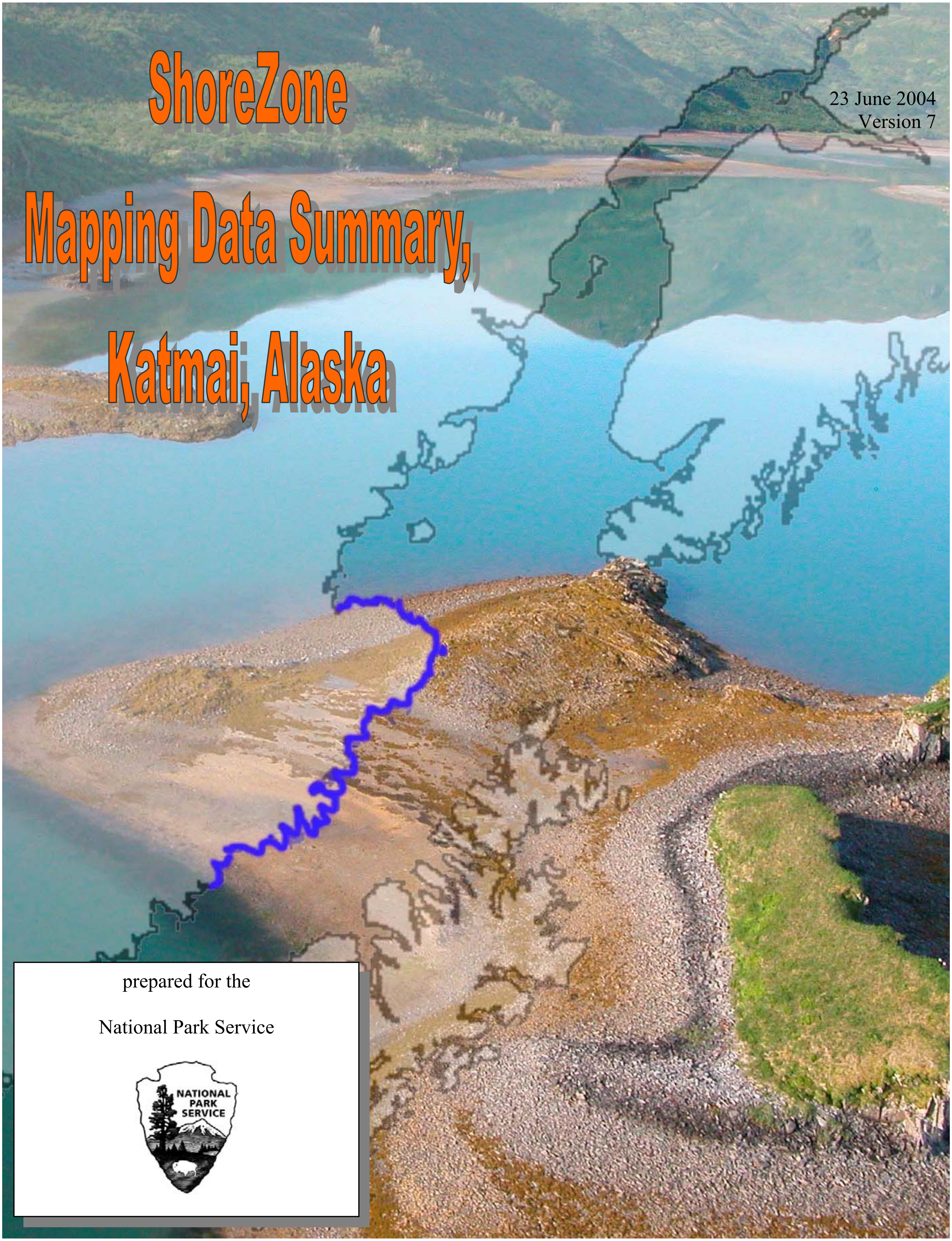

ShoreZone

Mapping Data Summary, Katmai, Alaska

23 June 2004
Version 7

prepared for the

National Park Service

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ShoreZone Mapping Data Summary, Katmai National Park, Alaska

by

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The Katmai region mapped as part of the 2003 ShoreZone project is shown in Figure 1. A total of 837 km of the Alaskan Peninsula have been completed encompassing all of Katmai National Park.

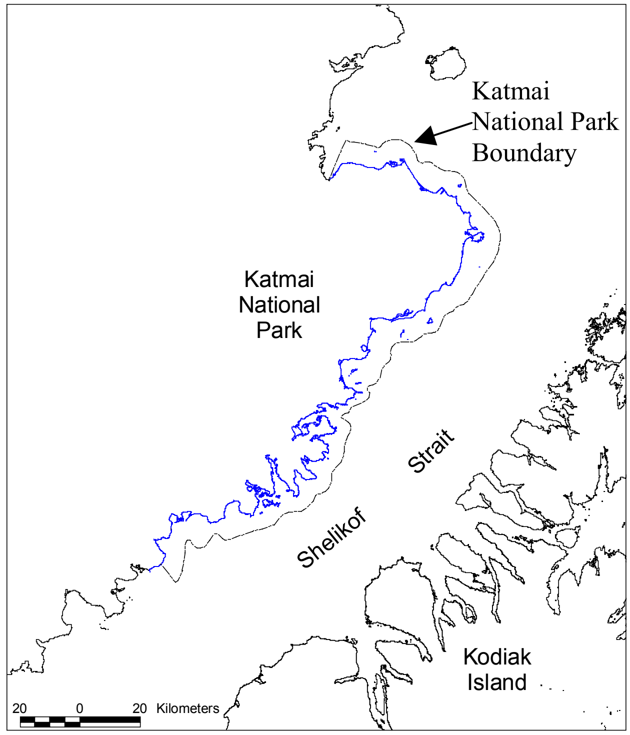

Figure 1 Coastline mapped in ShoreZone (blue).

The mapping data from ShoreZone is in the form of points, lines and polygons. The **line** segments are the primary spatial features with points identifying features that are too small to be represented as a line segment. Polygons represent features with significant width, although the polygonal features are also recorded in a linear format so that data can be compared on a park-wide basis. The spatial features for Katmai National Park are summarized in Table 1, as represented on a 1:62,500 scale digital map.

The average **unit** length over the 837 km of mapped shoreline is 332 m, providing considerable resolution in recording alongshore variation of both physical and biological features.

Table 1 Unit Types and Length

Unit Type	Number	Length (km)	Area (km^2)
Point	271	-	
Line	2,525	837	
Area	122		193
Totals:	**2,918**	**837**	**193**

Within each shoreline **unit**, the intertidal zone is further subdivided into **across-shore components**. These components are not represented on the maps; data attributes are recorded for each unit for forms, materials and biology (See Appendix A for Data Dictionaries). For the 2,918 units mapped, there are a total of 11,496 across-shore components, with an average of about four across-shore components per unit. There are almost 6,700 unique combinations of form and materials and over 950 unique combinations of biobands (Table 2).

Table 2 Across-Shore Characterization

Number of Across-Shore Components	Number of Unique Physical Combinations	Number of Unique Biological Combinations
11,496	6,690	988

Shore Types

Shore types represent repeatable assemblages of across-shore components and are the most easily visualized shoreline information (e.g., rock cliff, rock platform with sand and gravel beach, mudflat). Of the 34 possible shore type categories, 31 occur on the Katmai coast (Table 3). All but 10% of the units mapped fall into rock and sediment, sediment, or wetland/estuary categories.

Table 3 Summary of Shore Types in Katmai National Park

BC Class	Description	Length (km)	% Occurrence	Sum of %	Major Substrate Type
1	rock ramp, wide	1.6	<1%		
2	rock platform, wide	27.9	3%		
3	rock cliff, narrow	17.0	2%		
4	rock ramp, narrow	16.6	2%		
5	rock platform, narrow	2.1	<1%	*8%*	*Rock*
6	ramp w gravel beach, wide	3.4	<1%		
7	platform w gravel beach, wide	59.7	7%		
8	cliff w gravel beach, narrow	14.3	2%		
9	ramp w gravel beach, narrow	54.7	7%		
10	platform w gravel beach, narrow	12.6	2%		
11	ramp w S&G beach, wide	5.6	1%		
12	platform w S&G beach, wide	65.3	8%		
13	cliff w S&G beach, narrow	16.4	2%		
14	ramp w S&G beach, narrow	17.4	2%		
15	platform w S&G beach, narrow	3.6	<1%		
16	ramp w sand beach, wide	0.9	<1%		
17	platform w sand beach, wide	32.5	4%		
18	cliff w sand beach, narrow	0.8	<1%		
19	ramp w sand beach, narrow	0.2	<1%		*Rock &*
20	platform w sand beach, narrow	0.0	0%	*34%*	*Sediment*
21	gravel flat, wide	27.1	3%		
22	gravel beach, narrow	8.9	1%		
23	gravel flat or fan, narrow	0.8	<1%		
24	S&G flat, wide	89.8	11%		
25	S&G beach, narrow	13.4	2%		
26	S&G flat, narrow	1.1	<1%		
27	sand beach, wide	2.6	<1%		
28	sand flat, wide	146.0	17%		
29	mudflat, wide	16.8	2%		
30	sand beach, narrow	1.7	<1%	*37%*	*Sediment*
31	estuary/lagoon	163.1	19%	*19%*	*Wetland/Estuaries*
32	man-made, permeable	0.0	0%		
33	man-made, impermeable	0.0	0%	*0%*	*Man-Made*
34	current dominated	12.9	2%	*2%*	*Current Dominant*
		836.8	100%		

The generalized substrate types are summarized in Table 3 and Fig. 2. The mapping data show that mixtures of sediment and rock (e.g., thin sediment veneers over rock or rock cliffs with beaches) are the most common substrate type (37%). This result illustrates the point that it is overly simplistic to separate the shoreline into just rock (8%) and sediment (34%) categories. Wetland/estuaries comprise 19% of the shoreline length. Little of the Katmai coast is classified as current dominated shoreline (2%).

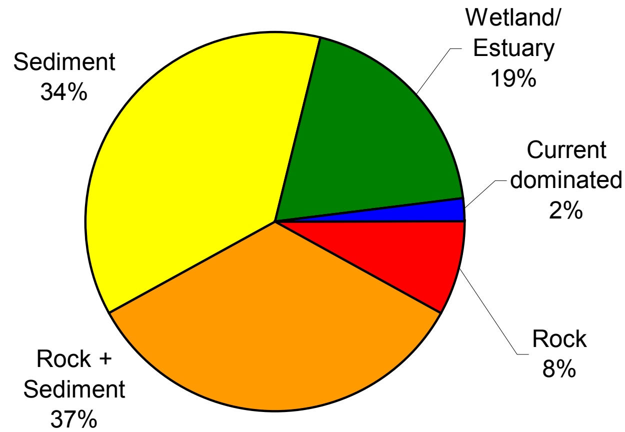

Figure 2 Relative occurrence of general shore types.

Katmai National Park is typically characterized by wide sediment flats and platforms (Fig. 3). Average intertidal zone widths in the mapping area are 209 m.

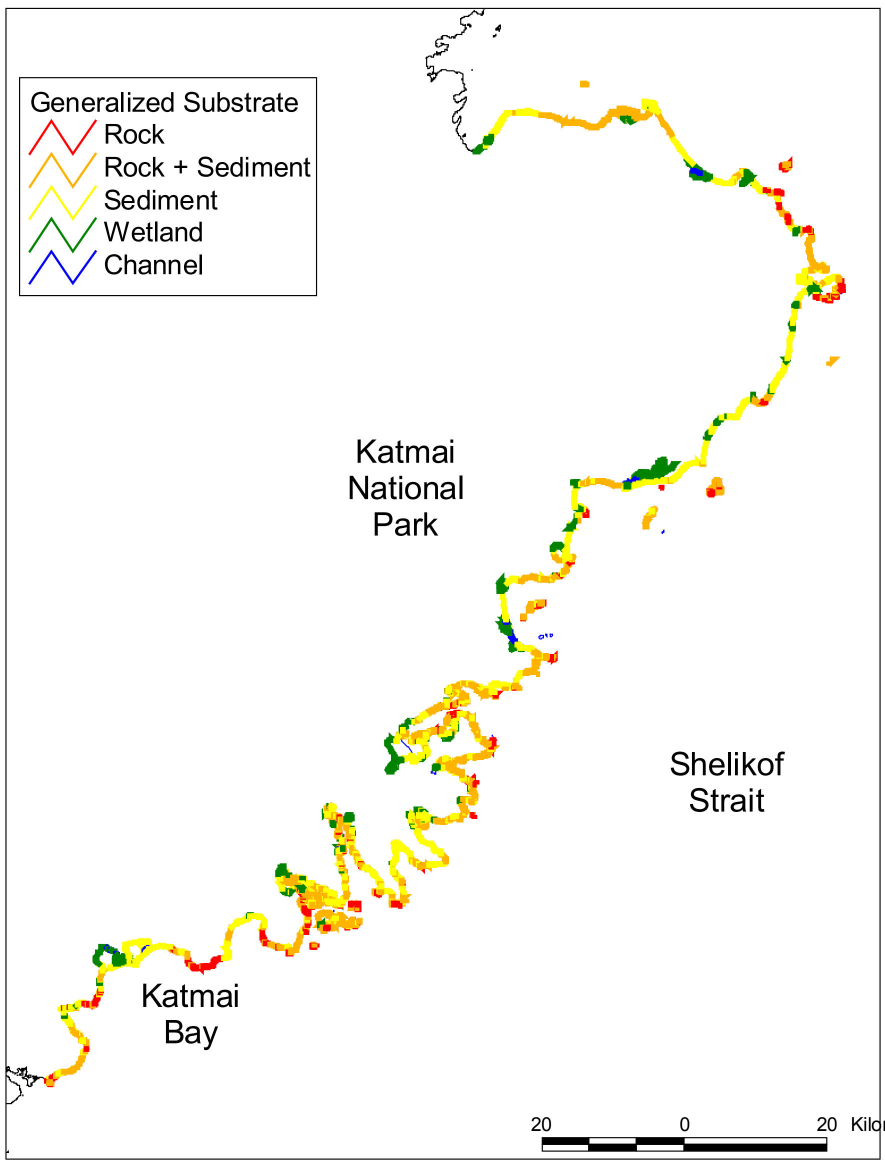

Figure 3 Distribution of general substrate types in Katmai National Park

Wave Exposure

Wave exposure is another important element of shore character and strongly influences physical processes as well as the biotic character of the coast. In ShoreZone, exposures are estimated from observations of biotic assemblages in the intertidal zone. Intertidal species generally have specific energy tolerances (e.g., eelgrass prefers low exposure levels) and by carefully noting key indicator species and assemblages, exposure of each shore unit can be estimated.

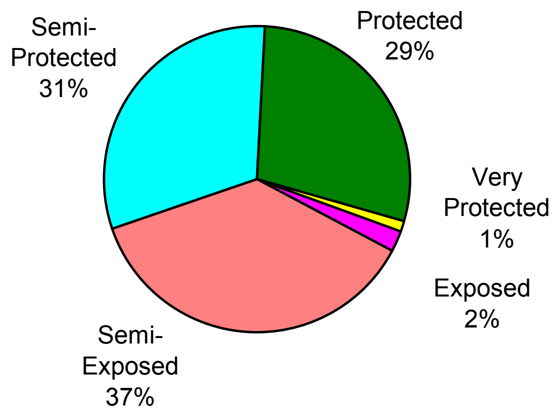

Figure 4 Wave exposure, based on observations of intertidal biota, summarized for Katmai National Park

Exposure categories are summarized in Figure 4 and the distribution is shown in Figure 5. While it would appear that most of the Katmai coast is a relatively high-energy shoreline, the numerous bays and inlets contain a significant portion of the coast and are protected. Over 60% of the shoreline is characterized as low energy (*semi-protected, protected and very protected*). Only 2% of the shoreline occur in the exposed category with the remaining 37% of the coast classified as semi-exposed.

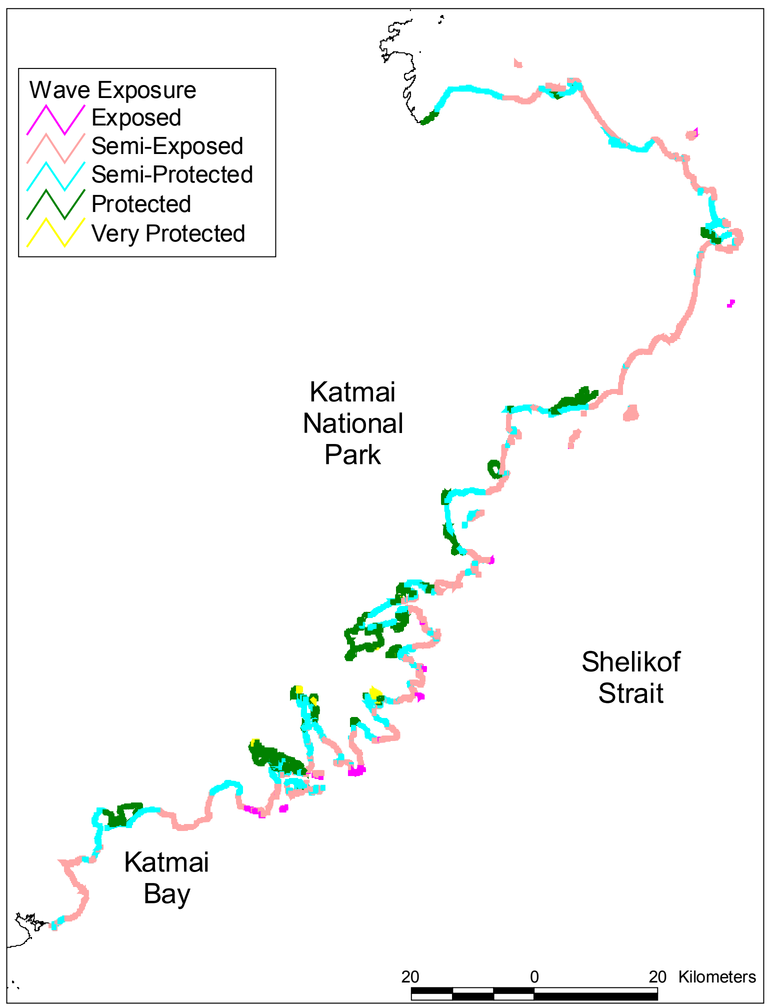

Figure 5 Spatial distribution of wave exposure, based on unit-by-unit observations of intertidal biota.

Shore Modification

Shoreline modification includes areas of seawalls, rip rap, docks, and dikes. Only two shore units in Katmai National Park have any form of shore modification in the intertidal zone. These both occur at Kukak in Kukak Bay and represent less than 1% of the shoreline. One of these units contains 10% landfill representing 12.7 m of shoreline and the other unit contains 10% rip rap representing 15.6 m of the shoreline (Table 4). The location of these modified shore segments can be seen in Figure 6.

Table 4 Summary of Shore Modification

Type	Length (m)
Landfill	12.7
Rip Rap	15.6
TOTAL:	28.3

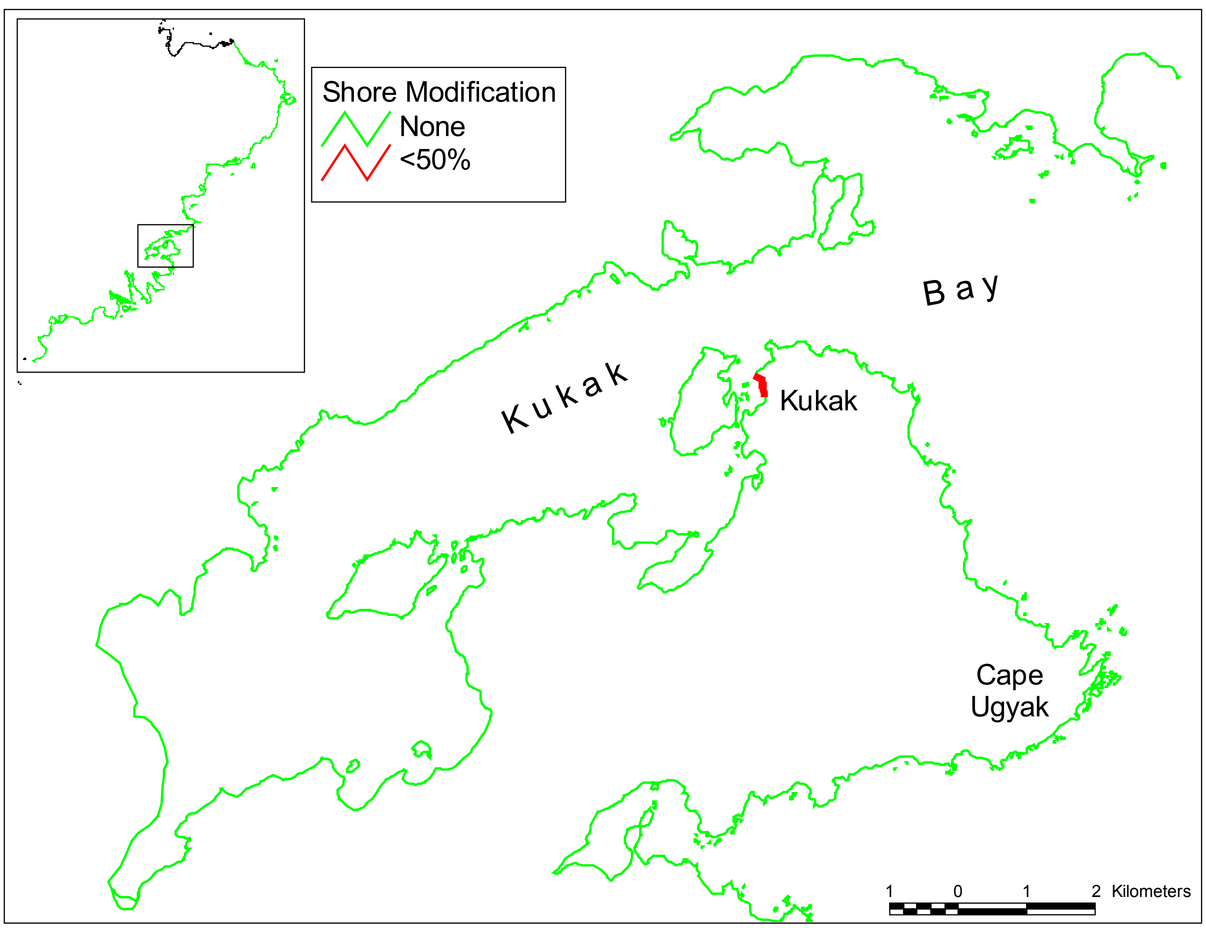

Figure 6 Summary of shore modifications (landfill and rip rap) for Katmai National Park.

Oil Residence Index

The ShoreZone dataset is potentially useful for oil spill contingency planning. In addition to the imagery and biological mapping data, physical attributes of the shore can be used to estimate the potential oil residence based on knowledge of wave exposure levels and substrate types.

Table 5 Summary of Oil Residence Index

Estimated Residence	ORI Code	Length (km)	% of Mapping
DAYS to weeks	1	51.7	6%
WEEKS to months	2	16.1	2%
weeks to MONTHS	3	250.0	30%
MONTHS to years	4	190.3	23%
months to YEARS	5	328.6	39%
	TOTALS:	**836.8**	**100%**

Impermeable surfaces such as rock or sheet piling have limited penetration of oil and generally a short residence time. Conversely, coarse sediments are highly permeable, can trap large volumes of oil and have lengthy oil residence periods. Wave action is the most effective process removing stranded oil from the shore and generally high-energy shorelines have short oil residence and low-energy shorelines have lengthy oil residence.

An *Oil Residence Index* (ORI) is computed, based on exposure and substrate characteristics of each unit. 92% of the Katmai National Park coastline has high ORI occurrences. This occurrence is summarized in Table 5 and plotted in Figure 7.

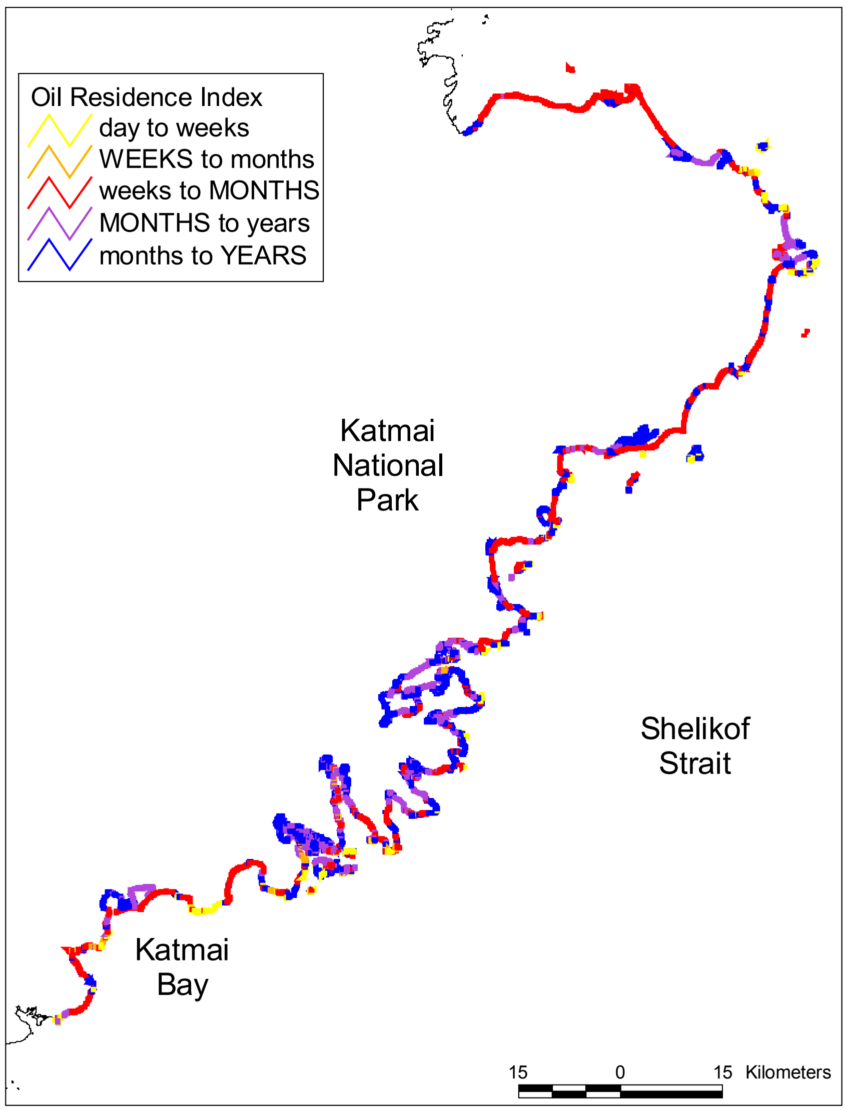

Figure 7 Distribution of Oil Residence Index in Katmai National Park.

BioBands

The physical data in the ShoreZone Mapping System is augmented by the overlay of biological data as observed from aerial video and still imagery, and observations from the in-flight narration of the biologist. Aerial observations are enhanced by ground truthing data collected concurrently at 41 intertidal shore stations in the Katmai region (summarized in CORI Project 02-27, July 2003). These data are used together to map the distribution of intertidal and nearshore subtidal biota.

Figure 8. Example of *Biobands*, distinct assemblages of intertidal biota, in an aerial view of a rock cliff.

Patterns of biotic assemblages mapped using the combined data sources are described using *BioBand* distribution. Biobands are **assemblages of attached epibenthic biota with distinct visual signatures easily recognized from the air** (Fig. 8). Some biobands are characterized by a single indicator species (e.g., the Blue Mussel band); others represent an assemblage of co-occurring species (e.g., the Mixed Red Algae band). The presence or absence of the bands and their distribution, mapped as continuous or patchy throughout an individual shore unit, are used to describe the species assemblages of the ShoreZone habitats. (Refer to Appendix B for complete bioband descriptions)

Because of its geomorphological diversity, Katmai National Park has a wide variety of biobands. In the wetland/estuarine areas, mixed marsh grasses and sedges were observed. In areas with rocky substrates, barnacles, rockweed, and blue mussels were observed at most wave exposures. In more protected areas, *Laminaria saccharina* and eelgrass were common, and at moderate wave exposures rich assemblages of mixed red algal species, kelps such as *Alaria*, *Cymathere triplicata* and *Laminaria bongardiana* appeared, with bull kelp frequently observed offshore. Surfgrass, coralline algae and blue mussels characterized higher wave exposure shores, with surfgrass disappearing at the highest exposures. The overall summary of shoreline lengths by bioband is listed in Table 6 and illustrated in Figure 9.

Table 6 Summary of *BioBand* Occurrence in Katmai National Park

BioBand Names	Code	Continuous (km)	Continuous %	Patchy (km)	Patchy %	Total (km)	% of Mapped
Splash Zone/Verrucaria	VER	----	----	----	----	422.9	51%
Wetland	PUC	94.6	11%	98.4	12%	192.9	23%
Dune Grass	GRA	267.9	32%	121.8	15%	389.7	47%
Sedges	SED	46.0	5%	18.1	2%	64.1	8%
Barnacles	BAR	241.7	29%	150.0	18%	391.7	47%
Rockweed	FUC	156.1	19%	234.8	28%	390.9	47%
Green Algae	ULV	33.8	4%	189.5	23%	223.3	27%
Bleached Red Algae	HAL9	15.1	2%	26.1	3%	41.1	5%
Blue Mussel	BMU	37.7	5%	183.7	22%	221.4	26%
Red Algae	RED9	214.2	26%	119.3	14%	333.5	40%
Alaria	ALA	264.1	32%	172.5	21%	436.6	52%
Soft Brown Kelps	SBR9	116.7	14%	128.5	15%	245.2	29%
Dark Brown Kelps	CHB9	36.1	4%	52.2	6%	88.3	11%
Surfgrass	SUR	26.9	3%	24.1	3%	51.0	6%
Eelgrass	ZOS	57.7	7%	70.6	8%	128.3	15%
Dragon Kelp	ALF	2.6	0%	5.0	1%	7.6	1%
Bull Kelp	NER	33.7	4%	47.8	6%	81.5	10%

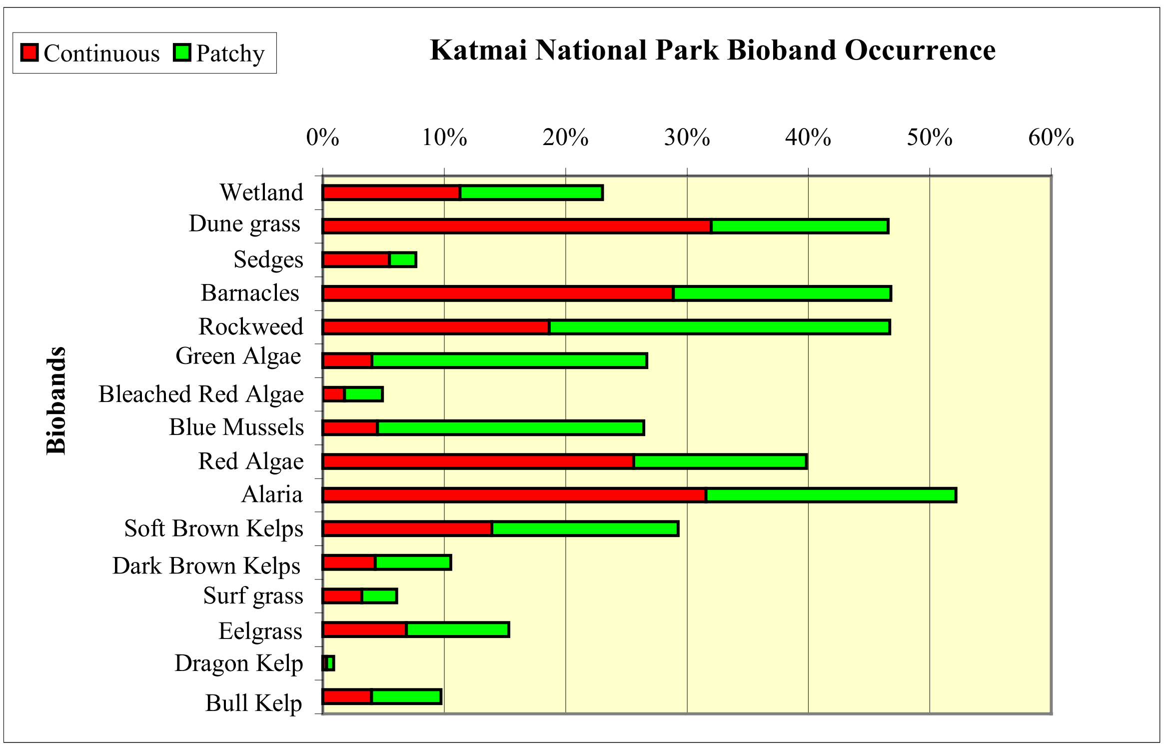

Figure 9 Occurrence of ShoreZone *Biobands* in Katmai National Park.

Biological Wave Exposures

Designation of wave exposure within a shore unit is based on the presence/absence and, to a lesser extent, the abundance of different species assemblages or biobands. A variety of biological indicators are used by mappers to assign the appropriate exposure category to a shore unit. Using expert local knowledge and published literature, the wave exposure tolerances and requirements of various marine species are well-known, and can be used to reliably indicate the degree of wave exposure that characterizes a shoreline where these occur. For example, the presence of surfgrass (*Phyllospadix* sp. or SUR bioband) is a good indication of a semi-exposed shore. The co-occurrence of certain biobands is also used to determine the exposure category. In areas of Alaska with high wave exposure, the typical bioband assemblages are the "dark brown kelps" (CHB), coralline red algae (included in RED), and a wide splash zone as indicated by "W" in the black lichen bioband (VER).

In the Katmai National Park area, there are five generalized exposure levels:

- **Exposed:** wave fetch windows typically over 500 km on the Katmai coast.
- **Semi-exposed:** wave fetch windows typically in the range of 50 km to 500 km.
- **Semi protected:** wave fetch windows typically between 10 and 50 km.
- **Protected:** wave fetch windows typically less than 10 km.
- **Very Protected:** wave fetch windows less than 1 km.

An important strength of the ShoreZone mapping methodology is the combination of physical and biological attributes. Field data collection involves synchronous recording of biological and physical observations, and the mapping process also involves frequent interaction between geologists and biologists. All biological data is precisely nested within the physical mapping data. In terms of habitat for marine organisms, it is the combined physical and biological attributes of the shore that determine the distribution and ecological function of the organism.

ShoreZone Habitats

There are over 950 unique combinations of biobands and almost 6,700 combinations of form and substrate on the Katmai National Park coast.

Habitat Class is a **summary classification that combines both physical and biological characteristics observed for a particular shoreline unit**. It is intended to provide a simplified biophysical summary of the unit overall, based on the detailed attributes that have been mapped.

Habitat Class is designed to convey the concept that species assemblages observed at a particular location are a reflection of both the physical characteristics of that shore segment, as well as the wave exposure (see discussion page 13). Thus, the species assemblage observed on an exposed shore with a mixture of rock and mobile sediment would be quite distinct from that found on a shore with a protected wetland complex. Since Habitat Class was developed for all shore types found in Alaska, some of the codes developed will not apply to the Katmai area. For instance, there are no anthropogenic shore features in the Katmai bio-region.

Substrate mobility is also an important factor in determining the development of an intertidal biotic assemblage. Where the substrate is stable, well-developed epibenthic assemblages occur (i.e., biobands). Where the substrate is mobile, the epibenthic community may be sparse or absent altogether, largely dependent on associated wave exposure.

Three classes of stability that are used in ShoreZone habitat characterization are:

- **Immobile or stable** substrates such as bedrock, or even boulders, cobbles, or pebbles on a low-exposure coasts.
- **Partially mobile** substrates such as a rock platform with a beach or sediment veneer. The partial mobility of the sediment limits the development of a full bioband assemblage, as would occur on a stable rock shoreline.
- **Mobile** substrates where energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota. These are bare sediment beaches at higher wave exposures.

The fourteen generalized *Habitat Classes* are described and occurrence summarized in Table 7. The distributions are plotted in Figure 10.

Photographic examples of selected Habitats mapped in Katmai National Park are included in Figures 11-17.

Table 7 Summary of Biophysical ShoreZone Habitats in Katmai National Park

	Biophysical Habitat Description	Habitat Classes	Length (km)	% of Mapping
Exposed	**Stable Substrate:** Rocky shorelines with high wave exposure.	10 20	7.8	1%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	11 21	10.0	1%
	Mobile Substrate: No epibenthic community in intertidal due to dynamic substrate.	12 22	0.9	<1%
Semi-Exposed	**Stable Substrate:** Rocky shorelines with moderate to high wave exposure.	30	62.7	7%
	Partially Mobile Substrate: Rocky shorelines with sediments that are sufficiently mobile to limit epibenthos in some portions of the shore.	31	127.6	15%
	Mobile Substrate: Small-size sediment shores generally have no epibenthic community. Cobble/boulder beaches may have biota. Dunes frequent in backshore.	32	103.9	12%
Semi-Protected	**Stable Substrate:** Rocky shorelines with moderate to low wave exposure.	40	24.9	3%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	41	92.5	11%
	Mobile Substrate: Small-size sediment shores generally have low biotic diversity. Cobble/boulder beaches usually support biota, especially in low intertidal/upper subtidal.	42	106.8	13%
Protected	**Stable Substrate:** Rocky shorelines with low wave exposure.	50 60	1.4	0%
	Partially Mobile Substrate: Rocky shorelines with sediments sufficiently mobile to limit epibenthos in some portions of the shore.	51 61	40.0	5%
	Mobile Substrate: Small-size sediment shores generally have low biotic diversity. Cobble/boulder beaches usually support biota, especially in low intertidal/upper subtidal.	52 62	89.1	11%
Wetland/ Estuary	**Estuary/ lagoon:** Generally low energy sediment shores with wetlands and marsh vegetation. Usually influenced by freshwater.	33 43 53 63	159.5	19%
Channel	**Current-Dominated Channel:** Channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units.	34 44 54	8.6	1%
	TOTALS:		**837.0**	**100%**

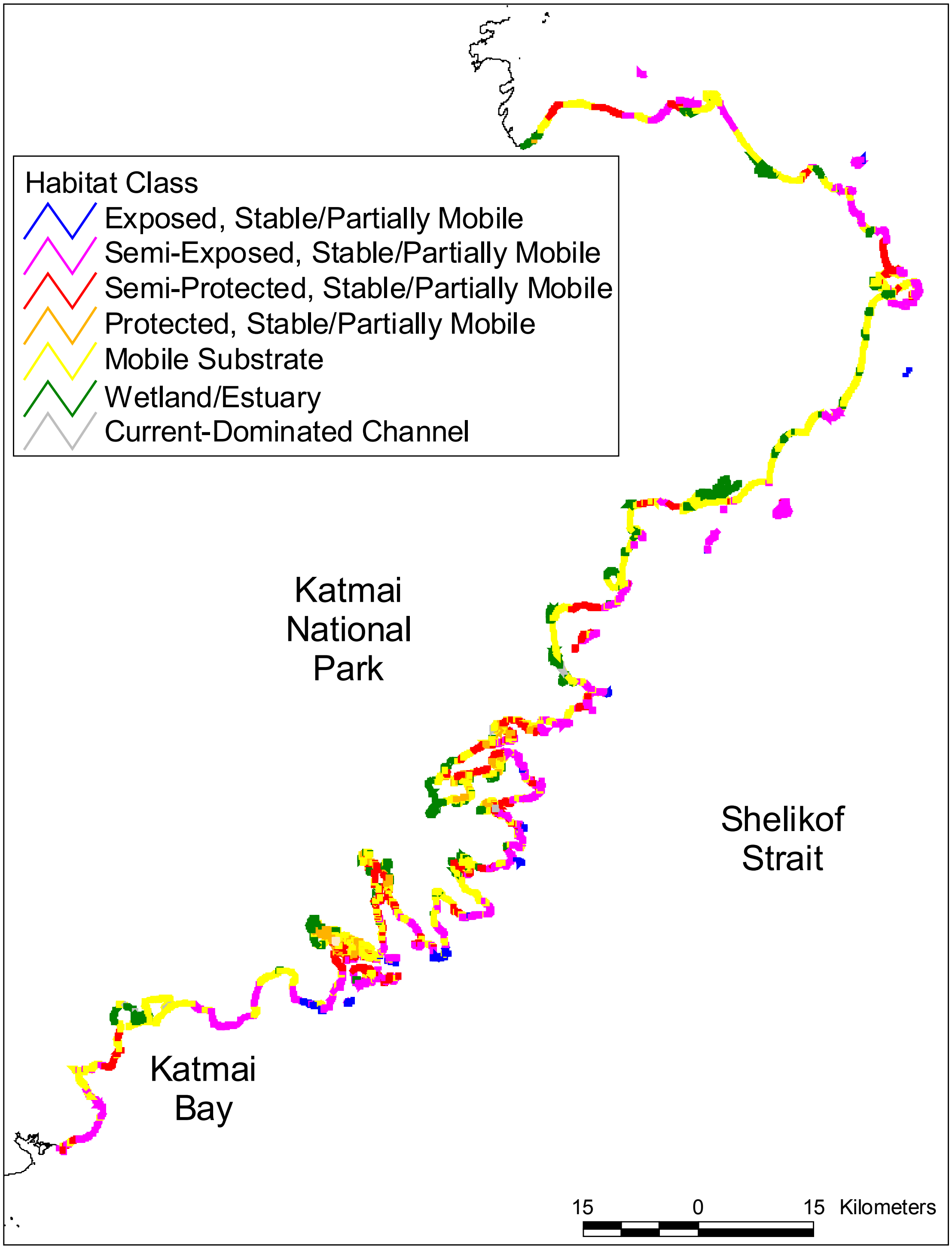

Figure 10 Spatial distribution of major Habitat Classes in Katmai National Park.

Figure 11. This exposed rock platform on the North of Cape Gull in Kaflia Bay has a wide *splash zone* (VER) bioband with *Barnacles* (BAR), *Rockweed*, (FUC), *Blue Mussels* (BMU), *Red Algae* (RED), *Alaria* (ALA), and *Bull Kelp* (NER). The Habitat Class is exposed, stable.

Figure 12. In this unit just North of Cape Ilktugitak, the immobile rock cliff shows established biobands (*splash zone* (VER), *Barnacles* (BAR), *Rockweed*, (FUC), *Blue Mussels* (BMU), *Alaria* (ALA), *Soft Brown Kelps* (SBR), and *Bull Kelp* (NER). The Habitat Class is semi-exposed, stable.

Figure 13. This rocky columnar basalt shoreline at Russian Anchorage in Kinak Bay has a medium *splash zone* (VER), *Barnacles* (BAR), *Rockweed*, (FUC), *Green Algae* (ULV), *Red Algae* (RED), *Alaria* (ALA), *Soft Brown Algae* (SBR) and *Bull Kelp* (NER). The Habitat Class is semi-protected, stable.

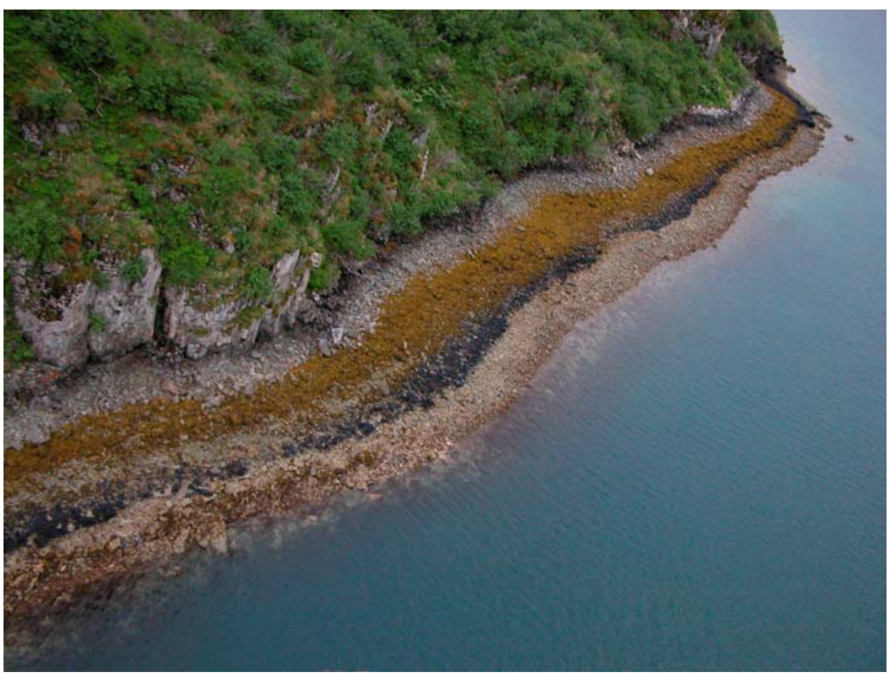

Figure 14. This protected boulder beach, located at the mouth of Geographic Harbour in Amalik Bay, shows distinct biobands (*splash zone* (VER), *Barnacles* (BAR), *Rockweed*, (FUC), *Blue Mussels* (BMU), *Red Algae* (RED), and *Soft Brown Kelps* (SBR). The Habitat Class is protected, partially mobile.

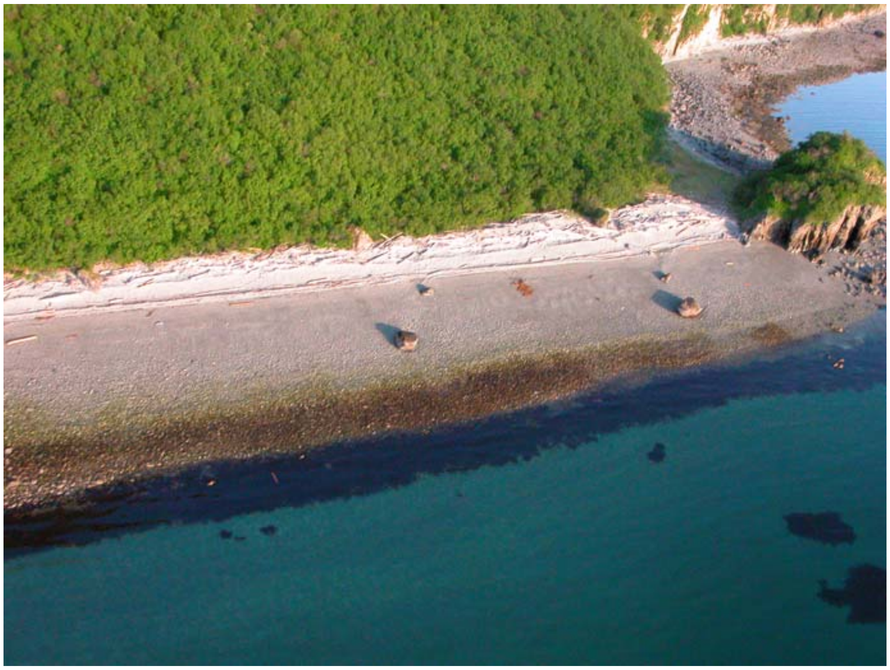

Figure 15. This cobble/boulder beach on the west shore of Kuliak Bay is bare in the upper intertidal (no biobands) but has some biobanding visible (*Green Algae* (ULV), *Red Algae* (RED), and *Soft Brown Kelp* (SBR)) in the lower intertidal. The Habitat Class is semi-exposed, partially mobile substrate.

Figure 16 Typical of the marsh areas in Katmai National Park, the *Wetland* (PUC), *Dune Grass* (GRA), and S*edge* (SED) biobands are visible in this view at the head of Kashvik Bay. The Habitat Class of this unit is semi-exposed, wetland/estuary.

Figure 17. This current-dominated channel was observed at the head of Kinik Bay. The unit has a rock platform with a boulder/cobble beach veneer (a common coastal class type in Katmai) and is one of the few examples of the current-dominated Habitat Class. Biobands here were a narrow *splash zone* (VER) with patchy *Rockweed* (FUC), *Blue Mussels* (BMU), and mixed *Red Algae* (RED).

Appendix A

Data Dictionary

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Table A-1 Summary of Data Fields in the Unit Database

Field Names	Type	Description
UnitRecID	I	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
REGION	T	coastal region number
AREAS	T	coastal area number
PHY_UNIT	T	physical unit number
SUBUNIT	T	sub unit number
TYPE	T	indicator of polygon, line or point unit type
Poly_01	T	ties polygon to specific unit
Poly_02	T	ties polygon to specific unit
Poly_03	T	ties polygon to specific unit
Poly_04	T	ties polygon to specific unit
BC_CLASS	I	shoreline type, BC classification system
ESI_CLASS	T	shoreline type, ESI classification system
LENGTH_M	N	alongshore length of unit in metres
AREA_M2	N	area of unit in square meters
GEO_MAPPER	T0	last name of geology mapper
GEO_EDITOR	T0	last name of individual responsible for reviewing and editing
GEO_MAP_DATE	D/T	date of geological mapping
GEO_SOURCE	T	data sources for geological interpretation
SCALE	T	scale of base maps used to delineate units
VIDEOTAPE	T	the videotape id number
HR	T	the "burned-in" tape time from the GPS that appears on the video image
MIN	T	the "burned-in" tape time from the GPS that appears on the video image
SED	T	the "burned-in" tape time from the GPS that appears on the video image
MAP_NO	I	page number from the DeLorme Alaska Atlas
CHART	T	NOAA chart number
EXP_OBSER	T	exposure observed by geomorphologist
EXP_CLASS	T	“best” estimate of exposure from calculated-, observed- and bio-exposure
ORI	I	oil residence index
SED_SOURCE	T	source of sediment within the unit
SED_ABUND	T	qualitative index of sediment in the unit
SED_DIR	T	estimate of sediment transport direction based on indicators within the unit
CHNG_TYPE	T	accretional, stable, erosional status
CHNG_RATE	N	rate of change
SHORENAME	T	local geographic name
UNIT_COMMENTS	T	comment
SHORE_PROB	T	indicator of significant base map problem
SM1_TYPE	T	type of primary shore modification (e.g., type of seawall)
SM%	I	estimate % occurrence of SM1 in unit
SM1_M	I	calculated length of SM1 in unit
SM2_TYPE	T	type of secondary shore modification (e.g., type of seawall)
SM2%	I	estimate % occurrence of SM2 in unit
SM2_ M	I	calculated length of SM2 in unit
SM3_TYPE	T	type of tertiary shore modification (e.g., type of seawall)
SM3%	I	estimate % occurrence of SM3 in unit
SM3_ M	I	calculated length of SM3 in unit
SMOD_TOT	I	total % occurrence of shore modification in the unit
RAMPS	I	number of boat ramps in the unit
PIERS_DOCKS	I	number of docks or pier within the unit
REC_SLIPS	I	number of “recreational slips within the unit
DEEPSEA_SLIP	I	number of ship or “deepsea” slips within the unit
ITZ	N	intertidal width; sum of the width for across-shore components

Data Dictionary for UNIT Databases

(Adapted from methods and codes outlined in Harper *et al* 1999)

Field Name	Type	Description
Unit_RecId	N	space for unique id for each record
PHY_IDENT	T	unique Physical Ident number for the unit, a combination of region, area, unit, and sub-unit. (RR/AA/UUUU/SS)
REGION	T	coastal region number
AREAS	T	coastal area number
PHY_UNIT	T	physical shore unit number; the unit is the primary alongshore subdivision during the mapping
SUBUNIT	T	sub-unit number: "0" for main Unit and "1, 2, 3...." for variants or point features; the sub-units may be added at a latter date to reflect additional mapping detail (e.g., degree of oiling)
TYPE	T	a description of Unit type: a polygon-type with (**A**)rea, a combination unit with (**B**)oth area and length, a (**L**)ine-type unit, or a (**P**)oint variant (see Table A-2)
Poly_01	T	ties polygon to specific unit--in order from HW to LW
Poly_02	T	ties polygon to specific unit--in order from HW to LW
Poly_03	T	ties polygon to specific unit--in order from HW to LW
Poly_04	T	ties polygon to specific unit--in order from HW to LW
BC_CLASS	N	a number indicating the BC 'coastal class' or 'shoreline type' (see Table A-3)
ESI_CLASS	T	a number code for the ESI coastal classification system (see Table A-4)
LENGTH_M	N	the unit or sub-unit along-shore length in M, to be calculated by the GIS software
AREA_M2	N	the polygon area in sq m to be calculated by GIS software
GEO_MAPPER	T	last name of mapper.
GEO_EDITOR	T	last name of editor or reviewer.
GEO_MAP_DATE	D	date of original mapping
GEO_SOURCE	T	the data source for the interpretations: (V)ideotape, (P)hoto-aerial, (T)opo maps, (C)harts, (O)ther.
SCALE	T	scale of the base map used to code and map original data
VIDEOTAPE	T	videotape identifier code(s)
HR	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available.
MIN	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available.
SEC	T	the "burned-in" tape time from the GPS that appears on the video image; "X" indicates no screen time was available.
MAP_NO	T	the page number of the map in the DeLorme Alaska Atlas where the Unit is plotted
CHART	T	the NOAA chart number(s) for the Unit
EXP_OBSER	T	an estimate of the wave exposure as observed by geomorphologist during mapping based on Table A-5.
EXP_CLASS	T	a code for best exposure estimate where EXP_BIO better than EXP_OBS better than EXP_CALC (see Table A-5)
ORI	N	a code indicating the potential oil residence index, see Tables A-6 and A-7.
SED_SOURCE	T	a code indicating the estimated sediment source for the unit, (B)ackshore, (A)longshore, (F)luvial, (O)ffshore

Field Name	Type	Description
SED_ABUND	T	code indicating the relative sediment abundance within the shore-unit, (A)bundant, (M)oderate, (S)carce
SED_DIR	T	one of the eight cardinal points of the compass indicating dominant sediment transport direction
CHNG_TYPE	T	a code indicating the stability of the shore unit, (A)ccretional, (E)rosional, (S)table
CHNG_RATE	T	the rate of change of the shoreline within the unit in m/yr
SHORENAME	T	the name of a prominent geographic feature near the unit; used to facilitate searches
UNIT_COMMENTS	T	a text field used for miscellaneous comments and notes during the mapping
SHORE_ PROB	T	comment on nature of the shore problem, usually the difference between electronic shoreline and observed shoreline
SM1_TYPE	T	the *primary* type of seawall occurring within the unit where:BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM1%	N	the estimated % occurrence of the *primary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM1_M	N	the calculated length in meters of the *Primary* seawall type
SM2_TYPE	T	the *secondary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP = sheet pile; RR = rip rap and WB = wooden bulkhead
SM2%	N	the estimated % occurrence of the *secondary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM2_M	N	the calculated length in meters of the *Secondary* seawall type
SM3_TYPE	T	the *tertiary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; RR = rip rap and WB = wooden bulkhead
SM3%	N	the estimated % occurrence of the *tertiary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM3_M	N	the calculated length in meters of the *Tertiary* seawall type
SMOD_TOTAL	N	the total % occurrence of seawall in the unit, in tenths
RAMPS	N	the number of boat ramps that occur within the shore zone of the unit or subunit. Ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate. Public boat ramps are shown as variants
PIERS/DOCKS	N	the number of piers or wharves that occur within the unit. Piers or docks must extend at least 10m into the shore zone. Category does not include anchored floats.
REC_SLIPS	N	the estimated number of recreational (or small) slips associated with the piers/docks of the unit based on small boat length (~<50’)
DEEPSEA_SLIPS	N	the estimated number of slips for ocean-going vessels (~>100’)
ITZ	N	the sum of the across-shore width of all the intertidal components (B-Zone) within the unit

Table A-2 Protocol for Unit Delineation

The primary goal of the mapping program is to catalog shore-zone features that may be of interest in resource management. As such the mapping should capture the key ecological features of the shore-zone. Units may be delineated as either *points*, *lines* or *polygons* within the spatial framework. This protocol provides criteria for assigning the most appropriate spatial characteristics to a unit.

1. the Alaska ShoreZone mapping system is primarily a lineal system (length but not width) so that *a line segment representation is the preferred unit type*. These units are coded as **L** in the "Type" Field.

2. point and polygon features should be used in certain cases to *provide a clear characterization of the physical and biological characteristics of the unit as well as the processes that affect the unit*. These cases are outlined below.

3. ***points*** are used to identify features that are of interest to resource managers but are too small (in terms of alongshore length) to be represented by a line segment. The following features are represented by points: stream mouths, public boat ramps, and other small features within a unit with ecological or management significance such as wetlands. Stream mouths or marshes are normally identified from the aerial video imagery. These units are coded as **P** in the "Type" Field.

4. ***polygons*** are used when a feature has unique spatial characteristics that are not captured by a single line segment representation. Examples of possible polygons include: a wetland where the shape of the wetland does not allow a reasonable approximation of area by length and width estimates, an intertidal ebb-tidal delta where controlling processes (tidal currents) differ substantially from surrounding units or a very wide mudflat backed by a gravelly sand beach. The minimum area for a polygon is $1 cm^2$ at a 1:12,000 mapping scale or 15,000 ft^2.

   Two types of polygons are represented:

   a. a polygon that incorporates features that span the entire "shore-zone" from supratidal to subtidal, and therefore have an associated alongshore length on the electronic shoreline. A large wetland area with associated fringing mudflat is an example of this type of polygon. In that the polygon has both an area and an alongshore length (where it intersects the electronic), the feature type is coded as **both** and both area and length measurements are added to the database. This type of unit is coded as **B** in the "Type" field.

   b. a polygon that describes only a portion of the shore-zone (equivalent to an across-shore component) and that does not intersect the MHWL shoreline. An ebb-tidal delta or a large, intertidal mudflat are examples of this type of polygon. This type of unit is coded as **A** in the "Type" field.

Table A-3 Rationale for BC Shore Types[1]

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

[1]Shore Type code is used to provide a generalized summation of the detailed physical data complied for each shore unit (from Howes *et al*. 1994).

Table A-4 ESI Shore Type Classification (after Peterson *et al* 2002)

ESI No.	Description
1A	Exposed rocky shores; Exposed rocky banks
1B	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	Riprap; Gravel Beaches (cobbles and boulders)*
6C	Riprap
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud, or clay; Sheltered rocky shores (impermeable)
8B	Sheltered, solid man-made structures; Sheltered rocky shores (permeable)
8C	Sheltered riprap
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 Exposure Matrix Used for Estimating Calculated Exposure (EXP_CALC)

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

Exposure definitions are the same categories listed in EXP_BIO – Table B-1.

Codes for exposures:		
	very protected	**VP**
	protected	**P**
	semi-protected	**SP**
	semi-exposed	**SE**
	exposed	**E**
	very exposed	**VE**

Table A-6 Oil Residence Index

Persistence	Oil Residence Index	Estimated Persistence
short	1	days to weeks
	2	**weeks** to months
↓	3	weeks to **months**
	4	**months** to years
long	5	months to **years**

Table A-7 Look-Up Table of Calculated ORI Classes Defined by Shore Type and Exposure

Shore Type	Calculated Exposure					
CLASS	VE	E	SE	SP	P	VP
1	1	1	1	2	3	3
2	1	1	1	2	3	3
3	1	1	1	2	3	3
4	1	1	1	2	3	3
5	1	1	1	2	3	3
6	2	3	5	4	4	4
7	2	3	5	4	4	4
8	2	3	5	4	4	4
9	2	3	5	4	4	4
10	2	3	5	4	4	4
11	1	2	3	4	5	5
12	1	2	3	4	5	5
13	1	2	3	4	5	5
14	1	2	3	4	5	5
15	1	2	3	4	5	5
16	1	2	3	3	4	4
17	1	2	3	3	4	4
18	1	2	3	3	4	4
19	1	2	3	3	4	4
20	1	2	3	3	4	4
21	2	3	5	4	4	4
22	2	3	5	4	4	4
23	2	3	5	4	4	4
24	1	2	3	4	5	5
25	1	2	3	4	5	5
26	1	2	3	4	5	5
27	2	2	3	3	4	4
28	2	2	3	3	4	4
29	999	999	999	3	3	3
30	2	2	3	3	4	4
31	5	5	5	5	5	5
32	2	2	3	3	5	5
33	1	1	1	2	2	2
34	999	999	999	4	4	4

Note: 999 combination should not occur; requires operator override

Table A-8 Summary of Data Fields in the BioUnit Database

Field Names	Type	Description
UnitRecID	I	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
EXP_BIO	T	exposure estimated from biota indicator species
HAB_CLASS	T	observed habitat based on morphology and EXP_BIO
HAB_OBS	I	observed habitat
HAB_CALC	I	predicted habitat based on BC_CLASS and EXP_CALC
BIO_SOURCE	T	data sources for biological interpretation
RIPARIAN%	I	% occurrence of coastal riparian (terrestrial vegetation overhang within the unit)
RIPARIAN_M	I	length of coastal riparian in meters
BIO_UNIT_COMMENT	T	comment field
BIO_MAPPER	T	last name of biology mapper
BIO_MAP_DATE	D/T	date of biological mapping
HAB_OBS_OVERRIDE	Y/N	yes/no if HAB_OBS is over-ride of HAB_CALC lookup
Photo	Y/N	yes/no if there is a photo (digital or slide) or a ground station

Data Dictionary for BioUnit Databases

Field Name	Type	Description
UnitRecID	N	unique id for each record
PHY_IDENT	T	unique Physical Ident number for the unit, a combination of region, area, unit, and sub-unit. (RR/AA/UUUU/SS)
EXP_BIO	T	an estimate of the exposure based on observed indicator species.
HAB_CLASS	T	Habitat Classification determined by the BIO mapper, that combines the EXP_BIO and the Physical features of the shoreline (see Table A-9).
HAB_OBS	N	the observed biotic assemblage from the imagery
HAB_CALC	N	the predicted biotic assemblage from the mapped BC_Class and the EXP_CALC
BIO_SOURCE	T	the source that was used to interpret shore-zone biota, (V)ideotape, (S)lide, (I)nferred
RIPARIAN%	T	estimate of the percentage of shoreline of the unit shaded by overhanging riparian vegetation, all substrate types
RIPARIAN_M	T	length, in meters, of the unit shaded by overhanging riparian vegetation, all substrate types
BIO_UNIT_ COMMENT	T	comment field
BIO_MAPPER	T	the last name of the biologist that provided the biological interpretation of the imagery.
BIO_MAP_DATE	D	the date of the bio mapping
HAB_OBS_OVER RIDE	Y/N	describes if the lookup code for Hab_Obs is over-ridden by the biomapper
Photo	Y/N	describes if there is a photo (digital or slide) or a ground station associated with the unit

Table A-9 Habitat Class Definitions for Katmai National Park

Hab_Class Code	Exp_ Bio	Habitat Class Name	Definition
20	E	Exposed, Stable Substrate	Stable substrate; rock, rubble or large boulders Wide VER Possible biobands: CHB, BAR, RED, BMU, ALA, NER, ALF; RED band usually includes corallines
21	E	Exposed, Partially Mobile Substrate	Some substrate stable, some mobile Wide VER; Often bare due to sediment mobility Possible biobands; BAR, RED, BMU, ALA, CHB, NER, ALF RED band usually includes corallines
22	E	Exposed, Mobile Substrate	Mobile substrate (sand/gravel) Possible bioband: GRA No other biobands due to sediment mobility
23	E	Exposed, Estuary	Does not occur in Katmai
24	E	Exposed, Current Channel	Does not occur in Katmai
30	SE	Semi-Exposed, Stable Substrate	Stable substrate; rock, rubble, large boulders Wide-Medium VER Possible biobands: BAR, FUC, BMU, ULV, RED, ALA, SBR, CHB, SUR, ALF, NER
31	SE	Semi-Exposed, Partially Mobile Substrate	Some substrate stable, some mobile Wide-Medium VER Possible biobands: BAR, FUC, BMU, ULV, RED, ALA, SBR, CHB, SUR, ALF, NER
32	SE	Semi-Exposed, Mobile Substrate	Mobile substrate (sand/gravel) Possible biobands: GRA, PUC Usually no other biobands due to sediment mobility
33	SE	Semi-Exposed, Estuary	Uncommon, might occur behind SE beach berm Possible biobands: GRA, PUC, SED, FUC, ULV, BMU, ZOS
34	SE	Semi-Exposed, Current Channel	Tidal current dominated causing higher Exp_Bio than adjacent units. Usually bedrock substrate. Medium VER Possible biobands: BAR, BMU, FUC, ULV, RED, ALA, SBR, CHB, NER, ALF, ZOS
40	SP	Semi-Protected, Stable Substrate	Stable substrate; rock, rubble, boulder, cobble Medium-Narrow VER Possible biobands: BAR, FUC, BMU, ULV, RED, HAL, SBR, ALA, NER
41	SP	Semi-Protected, Partially Mobile Substrate	Some substrate stable, some mobile Medium-Narrow VER Possible biobands: BAR, FUC, BMU, ULV, RED
42	SP	Semi-Protected, Mobile Substrate	Mobile sediment (sand/pebble) Often bare Possible biobands: PUC, GRA, SED, BAR, FUC, BMU, ULV, SBR, RED, HAL, ZOS
43	SP	Semi-Protected, Estuary	Freshwater input with marsh features, delta form Narrow VER where suitable substrate occurs Possible biobands: PUC, GRA, SED, FUC, BAR, BMU, ULV, ZOS
44	SP	Semi-Protected, Current Channel	Tidal current dominated causing higher Exp_Bio than adjacent units. Usually bedrock substrate. Narrow VER Possible biobands: BAR, BMU, FUC, ULV, RED, HAL, SBR, NER, ZOS

50	P	Protected, Stable Substrate	Immobile substrate; rock, rubble, boulder, cobble, pebble Narrow VER Possible biobands: BAR, FUC, BMU, ULV, SBR
51	P	Protected, Partially Mobile Substrate	Some substrate stable, some mobile Narrow VER Possible biobands: PUC, GRA, SED, BAR, FUC, BMU, ULV, ZOS
52	P	Protected, Mobile Substrate	Sediment (sand/mud) even in low exposure
53	P	Protected, Estuary	Freshwater input with marsh features, delta form Narrow VER where suitable substrate occurs Possible biobands: PUC, GRA, SED, FUC, BAR, BMU, ULV, ZOS
54	P	Protected, Current Channel	Tidal current dominated causing higher Exp_Bio than adjacent units. Usually bedrock substrate. Narrow VER where suitable substrate occurs Possible biobands: BAR, BMU, FUC, ULV, ZOS
60	VP	Very Protected, Stable Substrate	Does not occur in Katmai
61	VP	Very Protected, Partially Mobile	Some substrate stable, some mobile Narrow VER Possible biobands: PUC, GRA, SED, BAR, FUC, BMU, ULV, ZOS
62	VP	Very Protected, Mobile Substrate	Sediment (sand/mud) even in low exposure
63	VP	Very Protected, Estuary	Freshwater input with marsh features, delta form Narrow VER where suitable substrate occurs Possible biobands: PUC, GRA, SED, FUC, ULV, ZOS
64	VP	Very Protected, Current Channel	Does not occur in Katmai

Note: In Katmai, there were no shore units characterized by Very Exposed wave exposure, nor were there anthropogenically-modified shorelines. Tidewater glaciers, seen in other regions of Alaska, were not observed in the Katmai National Park region.

Table A-10 Summary of Data Fields in the Component Database (XSHR)

Field Names	**Type**	**Description**
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT
ZONE	T1	portion of shore-zone: supratidal, intertidal, subtidal
COMPONENT	Is	number of component
Form1	T20	descriptor of primary morphology of component
MatPrefix1	T1	descriptor holding "v" = veneer surface layer
Mat1	T20	descriptor of sediment of Form1
FormMat1Txt	T50	Translation sentence descriptor
Form2	T20	descriptor of primary morphology of component
MatPrefix2	T1	descriptor holding "v" = veneer surface layer
Mat2	T20	descriptor of sediment of Form2
FormMat2Txt	T50	Translation sentence descriptor
Form3	T20	descriptor of primary morphology of component
MatPrefix3	T1	descriptor holding "v" = veneer surface layer
Mat3	T20	descriptor of sediment of Form3
FormMat3Txt	T50	Translation sentence descriptor
Form4	T20	descriptor of primary morphology of component
MatPrefix4	T1	descriptor holding "v" = veneer surface layer
Mat4	T20	descriptor of sediment of Form4
FormMat4Txt	T50	Translation sentence descriptor
WIDTH	Is	average width of the primary component in metres
SLOPE	Is	estimated slope of primary component
PROCESS	T4	dominant coastal process modifying the primary component
COMPONENT_ORI	I	an estimate by the GeoMapper of the ORI of the primary component

Data Dictionary for Across-Shore Component Databases (XSHR)

(Adapted from methods and codes outlined in Howes *et al* 1994)

Field Name	Type	Description
UnitRecId	N	the record number of the Unit to which the component is related
XshrRecID	N	a unique record number for each X-SHR record
PHYS_IDENT	T	unique id combining the region-area-unit-subunit fields (see UNIT Table data dictionary, above).
CROSS_LINK	T	a unique alphanumeric id combining the region-area- unit-subunit-zone-component fields
ZONE	T	a text code indicating the across-shore position of the component: (A) supratidal, (B) intertidal or (C) subtidal zone
COMPONENT	N	further subdivision of Zones, numbered from highest elevation in across-shore profile within Zone to lowest.
Form1	T	describes primary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix1	T	veneer indicator field; blank = no veneer; “v” = veneer
Mat1	T	describes substrate associated with primary form (see Table A-12 for codes)
FormMat1Txt	T	translation of Form and Material codes into a sentence descriptor
Form2	T	describes secondary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix2	T	veneer indicator field; blank = no veneer; “v” = veneer
Mat2	T	describes substrate associated with secondary form (see Table A-12 for codes)
FormMat2Txt	T	translation of Form and Material codes into a sentence descriptor
Form3	T	describes tertiary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix3	T	veneer indicator field; blank = no veneer; “v” = veneer
Mat3	T	describes substrate associated with tertiary form (see Table A-12 for codes)
FormMat3Txt	T	translation of Form and Material codes into a sentence descriptor
Form4	T	describes forth most common physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix4	T	veneer indicator field; blank = no veneer; “v” = veneer
Mat4	T	describes substrate associated with forth-order form (see Table A-12 for codes)
FormMat4Txt	T	translation of Form and Material codes into a sentence descriptor
WIDTH	N	the mean across-shore width of the component in meters.
SLOPE	N	the estimated across-shore slope of the component in degrees; not coded in Carr Inlet
PROCESS	T	the dominant coastal process affecting the morphology of the component (F)luvial, (M)asswasting, (W)aves, (C)urrents, (O)ther, (E)olean
COMPONENT_ ORI	N	a numeric index between 1 and 5 that indicates the potential oil residency based on Table A-13

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

A = Anthropogenic

a	dolphin
b	breakwater
c	log dump
d	derelict shipwreck
f	float
h	shell midden
I	cable/ pipeline
j	jetty
k	dyke
m	marina
n	ferry terminal

log booms

p	port facility
q	aquaculture
r	boat ramp
s	seawall
t	landfill, tailings
w	wharf
x	outfall or intake
y	intake

B = Beach

b	berm
c	washover channel
f	face
I	inclined (no berm)
m	multiple bars&troughs
n	relic ridges, raised
p	plain
r	ridge (single intertidal bar)
s	storm ridge
t	low tide terrace
w	washover fan
v	veneer (modifier)

C = Cliff

a	eroding
p	passive
c	cave
f	fan, apron
g	surge channel
t	terraced
r	ramp

slope

I	inclined (20to35°)
s	steep (>35°)

Cliff cont.

height

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

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

ponds

r	ridge/swale
p	parabolic
v	veneer
w	vegetated

F = Reef

f	horizontal
I	irregular
r	ramp
s	smooth

I = Ice

g	glacier

L = Lagoon

open

c	closed

M = Marsh

f	drowned forest
h	high
l	mid to low (discontinuous)
c	tidal creek
e	levee

pond

s	brackish – supratidal
f	drowned forest

O = Offshore Island

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

elevation

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

P = Platform

f	horizontal
g	surge channel
h	high tide platform
I	irregular
l	low tide platform
r	ramp
t	terraced
s	smooth
p	tidepool

R = River Channel

a	perennial
t	intermittent
m	multiple channels
s	single channel

T = Tidal Flat

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

I = Ice

g	glacier

Table A-12 'Material' Code Dictionary. (after Howes *et al* 1994).

A = Anthropogenic

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

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

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

v sediment veneer

R = Bedrock
rock type:
I igneous
m metamorphic
s sedimentary
v volcanic

rock structure:
1 bedding
2 jointing
3 massive

U = Undefined

DESCRIPTION OF SUBSTRATE
Simplified from Wentworth scale

GRAVELS

boulder	> 25cm
cobble	6 to 25 cm
pebble	0.5 to 6 cm
granule	0.2 to 0.5 cm

SAND
from very coarse to very fine:
all between .5mm to 2 mm

FINES (MUD)
from silt to clay:
smaller than .5mm

[The 'material' descriptor consists of one primary term code and associated modifiers (e.g. Cskb, Ad). Up to three descriptors may be written in order of importance to describe each layer. If only one descriptor is used, indicated material comprises 75% of the volume of the layer (e.g.Cs), if more than one descriptor, they are ranked in order of volume. A surface layer can be described by prefix 'v' for veneer (e.g. vCsk).

Table A-13 Component ORI Matrix

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 w peb, cob, or boulder	1	2	3	4	5	5
sand v/o peb, cob, or boulder	2	2	3	3	4	4
mud	999	999	999	3	3	3
organics/vegetation	999	999	999	5	5	5
man-made, permeable	2	2	3	3	5	5

Table A-14 Summary of Data Fields in the BioBand Database

Field Names	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT
VER	T1	occurrence of Splash zone bioband
PUC	T1	occurrence of Wetland and other salt-tolerant herbaceous plants
GRA	T1	occurrence of Dune grasses.
SED	T1	occurrence of the Sedge bioband
BAR	T1	occurrence of Barnacle bioband
FUC	T1	occurrence of Rockweed bioband
ULV	T1	occurrence of Green algae bioband
HAL	T1	occurrence of Bleached red algae bioband
BMU	T1	occurrence of Blue mussel bioband
RED	T1	occurrence of Red algae bioband
ALA	T1	occurrence of *Alaria* bioband
SBR	T1	occurrence of Soft brown kelp band
CHB	T1	occurrence of the Chocolate brown kelp bioband
SUR	T1	occurrence of the Surfgrass bioband
ZOS	T1	occurrence of the Eelgrass bioband
ALF	T1	occurrence of the Dragon kelp band
NER	T1	occurrence of the Bull kelp bioband

Data Dictionary for BIOBAND Database

[Methodology described in Searing & Frith (1995)]

Field Name	Type	Description
UnitRecId	N	the record number of the Unit to which the component is related
XshrRecID	N	a unique record number for each X-SHR record
PHYS_IDENT	T	unique id combining the region-area-unit-subunit fields (see UNIT Table data dictionary, above).
CROSS_LINK	T	a unique alphanumeric id combining the region-area- unit-subunit-zone-component fields

Note: all Biobands are coded **P**atchy or **C**ontinuous (>50% cover) except the VER band, coded by width **N**arrow (<1m), **M**edium (1-5m) or **W**ide.(>5m) see Table B-1 for details.

Field Name	Type	Description
VER	T	bioband for 'VERrucaria' in supratidal splash zone
PUC	T	bioband for PUCcinellia and other salt tolerant grasses and herbs
GRA	T	bioband code for dune GRAsses of supra-tidal
SED	T	Bioband for mixed sedge of supratidal
BAR	T	bioband for continuous *Balanus/Semibalunus* BARnacle in upper intertidal
FUC	T	bioband for FUCus-/barnacle of upper intertidal
ULV	T	bioband for mixed filamentous and foliose green algae band, mid intertidal

Field Name	Type	Description
HAL	T	bioband for bleached mixed filamentous and foliose red algae.
BMU	T	bioband for blue mussels (*Mytilus trossulus)* of mid-intertidal, protected areas
RED	T	bioband for mixed filamentous and foliose RED algae of lower intertidal
ALA	T	pure stand of large or small morph of *Alaria spp*.
SBR	T	bioband for unstalked large-bladed laminarins; in the lower intertidal and nearshore subtidal
CHB	T	bioband for stalked bladed dark chocolate-brown kelps of lower intertidal/nearshore subtidal
SUR	T	bioband for green SURfgrass of lower intertidal
ZOS	T	bioband for *ZOStera* (eelgrass) of sheltered areas, lower intertidal and subtidal
ALF	T	nearshore dragon kelp bioband
NER	T	bioband for nearshore subtidal *NEReocystis* bull kelp

Table A-15 Summary of Data Fields in the BioSlide Database

Field Names	Type	Description
SlideID	N	unique slide ID value
UnitRecID	N	unique record number that relates across-shore records to a unit record
SlideName	T50	assigned slide name
TapeName	Date/ Time	Used to link data imagery to units
SlideDescription	T255	comments made by biomapper
ImageType	T10	"Digital or Slide"
FolderName	T50	name of folder containing slides
PhotoLink	Hyper-link	used to open digital photo

Data Dictionary for BIOSLIDE Database

Field Name	Type	Description
SlideId	N	a unique numeric ID given to each slide
UnitRecID	N	the record number of the Unit to which the component is related
SlideName	T	a unique alphnumeric name assigned to each slide or photo
TapeTime	D/T	combination of date (m/d/y) and time (hr:min:sec AM) when slide was taken

Field Name	Type	Description
SlideDescription	T	a text field used for comments made by the bioMapper to describe each slide
ImageType	T	either “Digital” photo or “Slide
FolderName	T	name of the folder where the images are stored-required to link images to the data
PhotoLink	H	clicking this link will open the photos related to each unit

Table A-16 Summary of Data Fields in the GroundStation Database

Field Names	Type	Description
StationID	N	unique ground station ID value
UnitRecID	N	unique record number that relates across-shore records to a unit record
Station	T50	ground station name
StationDescription	T255	description of ground station
Location	T50	location of ground station

Data Dictionary for GROUNDSTATION Database

Field Name	Type	Description
StationId	N	A unique numeric ID given to each ground station
UnitRecID	N	the record number of the Unit to which the component is related
Station	T	unique alphanumeric ID assigned to each ground station
StationDescription	T	a text field used for comments made by the bioMapper to describe each ground station
Location	T	location of each ground station

This table will link the ground station database to the aerial video mapping database. All ground stations are recorded in the unit where they were located, providing the spatial link, as well as the database link, between the two datasets.

APPENDIX B

Bioband Descriptions and Distributions

Table B - 1. Bioband Definitions: Shelikof Strait: Northwest coast of the Kodiak archipelago and the Katmai/Aniachak coast (Regions 6 and 7)

The presence of a bio-band — except the Splash Zone — is always recorded as either Patchy (P) 25%-50% coverage, or Continuous (C) 50%-100% coverage.

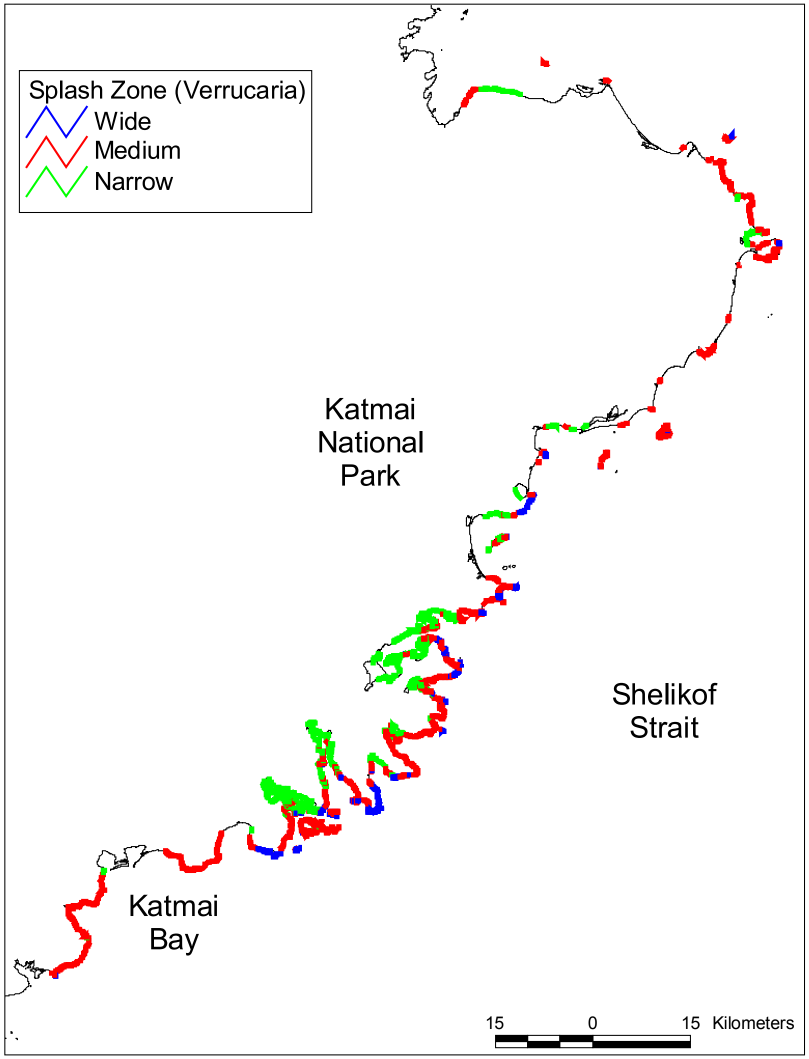
Zone	Bio-band Name	Database Label	Colour	Indicator Species	Description	Exposure	Associated Species
A	**Splash Zone**	**VER**	Black or bare rock	*Verrucaria sp*. Encrusting lichens	Visible as a dark band on bare rock, marking the upper limit of the intertidal zone. Occurs on bedrock or boulder/cobble shorelines, at all wave exposures. **Note:** This band is recorded by width Narrow (N) = less than 1m Medium (M) = 1m to 5m Wide (W) = more than 5m	Width varies with exposure N=VP-SP M=SP-SE W=SE-VE	*Enteromorpha sp.* *Hildenbrandia sp.* *Littorina sitkana* *Lottia sp.* *Neomolgus littoralis* *Tectura persona*
A	**Marsh grasses, herbs and sedges**	**PUC**	Light, bright or dark green; red or brown	*Puccinellia sp.* *Plantago maritima* *Triglochin sp.* *Carex sp.* *Honkenya peploides*	Occurs in wetlands around lagoons, marshes, and estuaries. Also appears on dunes, and can be distinguished from dune grass band by its colour.	VP-SE	other grasses and sedges
A	**Dune Grass**	**GRA**	Pale blue-green	*Elymus mollis*	Located in the upper intertidal zone, on dunes or beach berms. Dune grass is often the only band present on high-energy beaches.	VP-SE	*Honkenya peploides*
A	**Sedge**	**SED**	Bright green, yellow-green to red-brown. Often appears as a mosaic of greens.	*Carex ramenskii* *Carex lynbyei* *Carex sp.* *Eleocharis sp.* *Eriophorum sp.*	Appears in wetlands around lagoons and estuaries; always associated with freshwater. Tends to occur as a wide flat stand, often forming a circular pattern, and commonly bordered by a PUC band.	P-SE	* species referenced for this band from Cook Inlet ground survey reports: Bennett, 1996 and Tande, 1996.
B	**Rockweed**	**FUC**	Golden-brown to red-brown	*Fucus sp.*	Appears on bedrock, boulder, cobble or gravel. Commonly occurs at the same elevation as the barnacle band.	VP-E	*Pterosiphonia bipinnata* *Balanus sp.* *Semibalanus sp.* *Chthamalus dalli* *Mytilus trossulus* *Littorina sitkana*

B	**Barnacle**	**BAR**	Grey-white to pale yellow	*Balanus sp.* *Semibalanus sp.* *Chthamalus dalli*	Visible on bedrock or large boulders, this band can appear as a continuous frosting of barnacles, especially where overstory algae is absent. Generally occurs in upper intertidal, but at higher wave exposures, there is often a band of *Semibalanus* just above the waterline.	VP-E	*Endocladia muricata* *Pterosiphonia bipinnata* *Porphyra sp.* *Fucus sp.* *Neorhodomela sp.* *Mytilus trossulus* *Lottia sp.* *Littorina sitkana.*
B	**Green Algae**	**ULV**	Green	*Enteromorpha sp.* (usually in upper intertidal) *Ulva sp.* (usually in mid to low intertidal).	Found on a variety of substrates and includes filamentous and/or foliose species. Filamentous species often form a low turf of dark green in lower wave exposures. Foliose species often occur with red algae in a species-rich assemblage at higher exposures.	VP-SE	*Fucus sp.* *Pilayella sp.* *Alaria sp.* *Scytosiphon lomentaria* Diatom chains Filamentous and foliose red algae *Lottia sp.*
B	**Blue Mussel**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Occurs in dense clusters that form distinct black patches or bands above or below the barnacle band. Predation by *Pisaster sp* or *Nucella sp* causes this band to occur at higher elevations.	P-E	*Fucus sp.* *Pterosiphonia bipinnata* *Neorhodomela sp.* *Balanus sp.* *Chthamalus dalli* *Semibalanus cariosus* *Lottia sp.* *Littorina sitkana* *Nucella lima*
B	**Bleached Red Algae**	**HAL11**	Olive, golden or yellow-brown	Bleached foliose red algae including: *Palmaria sp.* *Halosaccion glandiforme*	Occurs on most substrates except fine sediments. Distinguished from the RED11 band by colour. Bleaching may be caused by a nutrient deficiency.	SP-SE	*Cryptosiphonia woodii* *Pterosiphonia bipinnata* *Neorhodomela sp* *Ulva sp.*
B	**Red Algae**	**RED11**	**Coralline:** pink or white **Foliose or filamentous**: Dark red, bright red or red-brown.	*Lithothamnion sp.* *Cryptosiphonia woodii* *Pterosiphonia bipinnata* *Odonthalia floccosa* *Palmaria sp.* *Porphyra sp.*	Occurs on most substrates except fine sediments. Lush coralline algae indicate high exposures; foliose red algae indicate moderate exposures, and filamentous species, often mixed with green algae, indicate moderate to low wave exposures.	SP-E	*Alaria sp.* *Fucus sp.* *Semibalanus cariosus* *Katharina tunicata* *Littorina sitkana*
B & C	**Alaria**	**ALA**	Dark brown or olive-brown	*Alaria marginata* morph	Occurs on bedrock cliffs and platforms, and boulder/cobble beaches. This often single-species band has a distinct ribbon-like texture, and may appear iridescent in some imagery.	SP-E	*Laminaria sp.* *Lithothamnion sp* Foliose red and green algae *Katharina tunicata.* *Nucella sp.* *Semibalanus cariosus* *Urticina crassicornis*

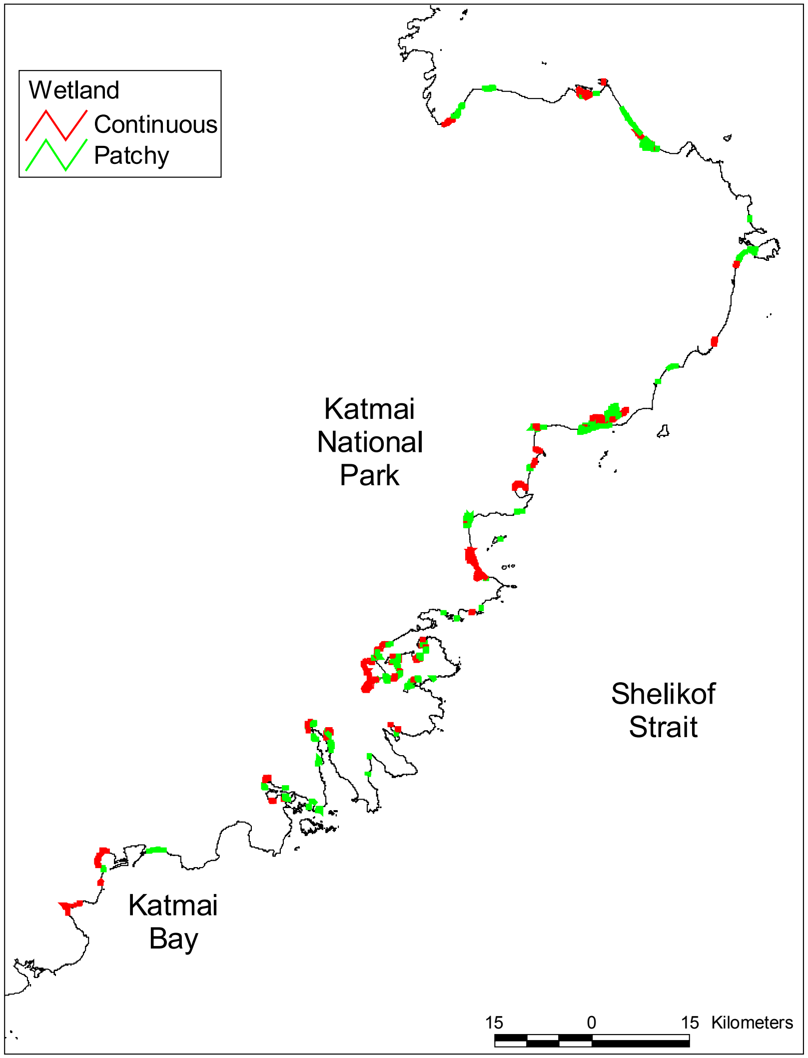
B & C	**Soft brown Kelp**	**SBR11**	Olive-brown or brown	*Laminaria saccharina* *Laminaria bongardiana* *Cystoseira sp.*	This band includes large brown algae characteristic of lower wave energy shores. Blades often have epiphytic diatoms and bryozoans, giving them a 'dusty' appearance.	P-SE	*Alaria sp.* *Cymathere sp.* *Costaria costata* *Zostera marina* Coralline red algae *Tonicella sp.*
B & C	**Stalked Dark Brown Kelp**	**CHB11**	Dark chocolate brown	*Cymathere triplicata* *Laminaria bongardiana* *Alaria marginata* morph	Kelps in this band occur in the lower intertidal and upper subtidal zones in higher wave exposures. Blades are leathery and shiny. Limited distribution of this bioband in Katmai, as the primary indicator species for this band do not occur in this region. RED band more common than CHB at high exposures in Shelikof Strait.	SE-E	*Costaria costata* *Odonthalia floccosa* *Palmaria sp.* Coralline algae *Semibalanus sp.*
B	**Surfgrass**	**SUR**	Bright green	*Phyllospadix sp.*	Occurs in tidepools on rock platforms, often forming extensive beds. This species has a clearly defined upper exposure limit of semi-exposed. Easily confused with ZOS, which occasionally occurs in similar conditions where there is fine sediment on platforms.	SP-SE	*Laminaria bongardiana* *Alaria sp.* Foliose and coralline red algae Bleached red algae
B& C	**Eelgrass**	**ZOS**	Bright to dark green	*Zostera marina*	Occurs in estuaries, lagoons and channels, in low intertidal and subtidal zones. Eelgrass is usually found in areas with fine sediments, and grows in sparse patches or extensive dense meadows.	VP-SP	Filamentous and foliose green algae *Pilayella sp.* *Macoma sp.*
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with a long blade and hollow floating midrib. Occurs in nearshore habitats, and when found in association with NER, it occurs inshore of that band.	SP-SE	*Nereocystis luetkeana*
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	A distinctive canopy-forming nearshore kelp, with many long strap-like blades growing from a bulb atop a long stipe. This band usually occurs further offshore than *Alaria fistulosa,* and usually indicates high current areas when observed at lower wave exposures.	SP-E	*Alaria fistulosa* *Costaria costata* *Cymathere triplicate* *Laminaria sp.* Diverse assemblage of filamentous, foliose and coralline red algae

Bennett, A.J. 1996. Physical and Biological Resource Inventory of the Lake Clark National Park - Cook Inlet Coastline, 1994-96. Unpublished Report, US National Parks Service, Kenai, AK. 137pp.

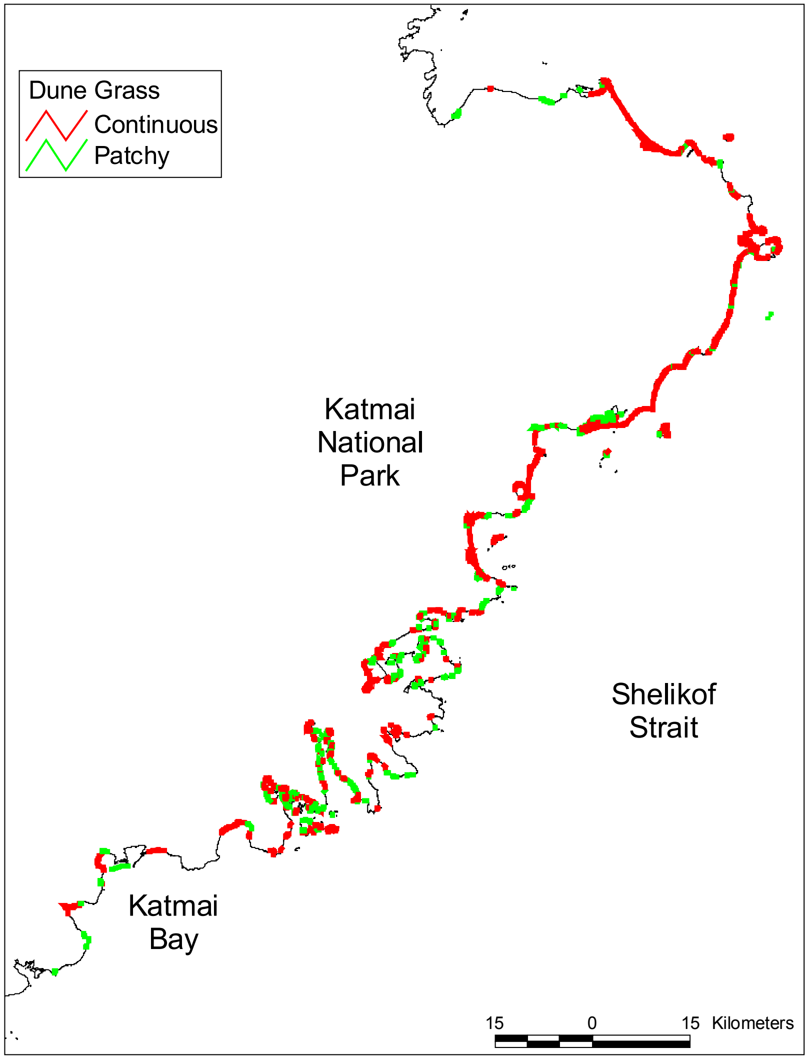
Tande, G.F. 1996. Mapping and Classification of Coastal Marshes. Lake Clark National Park and Preserve Alaska. Unpublished contract report for US National Parks Service, Lake Clark National Park and Preserve, Kenai, AK. 56pp

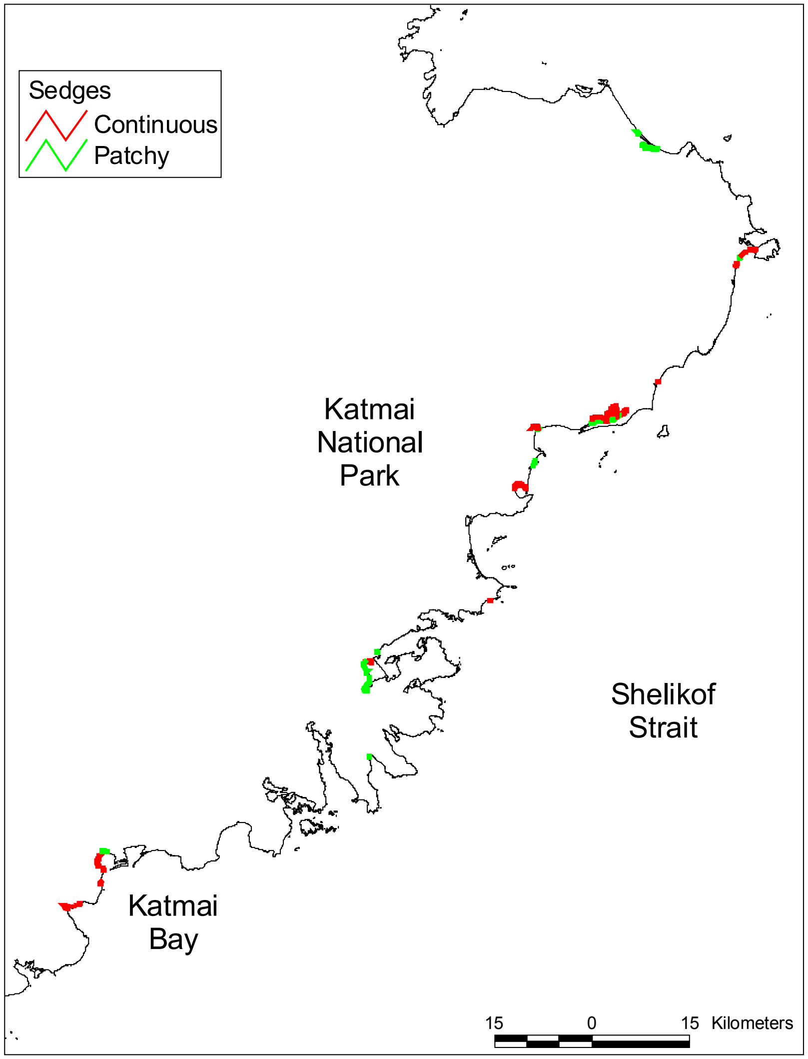


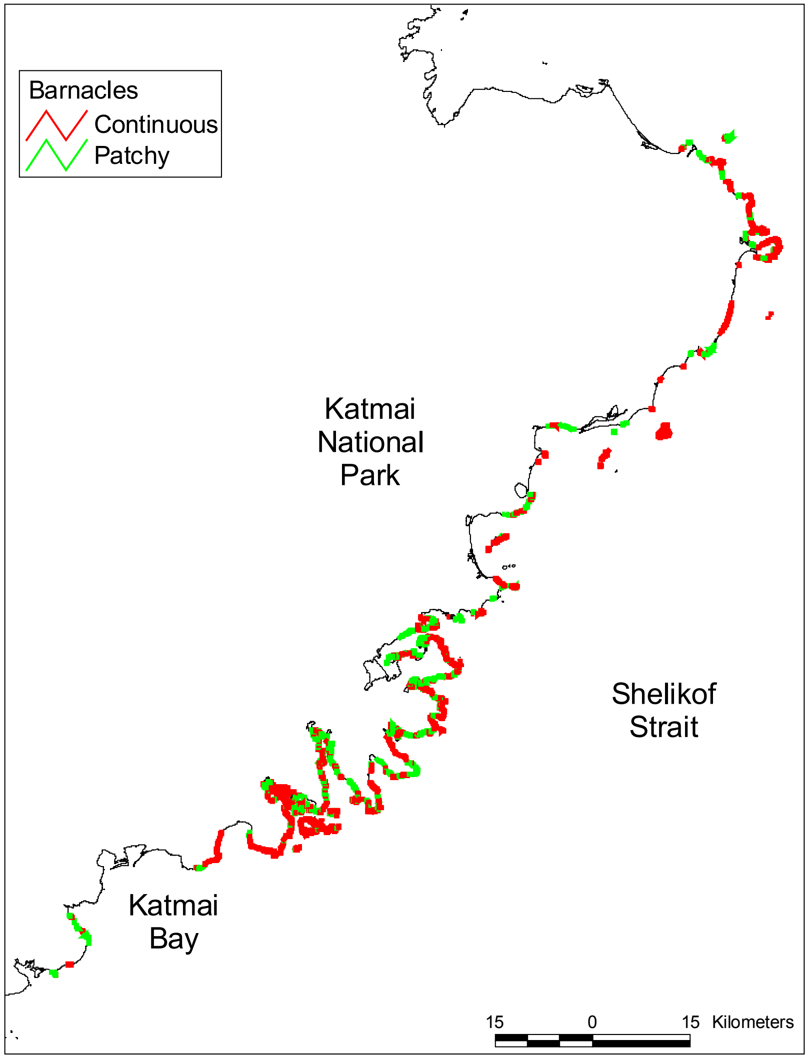
Splash Zone (Verrucaria)
Wide
Medium
Narrow
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15 0 15 Kilometers

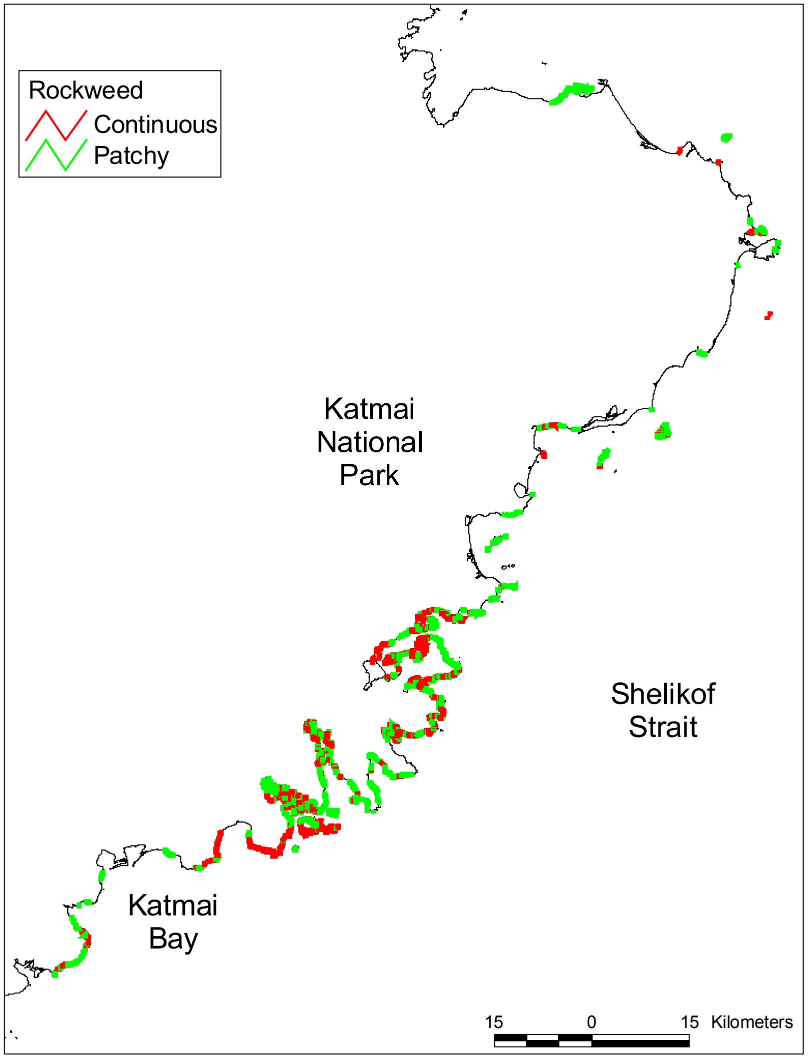


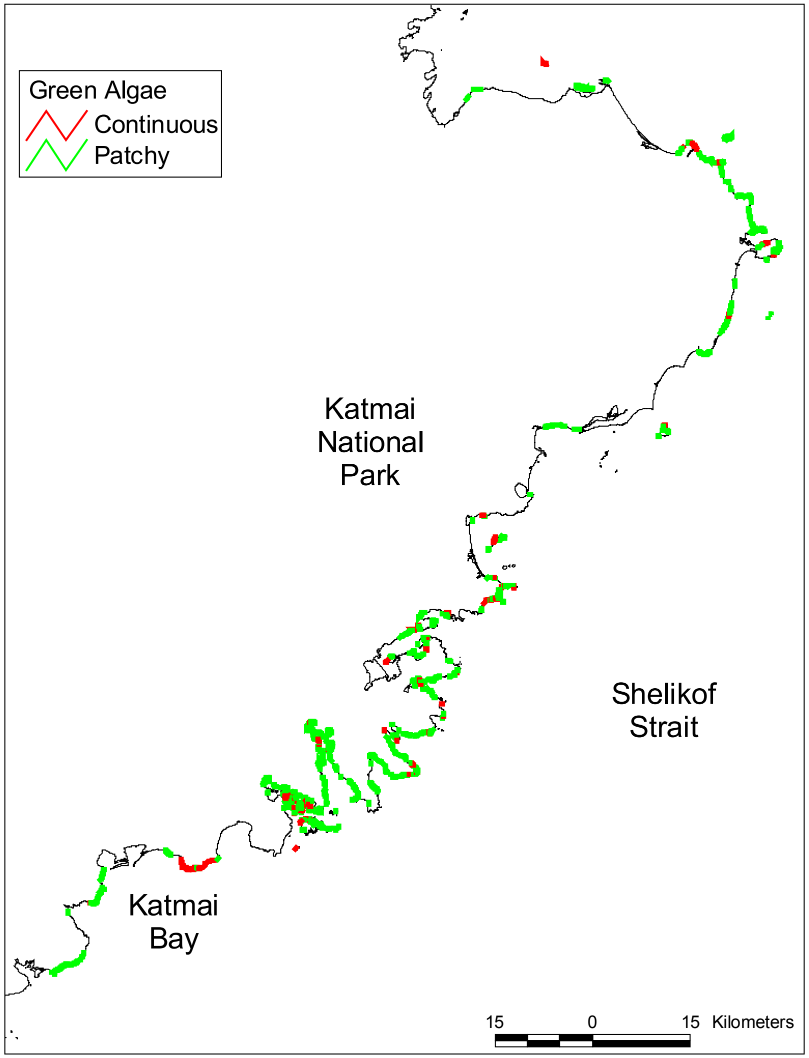
Wetland
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15 0 15 Kilometers

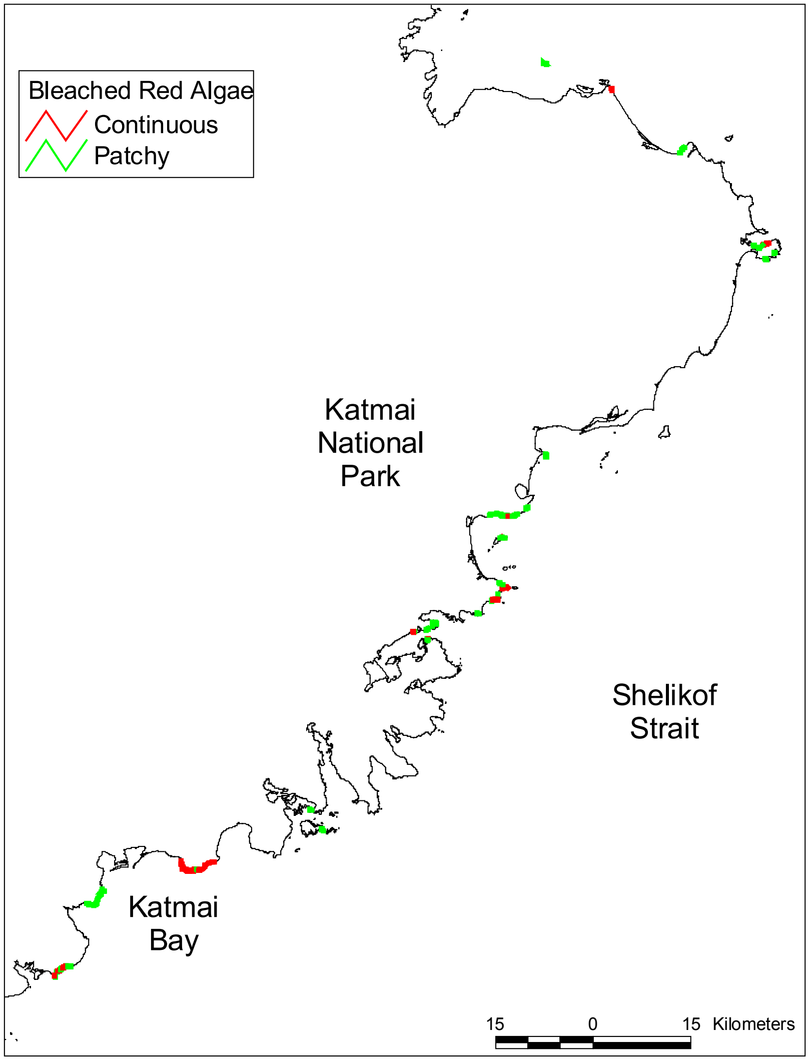

Dune Grass
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

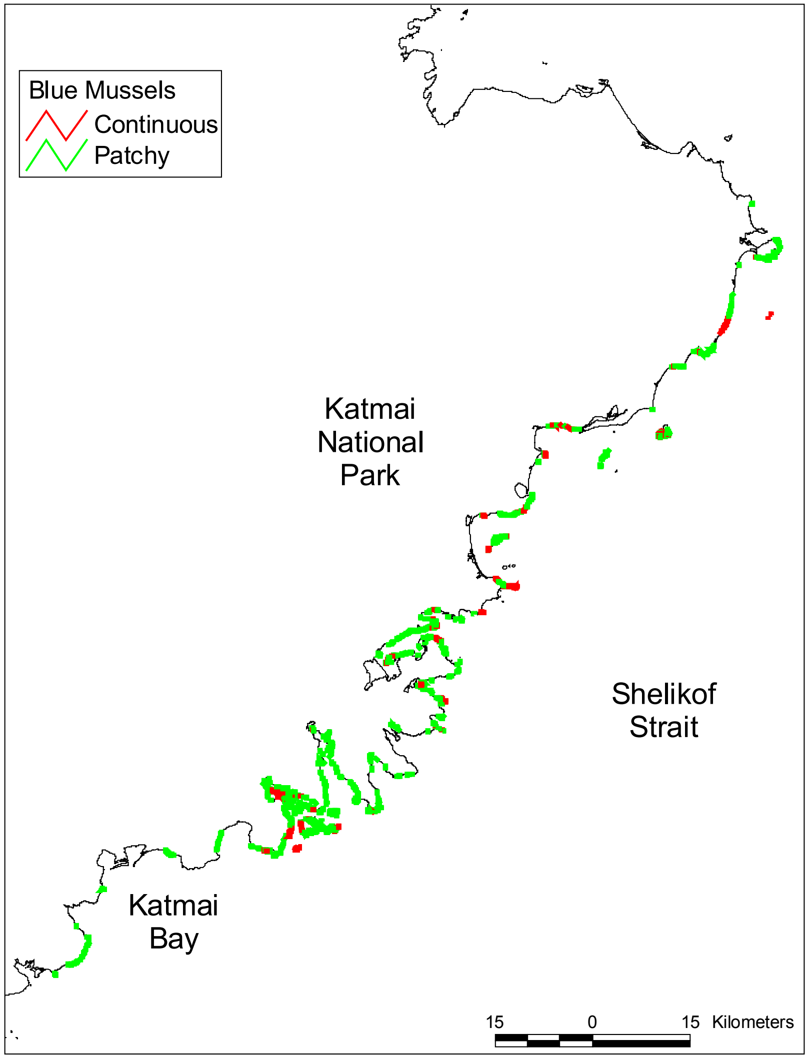

Sedges
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

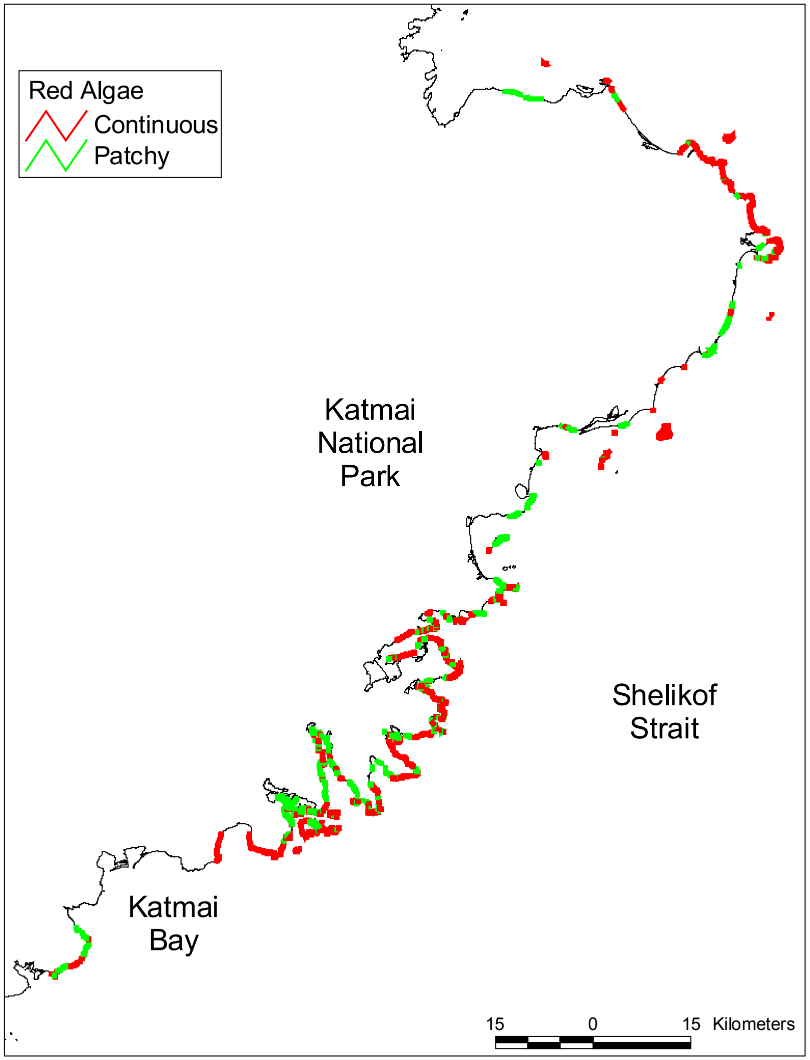

Barnacles
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15 0 15 Kilometers

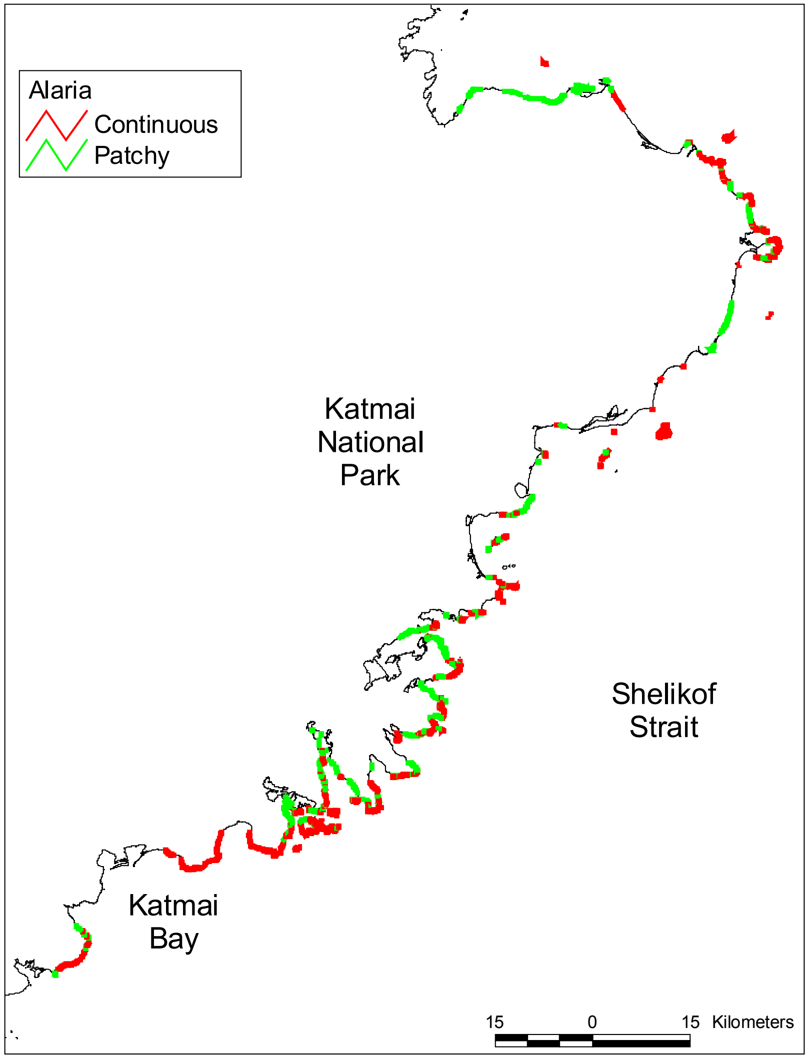

Rockweed
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15 0 15 Kilometers

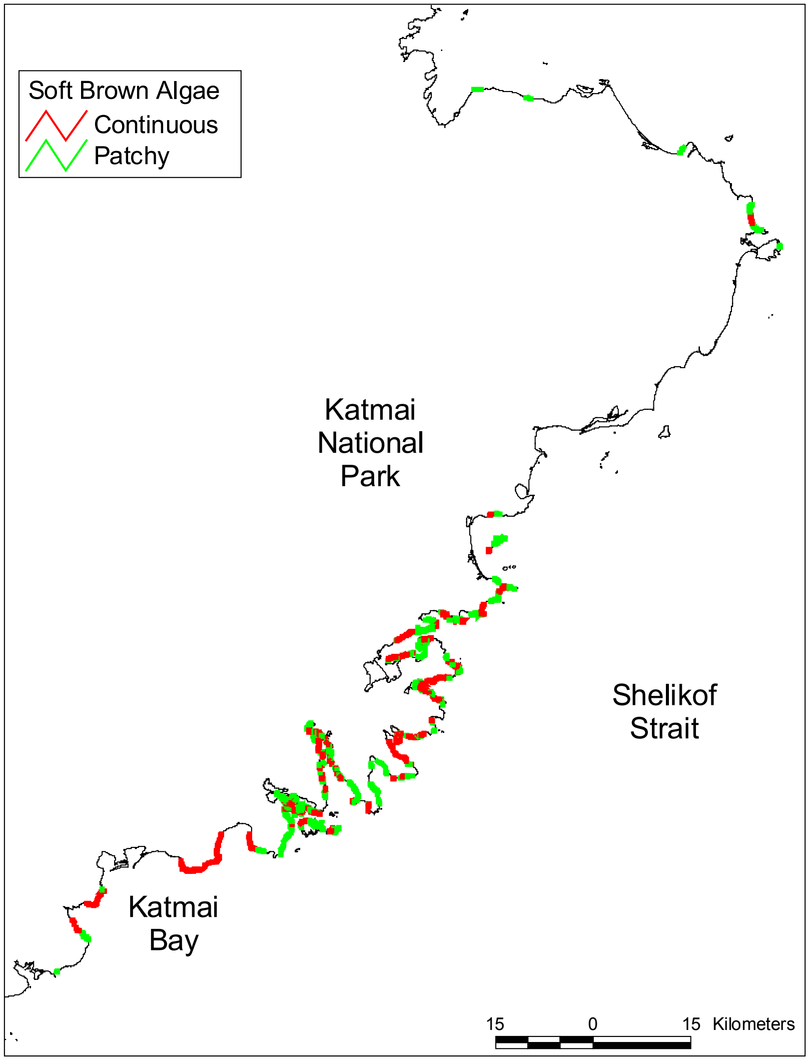

Green Algae
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

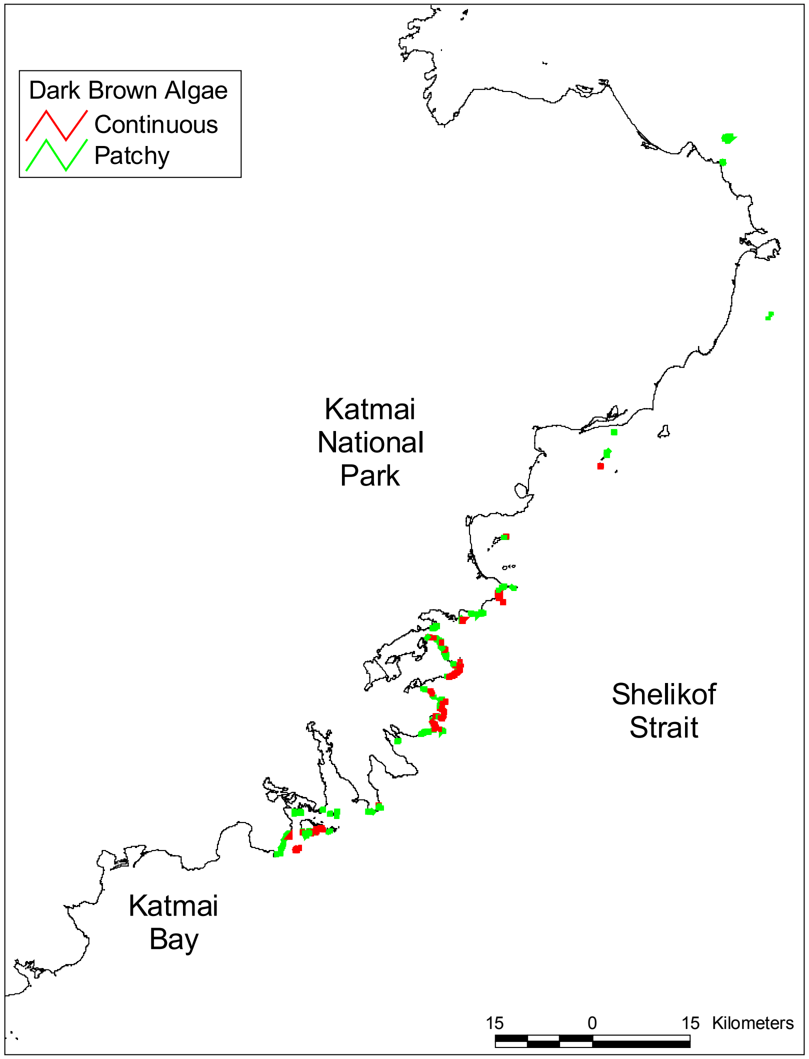

Bleached Red Algae
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

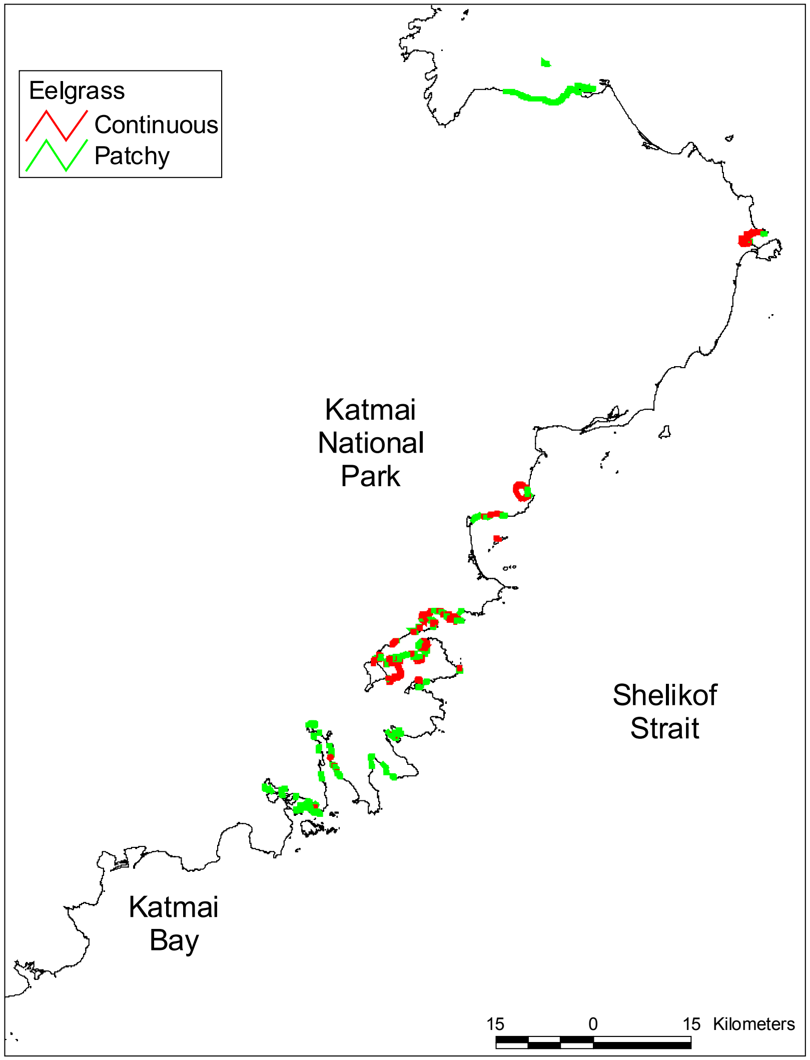

Blue Mussels
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

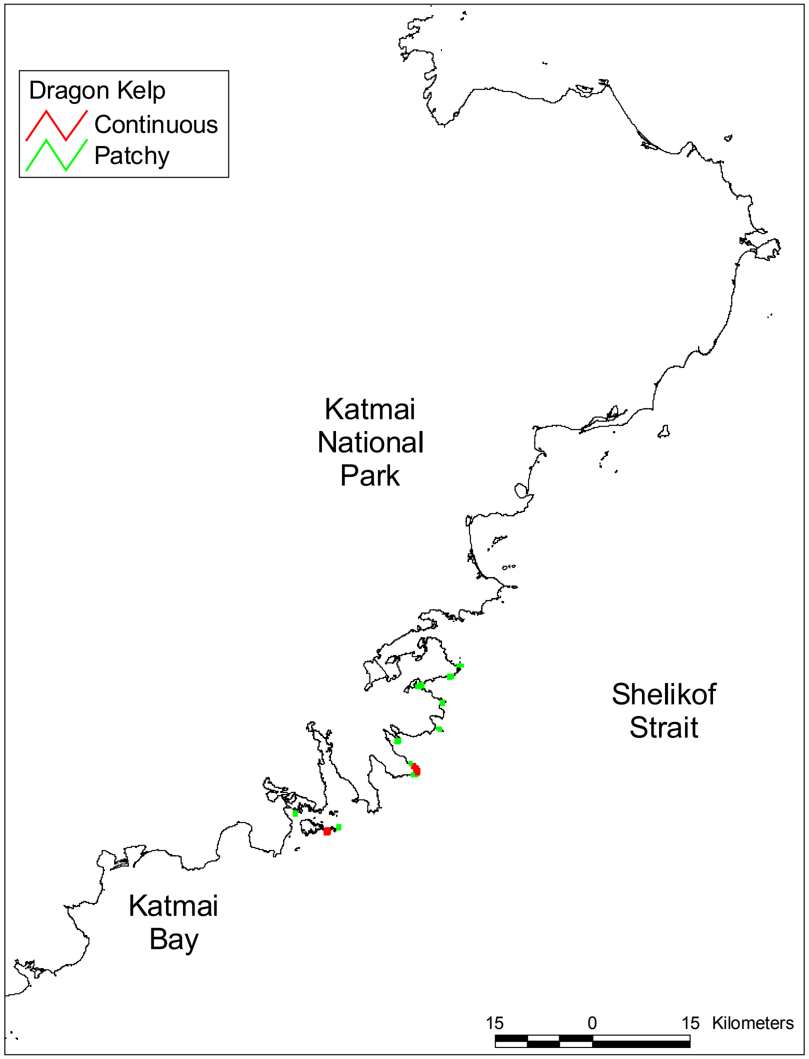

Red Algae
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

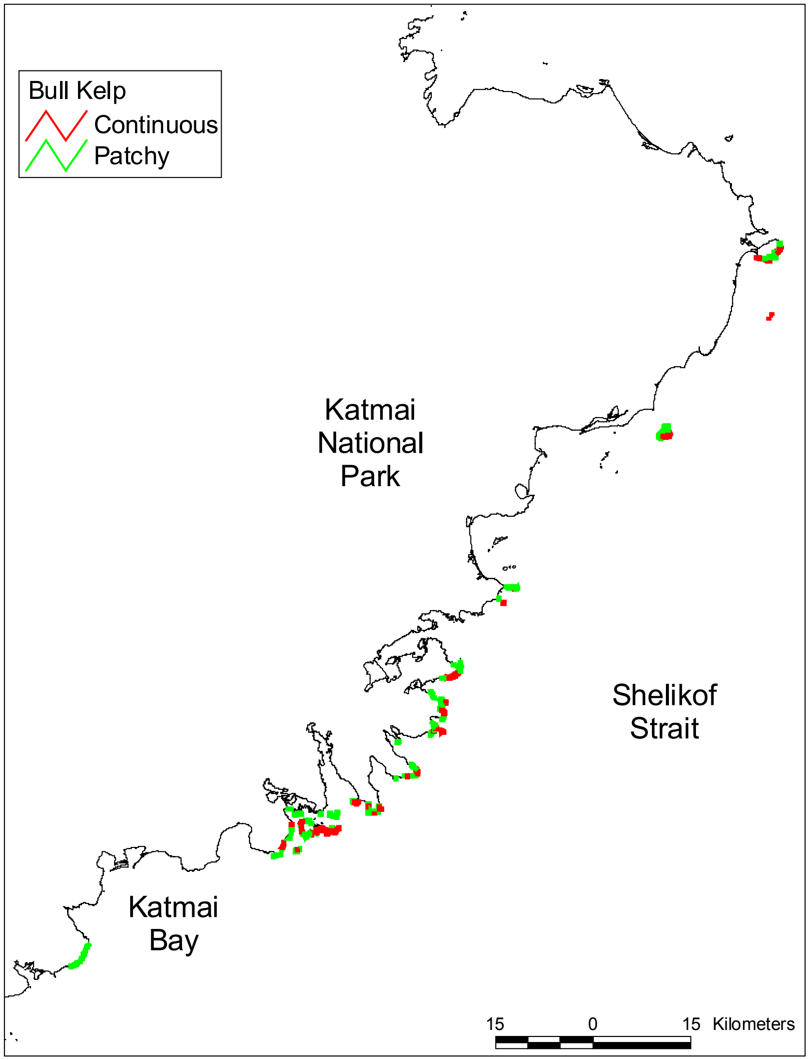

Alaria
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers


Soft Brown Algae
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers


Dark Brown Algae
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers


Eelgrass
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers


Dragon Kelp
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers


Bull Kelp
Continuous
Patchy
Katmai
National
Park
Shelikof
Strait
Katmai
Bay
15
0
15
Kilometers

APPENDIX C

Summary of Electronic Data Files

Electronic data files associated with the Katmai National Park ShoreZone data is as follows:

1) An Access97 database file [AVI_KatmaiNP_Database] with two geology tables (Unit and Xshr) and two biology tables (BioUnit and BioBand) containing all the mapped data. This database also includes links to aerial photos taken during the survey (tblBioSlide). Also included in the Access97 database are lookup tables for Habitat Class (Hab_Class) Habitat Observed (Hab_ObsClass), and the form and material codes (FormMatCodes). These lookup tables give descriptions of the codes in each of the related fields.

2) There are four photos folders containing all photos taken during the aerial survey [AVIpix2003-06-12, AVIpix2003-06-13, AVIpix2003-06-14, AVIpix2003-06-15]. These folders need to be in the same folder as the Access97 database in order for the photolinks in the database to work.

3) ArcView files in Albers projection for the point, line, and polygon data. The point, line, and polygon themes all have a Phy_Ident field which is the primary key linking the ShoreZone data to the master database. Files are also included containing the associated unit breaks, the flightline track, and the photo points. The ArcView shape file names are:

   - katmai_point_a.shp
   - katmai_line_a.shp
   - katmai_poly_a.shp
   - katmai_unitbreaks_a.shp
   - katmai_flightline_a.shp
   - katmai_photos_a.shp

4) A [metadata] folder containing metadata for the ArcView files explaining the source of the GIS data.