.

The occurrence of each bioband mapped in the Bristol Bay project area covered by this summary report is summarized in Table 5 and Figure 12.

Dune Grass (GRA) was the most commonly mapped bioband, with 85% of the coast having either patchy or continuous GRA recorded. Salt Marsh (PUC) bioband was the next most commonly mapped bioband as either patchy or continuous on 50% of the shoreline. Eelgrass (ZOS) was the most abundant subtidal bioband mapped with 12% of the coast having either patchy or continuous Eelgrass bioband recorded.

Only small amounts of biobands associated with stable substrate (Barnacle, Rockweed, Green Algae, Blue Mussels, and Red Algae biobands) were observed in Bristol Bay (Table 5 and Figure 12). Less than 1% of the area mapped had nearshore canopy kelps, Bull Kelp and Dragon Kelp.

Table 5. Bioband Abundances Mapped in Bristol Bay

Bioband		Continuous		Patchy		Total (km)	% of Mapped
Name	**Code**	**(km)**	**%**	**(km)**	**%**		
Tundra	TUN	44	1	0	0	44	1
Dune Grass	GRA	2,242	70	510	16	2,751	85
Sedges	SED	496	15	197	6	693	21
Salt Marsh	PUC	1,245	39	356	11	1,601	50
Barnacle	BAR	169	5	105	3	274	8
Rockweed	FUC	30	1	53	2	83	3
Green Algae	ULV	116	4	121	4	237	7
Blue Mussel	BMU	21	1	22	1	43	1
Bleached Red Algae	HAL	0	0	<1	<1	<1	<1
Red Algae	RED	210	7	70	2	280	9
Alaria	ALA	10	<1	5	<1	16	<1
Soft Brown Kelp	SBR	17	1	46	1	63	2
Dark Brown Kelp	CHB	0	0	1	<1	1	<1
Dragon Kelp	ALF	13	<1	1	<1	13	<1
Bull Kelp	NER	<1	<1	0	0	<1	<1
Eelgrass	ZOS	290	9	107	3	397	12

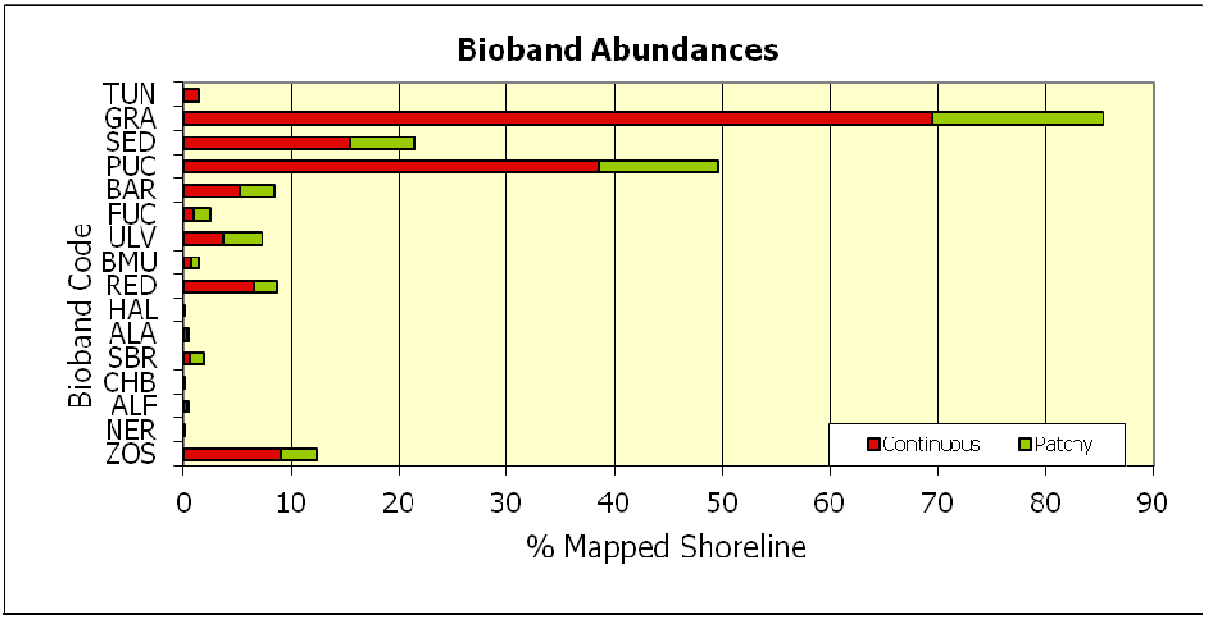

Figure 12. Bioband abundances mapped in Bristol Bay project area.

Bioband Distributions

Combinations of the various biobands are used to indicate different biological wave exposures and habitat classes. The distributions of examples of bioband combinations observed in the project area mapping are described below.

Dune Grass, Sedges and Salt Marsh Biobands

The three biobands that can occur in the supratidal (A zone) which are used to indicate salt marsh and estuarine conditions are the Dune Grass (GRA), Sedges (SED) and Salt Marsh (PUC) biobands. Each of these three biobands is dominated by rooted vascular plants, with the Salt Marsh bioband having the most diverse 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-18.

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 are shown in Figure 13:

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

Nearly all of the Bristol Bay survey shoreline was mapped with at least one of these three biobands present.

Eelgrass Bioband

Eelgrass (ZOS) is found in fine sediments in estuaries, lagoons or channels and more protected wave exposures. The distribution of the Eelgrass bioband mapped in the study area is shown in Figure 14.

Further descriptions of the characteristics of these biobands can be found in Appendix A, Table A-18.

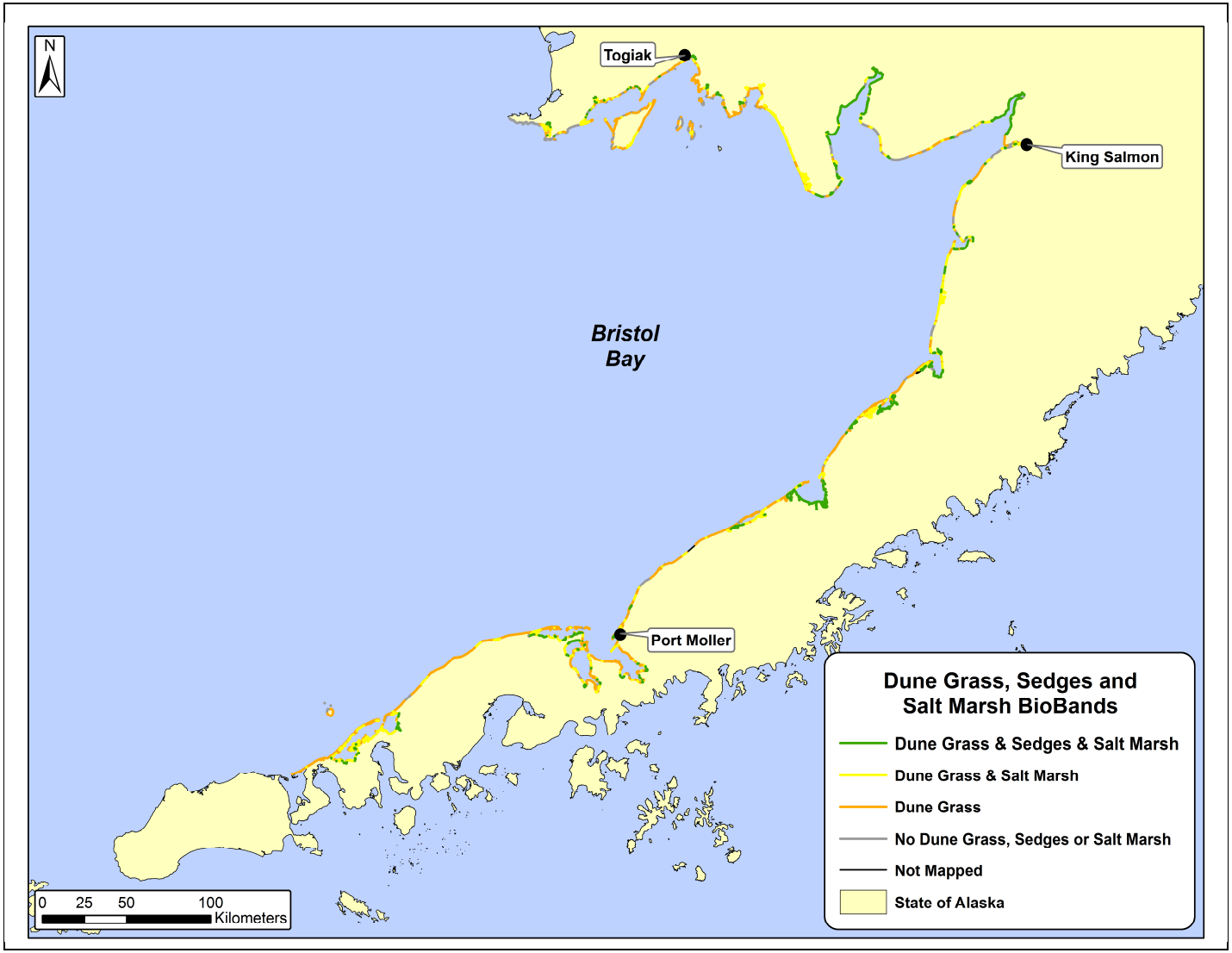

Figure 13. Distribution of units in which select combinations of the Dune Grass, Salt Marsh and Sedges biobands were observed in the Bristol Bay project area.

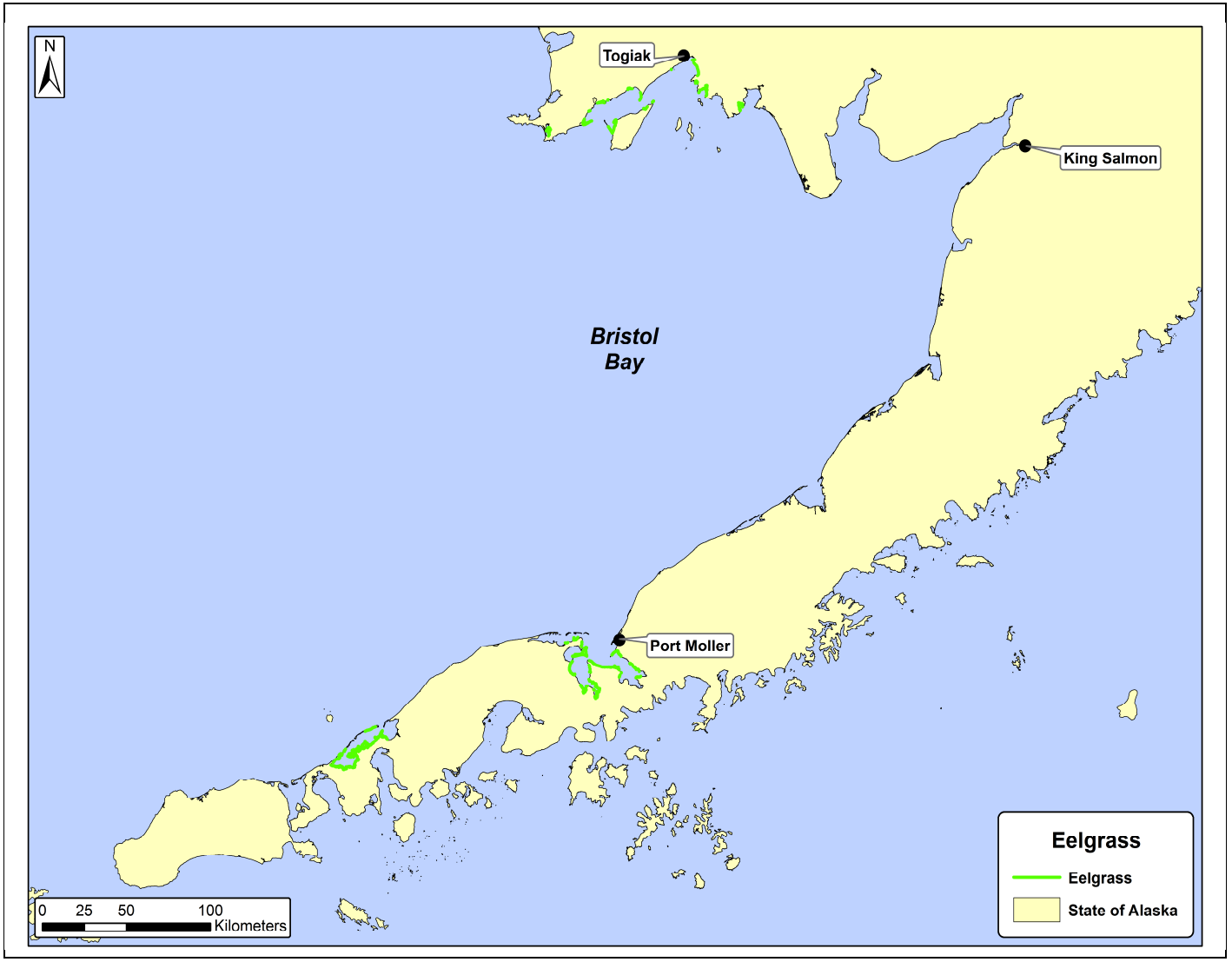

Figure 14. Distribution of units where the Eelgrass biobands were observed in the Bristol Bay project area.

3.2 Biological Wave Exposure

Biological wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are usually defined in ShoreZone on the basis of a typical set of biobands. When present, the observation and relative abundance of biota in each alongshore unit is used to determine the classification for the biological wave exposure. 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 (Appendix A, Tables A-5 and A-10).

In the Bristol Bay area classified for this project, attached intertidal and nearshore biobands are mostly absent. In units where no attached biota was visible, the physical mappers' estimate of wave energy (EXP_OBSER) was deemed to be equivalent to the biological wave exposure. The physical wave exposure is based on fetch window estimates and coastal geomorphology.

The physical wave exposure, as transcribed to the biological exposure attribute for units without attached biota, was also then used in the look up matrix for determining the Oil Residence Index (ORI) (Table A-7).

Species assemblages used as indicators of wave energy categories for shoreline with biota in the Alaska Peninsula region and elsewhere in Alaska ShoreZone are listed in Appendix A Table A-11. For more information about biobands, biological wave exposure, habitat class definitions and examples from other bioareas in Alaska, see data summary reports for Southeast Alaska and the current ShoreZone protocols. These reports are available for download from the ShoreZone website at http://alaskafisheries.noaa.gov/shorezone/

The occurrence of the wave exposure categories mapped in the Bristol Bay area is summarized in Table 6 and in Figure 15.

Most of the shoreline in the study area was classified with a wave exposure of Semi-Protected (SP) and lower (67%). Twenty percent of the area was mapped as Exposed (E) and 13% was mapped in the Semi-Exposed (SE) category. A summary map of the biological wave exposure categories distribution is shown in Figure 16.

Table 6. Summary of Wave Exposure in Bristol Bay

Wave Exposure		Shoreline Length (km)	% of Shoreline
Name	**Code**		
Exposed	E	652	20
Semi-Exposed	SE	401	13
Semi-Protected	SP	882	27
Protected	P	1,243	39
Very Protected	VP	46	1
Totals		**3,224**	**100**

Note: For most of the Bristol Bay shoreline, intertidal and subtidal biobands are absent and the exposure category was estimated from maximum fetch distances.

6

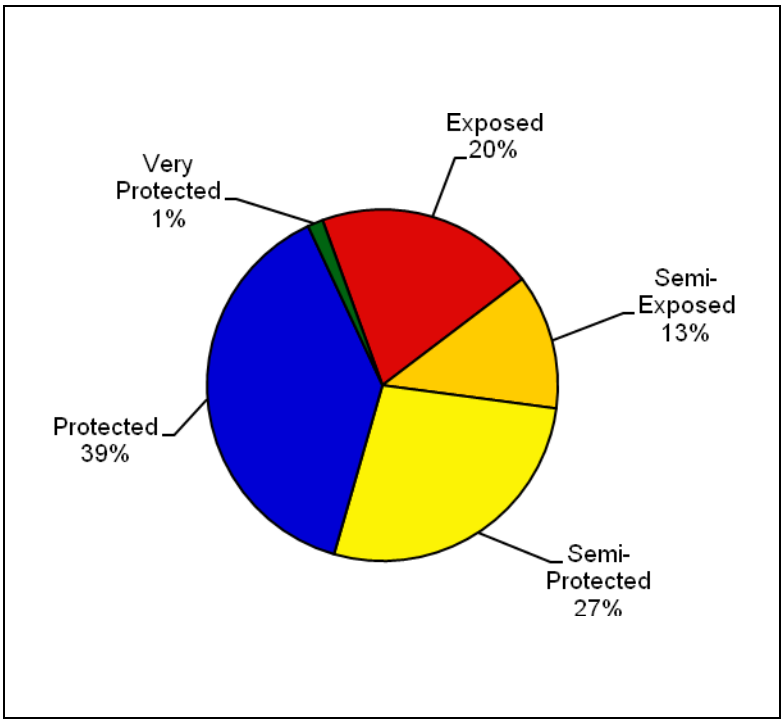

Figure 15. Summary of wave exposures mapped in the Bristol Bay study area. (Note that for the Bristol Bay shoreline, most intertidal and subtidal biobands are absent so exposure categories are estimated from maximum fetch distances).

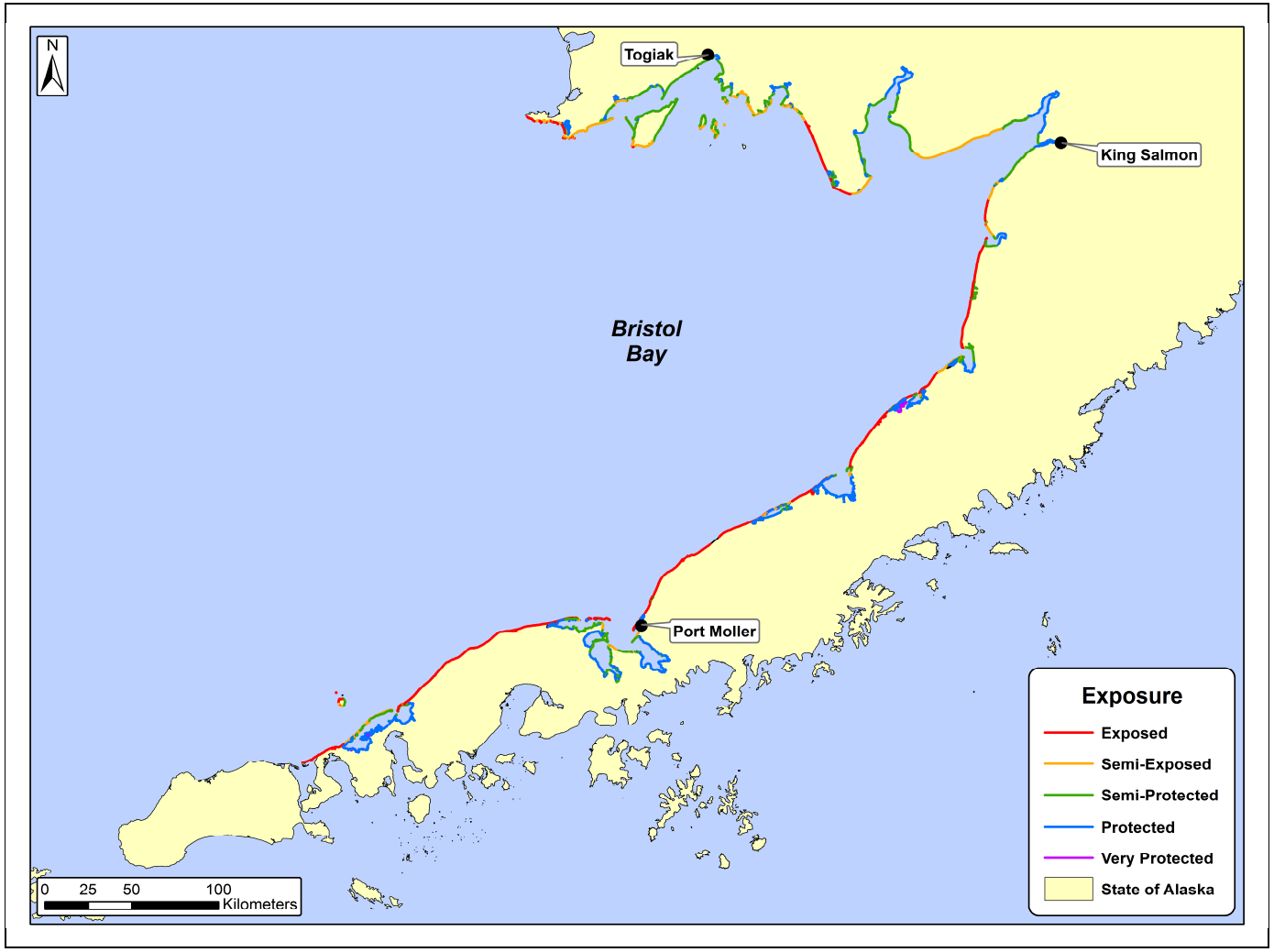

Figure 16. Distribution of wave exposure categories mapped in the Bristol Bay project area.
(Note that for the Bristol Bay shoreline, most intertidal and subtidal biobands are absent so exposure categories are estimated from maximum fetch distances).

3.3 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 (Figure 17 and Appendix A, Table A-9). A similar approach was applied in British Columbia to recognize the broad-scale eco-regional 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 outer coast Southeast Alaska – Sitka bioarea has a full range of wave exposures, dense nearshore canopy kelps and a diverse array of coastal morphologies. The Bristol Bay bioarea is characterized by broad mobile bare sediment beaches, numerous broad estuary flats, and near continuous biobands of Dune Grass (GRA) and Salt Marsh (PUC) in the supratidal. Canopy kelps are largely absent from the sediment-dominated mobile beach shorelines.

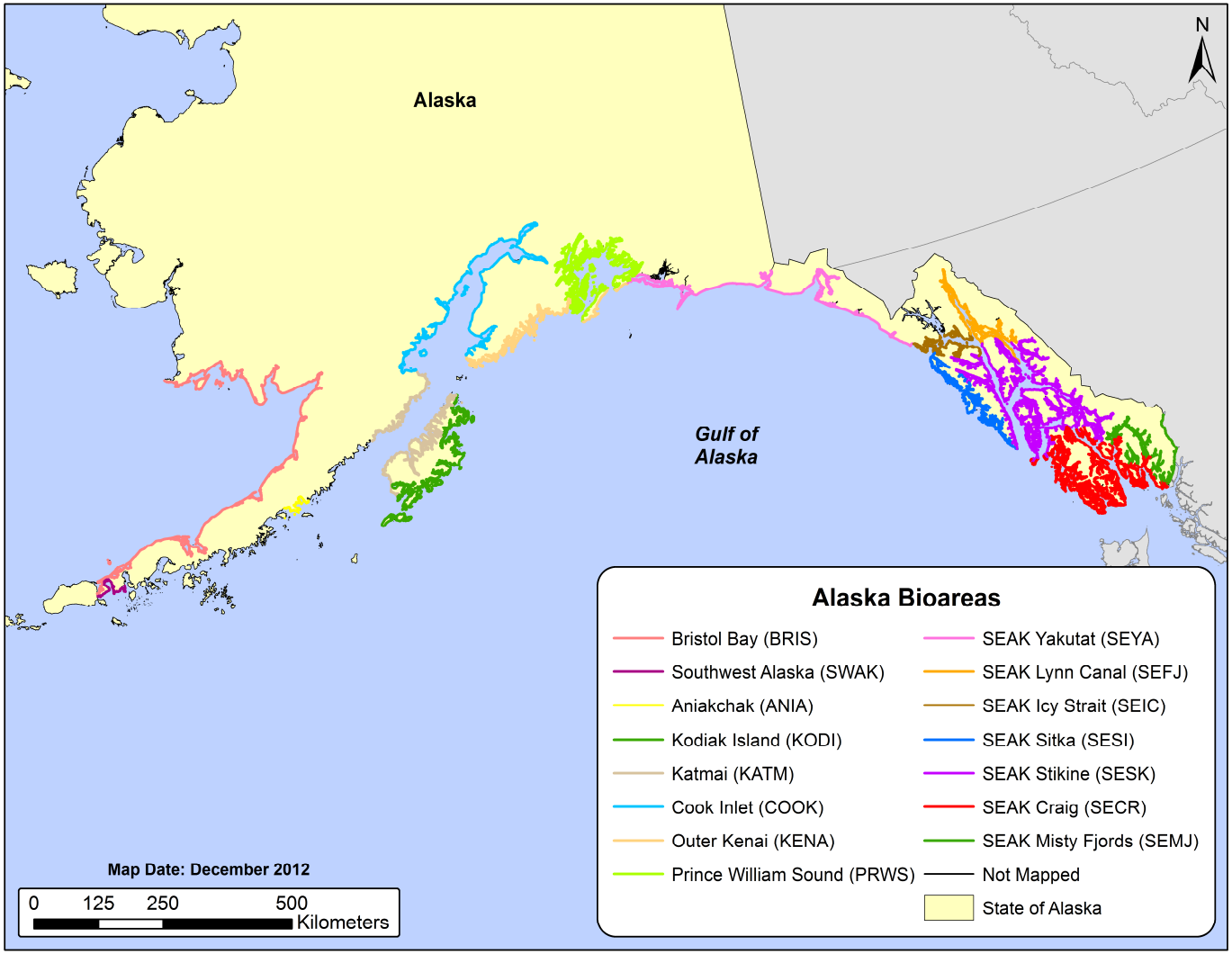

Figure 17. Bioareas identified in coastal Alaska ShoreZone mapping to date. Bioareas are delineated on the basis of observed regional differences in the distribution of biota and coastal geomorphology.

3.4 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.

In the Bristol Bay study area, the habitat class is determined from the biological wave exposure or from the physical wave exposure category on bare sediment beaches. The wave exposure category determined, in combination with the 'dominant structuring process' and geomorphic features of the site are used to assign the unit's Habitat Class. Wave energy is the most common structuring process, and less commonly observed habitats are those structured by current, estuarine/fluvial processes or anthropogenic structures.

In wave energy-structured habitat classes, the combination of wave exposure and substrate type determines the degree of substrate mobility, which in turn determines the presence and abundance of attached biota. Where the substrate is mobile, biota is sparse or absent, and where the substrate is 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 (note that Lagoons in the biological classification are mapped only as a secondary habitat class, see Table A-12 for further definition of secondary habitat class).

Further descriptions and definitions of the habitat class categories are presented in Appendix A, Tables A-12 and A-13. A new (2011) Habitat Class category to describe units where *periglacial processes* are the dominant structuring processes has been defined for mapping shorelines north of Bristol Bay, where permafrost is present. The definitions and codes for those habitat classes are listed in Tables A-12 and A-13; however periglacial habitat classes were not mapped in the Bristol Bay project area.

The occurrences of habitat class categories are summarized in Figure 18 and Table 7 Approximately 80% of all habitat class categories mapped are structured by wave energy, mostly in the mobile classes. Of the non-wave energy structured habitats, the Estuary habitat is one of the most often observed, and accounts for 20% of the shoreline mapped in Bristol Bay (Figure 19). The least common habitat class categories are those that are structured by current energy or are anthropogenic. Each of these classes account for approximately 1% or less of the shoreline mapped.

Approximately 53% of the shoreline mapped has a mobile habitat class which describes units which are mostly bare of attached intertidal biota.

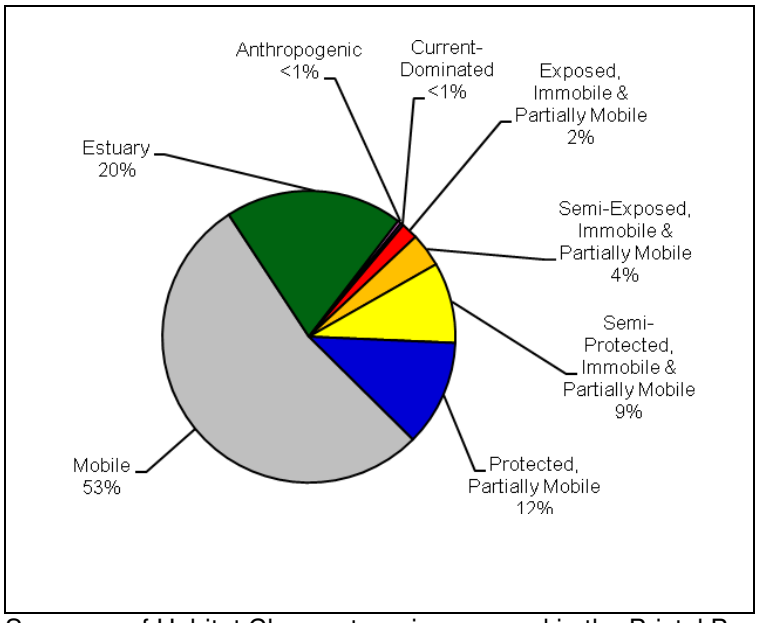

Figure 18. Summary of Habitat Class categories mapped in the Bristol Bay study area

Table 7. Summary of Occurrence of Habitat Classes

Dominant Structuring Process	Habitat Class		Bristol Bay area	
	Exposure Category	Substrate Mobility	Length (km)	% of Mapping
Wave Energy	Exposed (E)	Immobile & Partially Mobile	60	2
	Semi-exposed (SE)	Immobile & Partially Mobile	121	4
	Semi-protected (SP)	Immobile & Partially Mobile	289	9
	Protected (P)	Partially Mobile	380	12
	E, SE, SP, P	Mobile	1720	53
Fluvial/Estuarine processes	Estuary		633	20
Current energy	Current dominated		10	<1
Man-modified	Anthropogenic		12	<1
Lagoon *	Lagoon		299	9

* Lagoons are classified as *secondary habitat class* Appendix A, Table A – 12.

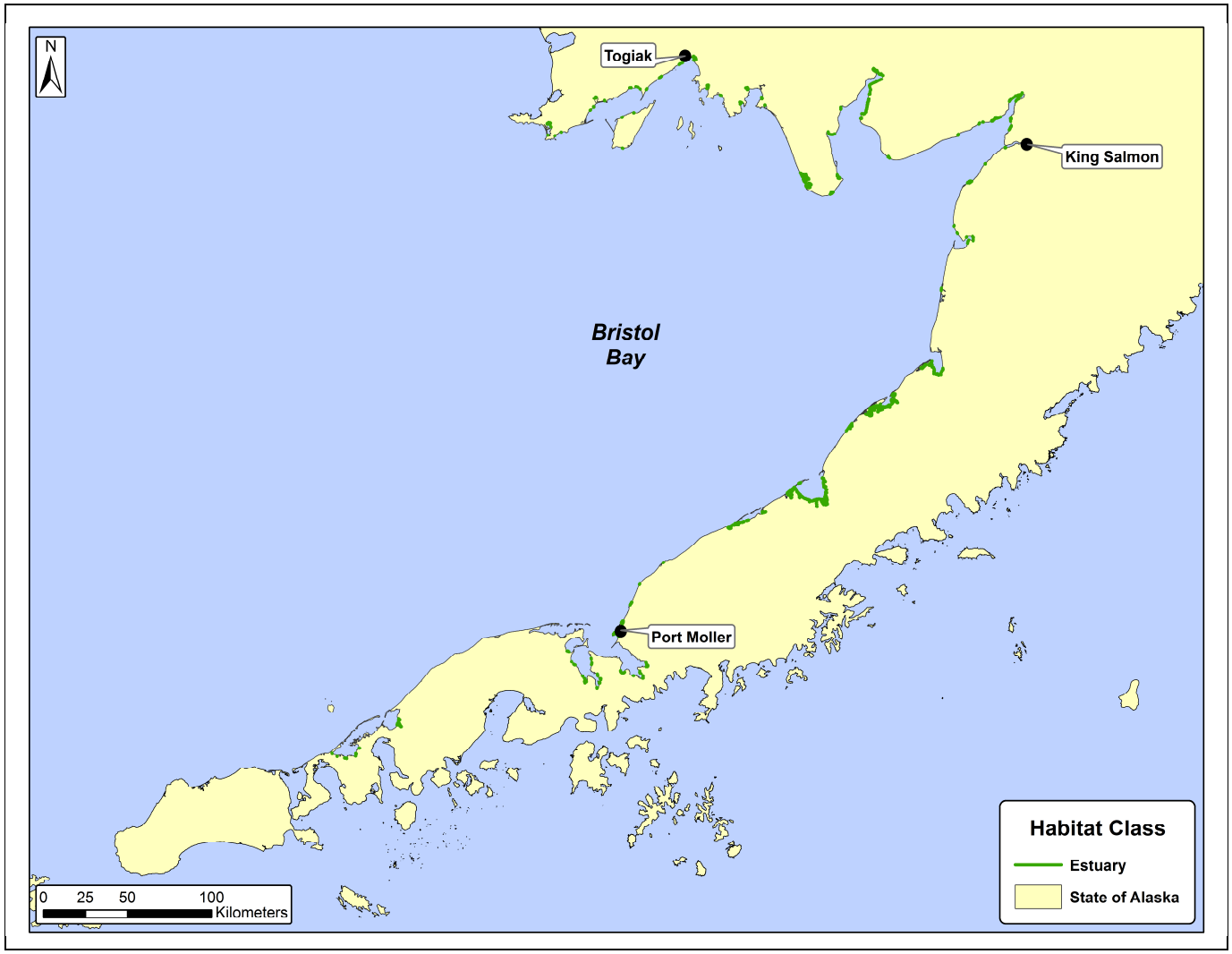

Figure 19. Distribution of Estuary habitat class category mapped in the Bristol Bay project area.

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5 ACKNOWLEDGMENTS

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We also thank the staff of Coastal and Ocean Resources Inc. and Archipelago Marine Research Ltd. for their efforts in the field and in the office.

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

Appendix A

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'
SHORE_TYPE	**Shore Type:** Code number for Coastal Class classification for the unit. Definitions of codes in Tables A-2 and A-3. 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-4, 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-5.

[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-6 and A-7
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 Shore Type attribute, in the UNIT table. (after Howes *et al* [1994] "BC Class" in British Columbia ShoreZone)

Substrate	Sediment	Width	Slope	Shore Type	
				Description	CODE
Rock	n/a	Wide (>30 m)	Steep (>20°)	n/a	-
			Inclined (5-	Rock Ramp, wide	1
			Flat (<5°)	Rock Platform, wide	2
		Narrow (<30 m)	Steep (>20°)	Rock Cliff	3
			Inclined (5-	Rock Ramp, narrow	4
			Flat (<5°)	Rock Platform, narrow	5
Rock & Sediment	Gravel	Wide (>30 m)	Steep (>20°)	n/a	-
			Inclined (5-	Ramp with gravel beach,	6
			Flat (<5°)	Platform with gravel beach,	7
		Narrow (<30 m)	Steep (>20°)	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 (>20°)	n/a	-
			Inclined (5-	Ramp w gravel & sand	11
			Flat (<5°)	Platform with G&S beach,	12
		Narrow (<30 m)	Steep (>20°)	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 (>20°)	n/a	-
			Inclined (5-	Ramp with sand beach,	16
			Flat (<5°)	Platform with sand beach,	17
		Narrow (<30 m)	Steep (>20°)	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 (>20°)	n/a	-
			Inclined (5-	Gravel beach, narrow	22
			Flat (<5°)	Gravel flat or fan	23
	Sand & Gravel	Wide (>30 m)	Steep (>20°)	n/a	-
			Inclined (5-	n/a	-
			Flat (<5°)	Sand & gravel flat or fan	24
		Narrow (<30 m)	Steep (>20°)	n/a	-
			Inclined (5-	Sand & gravel beach,	25
			Flat (<5°)	Sand & gravel flat or fan	26
	Sand/Mud	Wide (>30 m)	Steep (>20°)	n/a	-
			Inclined (5-	Sand beach	27
			Flat (<5°)	Sand flat	28
			Flat (<5°)	Mudflat	29
		Narrow (<30 m)	Steep (>20°)	n/a	-
			Inclined (5-	Sand beach	30
			Flat (<5°)	n/a	-

Table A-3 Shore Type definition for units with 'dominant structuring processes' other than 'wave energy' *

Structuring Processes	Description	Shore Type
Estuarine Processes Dominant	**estuarine** – organics, fines and vegetation dominate the unit; may characterize units with large marshes in the supratidal zone (if the marsh represents >50% of the combined supratidal and intertidal area of the unit), even if the unit has another dominant intertidal feature such as a wide tidal flat or sand beach. This "50% rule" may be ignored and a BC Class 31 applied if a significant amount of marsh (25% or more) infringes on the intertidal zone.	31
Anthropogenic Processes Dominant	***permeable man-made structures*** such as rip-rap, wooden crib structures where a surface oil from a spill will easily penetrate the structure. Man-made structure must comprise >50% of intertidal zone area.	32
	impermeable man-made structures such as concrete seawalls and steel sheet pile. Man-made structure must comprise >50% of intertidal zone area.	33
Current Processes Dominant	***current-dominated*** shore types occur in elongate channels with restricted fetches and where tidal currents are the dominant structuring process. In addition to obvious high currents, channel sides typically includes anomalous vegetation types.	34
Glacial Processes Dominant	***glacial ice*** dominates a few places on the Alaska coast where tide-water glacial are present. These location are characterized by unstable ice fronts	35
Lagoon Processes Dominant	***lagoons*** represent a special coastal feature that has some salt-water influence but may be largely disconnected from other marine processes such as tides and high wave exposure. Lagoons are distinguished from estuaries, which must have fluvial or deltaic landforms. Intertidal zones are often restricted in elevation and narrow. Saltwater influxes may be only episodic.	36
Periglacial Processes Dominant	***inundated tundra*** occurs where thaw-subsidence on low-relief shorelines causes the tundra surface to sink below mean sea level. Often the polygon fracture patterns associated with ice-wedges polygons are evident. Where the shallow ponds coalesce they may transition into lagoons. Usually there is > 25% water within the unit.	37
	ground ice slumps are areas where the thaw of high ice content shores causes mass-wasting is distinct patterns (e.g., ground ice slumps, thermo-erosional falls, solifluction lobes that dominate coastal morphology). Slump processes strongly influence (>50%) of the intertidal zone morphology and texture.	38
	low vegetated peat are areas of low-lying tundra peat banks; usually vegetated in the supratidal zone, but not always vegetated in the intertidal zone. Minimal mineral sediment is present. Usually low energy (shown by an absence of storm wave features). No distinct intertidal zone. Found in permafrost areas, with some occurrence in non-permafrost areas.	39

*** includes new Shore Types 36 through 39, added 2011, to describe permafrost shorelines in Arctic Alaska.**

Table A-4. 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-5. 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-6. 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-7. 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
peat/organics/vegetation	999	999	999	5	5	5
man-made, permeable	2	2	3	3	5	5

Table A-8. 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-9)
EXP_BIO	**Biological Wave Exposure:** A classification of the wave exposure category within the Unit, **In Bristol Bay:** assigned by the Biological mapper, based on physical wave exposure category [EXP_ OBSER] when biological indicators were not present.
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-12 and A-13). (In bare units in **Bristol Bay** EXP_BIO = EXP_OBSER)
HAB_CLASS_LTRS	**Habitat Class** in alphabetic code: translation from number codes in the HAB CLASS lookup table (Table A-13)
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-12 and A-13)
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 Lo or Lc in across-shore physical component table (Table A-15)
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-12)
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 PHOTOS Table A-20)
DateAdded DateModified	**Date/Time Mapped or Modified:** Date and time the unit was physically mapped (or modified)

Table A-9. 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, fro Cape Elizabeth at the east entrance of Cook Inlet to Port Bainbridge at the west entrance of Prince Willia Sound.	Rugged coastline, do inated by extre ely 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, fro Cape Douglas on the southwest entrance Cook Inlet, north to Anchorage, including Turnagain Ar and Kache ak Bay, to Cape Elizabeth at the southeast entrance of Cook Inlet.	Sedi ent-do inated, wide, low-slope shorelines, oderate to lower wave exposures. Affected by silt-laden freshwater input, absence of Giant Kelp and Dragon Kelp. Very wide co plexes of salt arshes and estuaries.
Kodiak Island	KODI	10	Kodiak archipelago, Gulf of Alaska side, fro 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, fro Very Protected estuaries to Exposed rock cliffs. Fully arine 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 platfor s with surfgrass beds and sedi ent do inated offshore islands.
Katmai / Shelikof Strait side of Kodiak Island	KATM	11	Kat ai National Park and Preserve, Alaska Peninsula, Shelikof Strait, includes the northwest side of the Kodiak archipelago.	Moderate to high wave exposures, affected by outflow fro Cook Inlet, and separated fro open Gulf of Alaska by Kodiak archipelago. Li ited 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 Monu ent and Preserve, Alaska Peninsula, Shelikof Strait, southwest of Kat ai National Park.	High wave exposure, wide bedrock platfor s and obile sedi ent 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 fro 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 sedi ent beaches do inant. Li ited canopy kelp distribution.
Southeast Alaska – Lynn Canal (fjord)	SEFJ	12	Lynn Canal fro 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 Snettisha with the southeast edge to the south tip of Glass Peninsula, Hugh Point on Ad iralty Island.	Fjord landscape, bedrock do inated, oderate 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 bioband codes for 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-9. 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, fro Point Lucan at west to False Bay, northeast Chichagof Island.	Glacial silty water, wide, sedi ent-do inated beaches co on, fringing salt arsh co on, oderate and lower wave exposures, wide estuary flats co on. Dragon Kelp do inant 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 O aney.	Fully arine, west coast, includes diversity of species, exposure and habitat categories, fro Exposed to Very Protected. Giant Kelp abundant, Dragon Kelp li ited distribution.
Southeast Alaska – Misty Fjords	SEMJ	12	Misty Fjords area includes all fjords in the southeast region of Southeast Alaska, including Beh Canal, George Inlet, Carroll Inlet, Thorne Ar , Boca de Quadra and the western side of Portland Inlet.	Fjord landscape, bedrock-do inated, 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, fro southern Coronation Island, south to Dixon Entrance.	Fully arine, west coast. High species diversity and habitat heterogeneity. Northern li it of California Mussel and Urchin Barrens biobands and certain species of other lower intertidal kelps. Southern li it of Dragon Kelp.
Southeast Alaska -- Stikine	SESK	12	The Stikine area enco passes central Southeast Alaska. Northern extent includes east Chichagof Island fro False Bay, west Ad iralty Island and south fro Tracy and Endicott Ar s. 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, oderate and lower wave exposures. Dragon Kelp do inant canopy kelp.
Prince William Sound	PRWS	13	All of Prince Willia Sound fro 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 Se i-Exposed to Very Protected wave exposures. Differences between conditions in eastern and western Sound, with interaction of circulation co plexities. Nu erous tidewater glaciers and affects of Copper River. Absence of Giant Kelp and Dragon Kelp.

* Suffix applied to bioband codes for 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. Definitions of the BIOAREA attribute in BIOUNIT table (continued).

Bioarea Name	Bioarea Code	Bioarea Suffix *	Geographic Extent	Characteristics
Chukchi Sea coast	CHUK	14	** BIOAREA extent to be confir ed during North Slope apping currently in progress. Chukchi Sea coast fro Point Hope to Point Barrow	Low tundra cliffs and flats, per afrost do inated shore
Beaufort Sea coast	BEAU	15	** BIOAREA extent to be confir ed during North Slope apping currently in progress. Point Barrow to Canadian border	Tundra cliffs and flats, offshore barrier sand islands, per afrost do inated shore
Bristol Bay	BRIS	16	False Pass, Bechevin Bay to Cape Newenha	Wide sand and ud flats, braided strea and river ouths, do inated by obile beaches, with few areas of i obile substrate.
Southwest Alaska Peninsula	SWAK	17	Southwest Alaska Peninsula fro Uni ak Island, northeast to include all survey area fro 2011 of Cold Bay and Sand Point tea s. Northeast boundary to be deter ined, and ay be extended to include Aniakchak (ANIA). Offshore Shu agin and Sanak Islands groups included in SWAK.	Wide high energy beaches and rock platfor s on ainland peninsula and offshore islands. So e lower wave exposures lagoons with eelgrass. Nearshore kelps Dragon Kelp.

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

Table A-10. 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-11. Definitions of BIOLOGICAL WAVE EXPOSURES (the EXP_BIO attribute in BIOUNIT table) for Gulf of Alaska. *

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				
		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
			Macrocystis integrifolia	Giant Kelp	MAC
		Nereocystis luetkeana		Bull Kelp	NER

*** Species and associated biobands typical of units in the Gulf of Alaska are listed. Most Bristol Bay units have only sparse attached biota.**

[continued]

Table A-11. Definitions of BIOLOGICAL WAVE EXPOSURES (the EXP_BIO attribute in BIOUNIT table) for Gulf of Alaska (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

*** Species and associated biobands typical of units in the Gulf of Alaska are listed. Most Bristol Bay units have only sparse attached biota.**

Table A-12. 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-13, 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. Lagoons have recently been added as one of several new **Shore Types** for arctic periglacial shorelines (Table A-3), and the corresponding **Habitat Class** codes are defined in Table A-13. 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-13. 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 & Sedi ent or Sedi ent	The epibiota in the i obile obility categories is influenced by the wave exposure at the site. In high wave exposures, only solid bedrock shorelines will be classified as 'i obile'. At the lowest wave exposures, even pebble/cobble beaches ay show lush epibiota, indicating an i obile Habitat Class.	10 VE_I	20 E_I	30 SE_I	40 SP_I	50 P_I	60 VP_I
	Partially Mobile	Rock & Sedi ent or Sedi ent	These units describe the co bination of sedi ent obility observed. That is, a sedi ent beach that is bare in the upper half of the intertidal with biobands occurring on the lower beach would be classed as 'partially obile'. This pattern is seen at oderate wave exposures. Units with i obile bedrock outcrops inter ingled with bare obile sedi ent beaches, as can be seen at higher wave exposures, could also be classified as 'partially obile'.	11 VE_P	21 E_P	31 SE_P	41 SP_P	51 P_P	61 VP_P
	Mobile	Sedi ent	These categories are intended to show the 'bare sedi ent beaches', where no epibenthic acrobiota are observed. Very fine sedi ent ay be obile even at the lowest wave exposures, while at the highest wave exposures; large-sized boulders will be obile 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 arsh vegetation in the upper intertidal, are always associated with a freshwater strea or river and often show a delta for . 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-Do inated	Species asse blages observed in salt-water channels are structured by current energy rather than by wave energy. Current-do inated sites are li ited 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 for the intertidal habitat. These Habitat Classes are rare and include a s all 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 – I per eable	I per eable odified Habitats are intended to specifically note units classified as Coastal Class 33. These Habitat Classes are rare and include a s all percentage of the shoreline length.	16 VE_X	26 E_X	36 SE_X	46 SP_X	56 P_X	66 VP_X
		Anthropogenic – Per eable	Per eable odified Habitats are intended to specifically note shore units classified as Coastal Class 32. These Habitat Classes are rare and include a s all 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 li ited drainage. They are often associated with wetlands and ay 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
Periglacial		Per afrost	Units consist of for s structured per afrost at the coast, such as inundated tundra, tundra sea cliffs or other periglacial features	19 VE_T	29 E_T	39 SE_T	49 SP_T	59 P_T	69 VP_T

Shaded boxes are Exposure categories which *Do Not Occur* in most regions

Table A-14. 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-15)
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-16)
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-15)
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-16)
FormMat2Txt	**Form/Material Text:** Automatically-generated field that is the translation of codes used in Form2 and Mat2 into text
Form3	**Form3:** Tertiary geomorphic feature within each across-shore component, described by a specific set of codes (Table A-15)
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-16)
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-15)
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-16)
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-15)
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,** based on substrate type and exposure category, where 1 is least persistent, 5 is most persistent (Tables A-6 and A-7)

Table A-15. 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
- d inundated tundra
- 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

U = Tundra
- g ground ice slump
- i inundated
- o isolated thaw ponds
- p plain or level surface
- r ramp

Table A-16. 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)
z	permafrost

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)
z	permafrost

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)
t	tephra
x	angular fragments (mix of block/rubble)
v	sediment veneer (used as modifier)
z	permafrost

I – Ice

i	ice

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-17. 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-18)
GRA	Bioband code for Dune **GRA**ss in supratidal (Table A-18)
TUN	Bioband code for **TUN**dra in supratidal (Table A-18)
SED	Bioband for **SED**ges in supratidal (Table A-18)
PUC	Bioband for Salt Marsh grasses, including **PUC***cinellia* and other salt tolerant grasses, herbs and sedges, in supratidal (Table A-11)
BAR	Bioband for **BAR**nacle (*Balanus/Semibalanus*) in upper intertidal (Table A-18)
FUC	Bioband for Rockweed, the **FUC***us*/barnacle in upper intertidal (Table A-18)
ULV	Bioband for Green Algae, including mixed filamentous and foliose greens (**ULV***a* sp*., Cladophora, Acrosiphonia*) in mid-intertidal (Table A-18)
BMU	Bioband for **B**lue **MU**ssel (*Mytilus trossulus*) in mid-intertidal (Table A-18)
MUS	Bioband for California **MUS**sel/gooseneck barnacle assemblage (*Mytilus californianus/Pollicipes polymerus*) in mid-intertidal (Table A-18)
HAL	Bioband for Bleached Red Algae, including mixed filamentous and foliose reds (*Palmaria, Odonthalia*, **HAL***osaccion*) in mid-intertidal (Table A-18)
RED	Bioband for **RED** Algae, including mixed filamentous and foliose reds (*Odonthalia, Neorhodomela, Palmaria*) in lower intertidal (Table A-18)
BFM	Bioband for **B**io**F**il**M** mat, in mid to lower intertidal (Table A-18)
ALA	Bioband for ribbon kelp, ALA*ria* spp. (Table A-18)
SBR	Bioband for **S**oft **BR**own Kelps, including unstalked large-bladed laminarians, in lower intertidal and nearshore subtidal (Table A-18)
CHB	Bioband for Dark Brown Kelps, including stalked bladed dark **CH**ocolate-**B**rown kelps in lower intertidal and nearshore subtidal (Table A-18)
SUR	Bioband for **SUR**fgrass (*Phyllospadix*) in lower intertidal and nearshore subtidal (Table A-18)
ZOS	Bioband for **ZOS***tera* (Eelgrass) in lower intertidal and subtidal (Table A-18)
URC	Bioband for **URC**hin Barrens (*Strongylocentrotus fransicanus*) in nearshore subtidal (Table A-18)
ALF	Bioband for Dragon Kelp (**AL***aria* **F***istulosa*) in nearshore subtidal (Table A-18)
MAC	Bioband for Giant Kelp (**MAC***rocystis integrifolia*) in nearshore subtidal (Table A-18)
NER	Bioband for Bull Kelp (**NER***eocystis luetkeana*) in nearshore subtidal (Table A-18)

* Distribution code for biobands observed are listed in Table A-19.

Table A-18. Definitions for BIOBAND attribute, for Gulf of Alaska, Bristol Bay and Arctic coast *.

Zone	Bioband		Color	Indicator Species	Physical Description	Biological Wave Exposure	Associate Species
	Name	Code					
A	**Tundra**	**TUN**	Grey green	tbd	Low turf of vascular herbs, grasses, sedges in storm surge and uppermost supratidal.	n/a	tbd
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-18. Definitions for BIOBAND attribute, for Gulf of Alaska, Bristol Bay and Arctic coast (continued) *.

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. (Only in southernmost SE Alaska)	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	**Biofilm**	**BFM**	Rusty orange, beige to dark	bacterial mat	Low, spongy turf on substrate. (Described for Arctic coastlines)	P to SE	
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-18. Definitions for BIOBAND attribute, for Gulf of Alaska, Bristol Bay and Arctic coast (continued) *.

Zone	Bioband		Color	Indicator Species	Physical Description	Exposure	Associate Species
	Name	Code					
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. (Only in southernmost SE Alaska)	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-19. 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-20. 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