Coastal and Ocean Resources

MCORI Project: 20-08 **May 2021**

ShoreZone Habitat Mapping Summary Report

Sunshine Coast Survey Area

Merry Island Lighthouse, Merry Island

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The suggested citation for this report is:
Coastal and Ocean Resources, 2021. ShoreZone Habitat Mapping Summary Report: Sunshine Coast Survey Area. Produced for the Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, BC. Produced by Coastal & Ocean Resources, Victoria, BC. 36p + Appendices

Sunshine Coast Survey Area Summary

1,443 km of shoreline mapped

7,985 shoreline units created

Average unit length is **181 m**

37% of the intertidal is classified as **Rock-dominated** and **30%** is classed as **Rock and Sediment-dominated**

62% of the shoreline has a high Oil Residence Index value (residence of months to years)

7% of the shoreline has a **Shoreline Modification** of some type

15 biobands were classified in the **intertidal** with **Green Algae, Barnacle** and **Rockweed** being the most common (**over 88%** of units each)

9 biobands were classified in the **supratidal** with **Black Lichen** (**75%** of units) and **White Lichen** (**48%** of units) being the most common

7 biobands were classified in the **subtidal** with **Sargassum** being the most common (**44%** of units)

Stillwater

Algerine Passage

Tzoonie River, Narrows Inlet

Jervis Inlet

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1 INTRODUCTION

ShoreZone is an imaging and habitat classification system for the coastal nearshore margin including the shallow subtidal, intertidal shoreline and supratidal fringe. One objective of ShoreZone is to produce a georeferenced, searchable inventory of the physical and biological attributes of coastal habitats. ShoreZone imagery and habitat mapping attributes can provide a useful baseline from which to study change over time, while the attributes mapped (such as shoreline sediments, predicted oil residence and biotic communities) provide an important resource for scientists, managers and responders. The ShoreZone mapping system provides a decision support tool with many potential uses including community planning, facilities citing, conservation planning, research and fisheries management, emergency planning and response, search and rescue, education and habitat modeling.

The ShoreZone system was developed in the 1980s and 1990s to map coastal habitats in British Columbia and Washington State (Howes 2001; Berry *et al.* 2004). In 2001 ShoreZone was implemented in Alaska, beginning with Cook Inlet, Outer Kenai, Katmai, and portions of the Kodiak Archipelago (Harper and Morris 2004). ShoreZone has since expanded to a spatially continuous database of over 122,000 km of coastal Alaska, British Columbia, Washington State and Oregon (see Figure 1). Figure 2 shows the extent of the shoreline mapped around the Sunshine Coast and is the section of shoreline covered by this summary report.

The ShoreZone imaging surveys conducted around the Sunshine Coast of British Columbia in July 2020 acquired aerial video and digital still images of the coast during minus tides (zero-meter tide levels and lower). The imagery and associated audio commentary were used to map the physical and biological attributes of the shoreline. The entire shoreline was mapped according the most recent ShoreZone coastal habitat mapping protocol (Cook *et al*. 2017).The purpose of this report is to provide a summary of the physical (Section 2) and biological (Section 3) data imaged and classified in the British Columbia Sunshine Coast survey area. Please see the Acknowledgments section included in this report for the imaging and mapping funding partners in British Columbia.

The length of shoreline mapped is **1,443 kilometers** in **7,985 along-shore segments** (units), averaging 181 m in length. The digital shoreline used for the ShoreZone habitat mapping was the CHS_Highwaterline_BCalbers.shp.

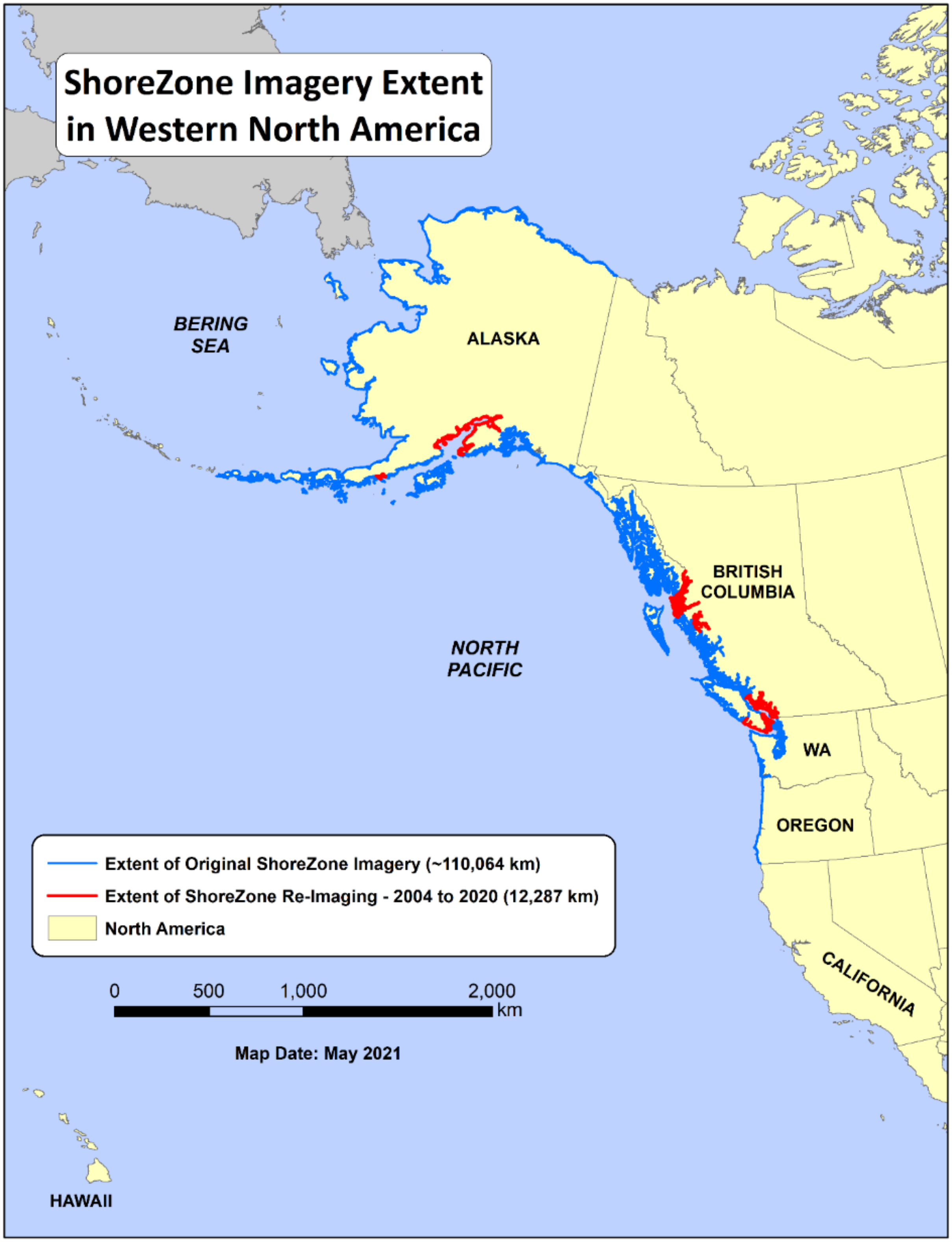

Figure 1. Extent of ShoreZone imagery in Alaska, British Columbia, Washington State and Oregon as of May 2021.

Figure 2. Extent of mapping for the Sunshine Coast of British Columbia covered in this report.

2 PHYSICAL ATTRIBUTE DATA SUMMARY

2.1 Coastal Class

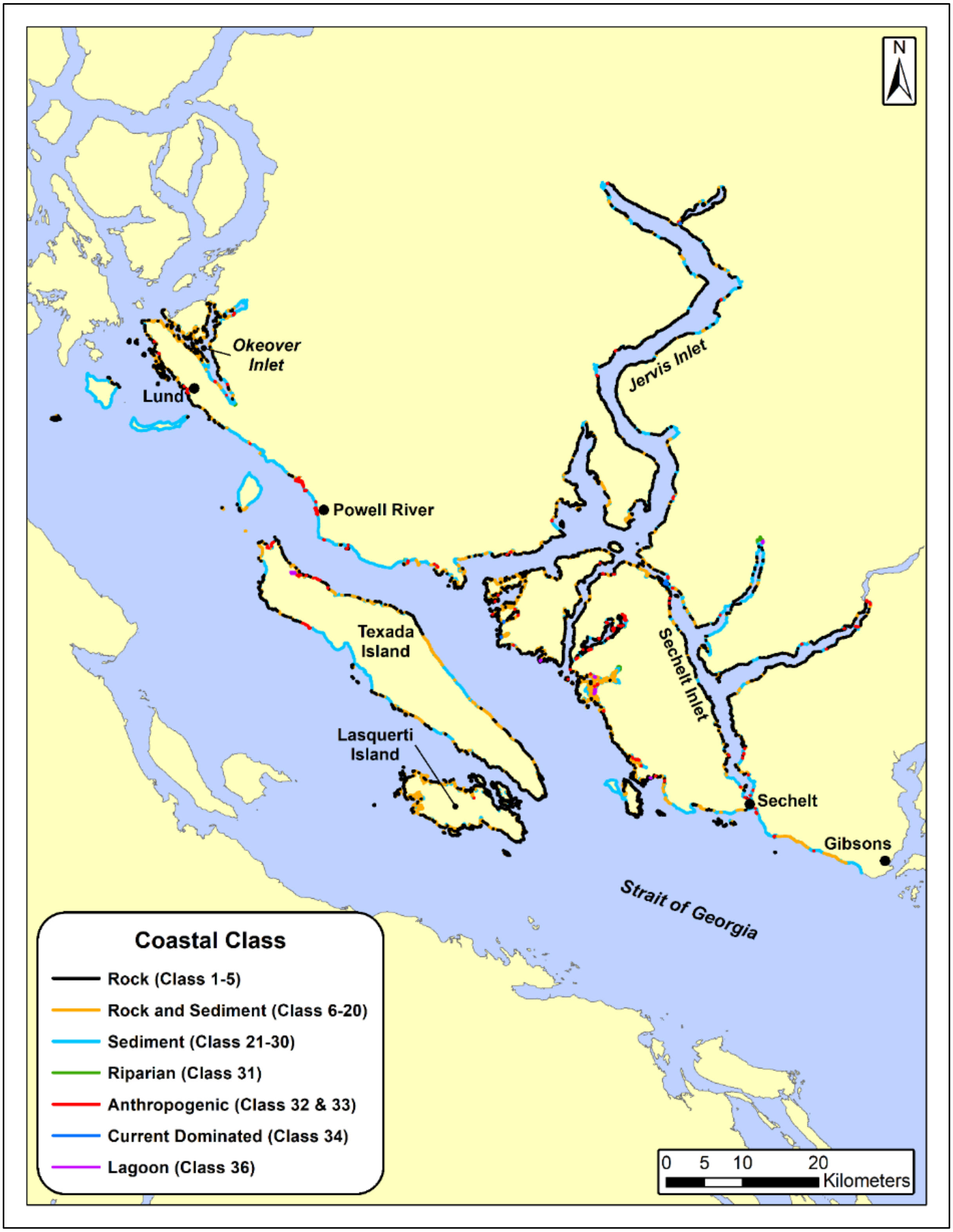

Figure 3. Map of the Coastal Class categories grouped by type (also known as Shore Type).

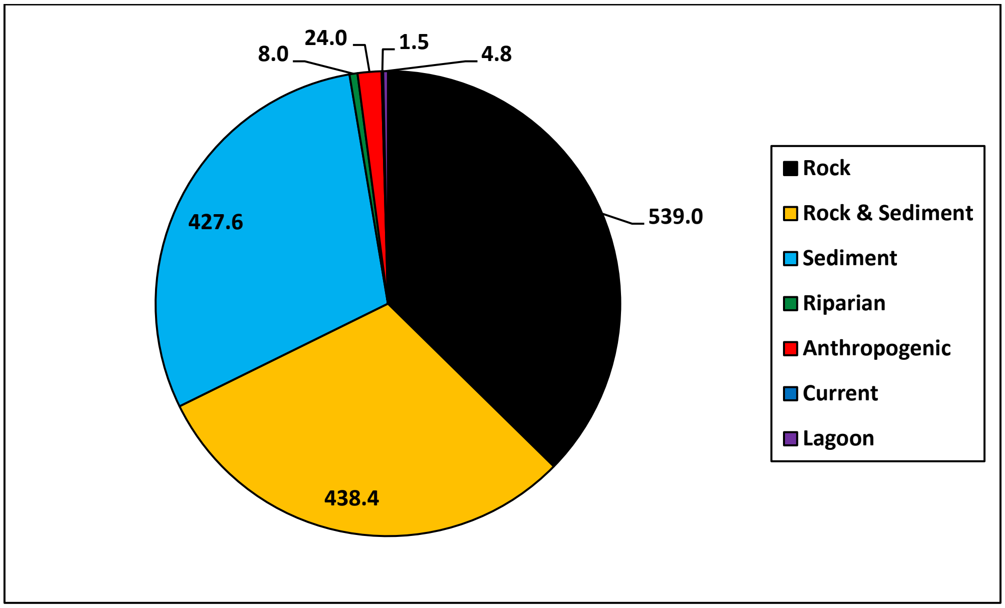

Figure 4. Grouped Coastal Class categories by shoreline length (km).

The Coastal Class is used to define along-shore coastal units based on the dominant process, geomorphic features and other attributes such as substrate size, across-shore width, and slope (Cook *et al*., 2017 after Howes *et al*., 1994). The principal characteristics of each along-shore unit are used to assign one of 39 overall unit classifications. Rock shorelines (37.3%) were prominent along with Rock and sediment shorelines (30.4%) and Sediment shorelines (29.6%) in the Sunshine Coast survey area. Riparian, Anthropogenic, Lagoon, and Current shorelines all comprised the rest of the coast (see Figures 3 and 4 for distribution and summary statistics). The description for each Coastal Class category in the survey area is given in Table 1. Photographic examples of the major Coastal Classes mapped in the Sunshine Coast survey area are found in Appendix A, Table A-1.

Table 1. Summary of Coastal Classes for the Sunshine Coast survey area.

Substrate Type	Shore Type No.	Shore Type Description	Sum of Unit Length (km)	# of Units	% Occurrence (by length)	Cumulative Occurrence (%, km)
Rock	1	Rock Ramp, wide	1	15	<1	37% 539 km
	2	Rock Platform, wide	2	13	<1	
	3	Rock Cliff	484	2,055	34	
	4	Rock Ramp, narrow	52	427	4	
	5	Rock Platform, narrow	1	7	<1	
Rock & Sediment	6	Ramp w gravel beach, narrow	3	20	<1	30% 438 km
	7	Platform w gravel beach, wide	1	7	<1	
	8	Cliff with gravel beach	123	818	9	
	9	Ramp with gravel beach	95	700	7	
	10	Platform with gravel beach	1	5	<1	
	11	Ramp w gravel & sand beach,	54	346	4	
	12	Platform with G&S beach, wide	22	126	2	
	13	Cliff with gravel/sand beach	42	395	3	
	14	Ramp with gravel/sand beach	96	833	7	
	15	Platform with gravel/sand beach	<1	1	<1	
	16	Ramp w sand beach, wide	2	9	<1	
	17	Platform w sand beach, wide	1	7	<1	
	18	Cliff with sand beach	<1	6	<1	
	20	Platform w sand beach, narrow	<1	1	<1	
Sediment	21	Gravel flat, wide	<1	4	<1	30% 436 km
	22	Gravel beach, narrow	34	214	2	
	24	Sand & gravel flat or fan	212	833	15	
	25	Sand & gravel beach, narrow	134	800	9	
	26	Sand & gravel flat or fan	<1	3	<1	
	27	Sand beach	<1	1	<1	
	28	Sand flat	43	111	3	
	29	Mudflat	4	9	<1	
	30	Sand beach	1	4	<1	
Organics	31	Organics/Estuarine	8	27	1	1% 8 km
Man-made	32	Man-made, permeable	23	153	2	2% 24 km
	33	Man-made, impermeable	1	10	<1	
Current	34	Channel	2	13	<1	<1% 2 km
Lagoon	36	Lagoon	5	12	<1	<1% 5 km
Totals:			***1,443***	***7,985***	***100***	***100%***

Note: This table only includes Coastal Classes observed in the survey area.

2.2 Environmental Sensitivity Index (ESI)

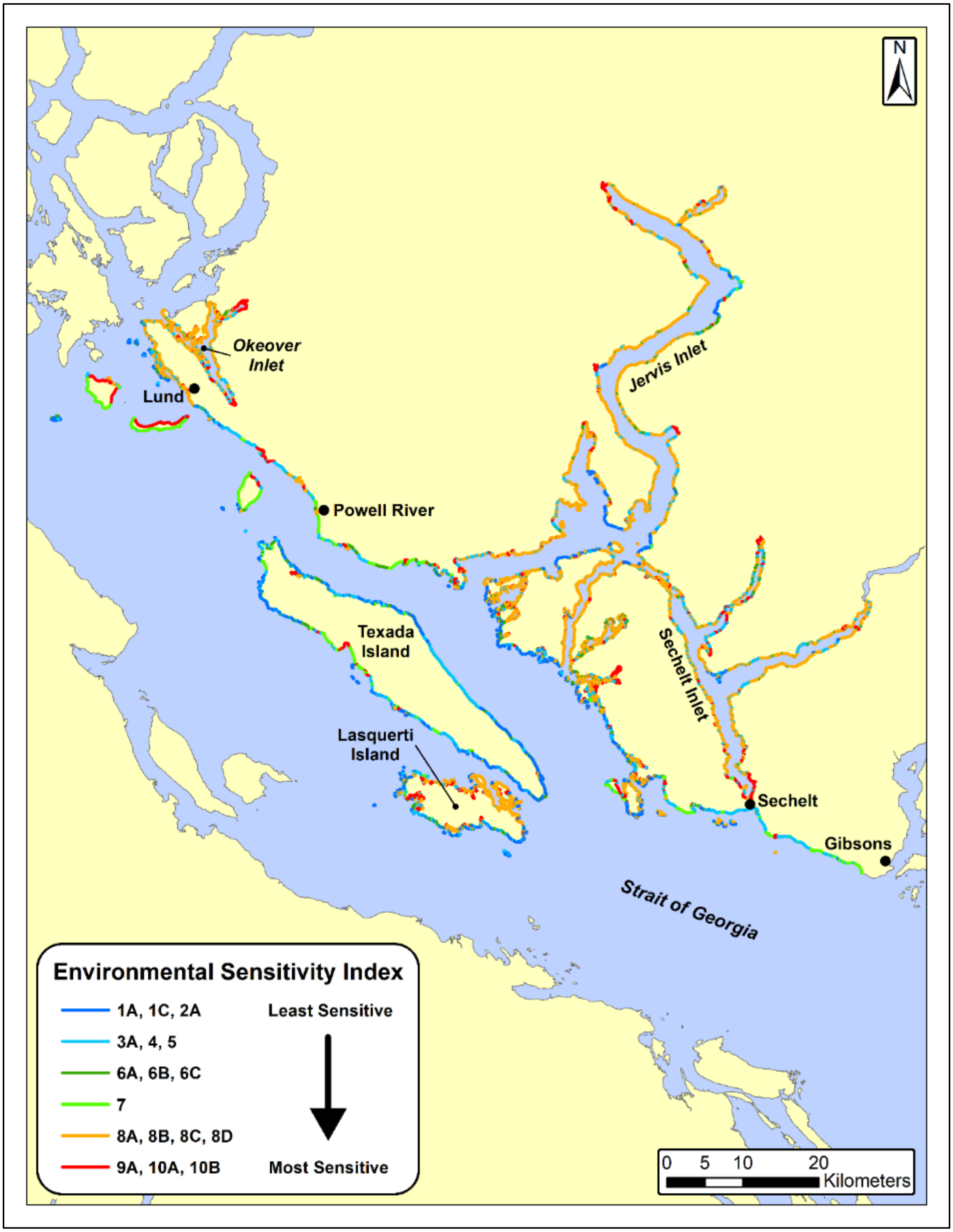

Figure 5. Distribution of the grouped ESI categories from least to most sensitive to oiling.

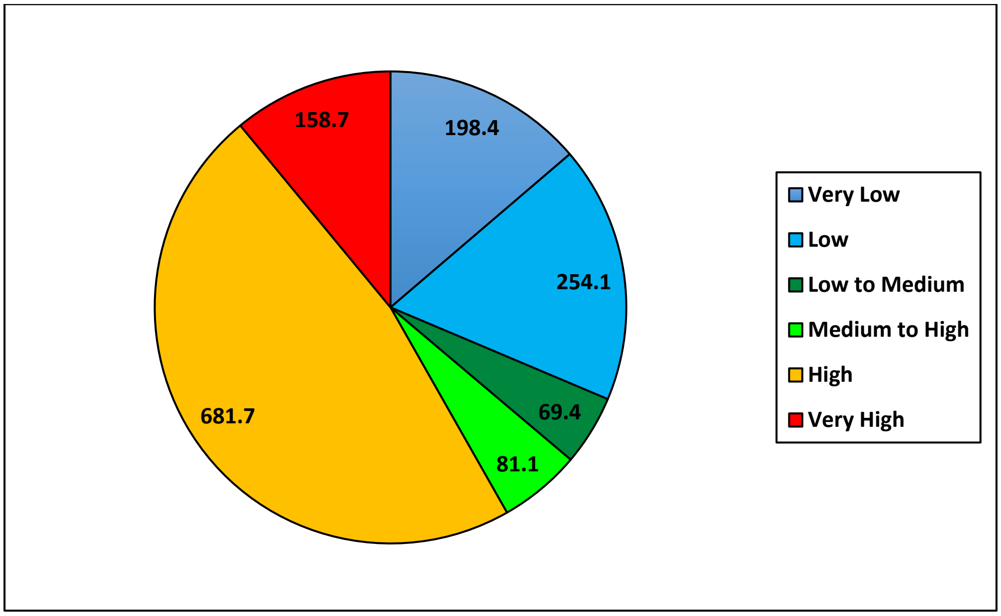

Figure 6. Grouped most sensitive ESI categories by shoreline length (km).

The NOAA Environmental Sensitivity Index (ESI) is a shoreline classification system developed to characterize coastal regions based on sensitivity to potential oil spills (Petersen *et al*., 2002). The ESI system uses wave exposure and principal substrate type to assign a rank of 1 to 10 (with 10 being the most sensitive to oil) to alongshore units. Up to three ESI numbers can be assigned to each ShoreZone unit (high, mid and low intertidal) if applicable. The highest ESI number for each unit, which is the most sensitive, is used in this analysis.

The majority of coastline around British Columbia's Sunshine Coast is represented by the grouped High and Very High categories (58.2% of shoreline length). These sections of the shoreline have a potentially high sensitivity to oil. At the other end of the spectrum, only 31.3% of the shoreline was mapped with a potentially low sensitivity to oil (Figures 5 and 6). The summary of Coastal Class by ESI class can be seen in Table 2.

Table 2. Summary of Coastal Classes by ESI Class for the Sunshine Coast survey area.

Environmental Sensitivity Index (ESI)		Sum of Unit Length (km)	# of Units	% of Total Shoreline Length
No.	**Description**			
1A	Exposed rocky shores; Exposed rocky banks	132	717	9
1C	Exposed rocky cliffs with boulder talus base	22	137	2
2A	Exposed wave-cut platforms in bedrock, mud, or clay	45	324	3
3A	Fine- to medium-grained sand beaches	<1	2	<1
4	Coarse-grained sand beaches	<1	3	<1
5	Mixed sand and gravel beaches	253	1,587	18
6A	Gravel beaches (granules and pebbles)	2	5	<1
6B	Gravel beaches (cobbles and boulders)	62	418	4
6C	Rip rap	6	35	<1
7	Exposed tidal flats	81	269	6
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	454	2,286	31
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	8	57	1
8C	Sheltered Rip Rap	15	98	1
8D	Sheltered rocky rubble shores	206	1,480	14
9A	Sheltered tidal flats	99	404	7
10A	Salt- and brackish-water marshes	58	144	4
10B	Freshwater marshes	2	19	<1
	Totals:	***1,443***	***7,985***	***100***

Note: ESI Classes not observed in this survey area were not included in the table.

2.3 Oil Residence Index (ORI)

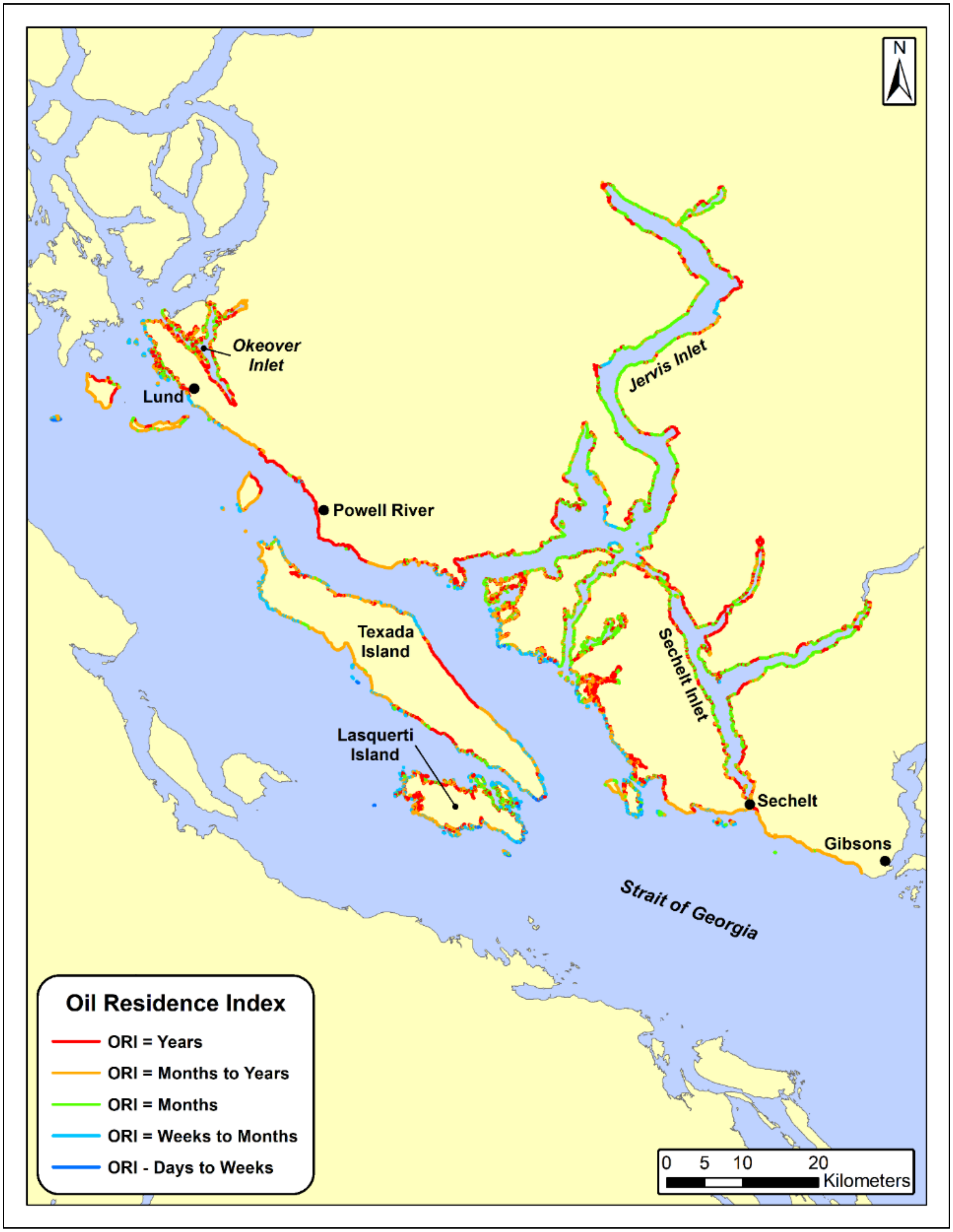

Figure 7. Distribution of the Oil Residence Index (ORI) categories.

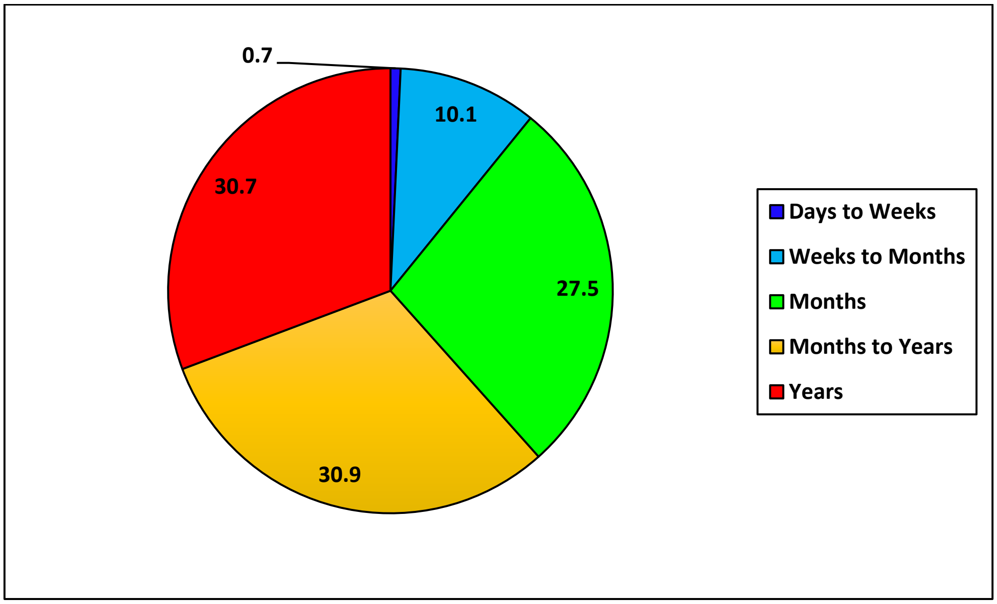

Figure 8. Oil Residence Index (ORI) categories by shoreline length (km).

The Oil Residence Index (ORI) is a rating between 1 and 5 with a value of 1 indicating a relatively short oil residence (days to weeks) while a value of 5 reflects potentially very long oil residence times (years). An ORI value is applied to each alongshore unit and to each across-shore component based on sediment texture and wave exposure (Cook *et al*., 2017). The ShoreZone ORI was developed by Dr. John Harper based on his many years of experience with cleaning up oiled shorelines, starting with the Exxon Valdez spill in Prince William Sound in Alaska. Lower wave exposures and mobile sediments lead to higher ORI values for 61.6% of the shore segments in the Sunshine Coast survey area, indicating oil residence times are on the order of months to years (see Figures 7 and 8 for distribution and summary statistics).

2.4 ShoreZone Coastal Vulnerability

2.4.1 Flood Zone Width

Figure 9. Distribution of the Coastal Vulnerability Flooding Class.

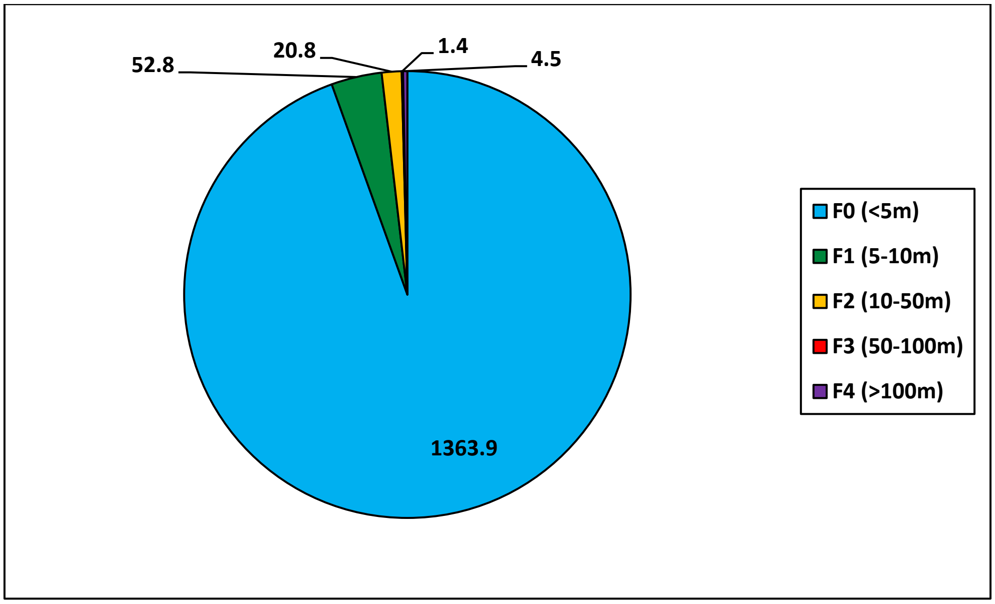

Figure 10. Flooding Class categories by shoreline length (km).

The Coastal Vulnerability Module (CVM) includes a classification of flooding sensitivity based on the across shore profile and photographic evidence of historical flooding such as an unambiguous marine debris line. The Flooding Class is an estimate of vulnerability to inundation of the terrestrial area beyond the supratidal. The distance to the debris line is measured and used to classify the flooding potential. Flat shorelines with very low gradients that show evidence of historical flooding have a higher risk of being inundated by storm surges. Potential for damage due to flooding is generally low in the study area, with 94.5% of the shoreline at a low risk of flooding <5m from the Mean High Waterline (MHW) (see Figures 9 and 10 for distribution and summary statistics). The flooding class is a parameter of the Coastal Vulnerability Index (see Page 16).

2.4.2 Coastal Vulnerability Observations

Figure 11. Distribution of the Coastal Vulnerability Observations categories.

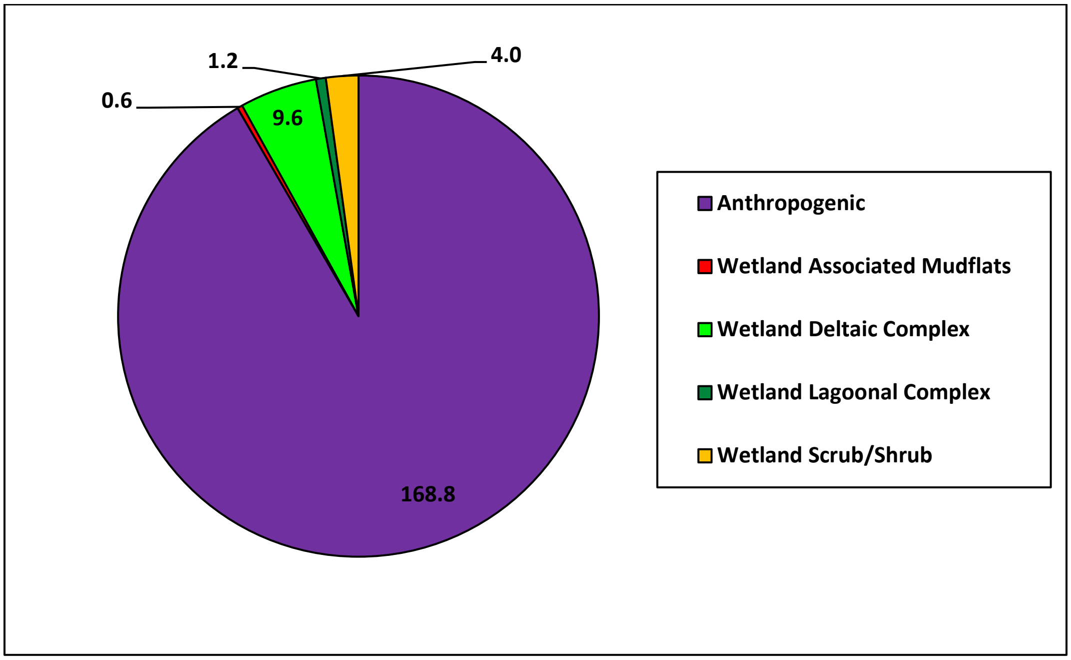

Figure 12. Coastal Vulnerability Observations categories by shoreline length (km). Category 'None' not shown.

The CVM Observations are features important for estimating the frequency and extent of coastal inundation. In the Sunshine Coast survey area, apart from the 'None' category, the majority of observations were from the Anthropogenic category with 168.8 km. The subsequent category was the Wetland Deltaic complex category with 9.6 km (see Figures 11 and 12 for distribution and summary statistics). With regards to the Anthropogenic category, it is important to point out that these areas are not necessarily areas of vulnerability, but areas potentially impacted.

2.4.3 Coastal Vulnerability Index

In the 2017 ShoreZone protocol (Cook *et al*., 2017), the methods of Thieler and Hammer-Klose (2000) (http://woodshole.er.usgs.gov/project-pages/cvi/) were adapted to calculate a Coastal Vulnerability Index (CVI) using five ShoreZone attributes: Coastal Class, Max Tide Range, Shoreline Erosion index, Flood Zone Width, and Significant Wave Height. When we first attempted to calculate the CVI for the portion of the shoreline funded in the Eastern Aleutians by the Oil Spill Response Institute, it did not match the observations of the mappers as it appeared to rank too much of the rocky, steep shoreline as High or Very High in terms of vulnerability to sea level rise. After analysis of the data, we determined this was due to the use of a relative ranking system where the values from the study area were only compared to each other to determine the CVI rank. To resolve this issue, we calculated an absolute value for each CVI rank which is described in the latest version of the protocol (Cook *et al*., 2017). An absolute value was also calculated for the 2014 Protocol CVI method. The distribution of ranks on the Sunshine Coast is shown in Figure 13. Due to the protected and generally rocky nature of the coastline, few units in the survey area were ranked Moderate in terms of vulnerability to sea level rise, while the rest were ranked as Low. The Coastal Class and low Wave Exposure were likely the driving factors behind the rankings in this survey area.

Figure 13. Distribution of Coastal Vulnerability index ranks in the Sunshine Coast survey area.

2.5 Anthropogenic Shore Modifications

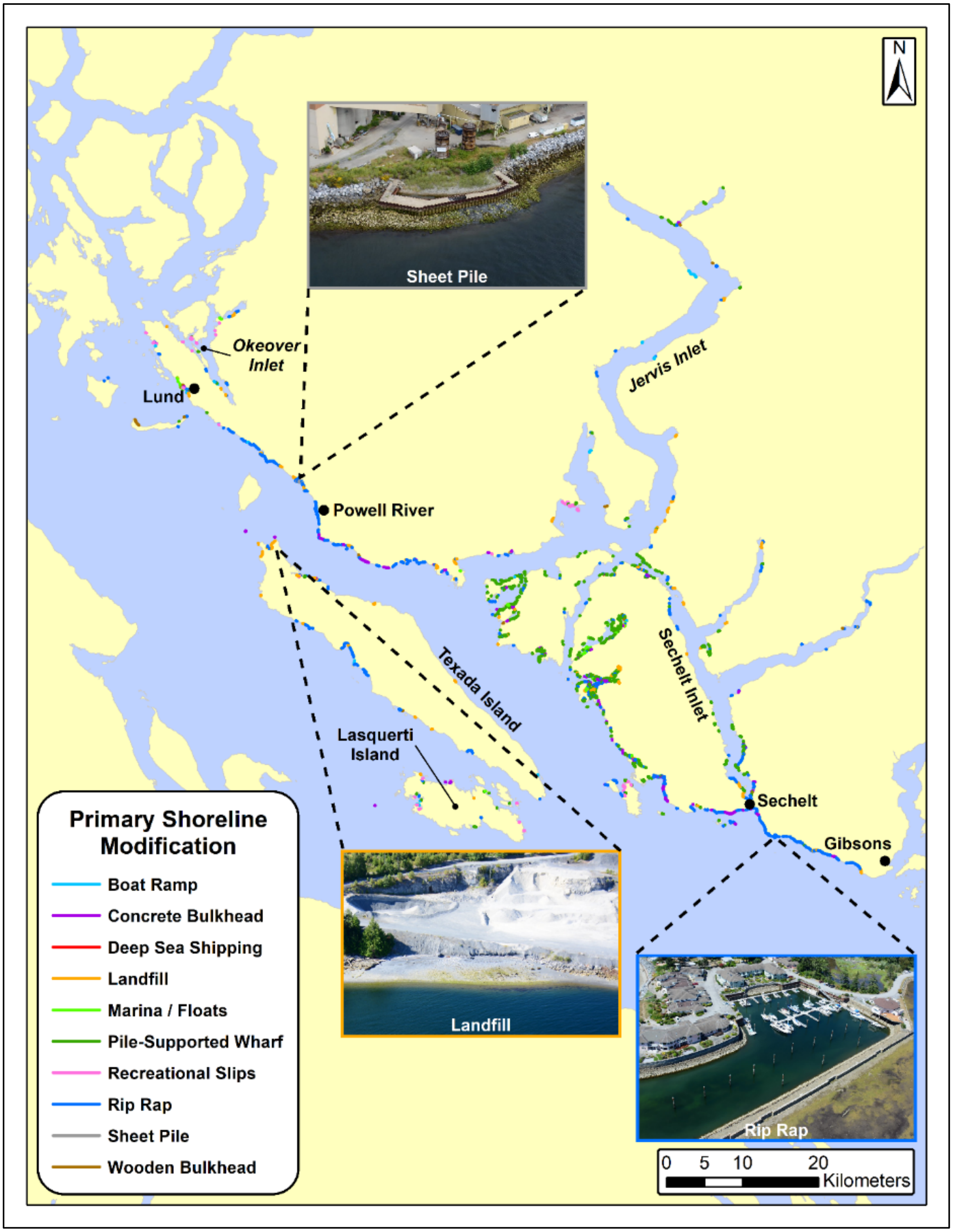

Figure 14. Distribution of types of the primary Shore Modifications. There may be other shore modifications in any given unit. That data would be found in the Shore Modifications table in the geodatabase.

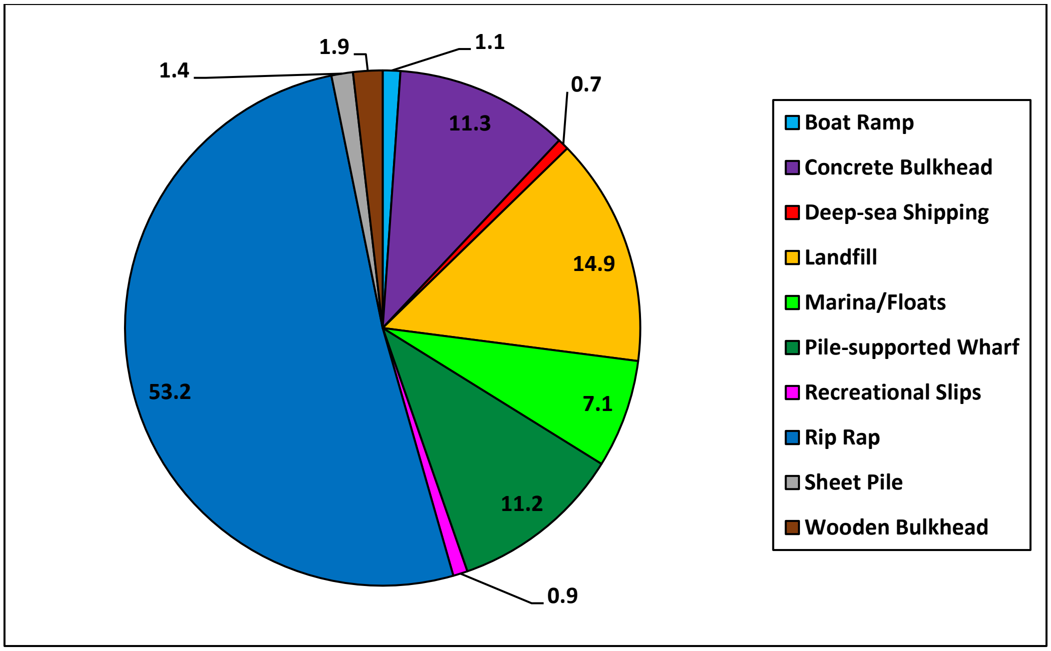

Figure 15. Shore Modifications by estimated shoreline length (km) of each modification type.

The Shoreline Modification attribute provides a thorough catalogue of the specific types of anthropogenic modification in each unit (Cook *et al*., 2017). This includes many modifications within a given unit. For example, if both riprap and a pile-supported wharf occur, both are catalogued in the appropriate zone of that unit with an estimate of the alongshore length of the unit that modification covers. A total of 7.2% of the shoreline (taking the estimated length of that modification within the unit into account) exhibits shore modifications in the Sunshine Coast study area (Figure 14). Rip Rap was the most commonly recorded observation (51.2%) with Landfill (14.3%) and Concrete Bulkheads (10.9%) rounding out the top three shoreline modifications along the coast. The associated map (Figure 14) shows the distribution of primary shore modifications, though it should be noted that any given modification is possible along the entire length of the indicated shore unit. The Geodatabase delivered with this report displays each shore modification with a specific length category (meters) along the shoreline pertaining to each unit as well as the specific zone (supratidal or intertidal) the modification occurs in.

3 BIOLOGICAL ATTRIBUTE DATA SUMMARY

3.1 Biobands

Biobands represent assemblages of coastal biota found on the shoreline at characteristic wave exposures, 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 (see Appendix A, Table A-2 for photographic examples of the common biobands from the Sunshine Coast survey area). Full descriptions of all biobands, including indicator and associated species can be found in the ShoreZone protocol (Cook *et al*., 2017).

There are several metrics used for the biobands within each unit. All biobands are classified as Patchy (in <50% of the length of the unit) or Continuous (in >50% of the length of the unit). The zone in which a bioband was observed determines how the bioband is further described. For example, biobands found in the supratidal (A Zone) and subtidal (C Zone) are described by percent of alongshore length of unit and a width category. The intertidal (B zone) biobands are described by percent of alongshore length of the unit and percent cover of the zone. All metrics are described in the 2017 ShoreZone protocol (Cook *et al*. 2017). The data presented in this report uses Patchy and Continuous as metrics as that is consistent across all biobands.

Biobands mapped in the Sunshine Coast survey area are summarized in Tables 3 and 4. The most commonly occurring intertidal biobands in the survey area was Green Algae in 91% of units as well as Barnacle and Rockweed which were found in 89% and 88% of units, respectively. The most common supratidal bioband was Black Lichen, occurring in 75% of the units, while the supratidal/high intertidal Salt Marsh bioband was found in 19% of units. The most common low intertidal/subtidal biobands were Sargassum (44%), Brown Bladed Kelps (26%) and Eelgrass (20%). Distribution maps, statistics and observations about some specific biobands are found in the following pages.

Table 3. Bioband abundances for non-splash zone biobands mapped on the Sunshine Coast.

Bioband		Patchy		Continuous		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%		
Trees and Shrubs	TRSH	4	0	34	2	38	3
Wetland Vegetation	WEVE	2	0	1	0	2	0
Dune Grass	DUGR	135	9	31	2	166	12
Grasses	GRAS	3	0	1	0	4	0
Salt Marsh	SAMB	187	13	94	7	281	19
Barnacle	BARN	216	15	1070	74	1286	89
Rockweed	ROCK	320	22	947	66	1268	88
Green Algae	GRAL	324	22	983	68	1306	91
Oysters	OYST	135	9	83	6	219	15
Blue Mussel	BLMU	249	17	168	12	417	29
Echinoderms	ECHI	19	1	0	0	19	1
Sand Dollars	SAND	4	0	3	0	7	0
Bleached Red Algae	BRAL	44	3	24	2	68	5
Filamentous and Foliose Red Algae	FFRA	162	11	152	11	314	22
Coralline Red Algae	CORA	2	0	1	0	3	0
Brown Bladed Kelps	BRBA	121	8	257	18	378	26
Anemones	ANEM	1	0	0	0	1	0
Rooted Vegetation	ROVE	4	0	1	0	5	0
Eelgrass	EELG	97	7	185	13	282	20
Sargassum	SARG	203	14	439	30	642	44
Urchin Barrens	URBA	2	0	1	0	3	0
Bull Kelp	BUKE	16	1	5	0	22	1

Table 4. Bioband abundances for splash zone biobands mapped on the Sunshine Coast.

Bioband		Narrow (<1m)		Medium (1-5m)		Wide (>5m)		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%	(km)	%		
Black Lichen	BLLI	738	51	337	23	11	1	1086	75
Splash Zone	SPZO	88	6	77	5	3	0	168	12
White Lichen	WHLI	422	29	251	17	16	1	689	48
Yellow Lichen	YELI	20	1	14	1	2	0	35	2

Salt Marsh was the most commonly occurring supratidal, non-splash zone bioband but was found in only 19% of units (see Figures 16 for a graph of proportion of the shoreline with that bioband and Figure18 for a distribution map). Salt Marsh can occur either in the lower supratidal or upper intertidal, while this map shows the width of the band at the top of the beach. The Salt Marsh in this area was mostly a narrow band near the tree line (see Figure 17 for photo). This is an important habitat for many shoreline species and can provide important ecological services, such as filtering land-based nutrients which can help maintain the balance of other habitats such as eelgrass meadows (Valiela *et al*., 2000).

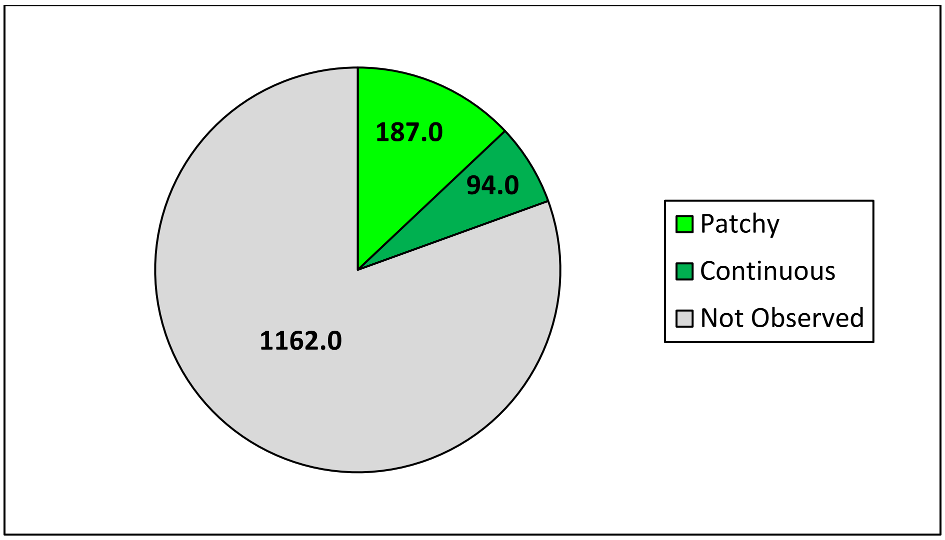

Figure 16. Proportion of shoreline length (km) of the supratidal/intertidal Salt Marsh (SAMB) bioband by category.

Figure 17. Photo of a narrow strip of Salt Marsh bioband (with Dune Grass above the logline) in Scottie Bay on Lasqueti Island (bc20_sc_15926).

Figure 18. Distribution of the Salt Marsh (SAMB) bioband on the Sunshine Coast.

Blue Mussels and Oysters are two bivalve-dominated biobands that both occur in the Sunshine Coast area (see Figures 19 for graphs of the proportion of the shoreline with these biobands and Figure 21 for a distribution map). The Blue Mussel bioband was found on bedrock and boulder across the survey area. It was generally a dark blue-black colour; however, in several areas in the more southern, more exposed part of the survey area (such as south Thormanby Island) had some patches of mussels that appeared light blue/grey (see Figure 20 for an example). This is more consistent with the California Mussel bioband which is not known to occur on the Sunshine Coast as the northern limit is thought to be just south of Victoria. However, the distribution of species has been changing along with changing physical conditions on the coast and it would be worth including these areas in any future ground survey in the area. The Oyster bioband is unusual in BC and is only seen where concentrations of the introduced Pacific Oyster (*Magallana gigas*) is high enough that it is visible from the aerial imagery. This was generally noted to occur in areas where there is or has been oyster aquaculture on the Sunshine Coast.

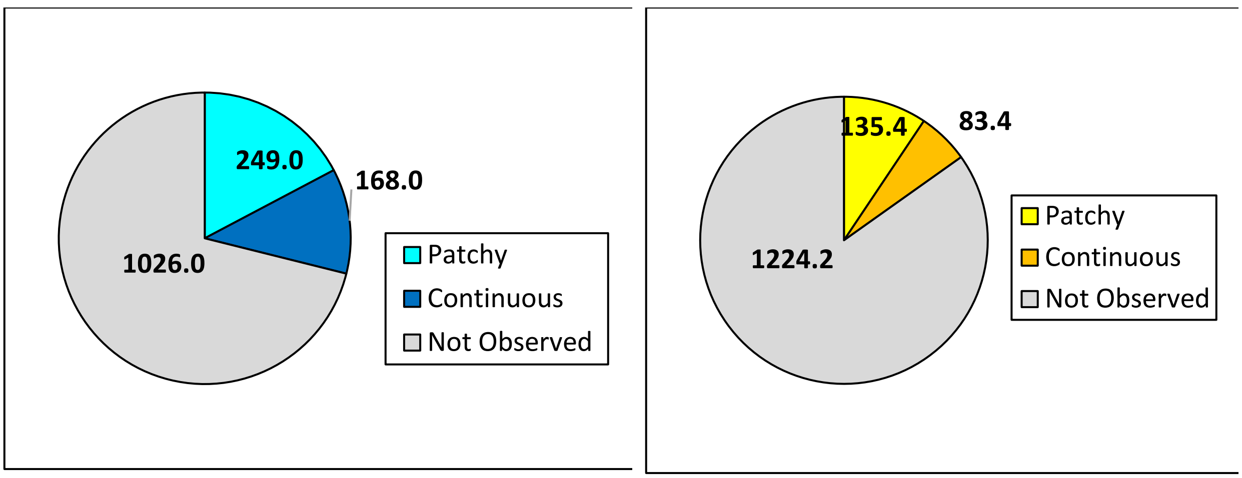

Figure 19. Distribution of the intertidal Blue Mussel (left) and Oyster (right) biobands by shoreline length (km).

Figure 20. Example of the blue/grey variant of the Blue Mussel bioband on south Thormanby Island (bc20_sc_02521).

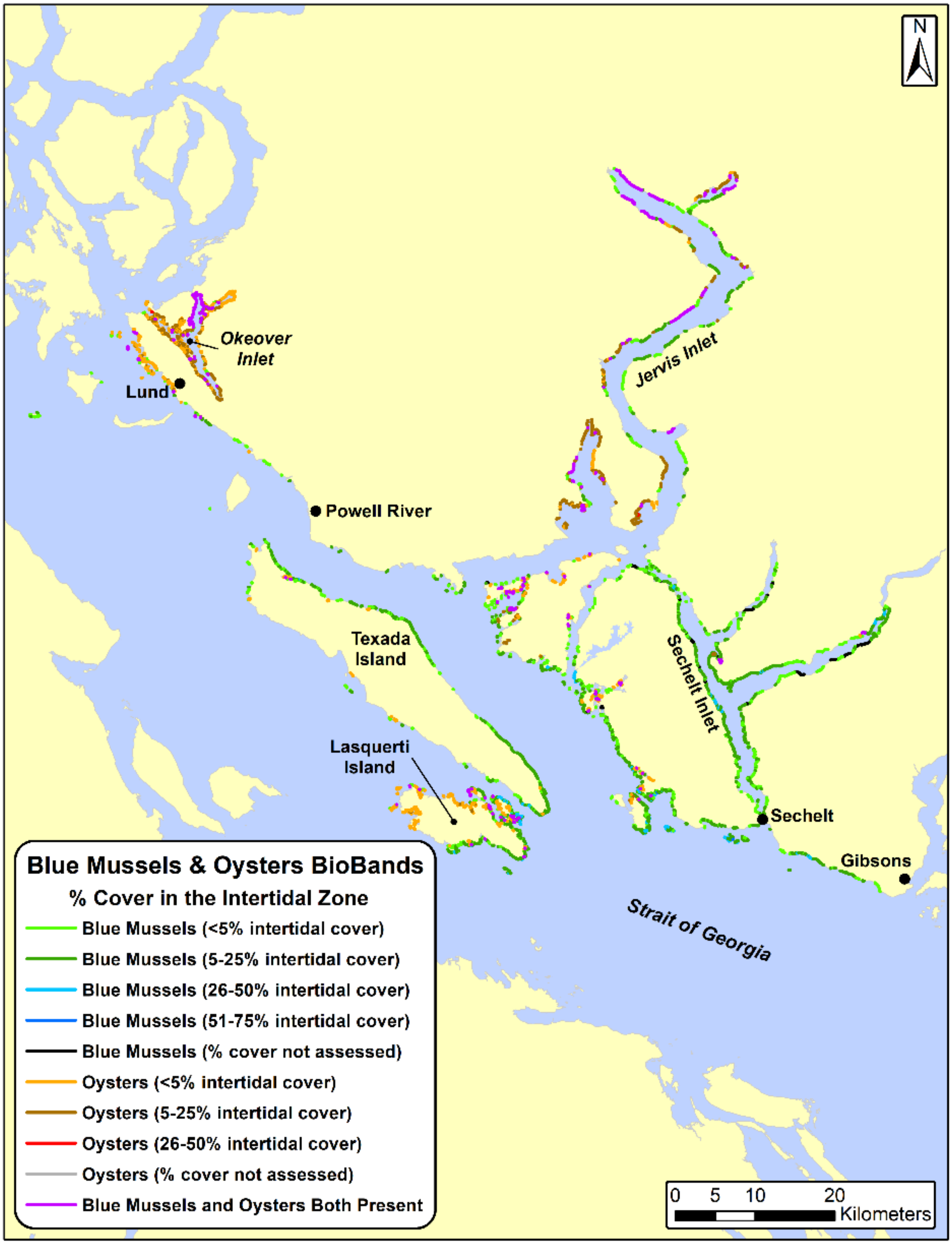

Figure 21. Distribution of the Blue Mussel (BLMU) and Oyster (OYST) biobands on the Sunshine Coast.

Eelgrass and Bull Kelp were both observed on the Sunshine Coast (See Figure 22 for a graph of the proportion of Eelgrass and a distribution map for both in Figure 23). Seagrasses are an important component of coastal ecosystems with Eelgrass beds forming in sandy substrate at Semi-Protected and lower exposures. Eelgrass beds are nursery habitats for juvenile fish and also sequester and store atmospheric carbon (called 'Blue Carbon') in addition to other valuable ecosystem services. Canopy kelps form valuable habitat for fish, invertebrates and other algae and are an important part of a healthy coastline and healthy fisheries. Bull Kelp was the only canopy kelp present in this survey area and it was only noted in higher current areas like Skookumchuck Narrows. The lack of Bull Kelp in this region could possibly be related to the effects of sea star wasting disease. The removal of Sunflower and other Stars led to a trophic cascade on the rocky reefs in Howe Sound and a dramatic increase in urchin barrens, coupled with a decrease in kelp (Schultz *et al*. 2016). Unlike the northern urchin barrens noted around Prince Rupert (Coastal and Ocean Resources 2019) which are dominated by Purple and Red Sea Urchins (*Strongylocentrotus purpuratus* and *S. fransicanus*), the Howe Sound barrens are created by Green Sea Urchins (*S. droebachiensis*) which are not distinguishable from aerial imagery as they blend in with the rock substrate. It is possible Urchin Barrens are far more widely distributed that would be apparent from the ShoreZone mapping. If the results of dive or towed camera surveys were used to define the appearance of the Green Urchin Barrens it may be possible to go back over the imagery and map the distribution of this bioband in the future.

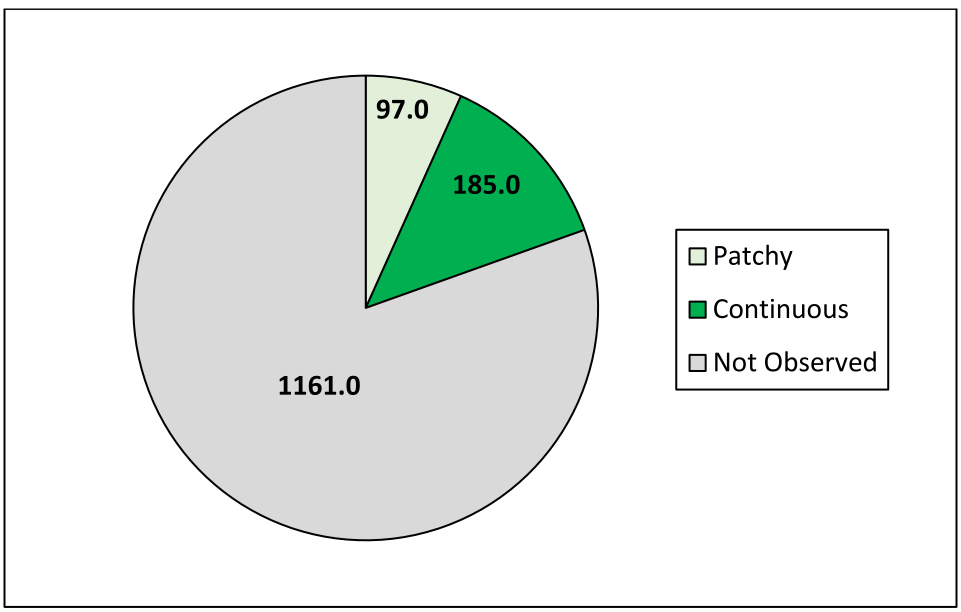

Figure 22. Distribution of the Eelgrass (EELG) bioband by shoreline length (km).

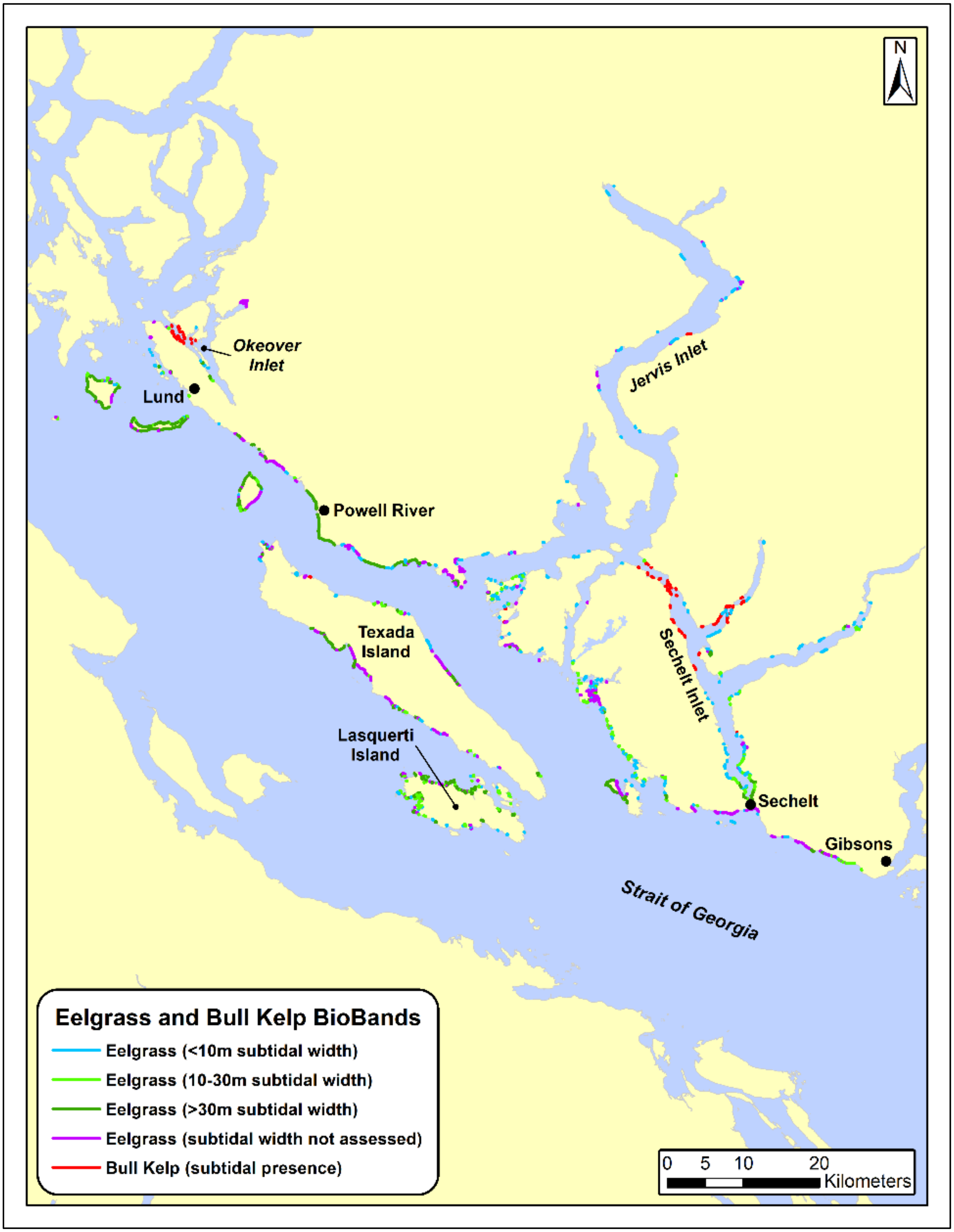

Figure 23. Distribution of the Eelgrass (EELG) and Bull Kelp (BUKE) biobands on the Sunshine Coast.

Sargassum and Bladed Brown Algae were the two kelp biobands observed on the Sunshine Coast. See Figures 24 and 25 for statistics on the distribution of the individual kelp biobands and a distribution map for both in Figure 26. The Sargassum bioband is defined by the presence of Japanese Wireweed (*Sargassum muticum*). The Sargassum band was observed in 44% of the unit making it the dominant kelp in the survey area. It is possible much of the Brown Bladed Kelp that was recorded was actually Sargassum (or other kelps mixed with Sargassum) as there were areas where browns could be observed in the subtidal but not enough detail could be seen to determine if Sargassum was present. It can therefore be assumed it was more widely distributed than indicated by the ShoreZone mapping. There is significant literature available on the impacts of introduced Japanese Wireweed with somewhat conflicting conclusions, as some studies find negative impacts on native species (DeWreede and Vandermeulen, 1988; Britton-Simmons, 2004) and some finding little to no impacts (Sanchez and Fernandez, 2005; Olabarria *et al*., 2009). White (2003) studied the effects of *S. muticum* on macroalgal communities and grazing invertebrates in BC and found that the effects of introduction were both density and time dependent and were mediated through competition for light and also that the effects went in both positive and negative directions depending on the species being studied.

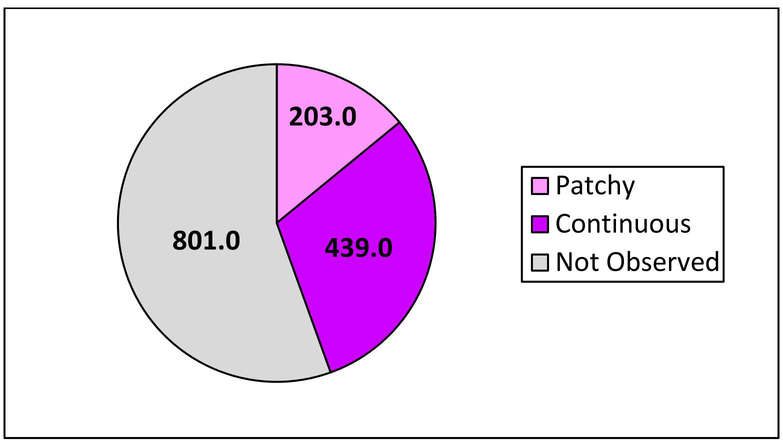

Figure 24. Distribution of the Sargassum (SARG) bioband by shoreline length (km).

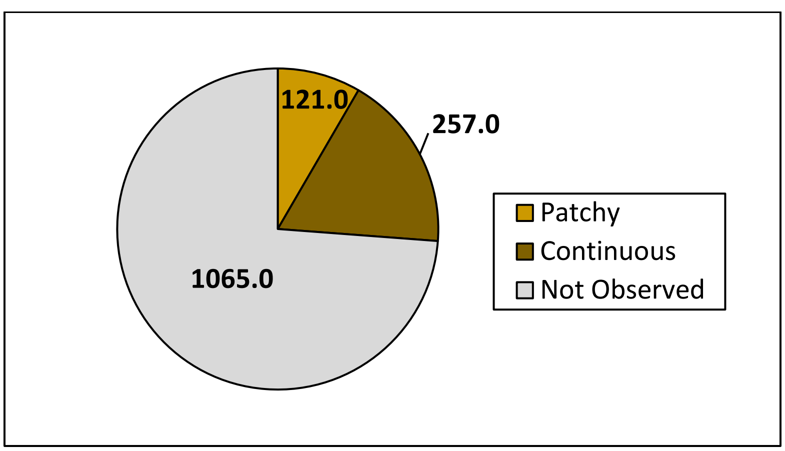

Figure 25. Distribution of the Brown Bladed Algae (BRBA) bioband by shoreline length (km).

Figure 26. Distribution of the Sargassum (SARG) and Bladed Brown Algae (BRBA) biobands on the Sunshine Coast.

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 relative abundance of biota in each alongshore unit is used as a proxy to determine the wave exposure at that site. For definitions of the Biological Wave Exposures and the exposure ranges of the biobands see the most recent ShoreZone protocol (Cook *et al*., 2017).

The distribution of the wave exposure categories mapped on the Sunshine Coast are summarized in Figure 27 and a distribution map of the categories is shown in Figure 28. Most of the coastline (99.1%) was in the lower to moderate wave exposures (Very Protected to Semi-Protected), with most of that Protected (72.0%).

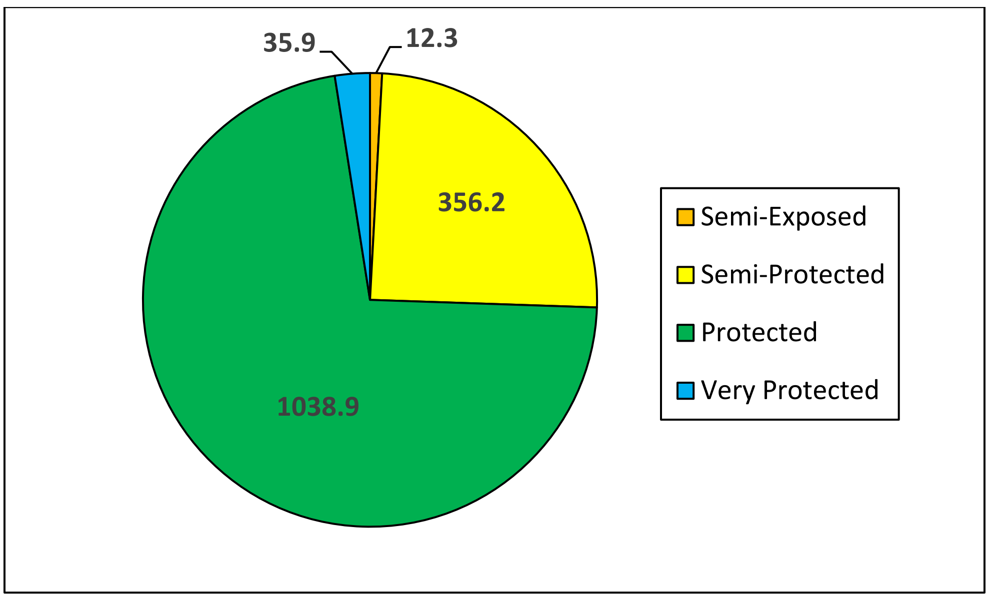

Figure 27. Distribution of Biological Wave Exposures mapped on the Sunshine Coast by shoreline length (km).

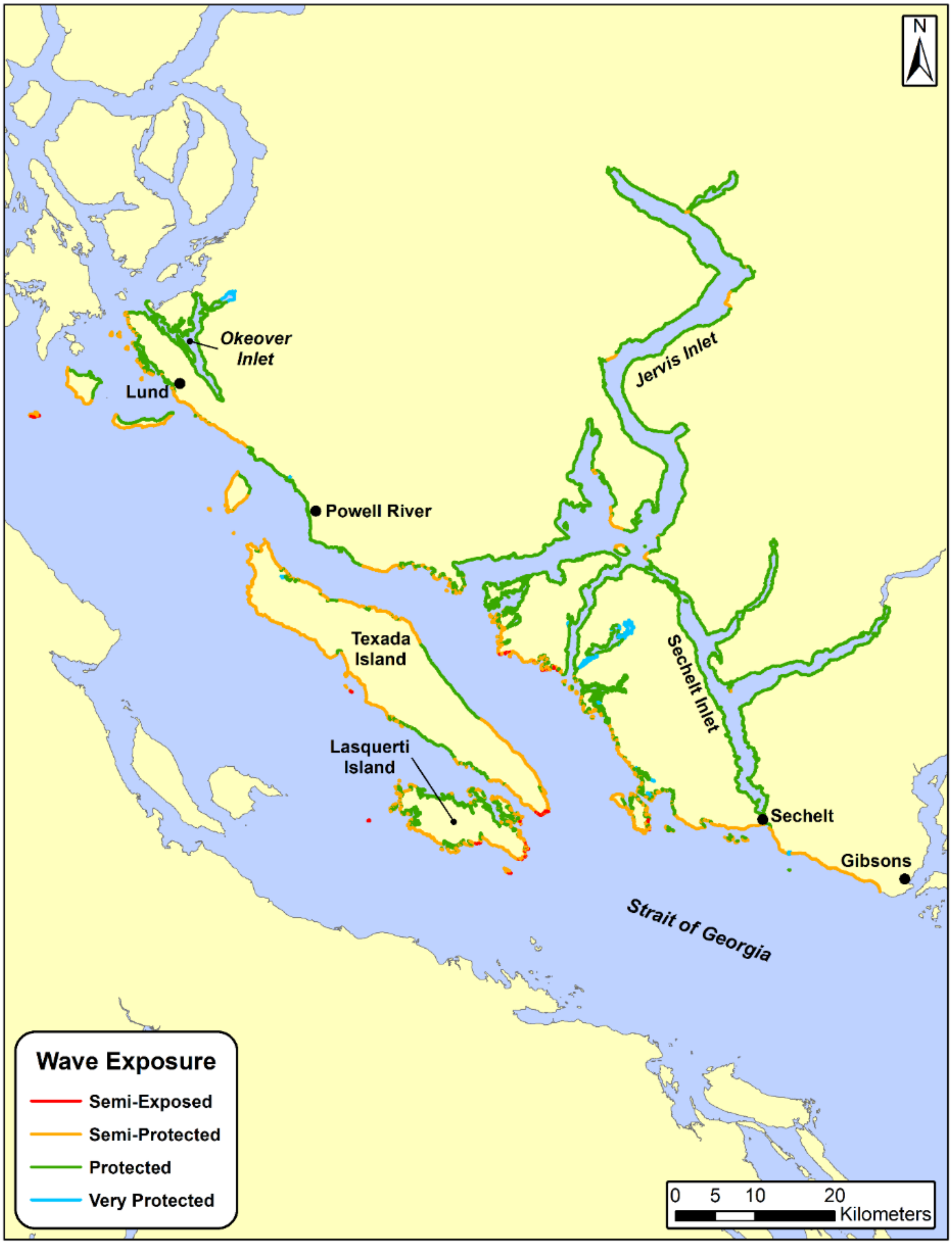

Figure 28. Distribution of the Biological Wave Exposure on the Sunshine Coast of BC.

3.3 Habitat Class

Habitat Class is a classification based on wave exposure and geomorphic characteristics observed in an alongshore unit. The habitat class is intended to provide a single attribute to characterize the biophysical features of each unit. The habitat class is assigned by the biological mapper and weighted according to the dominant structuring process. Wave action is the most common structuring process with less commonly observed habitats being those structured by current, estuarine/fluvial processes, and anthropogenic structures. For habitat classes structured by wave action substrate mobility determines the presence of epibenthic biota. Where the substrate is highly mobile, biota is sparse or absent, and where the substrate is stable, biota can be abundant. For further definitions and explanations of Habitat Class codes please see the most recent ShoreZone protocol (Cook *et al*., 2017).

The distribution of the Habitat Class categories mapped on the Sunshine Coast are summarized in Figure 29 and a distribution map of the categories is shown in Figure 30. Partially mobile substrate is the dominant shoreline type (52.2%), with Immobile only slightly less common (36.6%). The Estuary classification made up 3.5% of the shoreline and is associated with spawning and nursery habitats for fish as well as breeding and foraging grounds for birds and other wildlife. It should be noted that, although individual units may not have been classed as estuaries, the Fraser River is still a significant influence in the area and much of the survey area could be considered estuarine in nature. The Anthropogenic classification occurred in 2.0% of units as the only communities with more developed shorelines were Powell River and Sechelt.

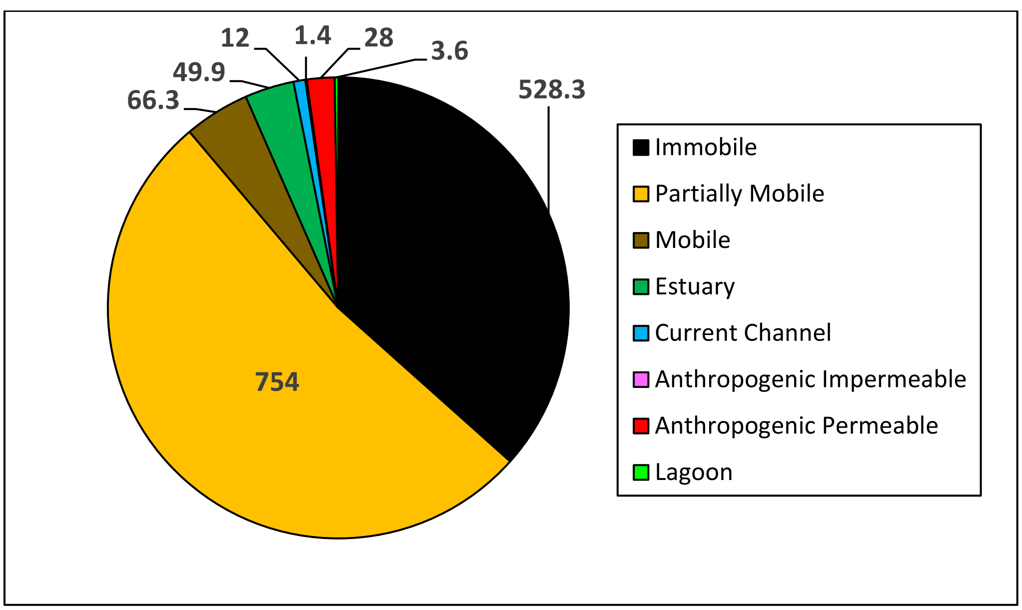

Figure 29. Distribution of Habitat Class categories on the Sunshine Coast by shoreline length (km).

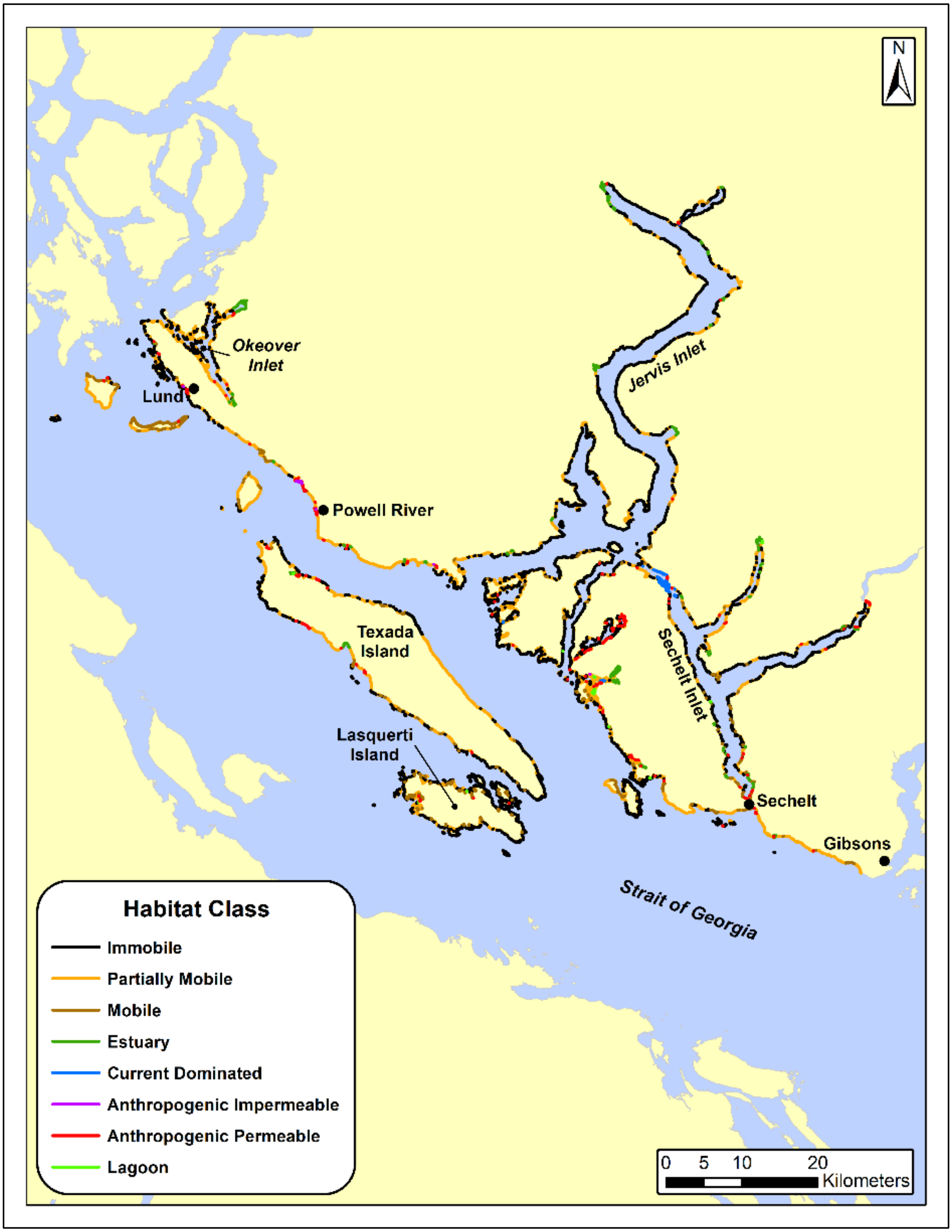

Figure 30. Distribution of Habitat Class categories on the Sunshine Coast.

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5 ACKNOWLEDGMENTS

We would like to acknowledge DFO Science in support of PIER for funding the ShoreZone imaging and mapping represented in this summary report. We would also like to thank the shíshálh and Tla'amin Nations for their support during this project. The international ShoreZone program is a partnership of scientists, GIS specialists, web specialists, non-profit organizations and governmental agencies in two countries, one Province and four States. We gratefully acknowledge the support of other organizations working in partnership for the ShoreZone effort including: the Tsleil-Waututh Nation, the Musqueam Indian Band, the Vancouver Fraser Port Authority, the Prince Rupert Port Authority, Nexxen, Pacific Northwest LNG, the Metlakatla First Nation, the Gitxaala First Nation, the Nisga'a Lisims Government, the BC Ministry of Environment, the Alaska Department of Fish and Game, the Alaska Department of Natural Resources, Archipelago Marine Research Ltd., Cook Inlet Regional Citizens' Advisory Council, Exxon Valdez Oil Spill Trustee Council, National Park Service, NOAA National Marine Fisheries Service, Prince William Sound Regional Citizens' Advisory Council, The Nature Conservancy, United States Fish and Wildlife Service, the University of Alaska and the US Forest Service.

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 for the US dataset can be downloaded online at www.ShoreZone.org or the NOAA ShoreZone Page and the BC imagery dataset can be accessed through the Coastal and Ocean Resources' ArcGIS site. The mapping geodatabases and summary reports (as well as ground survey data and reports) can be downloaded through the Coastal and Ocean Resources download center. Further ShoreZone resources, including a newly updated Illustrated Data Dictionary, can be accessed through the NOAA ShoreZone Page.

Any hardcopies or published data sets utilizing ShoreZone products shall clearly indicate their source. For questions regarding the protocols or information in this report, please contact Sarah Cook, General Manager of Coastal and Ocean Resources at Sarah@coastalandoceans.com (250-658-4050). For data requests or analytical support contact Kalen Morrow at Kalen@coastalandoceans.com.

APPENDIX A

Photographic Examples of Coastal Classes and Biobands

Table A-1. Examples of the Coastal Classes in the Sunshine Coast survey area (Page 38).
Table A-2. Examples of the Biobands in the Sunshine Coast survey area (Page 47).

Table A-1. Examples of the Coastal Classes in the Sunshine Coast survey area.

Photo bc20_sc_09707: Example of Coastal Class 2; Rock Platform, wide.
Skookumchuck Narrows.

Photo bc20_sc_11931: Example of Coastal Class 3; Rock Cliff.
Agamemnon Channel.

Photo bc20_sc_15815: Example of Coastal Class 4; Rock Ramp.
Lasqueti Island.

Photo bc20_sc_08778: Example of Coastal Class 8; Cliff gravel beach.
Princess Louisa Inlet.

Photo bc20_sc_15821: Example of Coastal Class 9; Ramp with gravel beach.
Lasqueti Island.

Photo bc20_sc_14893: Example of Coastal Class 11; Ramp with gravel & sand beach.
Strait of Georgia.

Photo bc20_sc_14778: Example of Coastal Class 12; Platform with gravel & sand beach, wide. Trail Bay.

Photo bc20_sc_14628: Example of Coastal Class 13; Cliff with gravel & sand beach. Welcome Passage.

Photo bc20_sc_12329: Example of Coastal Class 14; Ramp with gravel & sand beach.
Nelson Island.

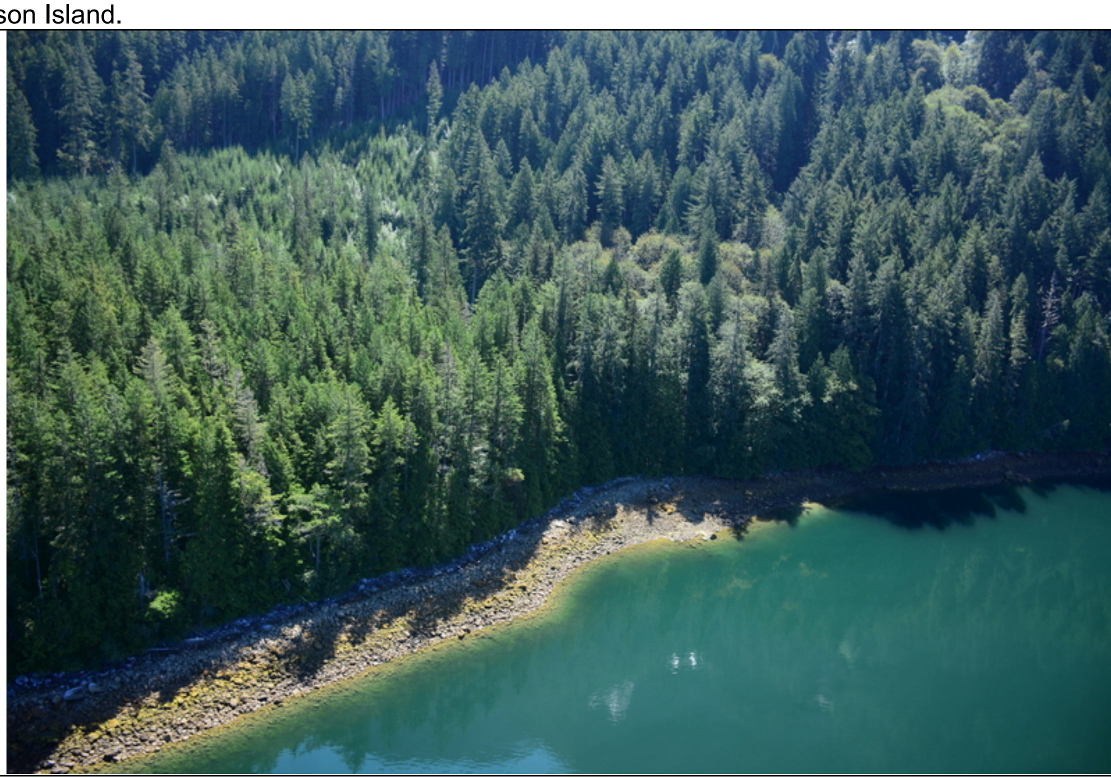

Photo bc20_sc_09203: Example of Coastal Class 22; Gravel beach, narrow.
Princess Royal Reach.

Photo bc20_sc_14752: Example of Coastal Class 24; Sand & gravel flat or fan.
Strait of Georgia.

Photo bc20_sc_14734: Example of Coastal Class 25; Sand & gravel beach, narrow.
Strait of Georgia.

Photo bc20_sc_10909: Example of Coastal Class 28; Sand flat.
Porpoise Bay.

Photo bc20_sc_10355: Example of Coastal Class 31; Organics/Fines.
Pender Harbour.

Photo bc20_sc_14094: Example of Coastal Class 32; Permeable man-made structures.
Secret Cove.

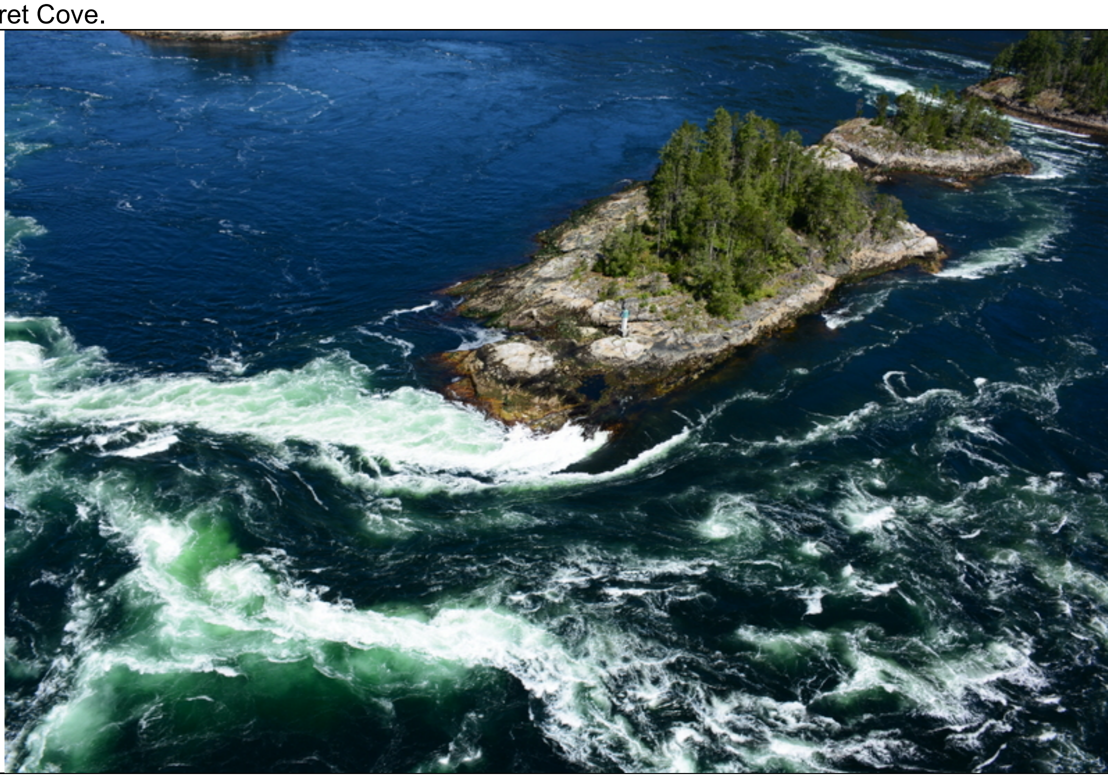

Photo bc20_sc_09787: Example of Coastal Class 34; Current.
Sechelt Rapids.

Photo bc20_sc_10793: Example of Coastal Class 36; Lagoons.
Bargain Bay.

Table A-2. Examples of the Biobands in the Sunshine Coast survey area.

Photo bc20_sc_15058: Good example of the Black Lichen (BLLI) bioband which is a black band in the supratidal zone, usually caused by the lichen *Verrucaria* sp., and the Yellow Lichen (YELI) bioband. Lasqueti Island.

Photo bc20_sc_02113: Good example of the Splash Zone (SPZO) bioband which is an erosional or active A Zone without attached vegetation. South Texada Island.

Photo bc20_sc_13221: Good example of White Lichen (WHLI) bioband in the supratidal zone, above the Black Lichen band. Nelson Island.

Photo bc20_sc_16067: Good example of blue-green Dune Grass (DUGR) bioband in the supratidal zone. Lasqueti Island.

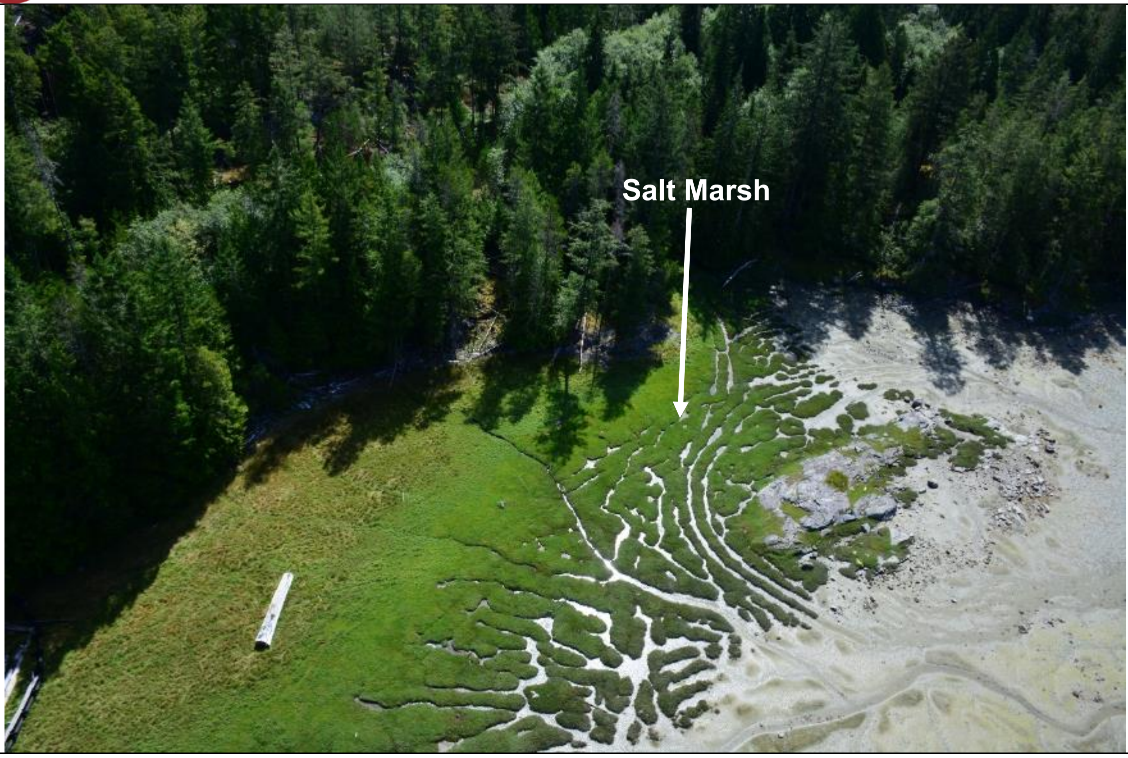

Photo bc20_sc_12019: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Agamemnon Channel.

Photo bc20_sc_02247: Good example of the white Barnacle (BARN) bioband in the intertidal zone. Texada Island.

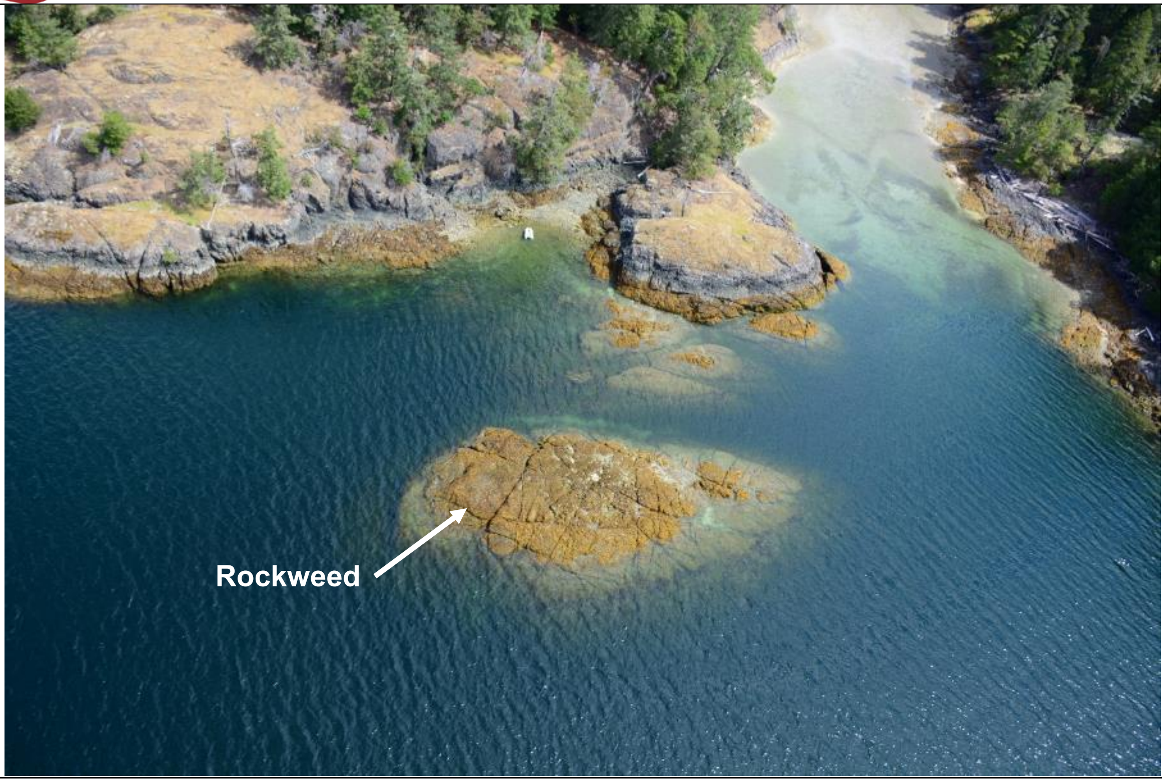

Photo bc20_sc_15262: Good example of the golden-brown Rockweed (ROCK) bioband. Lasqueti Island.

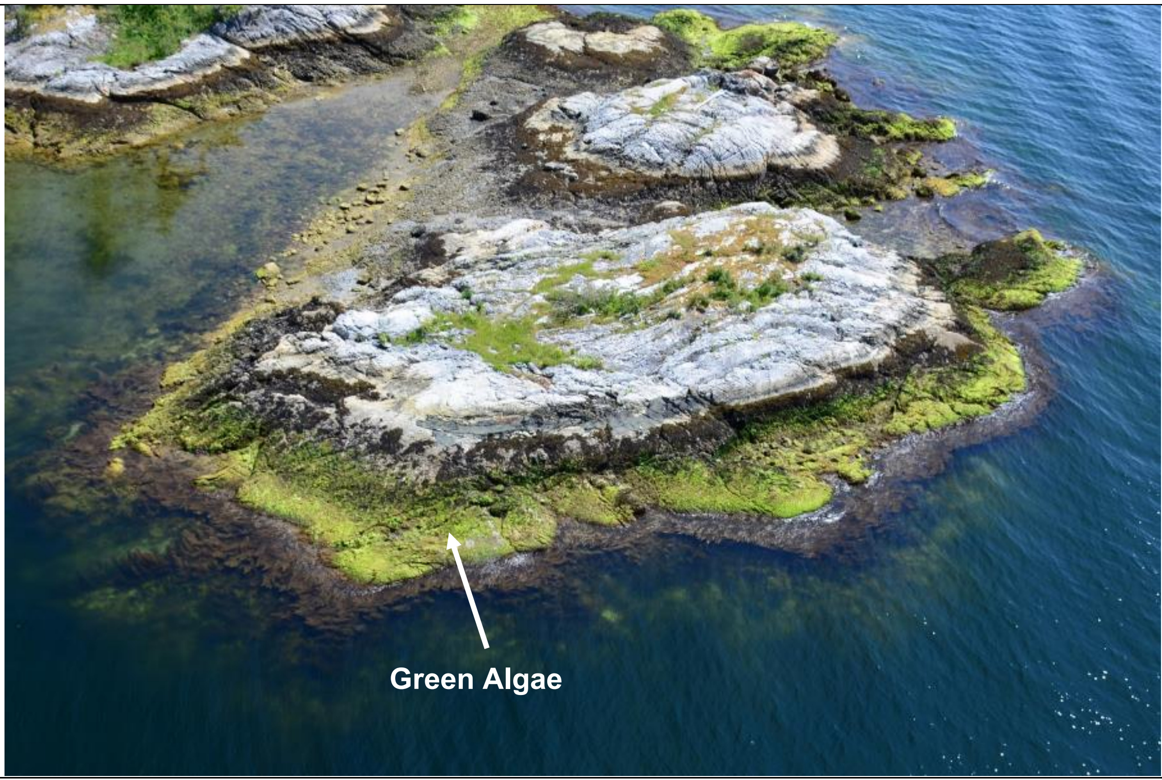

Photo bc20_sc_06446: Good example of the Green Algae (GRAL) bioband in the lower intertidal. Salmon Inlet.

Photo bc20_sc_16232: Good example of the white spots of the Oyster (OYST) bioband. Lasqueti Island.

Photo bc20_sc_16735: Good example of the black Blue Mussel (BLMU) bioband in the mid-intertidal. Lasqueti Island.

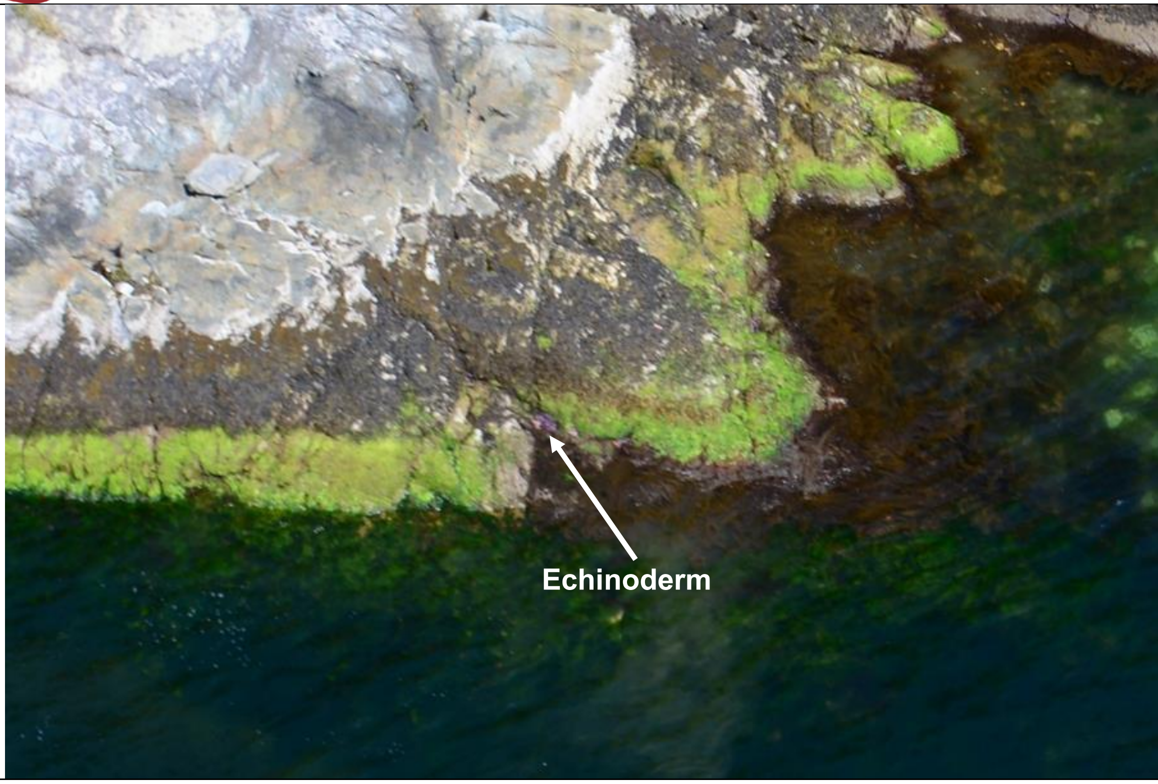

Photo bc20_sc_06378: Good example of the Echinoderm (ECHI) bioband which was all *Pisaster* sp. in this study area. Near Salmon Inlet.

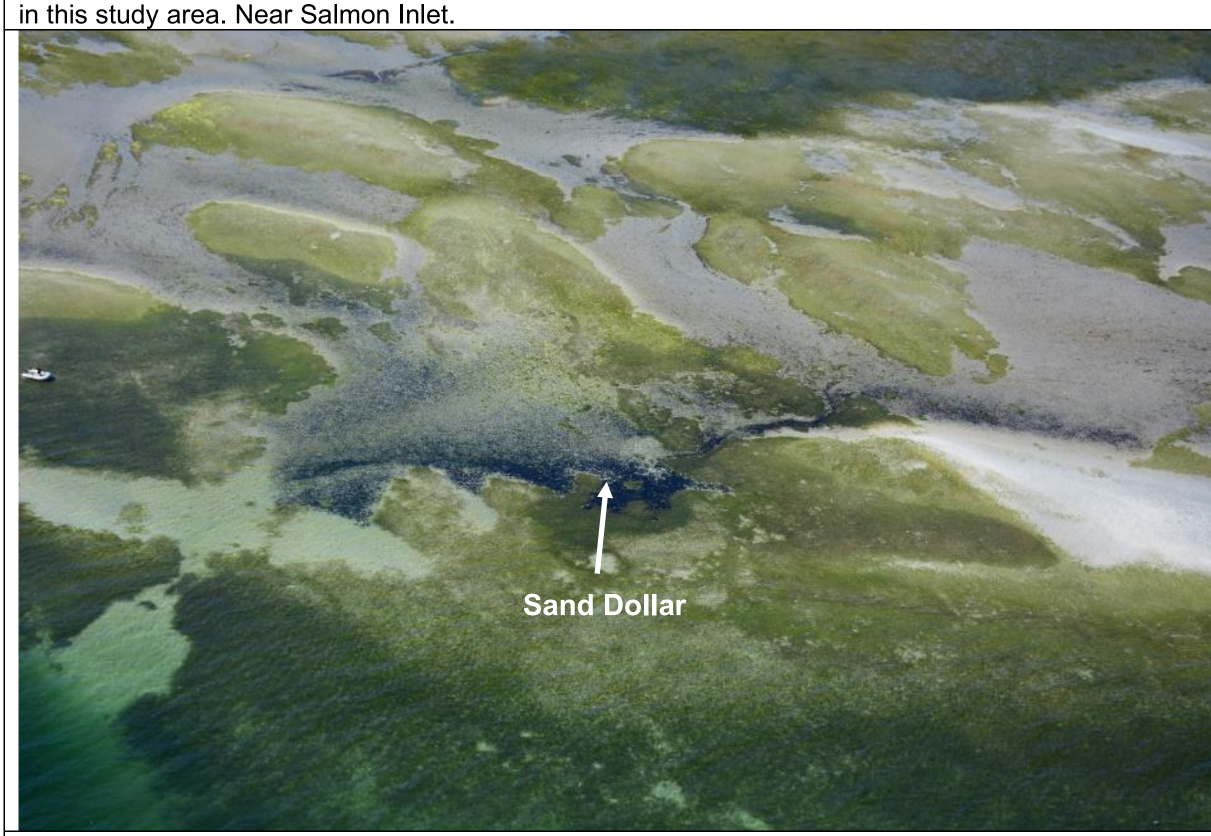

Photo bc20_sc_01206: Good example of the black Sand Dollar (SAND) bioband in sand substrate. Savary Island.

Photo bc20_sc_15915: Good example of the golden Bleached Red Algae (BRAL) bioband in the lower intertidal. Lasqueti Island.

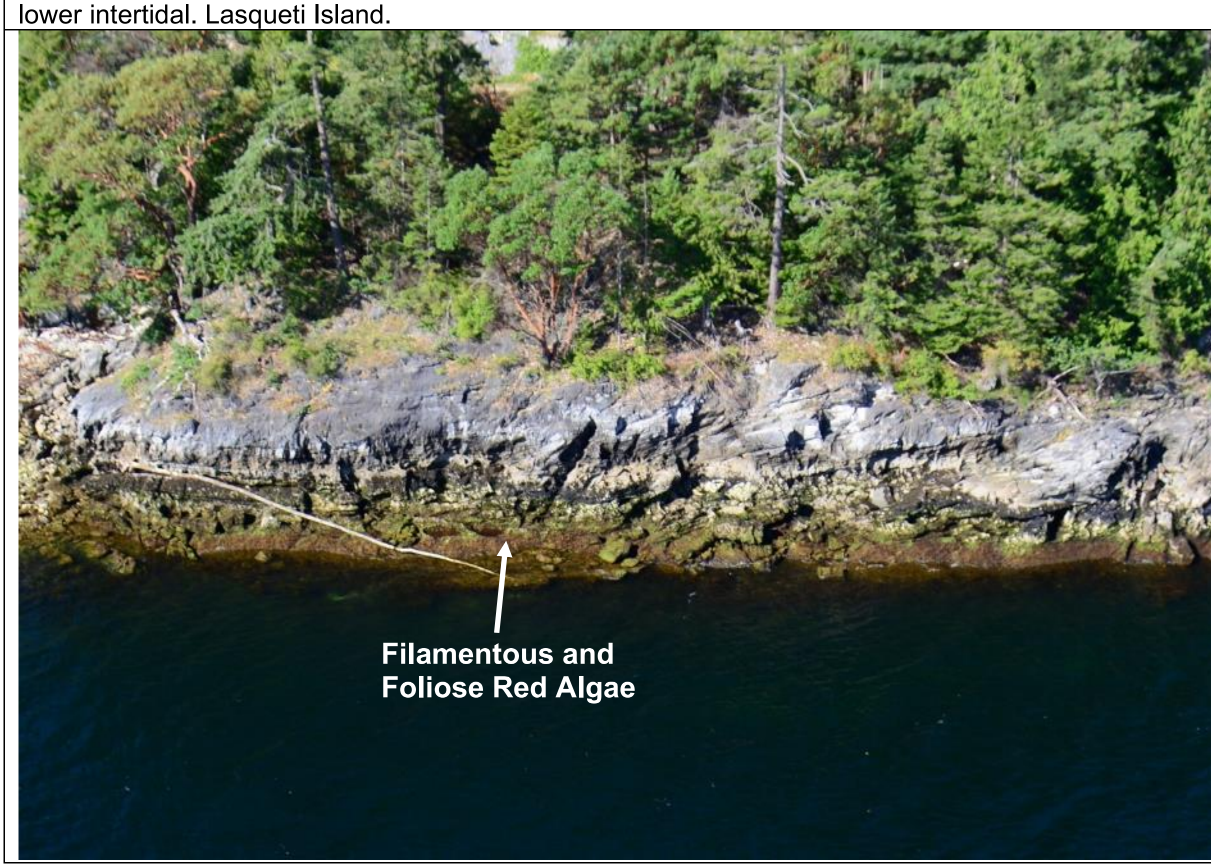

Photo bc20_sc_00732: Good example of the Filamentous and Foliose Red Algae (FFRA) bioband in the lower intertidal. Texada Island.

Photo bc20_sc_04237: Good example of Brown Bladed Algae in the subtidal (BRBA). Copeland Islands.
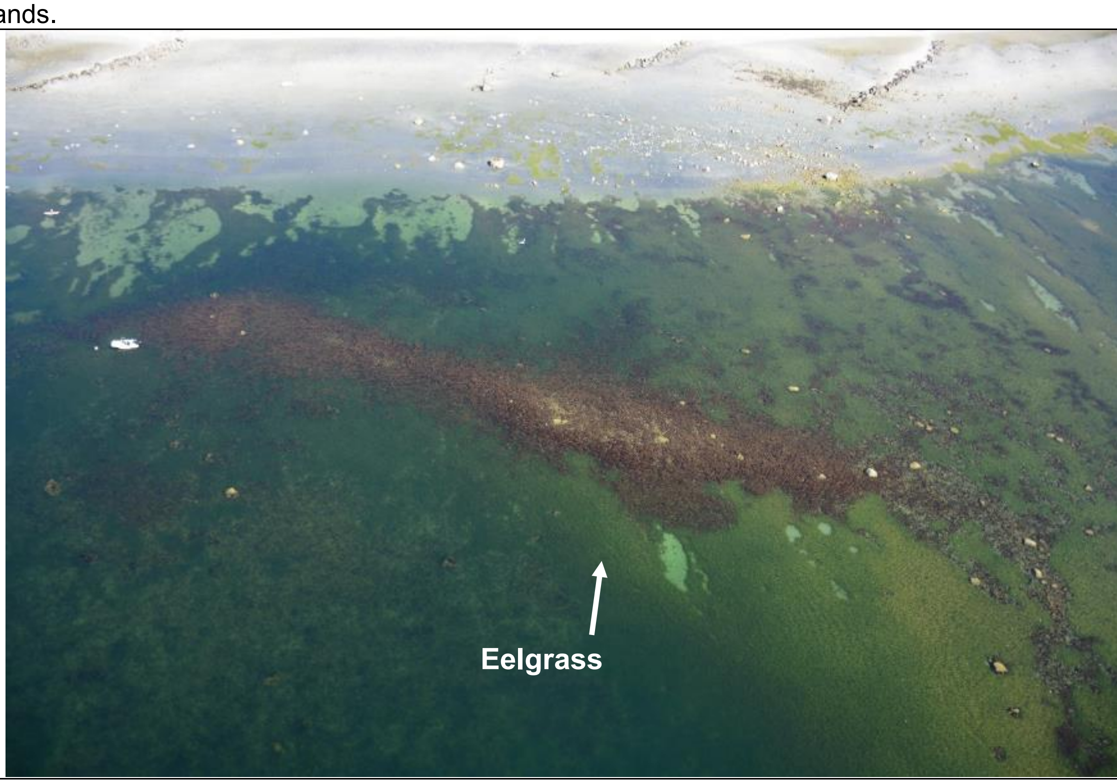
Photo bc20_sc_01638: Example of the Eelgrass (EELG) bioband in the lower intertidal/subtidal. Savary Island.

Photo bc20_sc_06463: Good example of the fluffy, floating Sargassum (SARG) bioband. Salmon Inlet.

Photo bc20_sc_09829: Good example of the Bull Kelp (BUKE) bioband in the nearshore. Skookumchuck Narrows.

Photo bc20_sc_11588: Good example of the Trees and Shrubs (TRSH) bioband overhanging the waterline in Sakinaw Lake.

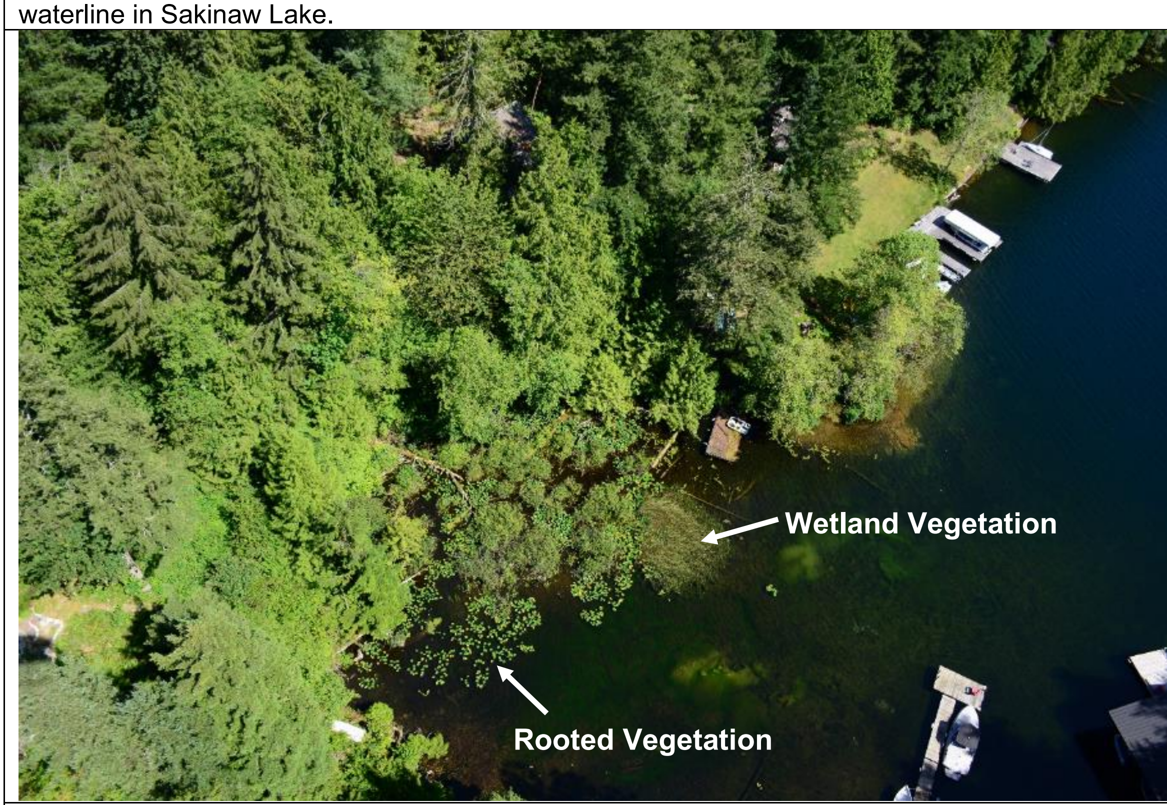

Photo bc20_sc_11679: Good example of the Rooted Vegetation (ROVE) bioband (mainly waterlilies) and Wetland Vegetation (WEVE) bioband in Sakinaw Lake

Photo bc20_sc_11680: Good example of the Grasses (GRAS) bioband on the shore of Sakinaw Lake. This was mainly groomed lawn in this survey area.

APPENDIX B

Sakinaw Lake Summary Report

The ShoreZone survey of the Sunshine Coast was mostly focused on the marine shoreline of the area but also included Sakinaw Lake, a large, freshwater, non-tidal lake. Sakinaw Lake is a popular local recreation area and is also an area of interest for the shíshálh First Nation and for DFO resource managers as it has an endangered population of lake-spawning Sockeye Salmon (*Oncorhynchus nerka*). This population is SARA listed because it has unique genetic and biological characteristics. The population has collapsed due to numerous stressors such as logging, development of the lake shore, and overexploitation (COSEWIC, 2003). It also contains critical habitat for Western Painted Turtles (*Chrysemys picta bellii*) which are considered threatened due to stressors such as wetland loss, pressures from invasive species such as other turtles and bullfrogs, and road mortality (COSEWIC, 2016).

This was the first time ShoreZone imaging and mapping have been applied to a lake environment, although it has been applied in several large rivers including the lower portions of the Fraser, Yukon and Kuskokwim Rivers. The imaging protocol translated quite well to a lake environment and the low-altitude, oblique imagery captured the backshore and nearshore environments in high detail. The ShoreZone habitat mapping protocol required some modification mostly related to the lack of an intertidal zone, which is where ShoreZone tends to be focused. To address that, we put more emphasis on the supratidal and subtidal zones with what we call the 'intertidal' describing just the narrow strip of lakeshore directly above the water line. We also used the ShoreZone forms and materials codes (described in the ShoreZone protocol (Cook *et al*., 2017)) to describe the subtidal (C Zone) that was visible from the imagery. Any beaches (such as those used by Sockeye Salmon for spawning) would therefore be described in the C Zone attributes in the database.

Physical Attribute Mapping

The Coastal Class is used to define relatively homogenous along-shore coastal units based on the dominant process, geomorphic features and other attributes such as substrate size, across-shore width, and slope (Cook *et al*., 2017). The principal characteristics of each along-shore unit are used to assign one of 39 overall unit classifications. The description for each Coastal Class category in the survey area is given in Table 1 in the main portion of this report. The Coastal Class generally describes the intertidal zone; however, in Sakinaw Lake the Coastal Class describes the main shoreline and also the immediate subtidal. The distribution of Coastal Classes in Sakinaw Lake is shown in Figure B-1.

The Shoreline Modification attribute provides a thorough catalogue of the specific types of anthropogenic modification in each unit (Cook *et al*., 2017). This includes many modifications within a given unit. For example, if both riprap and a pile-supported wharf occur, both are catalogued in the appropriate zone of that unit with an estimate of the alongshore length of the unit that modification covers. Figure B-2 shows the distribution of primary shore modifications in Sakinaw Lake, though it should be noted that any given modification is possible along the entire length of the indicated shore unit. The Geodatabase delivered with this report displays each shore modification with a specific length category (meters) along the shoreline pertaining to each unit as well as the specific zone (supratidal or intertidal) the modification occurs in.

As large woody debris is of special concern in Sakinaw Lake, given that is can provide habitat for Western Painted Turtles, Figure B-3 shows the distribution of the Biogenic logs materials code (Bl) which would indicate places where logs were noted. Figure B-4 shows a photographic example of this woody debris in Sakinaw Lake.

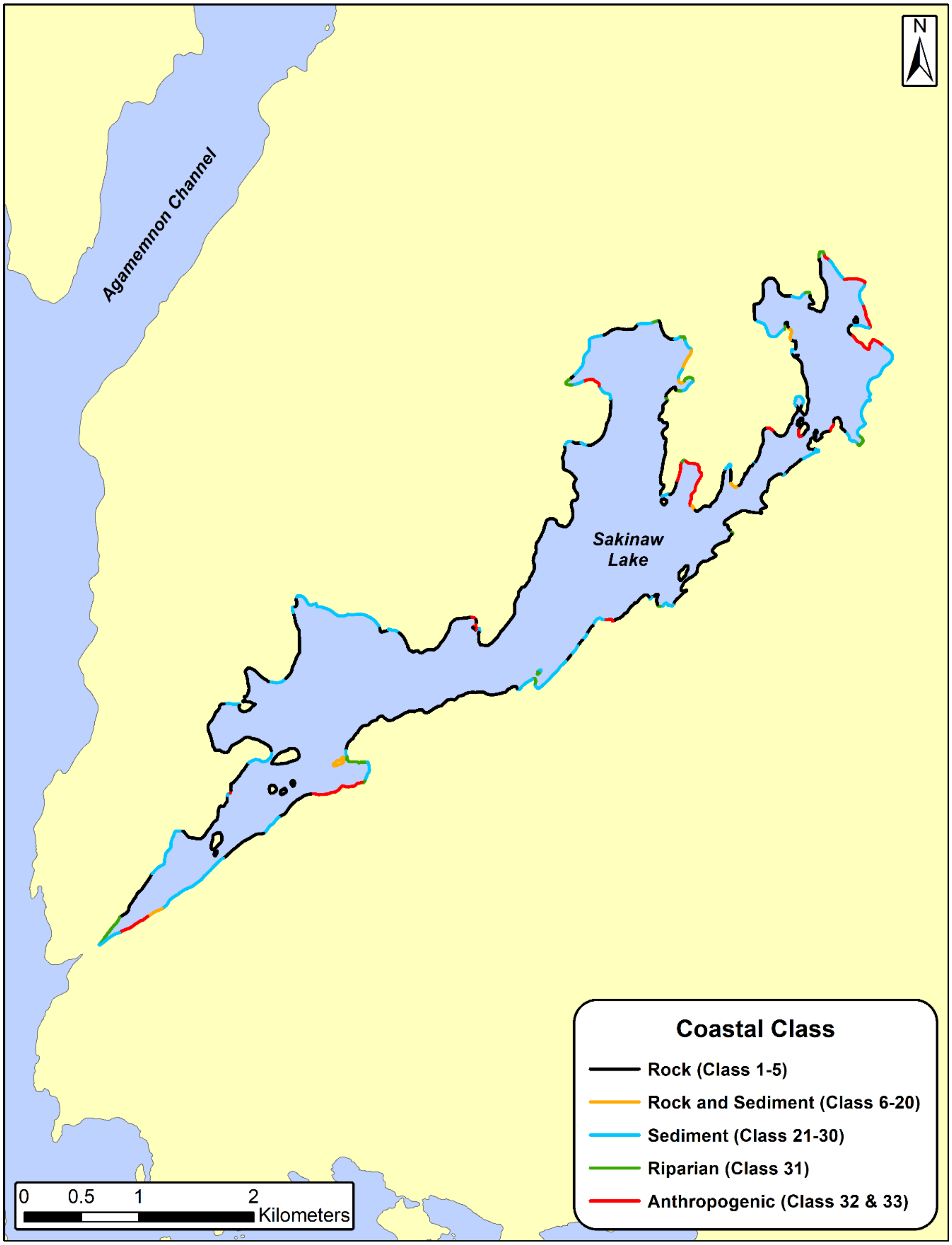

Figure B-1. Distribution of the Coastal Class attribute in Sakinaw Lake.

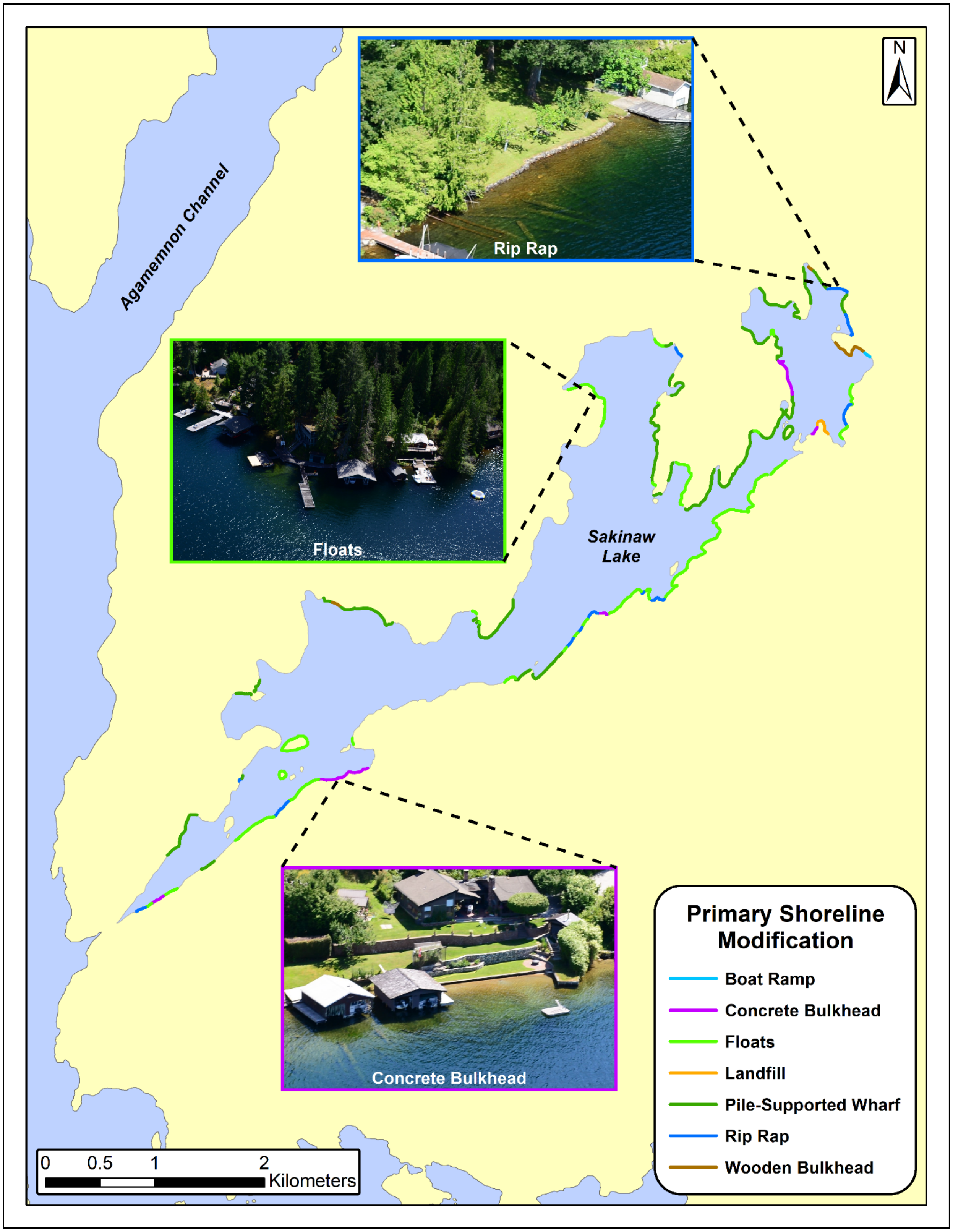

Figure B-2. Distribution of the Primary Shoreline Modification attribute in Sakinaw Lake.

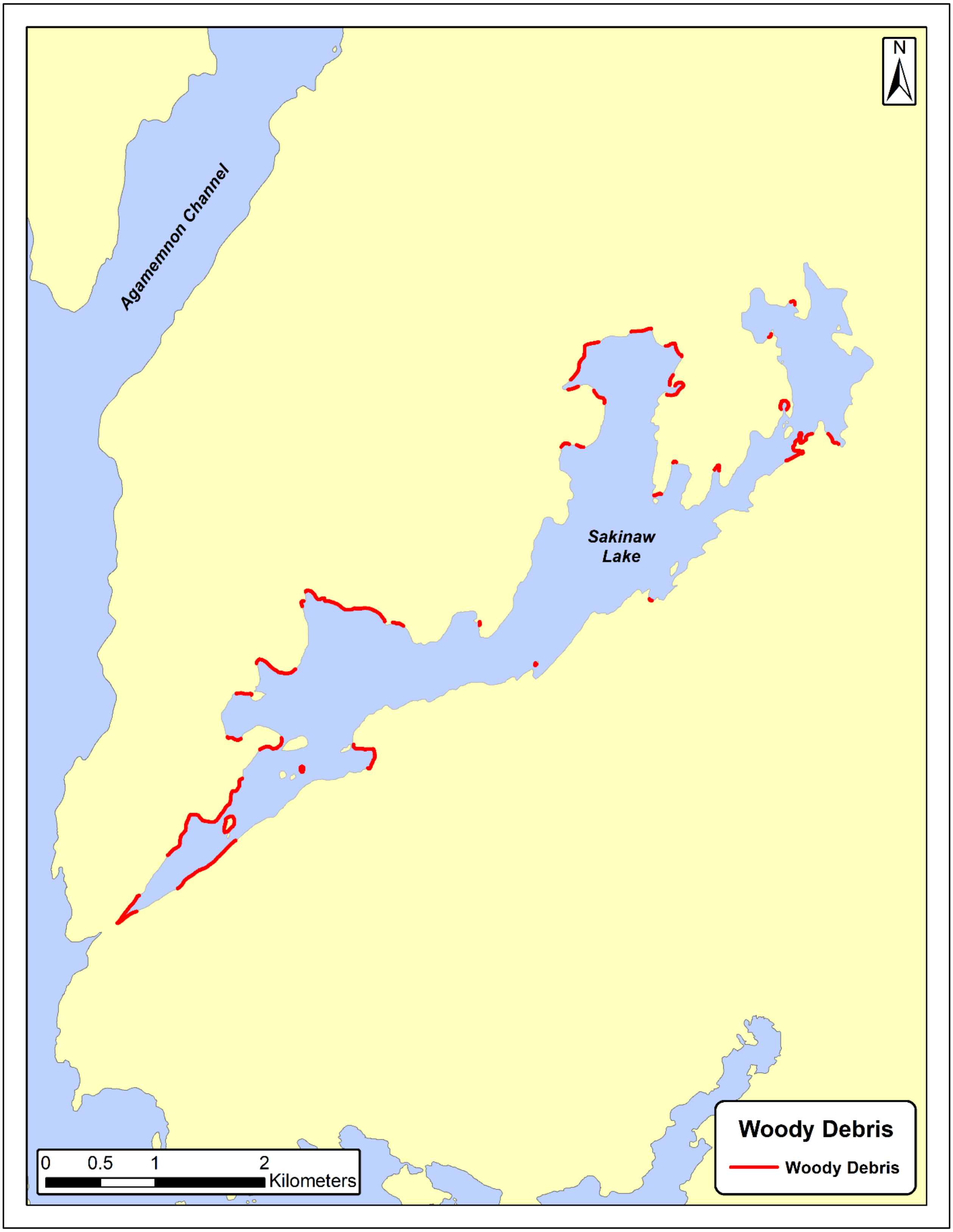

Figure B-3. Distribution of the Woody Debris (BI Materials code) attribute in Sakinaw Lake.

Figure B-4. Example of Woody Debris in Sakinaw Lake (bc20_sc_11475).

Biobands

Biobands represent assemblages of coastal biota found on the shoreline at characteristic wave exposures, substrate conditions and typical across-shore elevations. Because Sakinaw Lake is not marine or tidal we did not observe most of the typical ShoreZone biobands we would observe during a typical ShoreZone survey. Fortunately, our biobands definitions include some that are broad enough to encompass what we observed in the Lake. We observed 4 distinct vegetation types in the Lake:

1. Pond-lilies (Nuphar sp.) which we recorded as the Rooted Vegetation (ROVE) bioband (see Figures B-5 and B-6 for a map of distribution and a photographic example),
2. sedges and rushes that we recorded as Wetland Vegetation (WEVE) bioband (see Figures B-7 and B-8 for a map of distribution and a photographic example),
3. manicured lawns of an anthropogenic nature which we recorded as the Grasses (GRAS) bioband (see Figures B-9 and B-10 for a map of distribution and a photographic example),
4. and forest growing right to the water which we recorded as the Trees and Shrubs (TRSH) bioband.

Full descriptions of all biobands, including indicator and associated species can be found in the ShoreZone protocol (Cook *et al*., 2017).

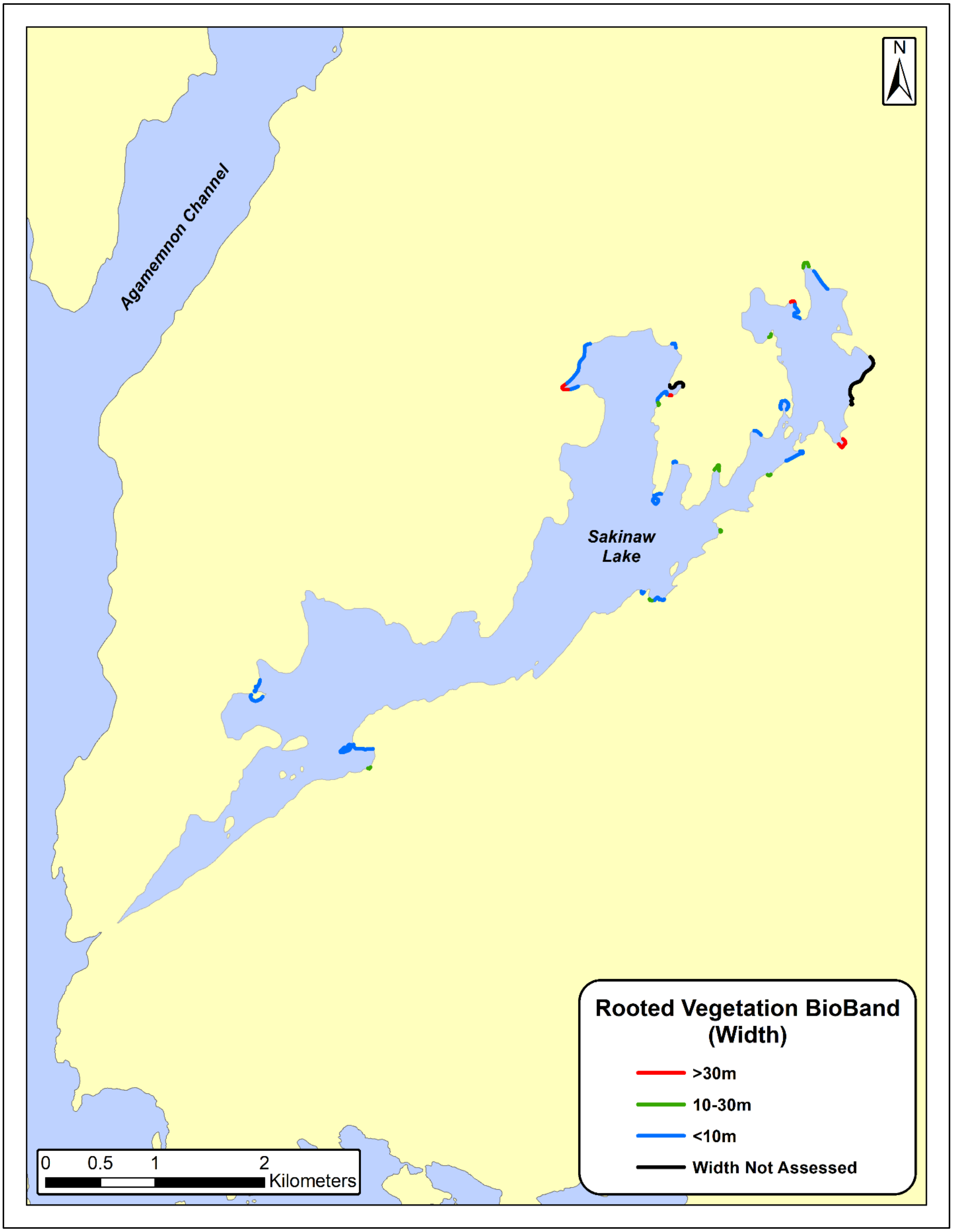

Figure B-5. Distribution of the Rooted Vegetation bioband in Sakinaw lake. This bioband was used where Pond-lilies (*Nuphar* sp.) were present.

Figure B-6. Example of Rooted Vegetation (Pond-lilies (*Nuphar* sp.)) bioband in Sakinaw Lake (bc20_sc_11475).

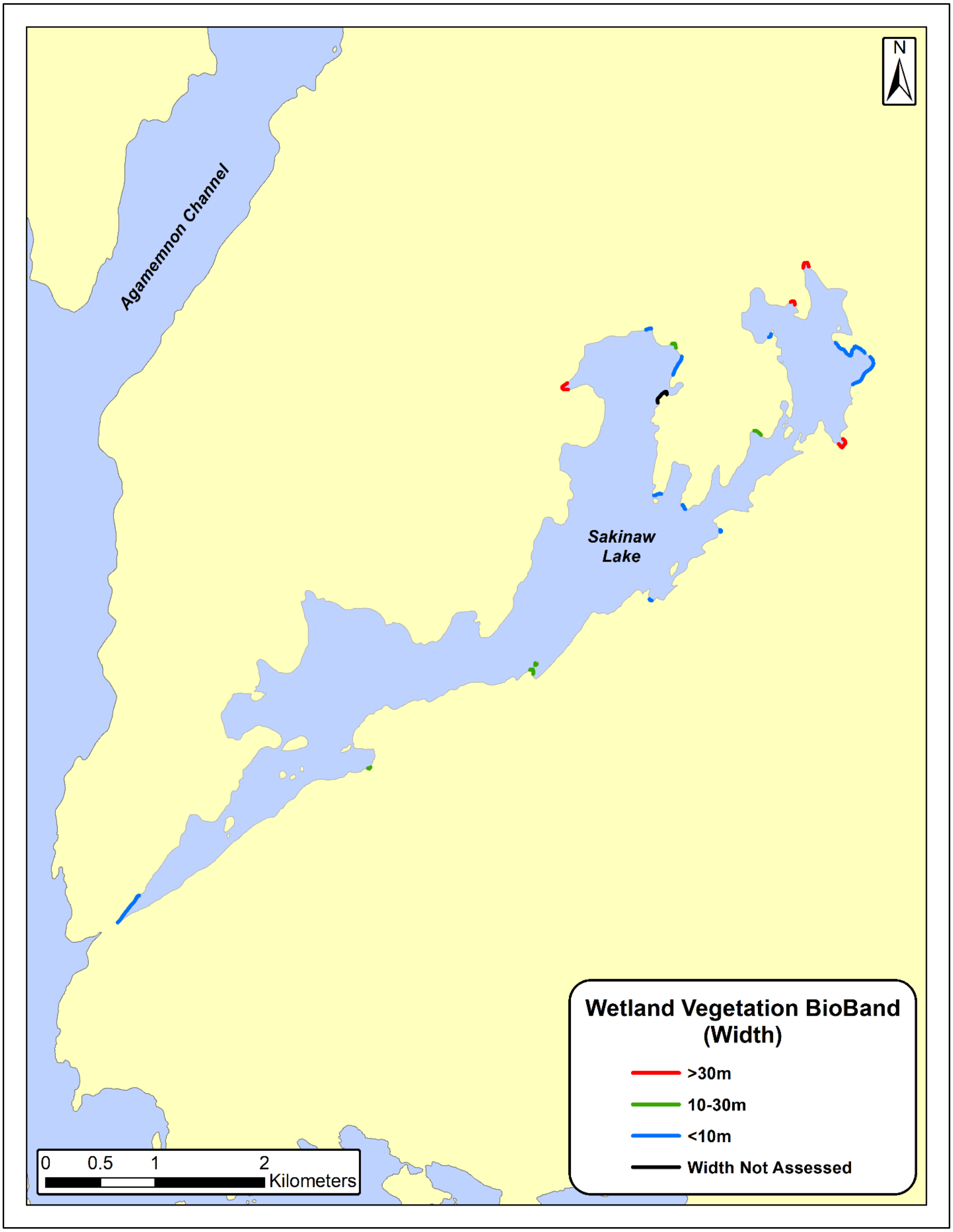

Figure B-7. Distribution of the Wetland Vegetation bioband in Sakinaw lake.

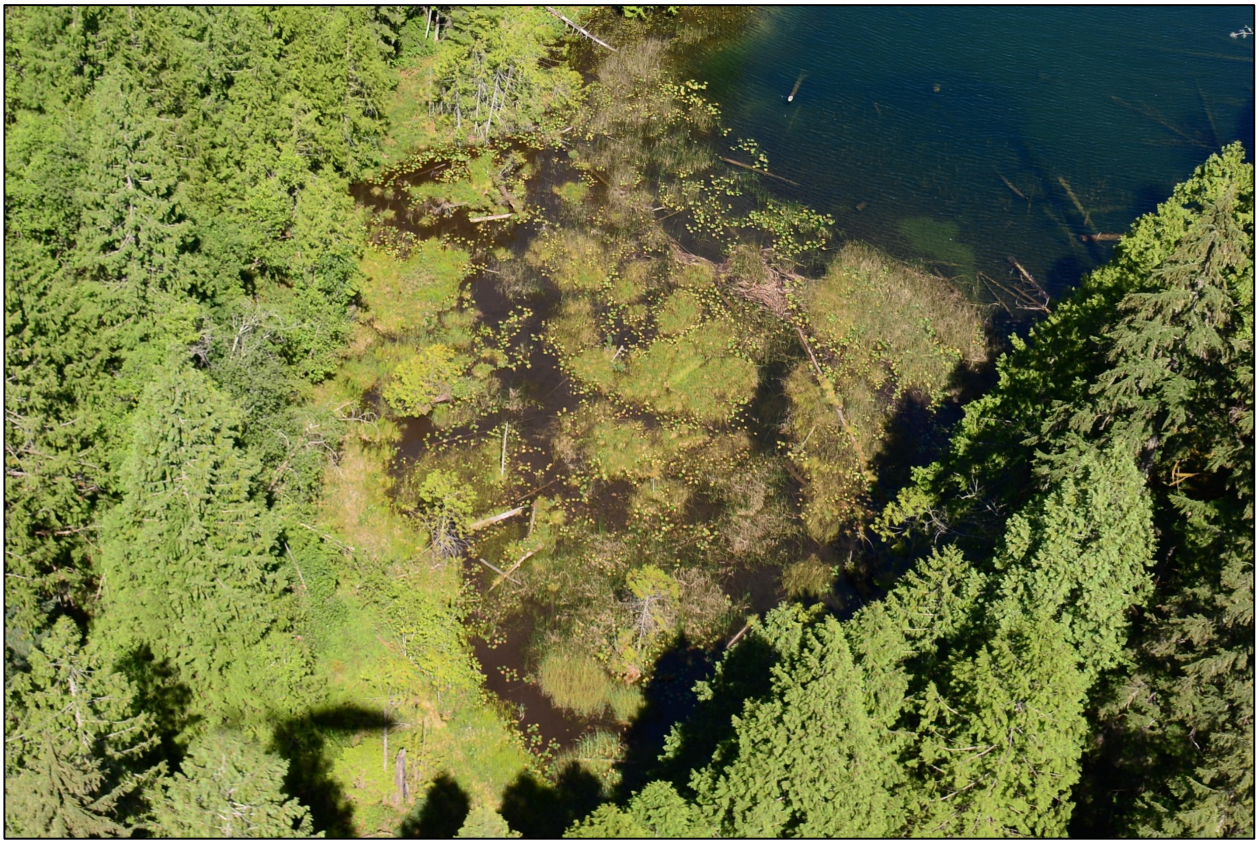

Figure B-8. Example of the Wetland Vegetation bioband mixed with Rooted Vegetation (Pond-lilies) in Sakinaw Lake (bc20_sc_11557).

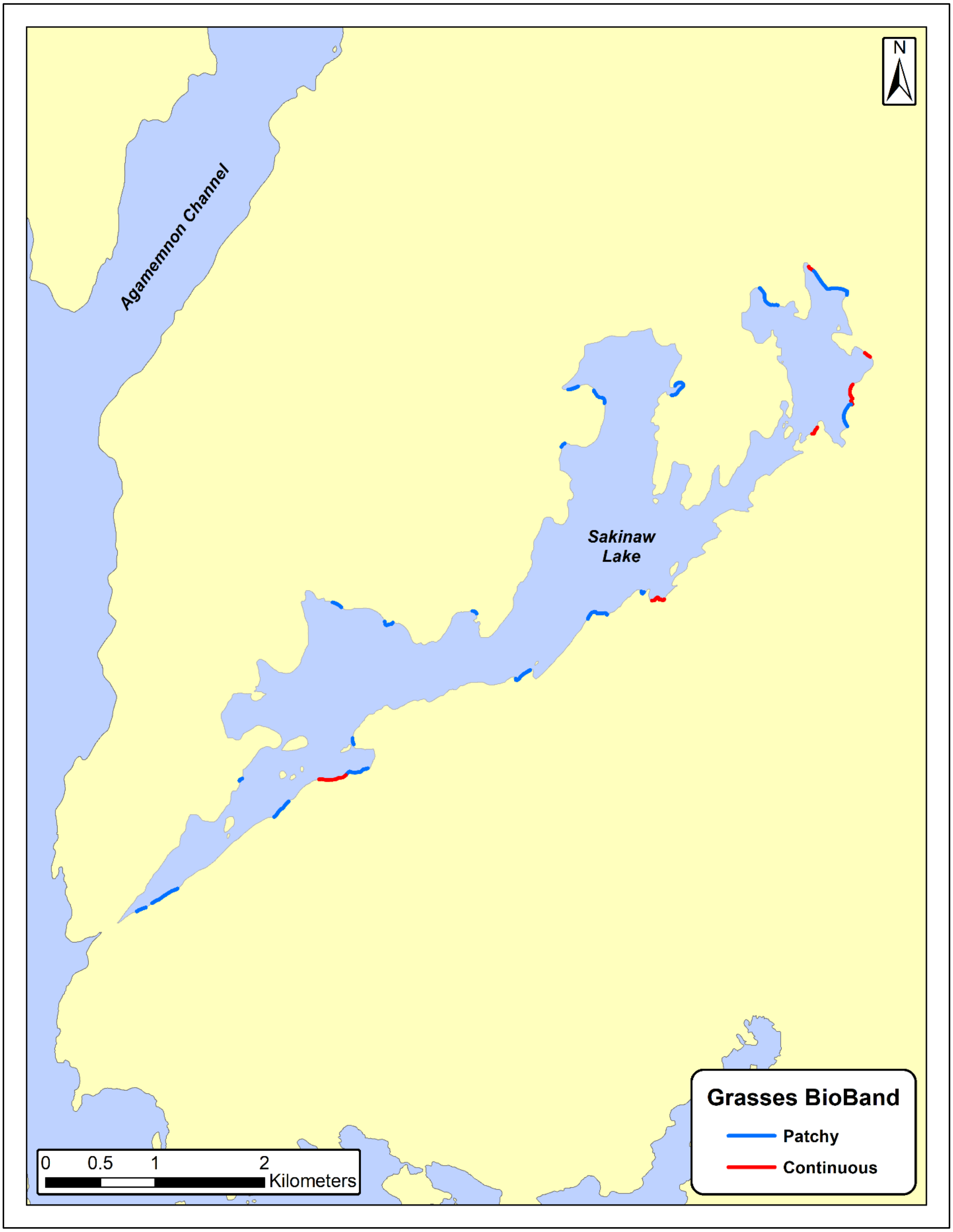

Figure B-9. Distribution of the Grasses bioband in Sakinaw Lake. This was only used where lawns (anthropogenic) were present right to the water.

Figure B-10. Example of the Grasses bioband in Sakinaw Lake (bc20_sc_11846). This was only used where lawns (anthropogenic) were present right to the water.

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