Coastal and Ocean Resources

MCORI Project: 20-05 **December 2020**

ShoreZone Habitat Mapping Cumulative Summary Report

North Coast of British Columbia

Green Island Lighthouse, Green Island

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British Columbia North Coast Area Summary

4,151 km of shoreline mapped

17,570 shoreline units created

Average unit length is **236 m**

41% of the intertidal is classified as **Rock and Sediment-dominated** and **27%** is classed as **Rock-dominated**

69% of the shoreline has a high Oil Residence Index value (residence of months to years)

3% of the shoreline has a **Shoreline Modification** of some type

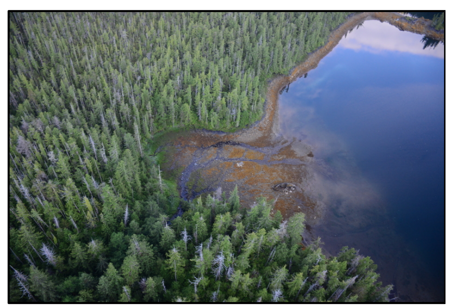
21 biobands were classified in the **intertidal** with **Rockweed** and **Green Algae** being the most common (**over 79%** of units each)

9 biobands were classified in the **supratidal** with **Black Lichen** (**82%** of units) and **Salt Marsh** (**54%** of units) being the most common

13 biobands were classified in the **subtidal** with **Bladed Brown Algae** being the most common (**75%** of units)

Prince Rupert

Zayas Island



Wales Harbour

Proctor Islands

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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 Prince Rupert and is the section of shoreline covered by this summary report.

The ShoreZone imaging surveys conducted around the north coast of British Columbia in June 2014, June 2015, August 2018, and July 2019 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. This mapping took place over the span of 7 years and during this time the ShoreZone protocol was updated. Approximately three quarters of the shoreline was mapped according the most recent ShoreZone coastal habitat mapping protocol (Cook *et al*. 2017) and a quarter was mapped according the to 2014 ShoreZone protocol (Harper *et al.* 2014). 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 North Coast survey area. Please see the Acknowledgments section for the funding partners of the imaging and mapping in Northern British Columbia.

The length of shoreline mapped is **4,151 kilometers** in **17,570 along-shore segments** (units), averaging 236 m in length. The digital shoreline used for the ShoreZone habitat mapping was the CHS_Highwaterline_BCalbers.shp.

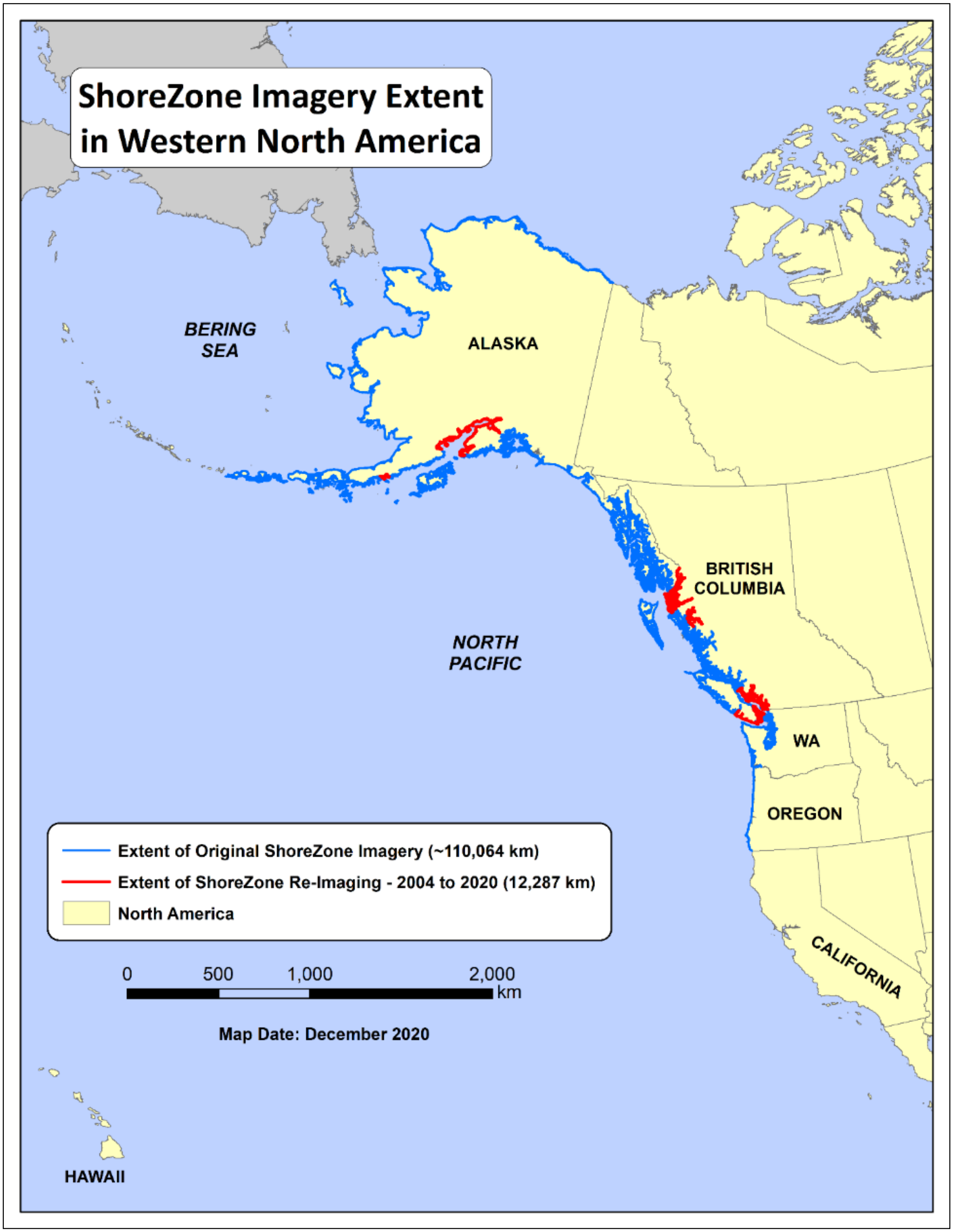

Figure 1. Extent of ShoreZone imagery in Alaska, British Columbia, Washington State and Oregon as of December 2020.

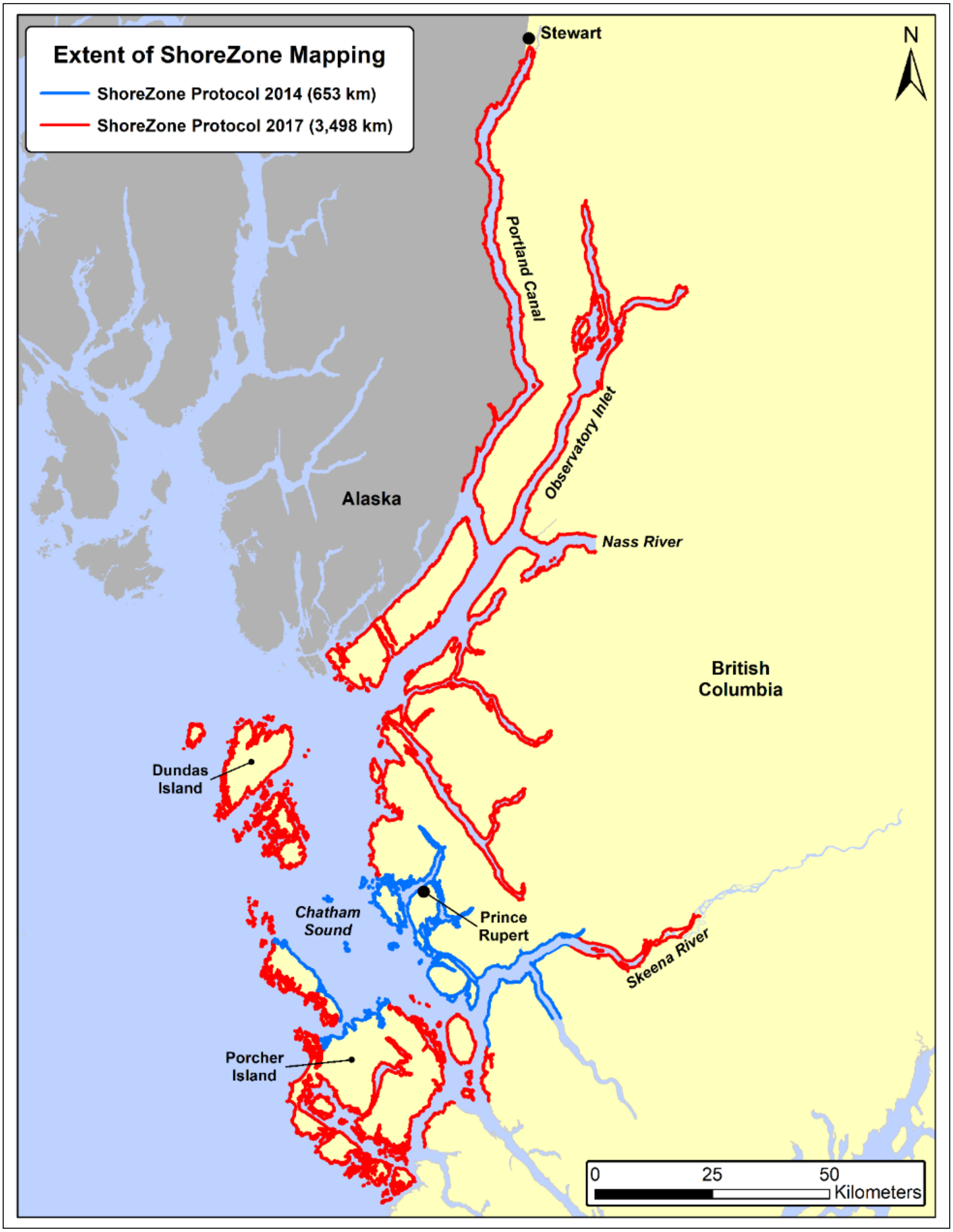

Figure 2. Extent of mapping for the North Coast of British Columbia covered in this report.

2 PHYSICAL ATTRIBUTE DATA SUMMARY

2.1 Coastal Class

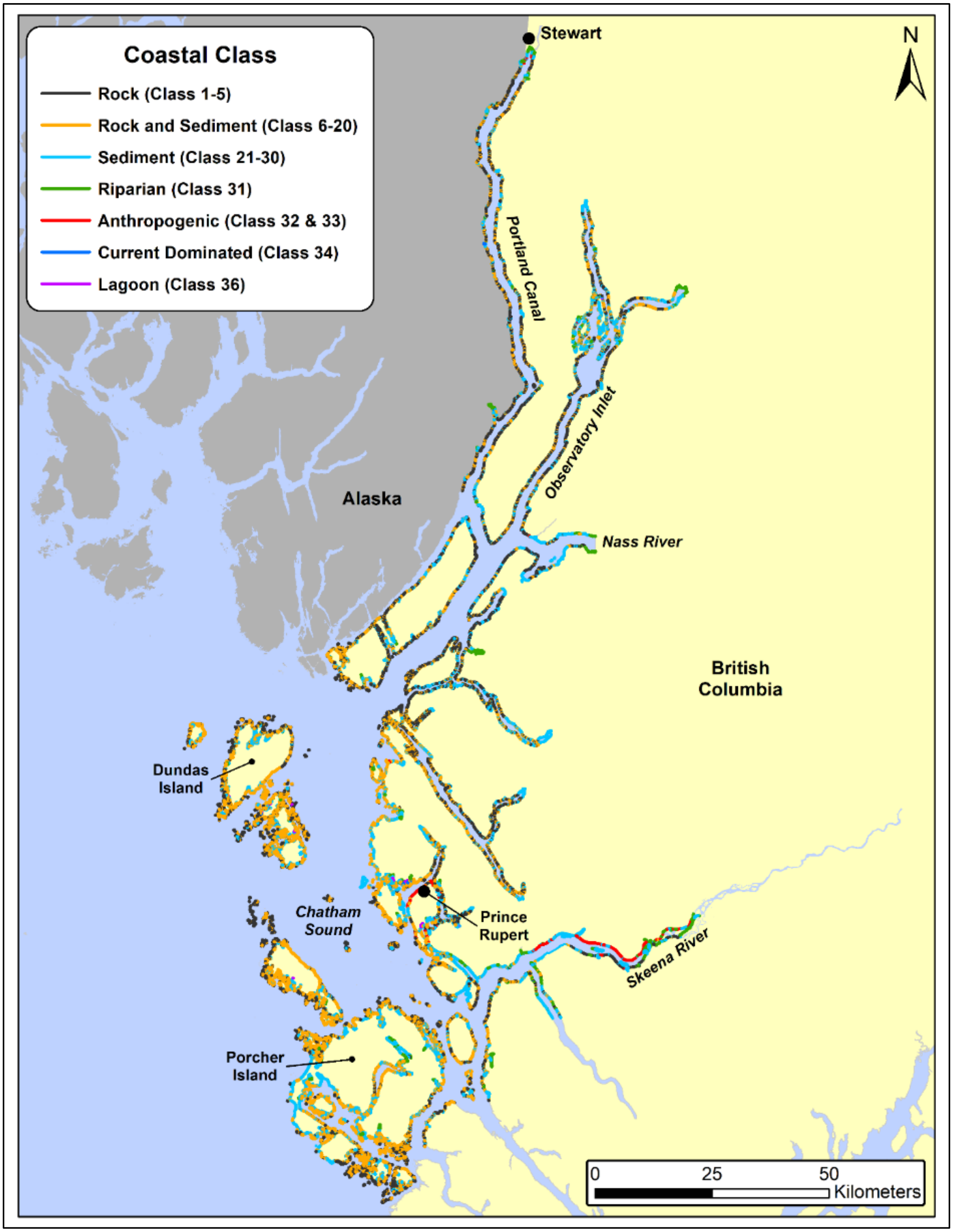

Figure 3. Map of the Coastal Class categories grouped by type (also known as Shore Type).

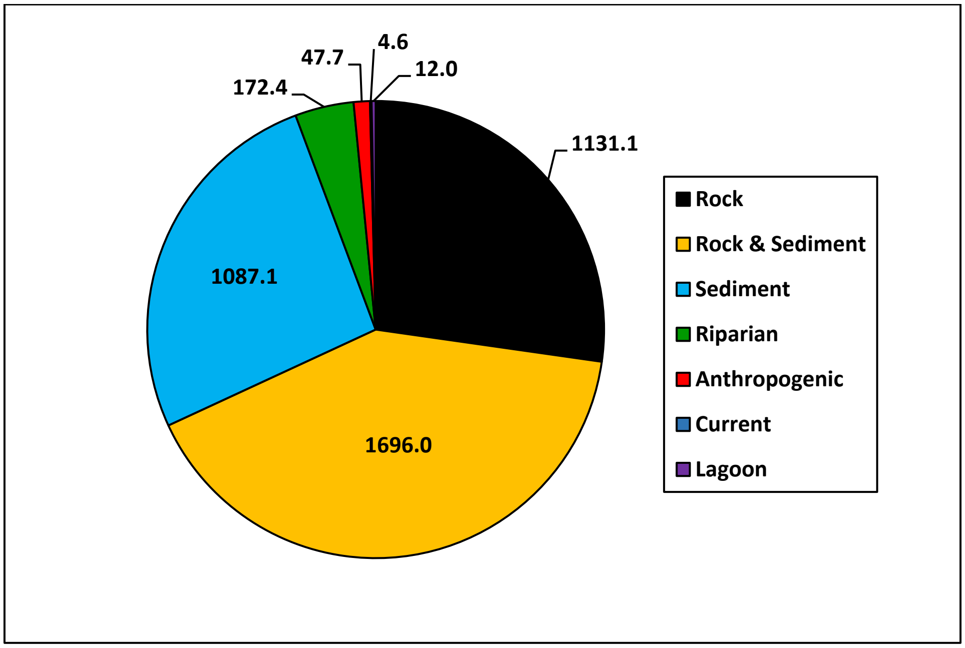

Figure 4. Grouped Coastal Class categories by shoreline length (km).

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 and Sediment shorelines (40.9%) along with Rock shorelines (27.3%) dominated the North Coast British Columbia survey area. Sediment shorelines followed with 26.2%, while 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 British Columbia North Coast survey area are found in Appendix A, Table A-1.

Table 1. Summary of Coastal Classes for the North Coast of BC.

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	29	161	1	**27% 1,131 km**
	2	Rock Platform, wide	23	125	1	
	3	Rock Cliff	921	3,742	23	
	4	Rock Ramp, narrow	159	1,036	4	
	5	Rock Platform, narrow	1	3	<1	
Rock & Sediment	6	Ramp w gravel beach, narrow	65	321	2	**41% 1,696 km**
	7	Platform w gravel beach, wide	26	107	1	
	8	Cliff with gravel beach	293	1,543	7	
	9	Ramp with gravel beach	210	1,242	5	
	10	Platform with gravel beach	1	4	<1	
	11	Ramp w gravel & sand beach, ...	366	1,647	9	
	12	Platform with G&S beach, wide	349	1,020	9	
	13	Cliff with gravel/sand beach	91	614	2	
	14	Ramp with gravel/sand beach	241	1,571	6	
	15	Platform with gravel/sand beach	1	5	<1	
	16	Ramp w sand beach, wide	27	96	1	
	17	Platform w sand beach, wide	11	36	<1	
	18	Cliff with sand beach	10	43	<1	
	19	Ramp w sand beach, narrow	6	34	<1	
	20	Platform w sand beach, narrow	<1	2	<1	
Sediment	21	Gravel flat, wide	20	78	1	**26% 633 km**
	22	Gravel beach, narrow	63	401	2	
	24	Sand & gravel flat or fan	603	1,915	15	
	25	Sand & gravel beach, narrow	195	973	5	
	26	Sand & gravel flat or fan	3	20	<1	
	27	Sand beach	1	6	<1	
	28	Sand flat	140	248	3	
	29	Mudflat	52	95	1	
	30	Sand beach	10	24	<1	
Organics	31	Organics/Estuarine	172	260	3	**3% 80 km**
Man-made	32	Man-made, permeable	47	145	1	**1% 47 km**
	33	Man-made, impermeable	1	6	<1	
Current	34	Channel	5	23	<1	**<1% 5 km**
Lagoon	36	Lagoon	12	24	<1	**<1% 12 km**
Totals:			***4,151***	***17,570***	***100***	***100%***

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

2.2 Environmental Sensitivity Index (ESI)

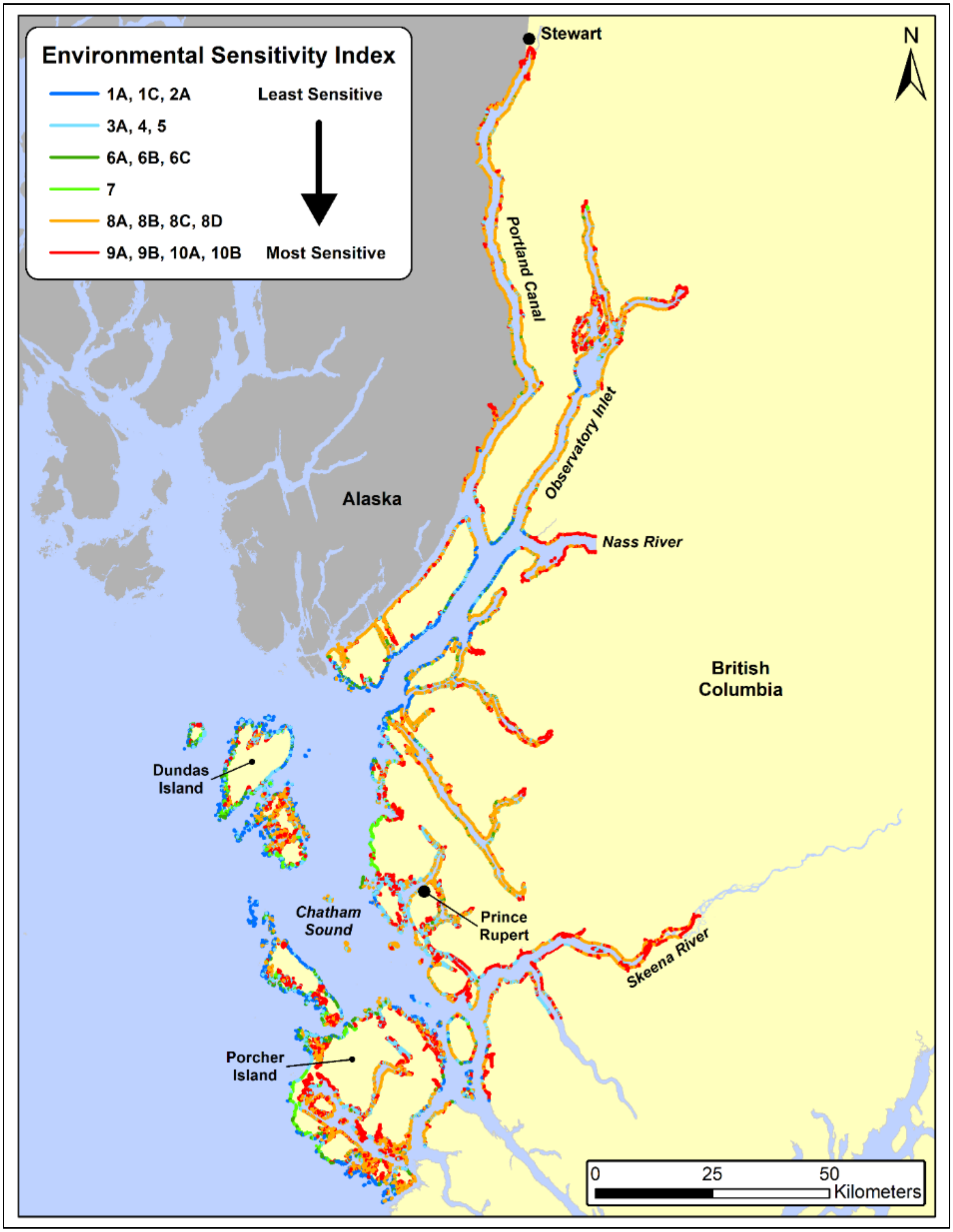

Figure 5. Distribution of the grouped ESI categories from least to most sensitive to oiling.

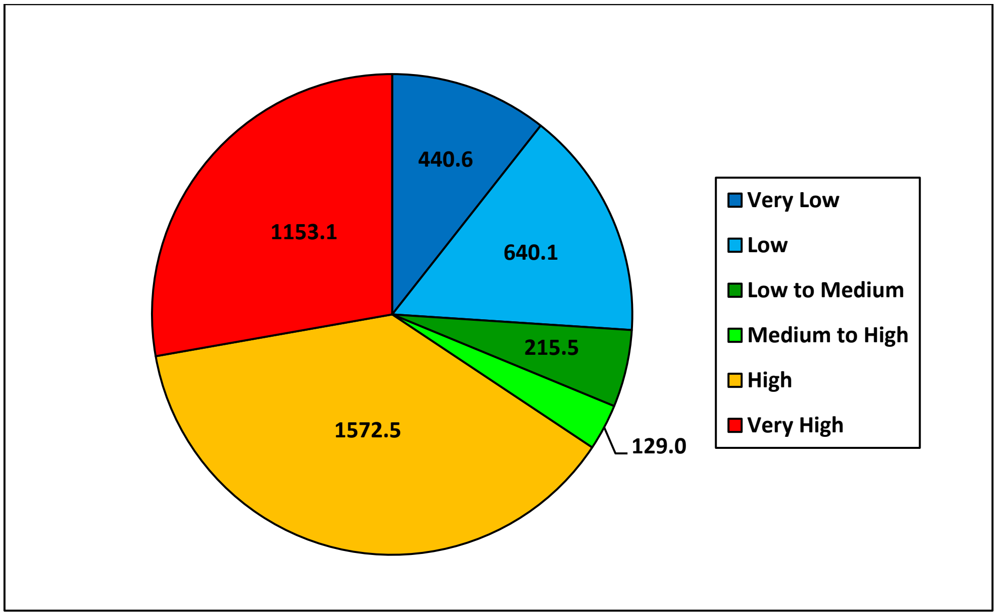

Figure 6. Grouped most sensitive ESI categories by shoreline length (km).

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 north coast is represented by the grouped High and Very High categories (65.7% of shoreline length). These sections of the shoreline have a potentially high sensitivity to oil. At the other end of the spectrum, only 26.0% 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 BC North 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	250	1,107	6
1C	Exposed rocky cliffs with boulder talus base	32	163	1
2A	Exposed wave-cut platforms in bedrock, mud, or clay	160	896	4
3A	Fine- to medium-grained sand beaches	34	153	1
4	Coarse-grained sand beaches	5	26	<1
5	Mixed sand and gravel beaches	601	2,894	15
6A	Gravel beaches (granules and pebbles)	2	12	<1
6B	Gravel beaches (cobbles and boulders)	212	1,163	5
6C	Rip rap	1	6	<1
7	Exposed tidal flats	129	321	3
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	921	4,422	22
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	42	179	1
8C	Sheltered Rip Rap	41	123	1
8D	Sheltered rocky rubble shores	569	3,148	14
9A	Sheltered tidal flats	520	1,355	13
9B	Vegetated low banks	26	41	1
10A	Salt- and brackish-water marshes	591	1,542	14
10B	Freshwater marshes	15.8	19	<1
	Totals:	***4,151***	***17,570***	***100***

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

2.3 Oil Residence Index (ORI)

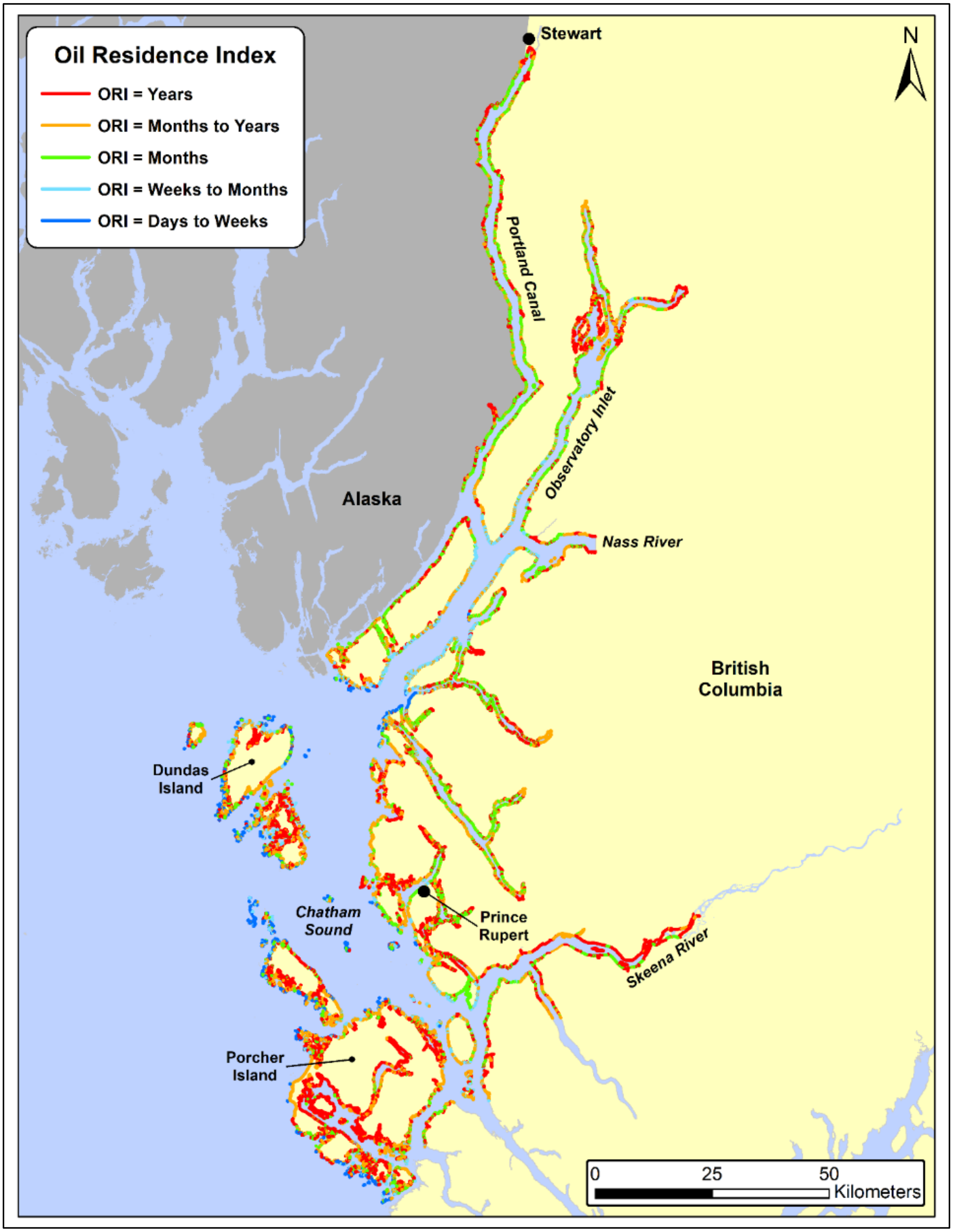

Figure 7. Distribution of the Oil Residence Index (ORI) categories.

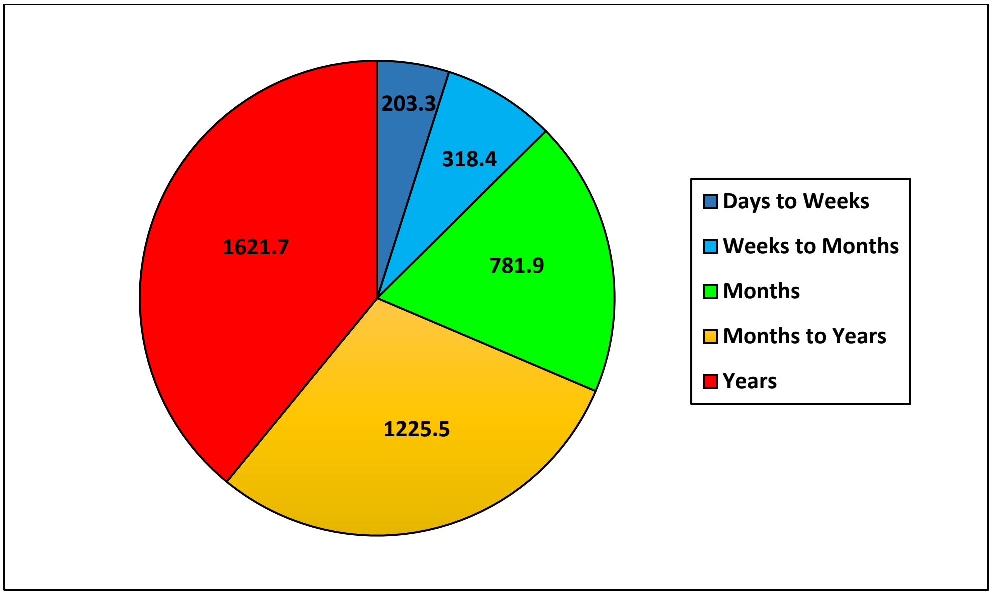

Figure 8. Oil Residence Index (ORI) categories by shoreline length (km).

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 68.6% of the shore segments in the British Columbia North 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

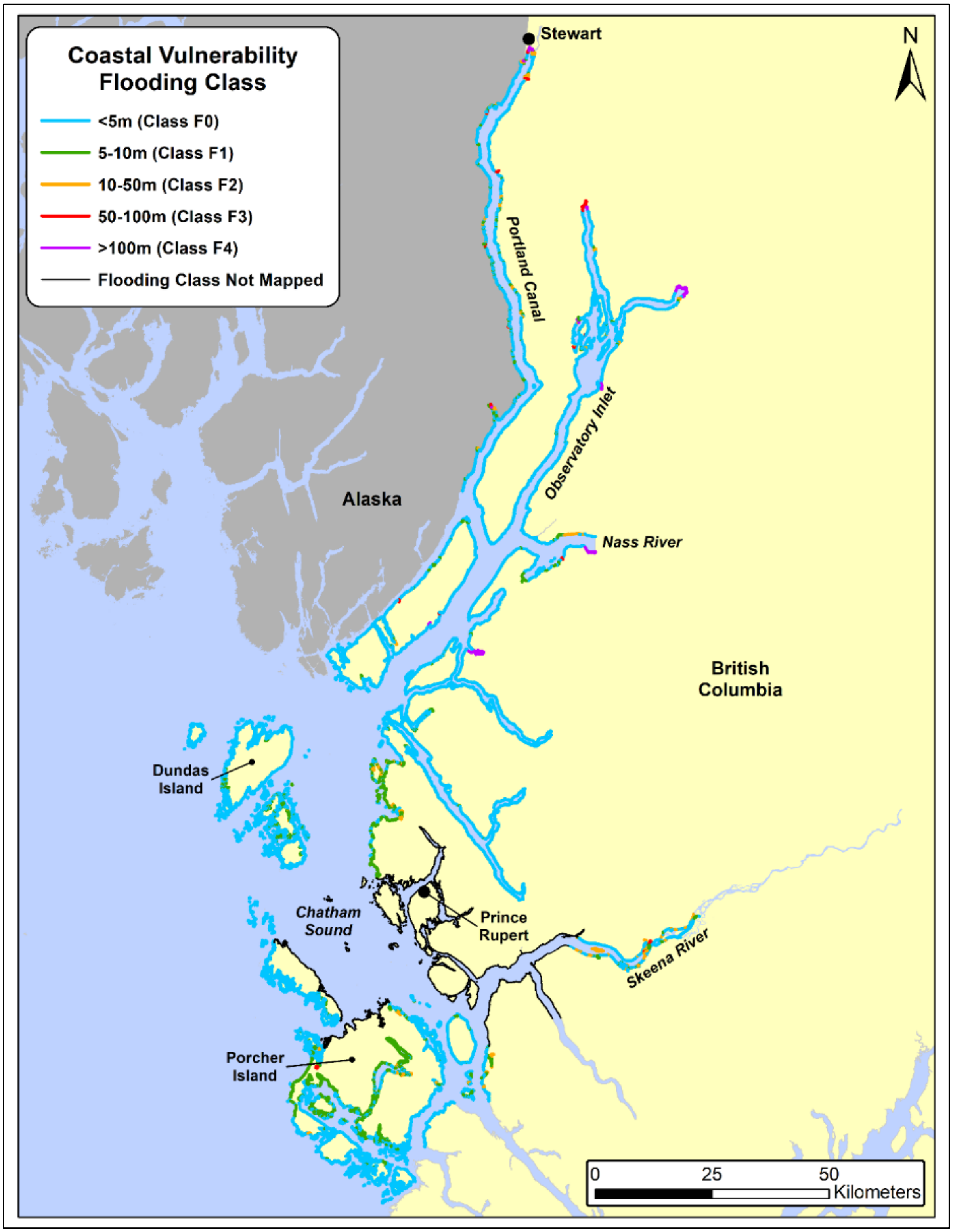

Figure 9. Distribution of the Coastal Vulnerability Flooding Class.

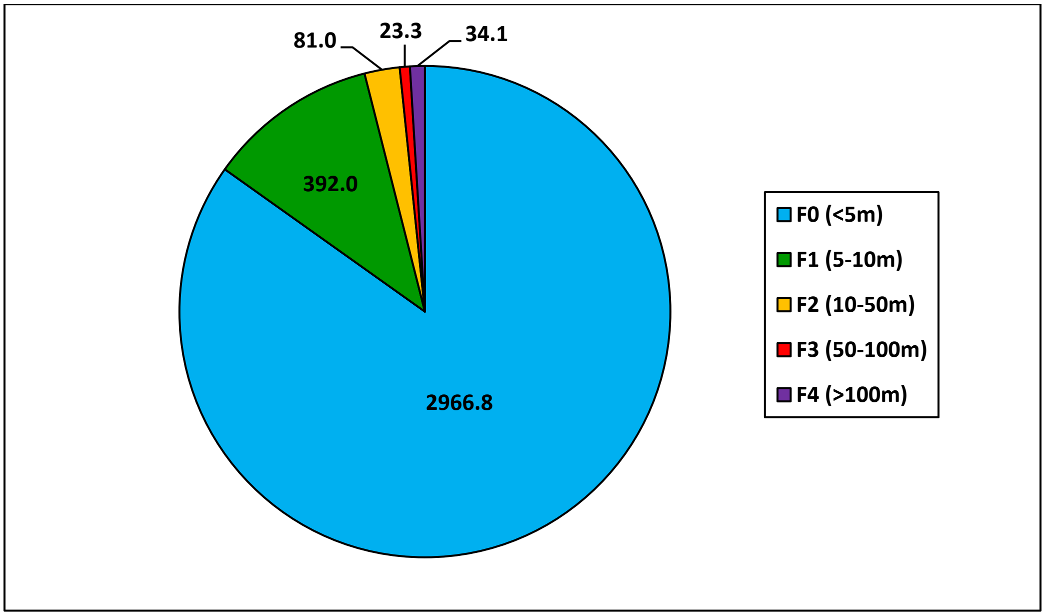

Figure 10. Flooding Class categories by shoreline length (km).

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 84.8% of the shoreline at a low risk of flooding <5m from 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). Note that approximately a quarter of the British Columbia North Coast mapping in this report was completed under a different ShoreZone protocol which did not included the Coastal Vulnerability Module.

2.4.2 Coastal Vulnerability Observations

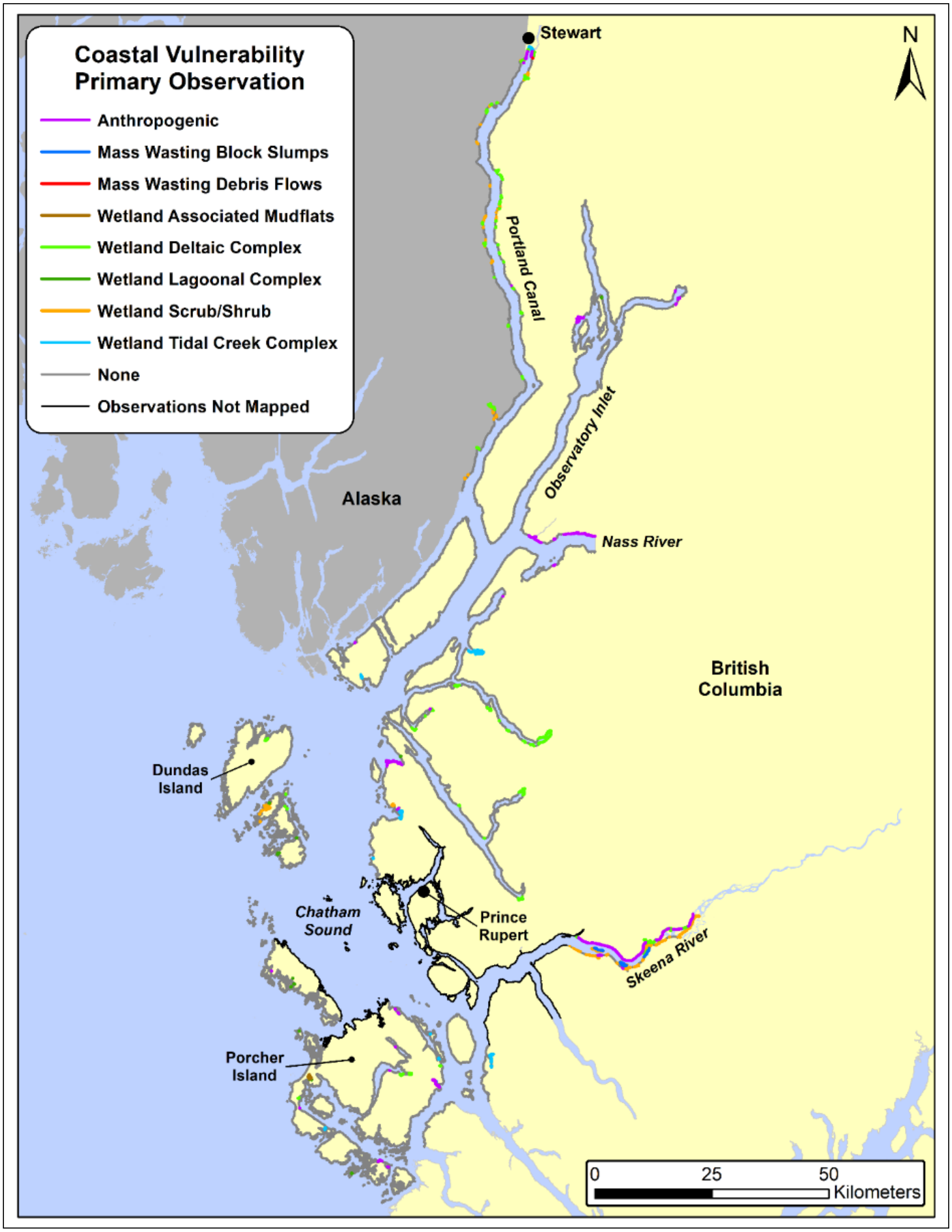

Figure 11. Distribution of the Coastal Vulnerability Observations categories.

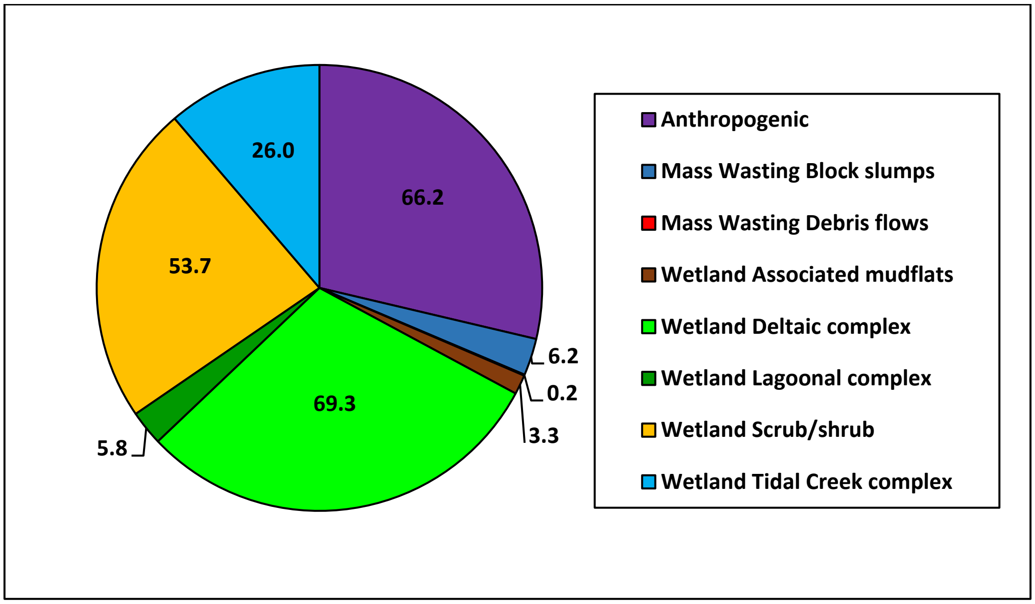

Figure 12. Coastal Vulnerability Observations categories by shoreline length (km). Category 'None' not shown.

The CVM Observations are features important for estimating the frequency and extent of coastal inundation. In the British Columbia North Coast area, apart from the 'None' category, the majority of observations were from the Wetland Deltaic complex category with 69.3 km and the Anthropogenic category with 66.2 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. Note that approximately a quarter of the British Columbia North Coast mapping in this report was completed under a different ShoreZone protocol which did not included the Coastal Vulnerability Module.

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. This method of calculating the CVI was used for the 3,498 km of the North Coast mapped after the implementation of the 2017 protocol. The 653 km of shoreline mapped using the 2014 protocol, before the development of the CVI, were originally not included in the CVI calculation as the definitions of the classification for Shoreline Erosion and Flood Zone Width were different; however, in 2020 the Prince Rupert Port Authority started a process to update their Land Use Management Plan and also began a Transportation Asset Risk Assessment (TARA) process. As part of that process, they commissioned an update to the Foreshore Habitat Value ranking that had previously been completed around the Port in 1999. This update used 300 km of the ShoreZone imagery and mapping immediately around the Port which was completed using the 2014 Protocol (Harper and Morris, 2014). Part of that analysis also included modifying the ShoreZone CVI formula to be used with the 2014 mapping dataset. The report for that work details the CVI calculation to be used with the 2014 mapping (Cook, 2020). This method has now been applied to all 653 km of 2014 protocol mapping on the North Coast of BC, making it consistent with the 2017 Protocol mapping.

When we first attempted to calculate the CVI for the portion of the shoreline funded in the Eastern Aleutians by OSRI, 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 North Coast of BC is shown in Figure 13. Due to the large (>6m) tide range and generally rocky nature of the coastline, only 5 units in the survey area were ranked Moderate in terms of vulnerability to sea level rise, while the rest were ranked as Low. Wave Exposure was clearly a driving factor in the distribution of values, with geomorphology (more sediment dominated beaches or low-lying marshy areas) being a deciding factor along more protected parts of the coastline.

Figure 13. Distribution of Coastal Vulnerability index ranks in the Prince Rupert survey area.

2.5 Anthropogenic Shore Modifications

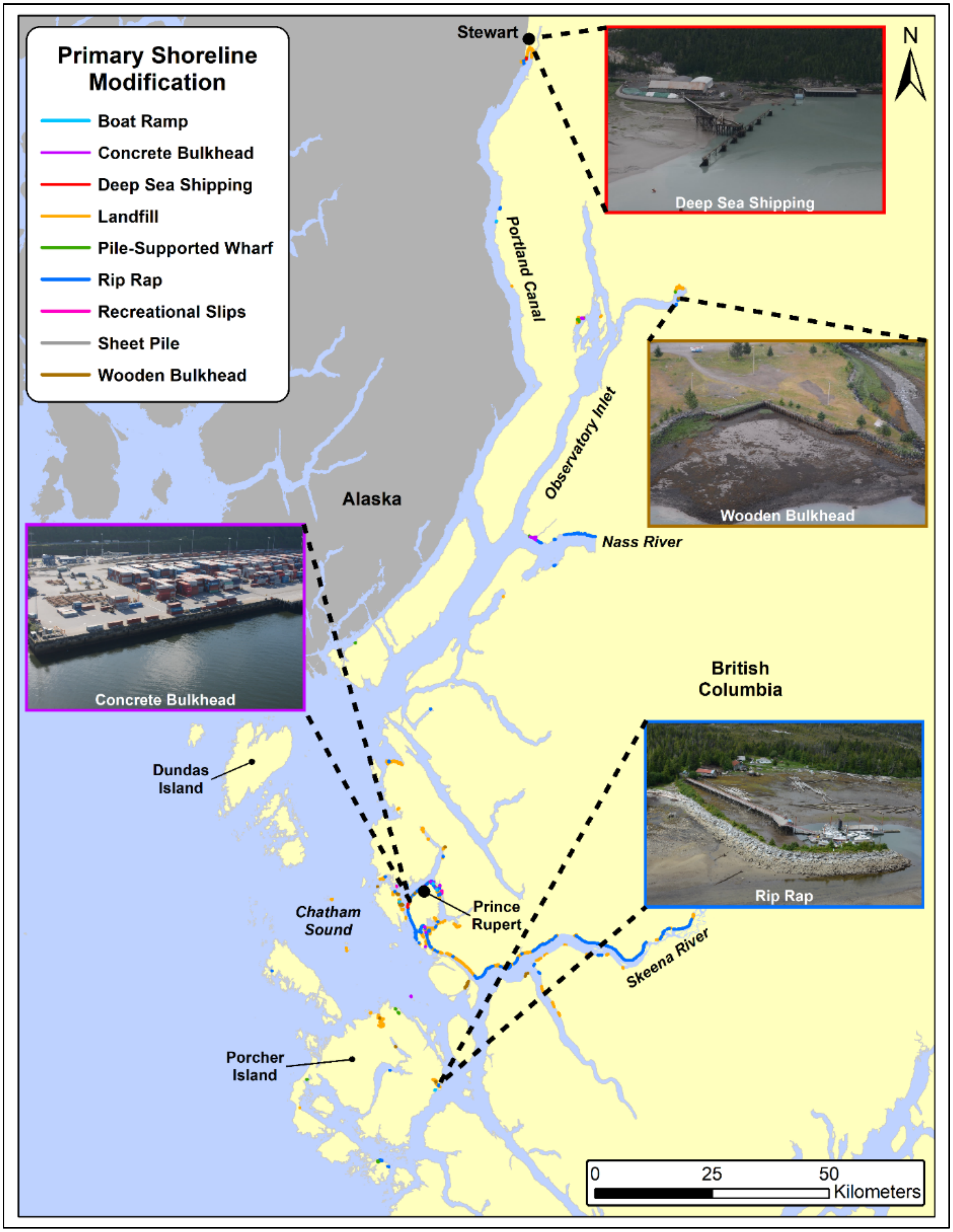

Figure 14. Distribution of types of the primary Shore Modifications. There may be other shore modifications in any given unit. That data would be found in the Shore Modifications table in the geodatabase.

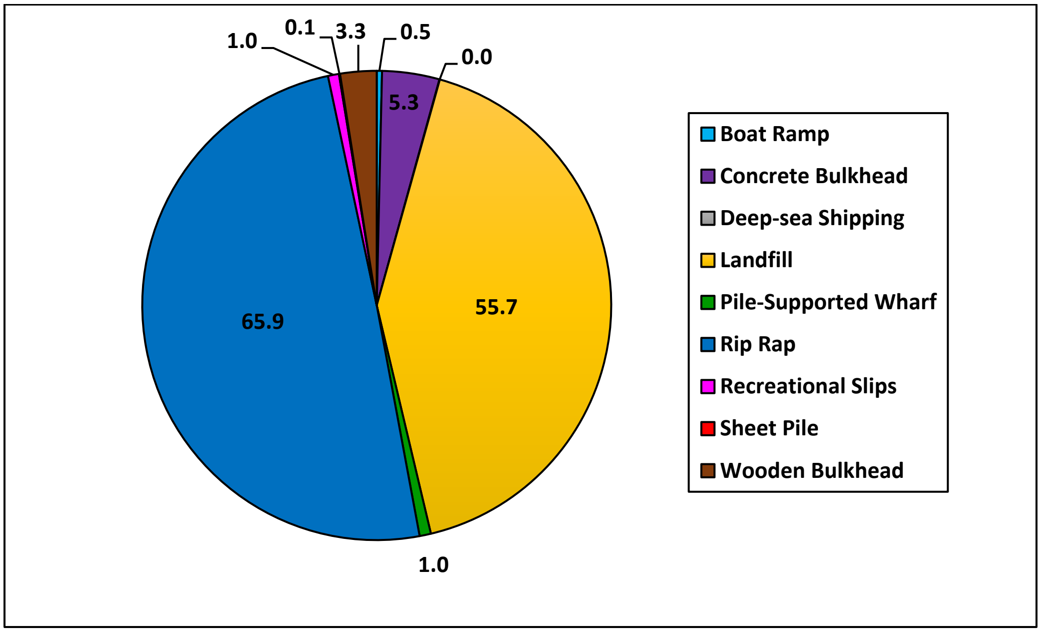

Figure 15. Shore Modifications by estimated shoreline length (km) of each modification type.

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 3.2% of the shoreline (taking the estimated length of that modification within the unit into account) exhibits shore modifications in the British Columbia North Coast study area (Figure 14). Rip Rap was the most commonly recorded observation (49.6%) with Landfill (41.9%) and Concrete Bulkheads (4.0%) 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. Note approximately a quarter of the British Columbia North Coast mapping in this report was completed under a different ShoreZone protocol which mapped Recreational Slips and Wharfs in a different manner - one in which they cannot be represented proportionally by shoreline length. That particular data is in the Geodatabase for reference.

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

It is important to note that a nested bioband classification was developed and applied to all ShoreZone mapping completed after 2015. Changes to the bioband definitions include the application of a consistent naming convention and new four-digit codes for each bioband. A number of new biobands were added and some were split to better describe the banding that has been observed as ShoreZone continues to move into new and unique areas. The mapping completed for DFO that is incorporated into this report was completed under the 2017 protocol while the mapping for the Port of Prince Rupert and Metlakatla First Nation was completed under the 2014 ShoreZone protocol (Harper and Morris, 2014) so did not include the new bioband names or metrics (see Figure 2 for exact areas mapped under each protocol).

In the 2014 ShoreZone protocol, only two descriptors were used for the distribution of biobands within each unit: Patchy (in <50% of the length of the unit) or Continuous (in >50% of the length of the unit). In the 2017 protocol, the specific elevation or zone of the shoreline determined how the bioband attributes were 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 the two datasets. CORI has translated the mapping completed under the 2014 ShoreZone protocol to the 2017 protocol format in the geodatabase that accompanies this report. All bioband names are therefore now consistent across the datasets but other fields, such as % length and % cover will be blank for the older mapping.

Biobands mapped in the Prince Rupert area to date are summarized in Tables 3 and 4. The most commonly occurring intertidal biobands in the survey areas were Rockweed which was found in 89% of units while Green Algae and Barnacles were found in 79% and 72% of units, respectively. The most common supratidal bioband was Black Lichen, occurring in 82% of the units, while the supratidal/high intertidal Salt Marsh bioband was found in 54% of units. The most common low intertidal/subtidal biobands were Brown Bladed Kelps (75%), Eelgrass (24%) and Bull Kelp (24%). All the most common biobands were typically associated with Semi-Protected to Protected partially mobile shorelines, which is a good description of the majority of this area. 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 North Coast.

Bioband		Patchy		Continuous		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%		
Trees and Shrubs	TRSH	2	<1	110	3	112	3
Wetland Vegetation	WEVE	19	<1	53	1	73	2
Dune Grass	DUGR	265	6	36	1	301	7
Sedges	SEDG	8	<1	55	1	62	1
Salt Marsh	SAMB	958	23	1269	31	2228	54
Barnacle	BARN	798	19	2198	53	2996	72
Rockweed	ROCK	755	18	2954	71	3709	89
Green Algae	GRAL	1508	36	1774	43	3282	79
Blue Mussel	BLMU	364	9	497	12	861	21
Echinoderms	ECHI	92	2	0	0	92	2
Bleached Red Algae	BRAL	52	1	12	<1	65	2
Filamentous and Foliose Red Algae	FFRA	894	22	1382	33	2276	55
Coralline Red Algae	CORA	116	3	52	1	168	4
Alaria	ALAR	3	<1	23	1	26	1
Soft Brown Kelp	SOBK	310	7	636	15	946	23
Dark Brown Kelp	DABK	17	<1	189	5	206	5
Brown Bladed Kelps	BRBA	1182	28	1925	46	3107	75
Anemones	ANEM	2	<1	0	0	2	<1
Cnidarians	CNID	<1	<1	0	0	<1	<1
Sponges	SPON	1	<1	0	0	1	<1
Surfgrass	SURF	192	5	92	2	285	7
Eelgrass	EELG	489	12	491	12	980	24
Urchin Barrens	URBA	155	4	368	9	523	13
Giant Kelp	GIKE	216	5	299	7	515	12
Bull Kelp	BUKE	540	13	439	11	979	24
Canopy Kelp	BRCA	7	<1	7	<1	13	<1

Table 4. Bioband abundances for splash zone biobands mapped around Prince Rupert to date.

Bioband		Narrow (<1m)		Medium (1-5m)		Wide (>5m)		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%	(km)	%		
Black Lichen	BLLI	1932	47	1305	31	149	4	3385	82
Splash Zone	SPZO	34	1	38	1	1	<1	72	2
White Lichen	WHLI	560	13	663	16	96	2	1319	32
Yellow Lichen	YELI	1	<1	3	<1	1	<1	4	<1

Salt Marsh (SAMB) was the most commonly occurring supratidal, non-splash zone bioband and was found in 54% 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 supratidal or lower intertidal, both occurrences are incorporated here. Salt Marsh was fairly ubiquitous along the shoreline, mostly as a narrow strip of vegetation between the trees and intertidal zone (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).

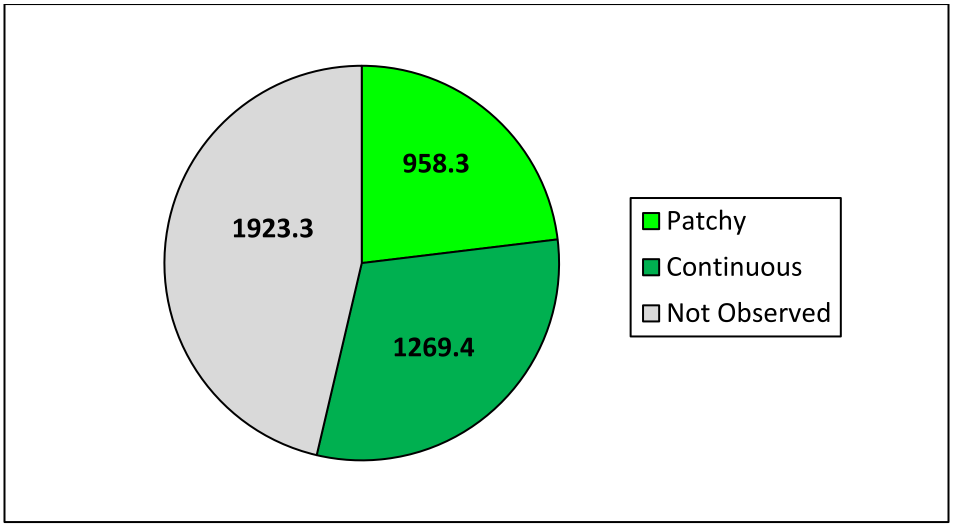

Figure 16. Proportion of shoreline length (km) of the supratidal/intertidal Salt Marsh (SAMB) bioband by category.

Figure 17. Photo of a narrow strip of Salt Marsh bioband on Gurd Island in Porcher Inlet (bc15_sh_11051).

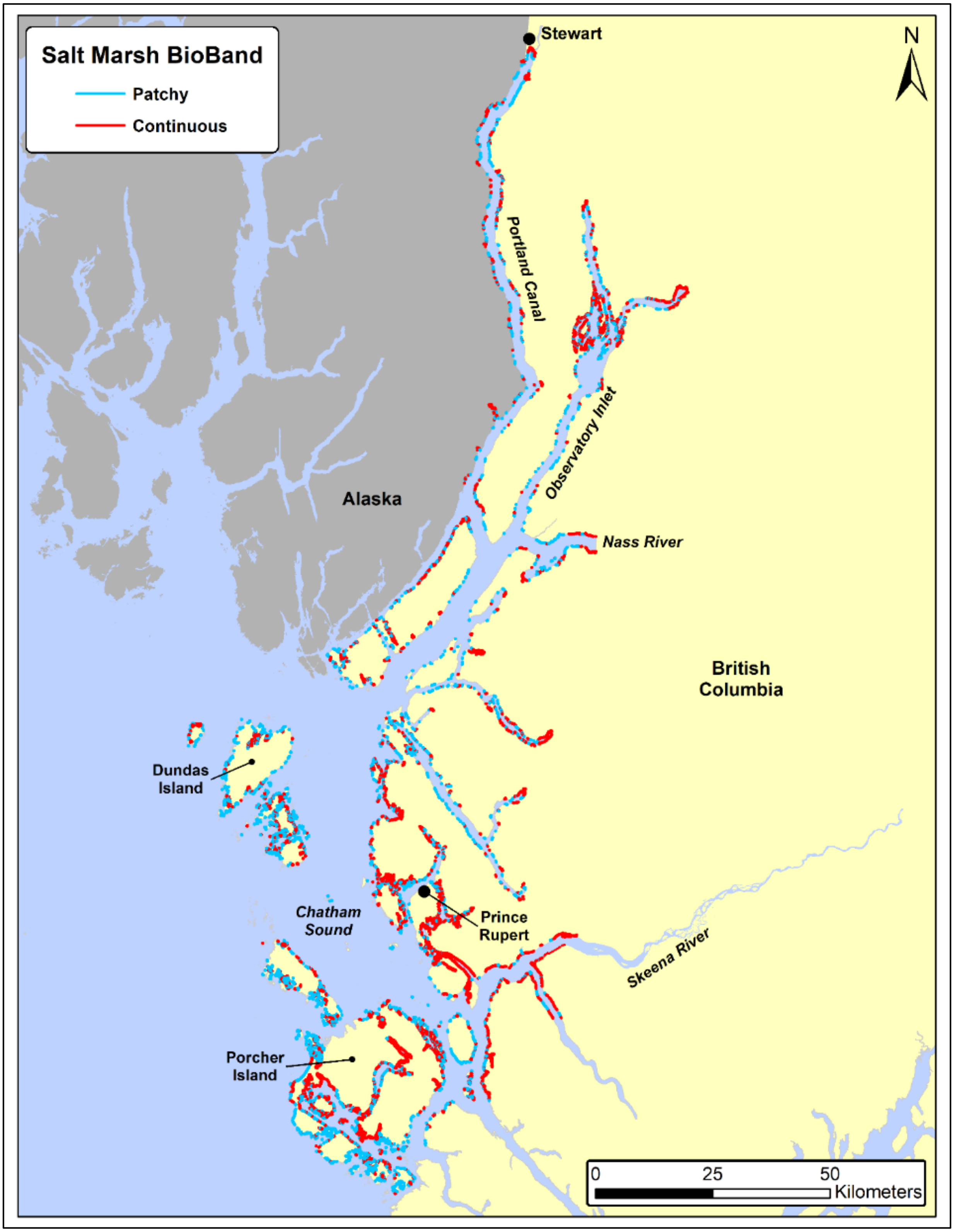

Figure 18. Distribution of the Salt Marsh (SAMB) bioband on the North Coast of BC.

Urchin Barrens (URBA) are subtidal areas where the lack of predators, such as Sea Otters over the long term and sea stars in the shorter term (Schultz *et al*., 2016), has allowed sea urchins to proliferate. This bioband occurs in 13% of the mapped units (see Figures 19 for a graph of proportion of the shoreline with that bioband and Figure 21 for a distribution map). The urchins graze down the kelp and expose the underlying substrate, which is often covered by coralline red algae. Bladed Kelp and Canopy Kelp biobands can also co-occur with the Urchin Barrens bioband as a narrow strip in the upper subtidal. This narrow strip is the zone where wave action prevents the urchins from grazing; however, around Dundas Island (which was imaged in 2019) the Urchin Barrens were actually extending up into the intertidal and piles of urchins were even noted out of the water (see photo in Figure 20). The density of urchins in the subtidal around Dundas Island appeared to be higher than along other parts of the coastline, although it should be noted that other areas were imaged before the worst effects of the sea star wasting disease were likely to have been felt. Urchin Barrens were ubiquitous along the outer portions of the coast, generally in Semi-Protected and higher exposures.

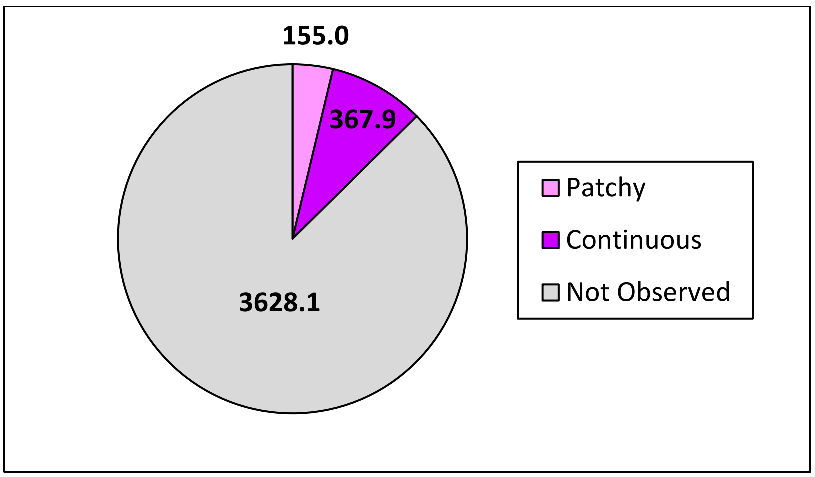

Figure 19. Distribution of the subtidal Urchin Barrens bioband by shoreline length (km).

Figure 20. Example of the Urchin Barren bioband extending into the intertidal on Dundas Island (bc19_dd_01224). The high density of urchins are also visible in the subtidal.

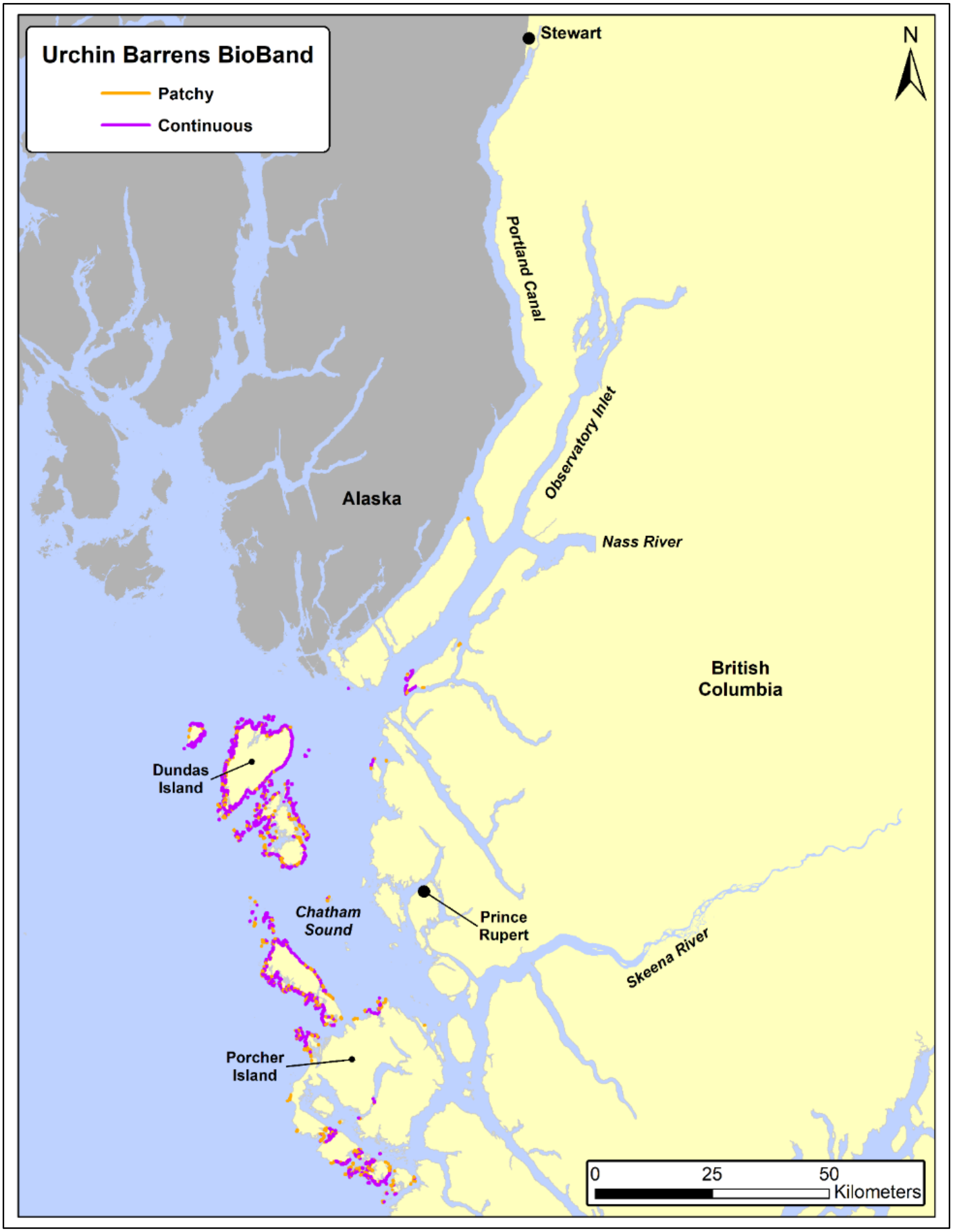

Figure 21. Distribution of the Urchin Barrens (URBA) bioband on the North Coast of BC. Please note that Bladed Kelps (SOBK/DABK/BRBA) and Canopy Kelps (GIKE/BUKE) can co-occur with Urchin Barrens as a narrow strip in the upper subtidal/lower intertidal zone.

Two canopy kelps were observed on the North Coast of BC, Bull Kelp (BUKE) and Giant Kelp (GIKE). 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 found along more varied parts of the coastline, while Giant Kelp tended to be found in areas that were Semi-Protected/Protected. Where the two canopy kelps co-occurred, the Giant Kelp was generally found inshore of the Bull Kelp bed, although they were also noted mixed together. Giant Kelp is also less tolerant of lower salinity so was not found in the area around the mouth of the Skeena River, to the south of Prince Rupert or in the fjords and inlets north of Work Channel likely due to the influence of the Nass River among others large rivers in the area. See Figures 22 and 23 for statistics on the distribution of the individual canopy kelp biobands and a distribution map for both in Figure 24.

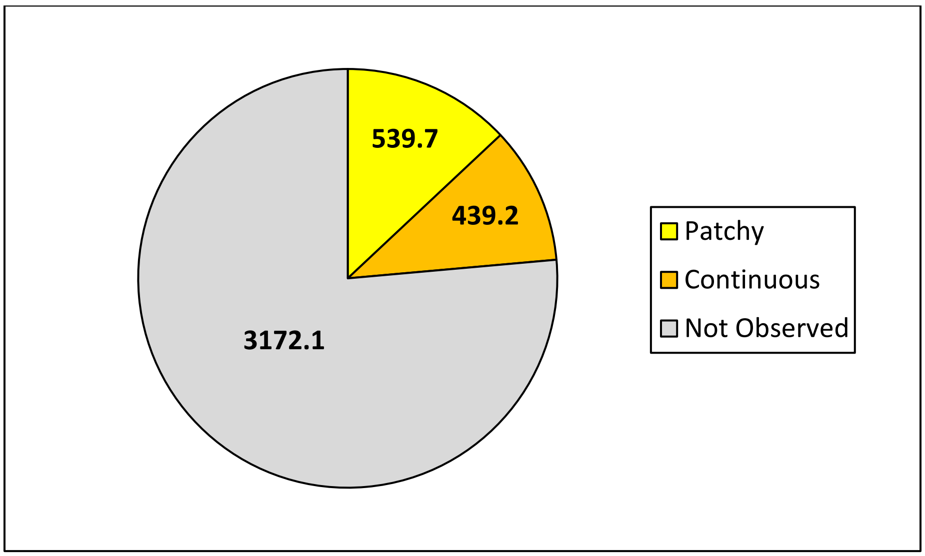

Figure 22. Distribution of the subtidal Bull Kelp (BUKE) bioband by shoreline length (km).

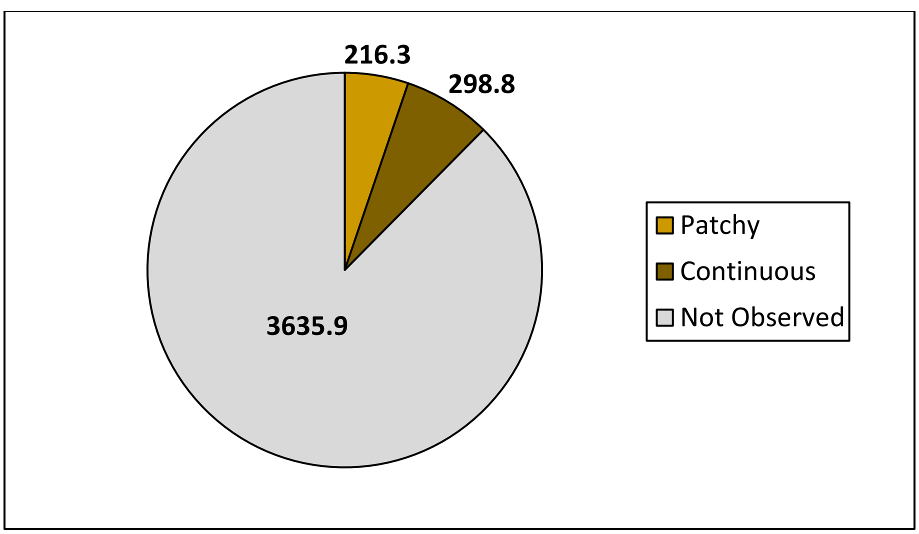

Figure 23. Distribution of the subtidal Giant Kelp (GIKE) bioband by shoreline length (km).

Figure 24. Distribution of the canopy kelp biobands, Bull Kelp (BUKE) and Giant Kelp (GIKE) on the North Coast of BC.

Two seagrass biobands were observed on the North Coat of BC: Eelgrass (EELG) and Surfgrass (SURF). Seagrasses are an important component of coastal ecosystems with Eelgrass beds forming in sandy substrate at Semi-Protected and lower exposures while Surfgrass generally attaches to hard substrate on Semi-Protected or Semi-Exposed beaches. 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. See Figures 25 and 26 for statistics on the distribution of the individual seagrass biobands and a distribution map for both in Figure 27.

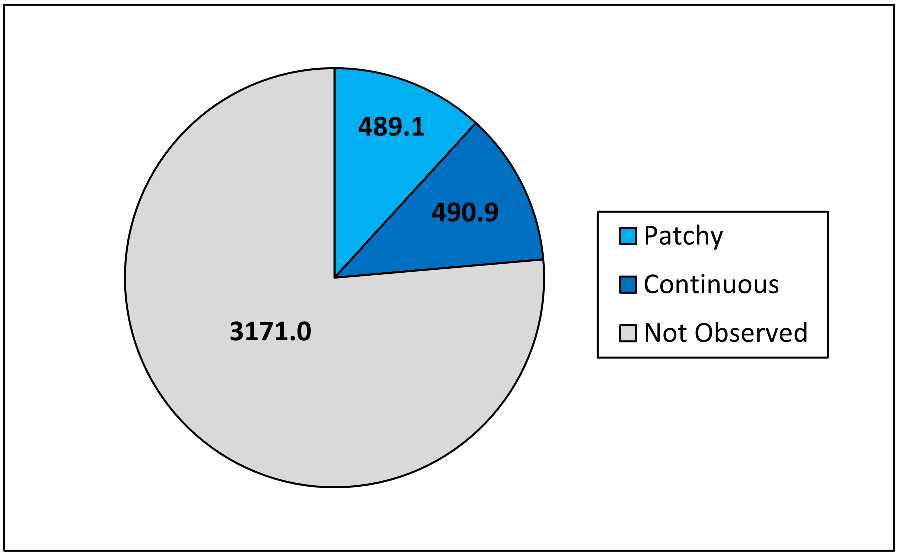

Figure 25. Distribution of the lower intertidal/subtidal Eelgrass (EELG) bioband by shoreline length (km).

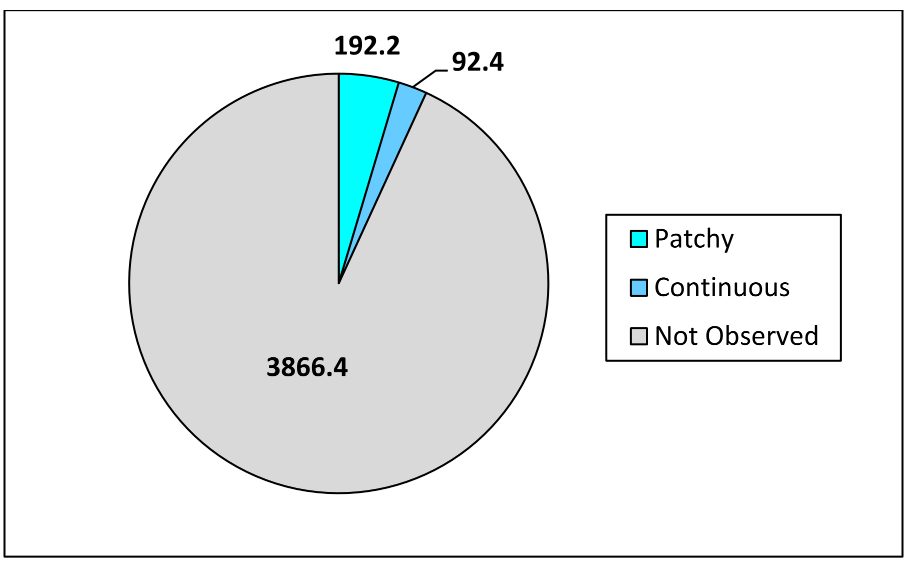

Figure 26. Distribution of the intertidal/subtidal Surfgrass (SURF) bioband by shoreline length (km).

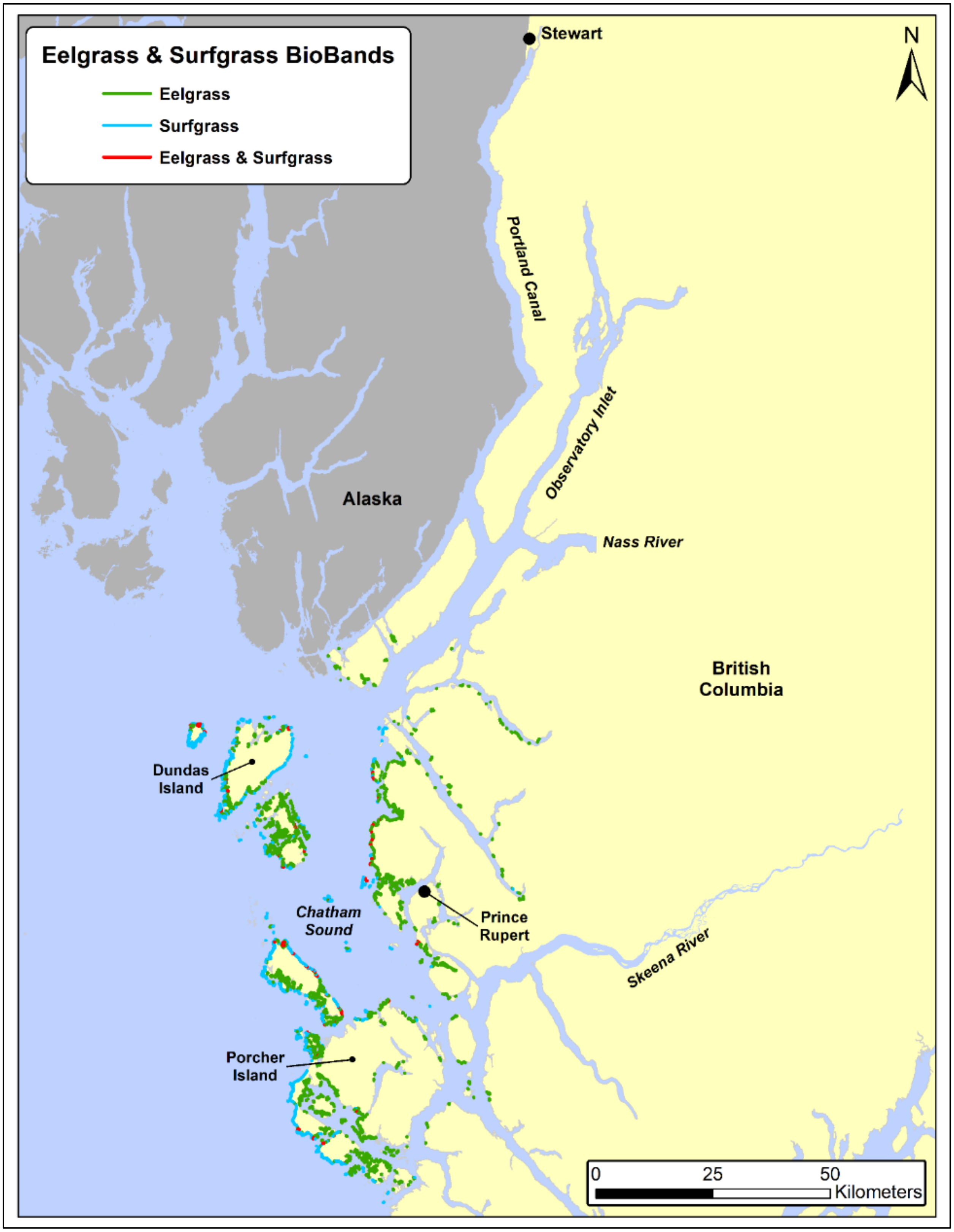

Figure 27. Distribution of the seagrass biobands, Eelgrass (EELG) and Surfgrass (SURF), on the North Coast of BC.

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 North Coast of BC are summarized in Figure 28 and a distribution map of the categories is shown in Figure 29. Most of the coastline (91.4%) was in the lower to moderate wave exposures (Very Protected to Semi-Protected), with most of that Protected (64.7%).

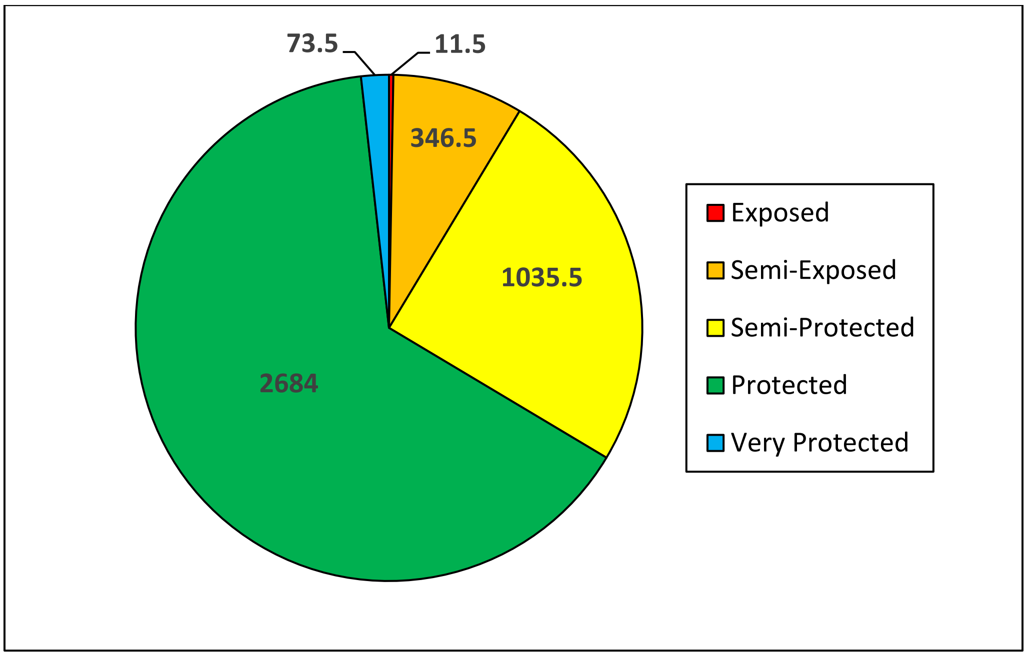

Figure 28. Distribution of Biological Wave Exposures mapped in the Prince Rupert area to date by shoreline length (km).

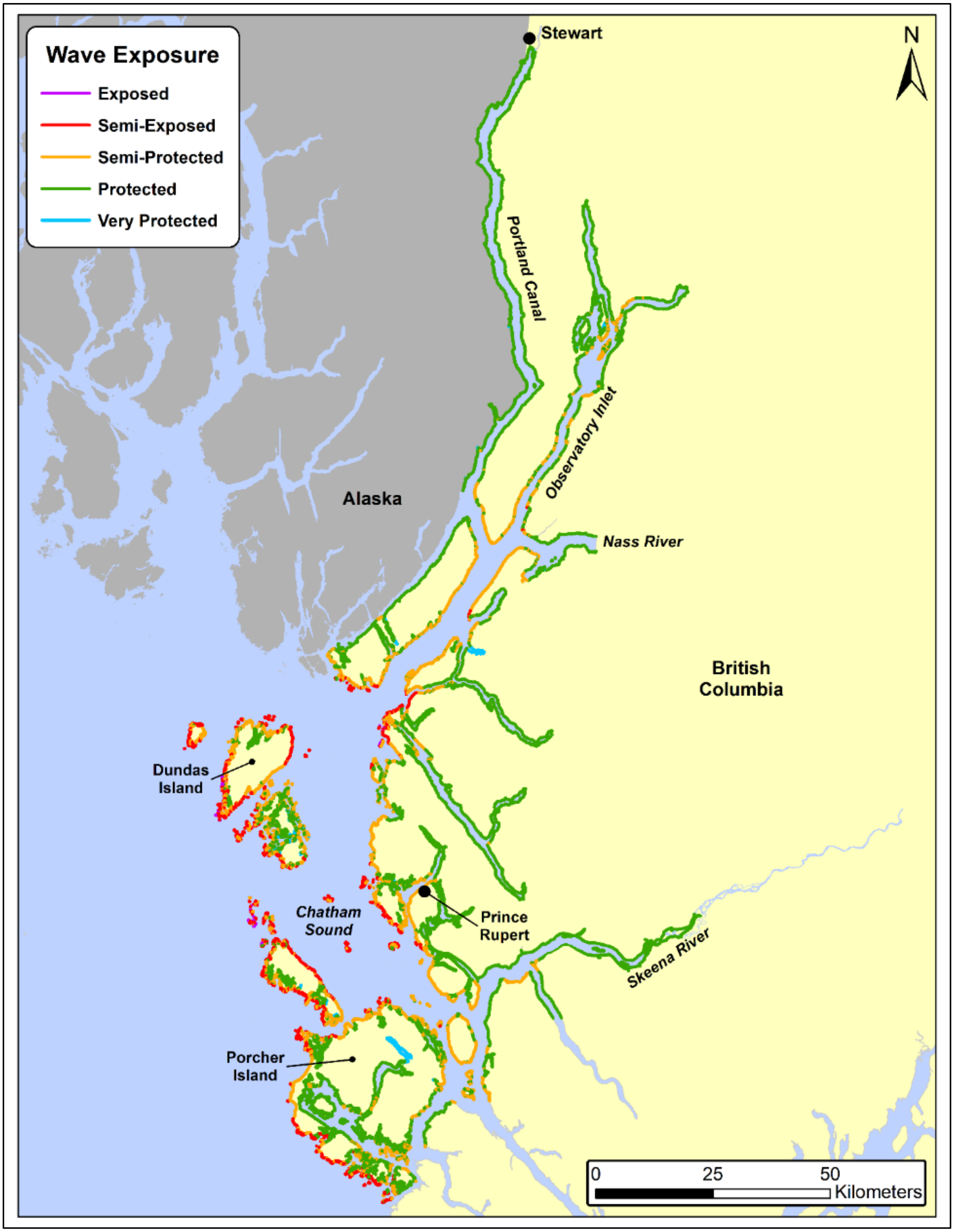

Figure 29. Distribution of the Biological Wave Exposure on the North Coast of BC.

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 North Coast of BC are summarized in Figure 30 and a distribution map of the categories is shown in Figure 31. Partially mobile substrate is the dominant shoreline type (60.8%). Estuaries are not very common in this area with only 5.5% of the shoreline in that classification. The estuary habitat class is associated with spawning and nursery habitats for fish as well as breeding and foraging grounds for birds and other wildlife. However, although individual units may not have been classed as estuaries, the Skeena River is a significant influence in the area and much of the southern portion of the area surveyed could be considered estuarine in nature. The same could be said of the northern-most inlets due to the influence of large rivers like the Nass. The Anthropogenic habitat occurred in 1.6% of units as the only majorly developed areas are the Port of Prince Rupert and Port Edward.

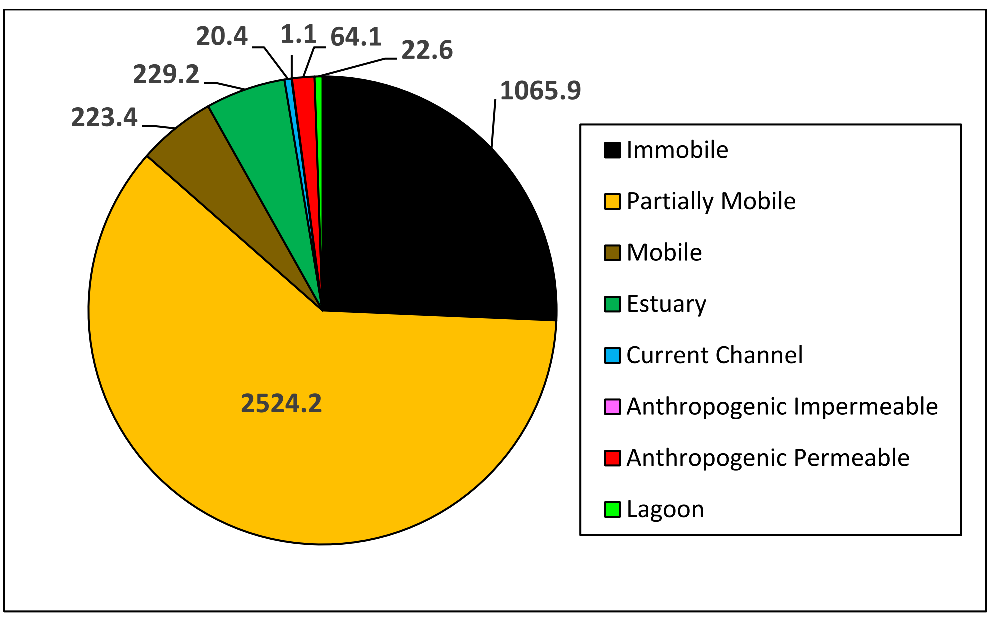

Figure 30. Distribution of Habitat Class categories on the North Coast of BC by shoreline length (km).

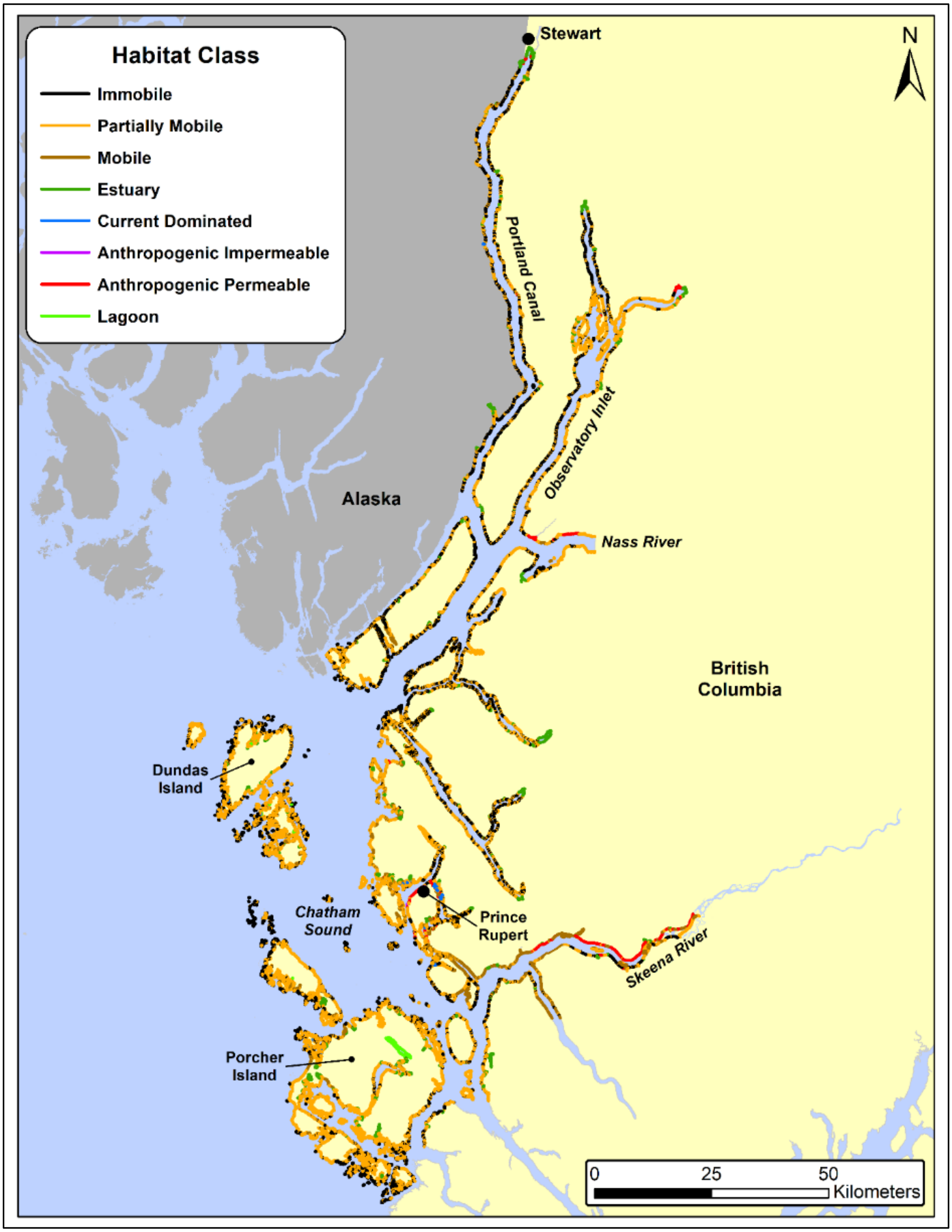

Figure 31. Distribution of Habitat Class categories on the North Coast of BC.

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5 ACKNOWLEDGMENTS

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Protocols for data access and distribution are established by the program partner agencies. Please see www.ShoreZone.org for a list of partner agencies and related web sites. Video imagery can be viewed and digital stills 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 BC North Coast Survey Area.

Photo bc18_gz_01072: Example of Coastal Class 1; Rock Ramp, wide.
Truro Island.

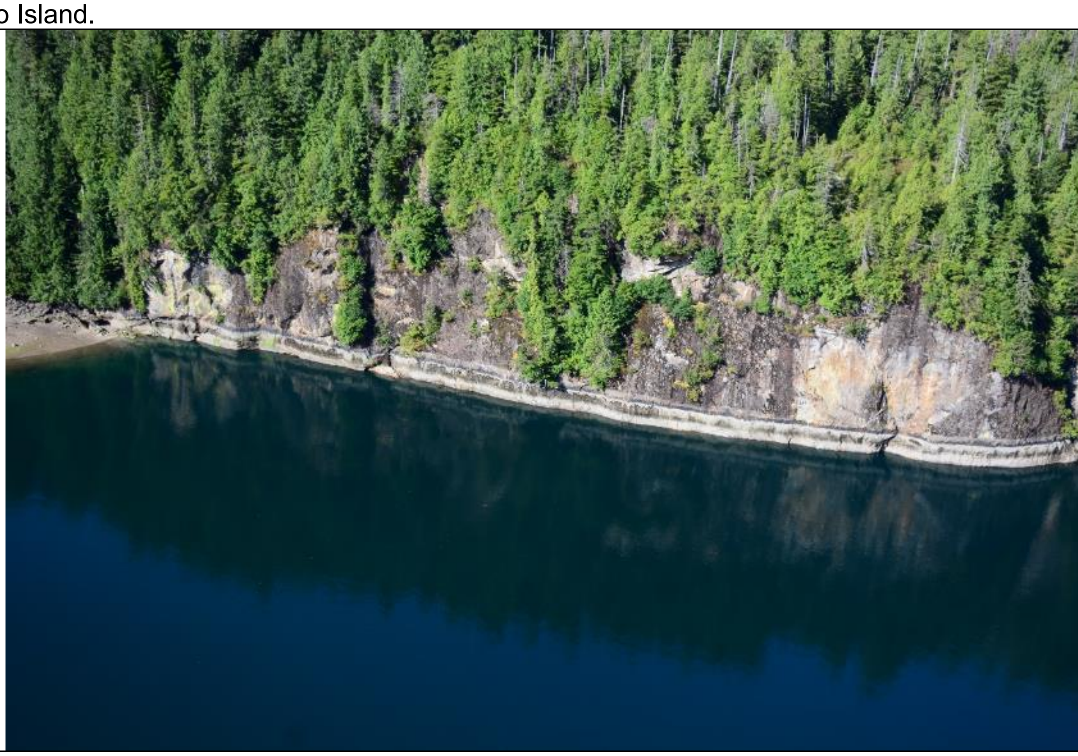

Photo bc18_gz_01932: Example of Coastal Class 3; Rock Cliff.
Khutzeymateen Inlet.

Photo bc14_pr_05671: Example of Coastal Class 4; Rock Ramp.
Work Channel.

Photo bc14_pr_15972: Example of Coastal Class 6; Ramp with gravel beach, wide.
Goschen Island.

Photo bc14_pr_06362: Example of Coastal Class 8; Cliff with gravel beach.
Davies Bay.

Photo bc14_pr_15854: Example of Coastal Class 9; Ramp with gravel beach.
Goschen Island.

Photo bc14_pr_16584: Example of Coastal Class 12; Platform with gravel & sand beach, wide. Shakes Island.

Photo bc14_pr_15777: Example of Coastal Class 13; Cliff with gravel & sand beach. Goschen Island.

Photo bc18_gz_01727: Example of Coastal Class 14; Ramp with gravel & sand beach.
Khutzeymateen Inlet.

Photo bc14_pr_15925: Example of Coastal Class 21; Gravel Flat, wide.
Goschen Island.

Photo bc14_pr_15349: Example of Coastal Class 22; Gravel beach, narrow.
Porcher Island.

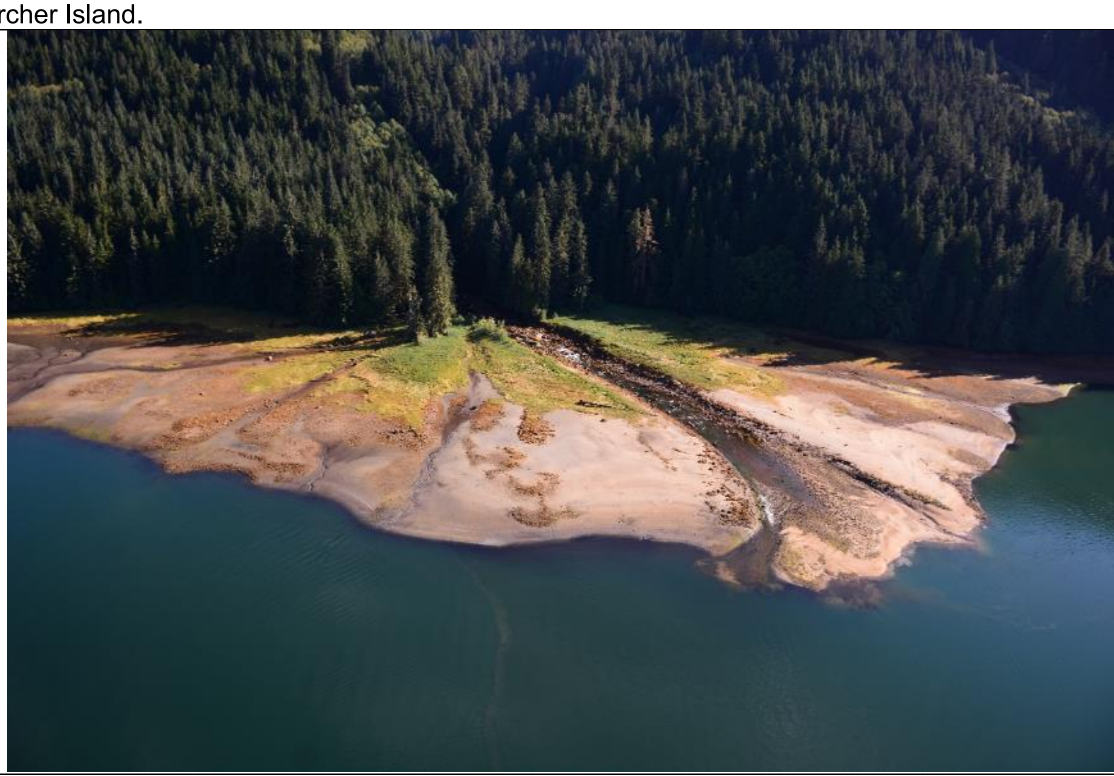

Photo bc18_gz_01587: Example of Coastal Class 24; Sand & gravel flat or fan.
Khutzeymateen Inlet.

Photo bc14_pr_06146: Example of Coastal Class 25; Sand & gravel beach, narrow.
Quottoon Inlet.

Photo bc14_pr_15286: Example of Coastal Class 28; Sand flat.
Porcher Island.

Photo bc15_sh_10379: Example of Coastal Class 31; Organics/Fines.
Prescott Island.

Photo bc14_pr_02667: Example of Coastal Class 32; Permeable man-made structures.
Seal Cove.

Photo bc14_pr_06375: Example of Coastal Class 34; Current.
Davies Lagoon.

Photo bc14_pr_01509: Example of Coastal Class 36; Lagoons.
Metlakatla.

Table A-2. Examples of the most common Biobands in the BC North Coast survey area.

Photo bc19_dd_00111: Good example of the Black Lichen (BLLI) bioband which is a black band in the supratidal zone, usually caused by the lichen *Verrucaria* sp. Dundas Island.

Photo bc19_dd_01573: Good example of the blue-green Dune Grass (DUGR) bioband. Dundas Island.

Photo bc15_sh_09244: Good example of White Lichen (WHLI) bioband in the supratidal zone, above the Black Lichen band. Tree Nob Island group.

Photo bc14_pr_01900: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Prince Rupert Harbour.

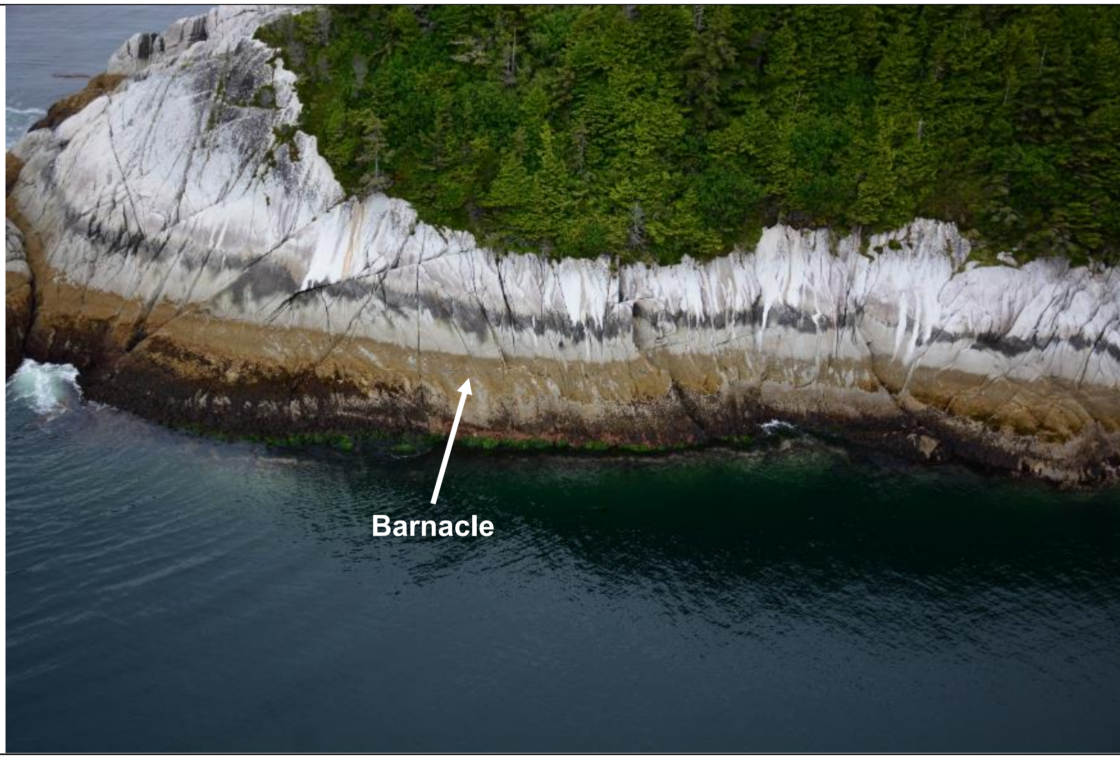

Photo bc19_dd_00610: Good example of the beige Barnacle (BARN) bioband in the high intertidal zone. Dundas Island.

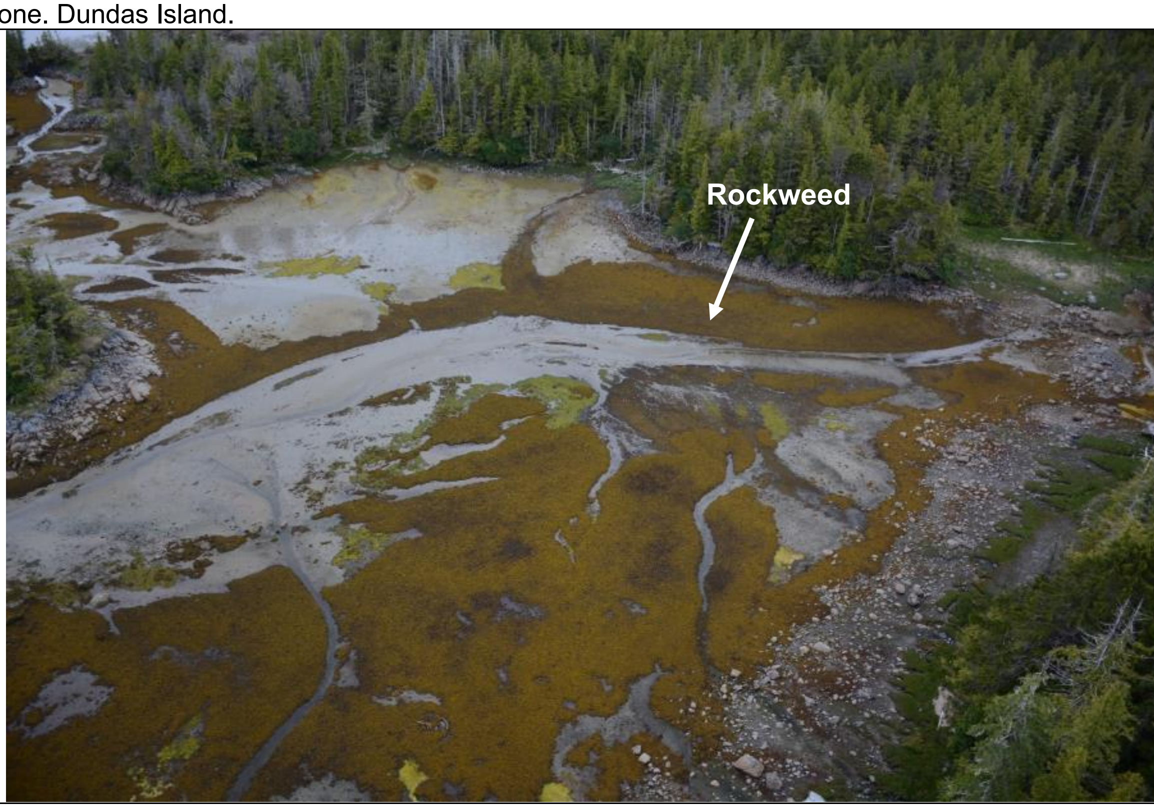

Photo bc14_pr_16606: Good example of the golden-brown Rockweed (ROCK) bioband. Porcher Inlet.

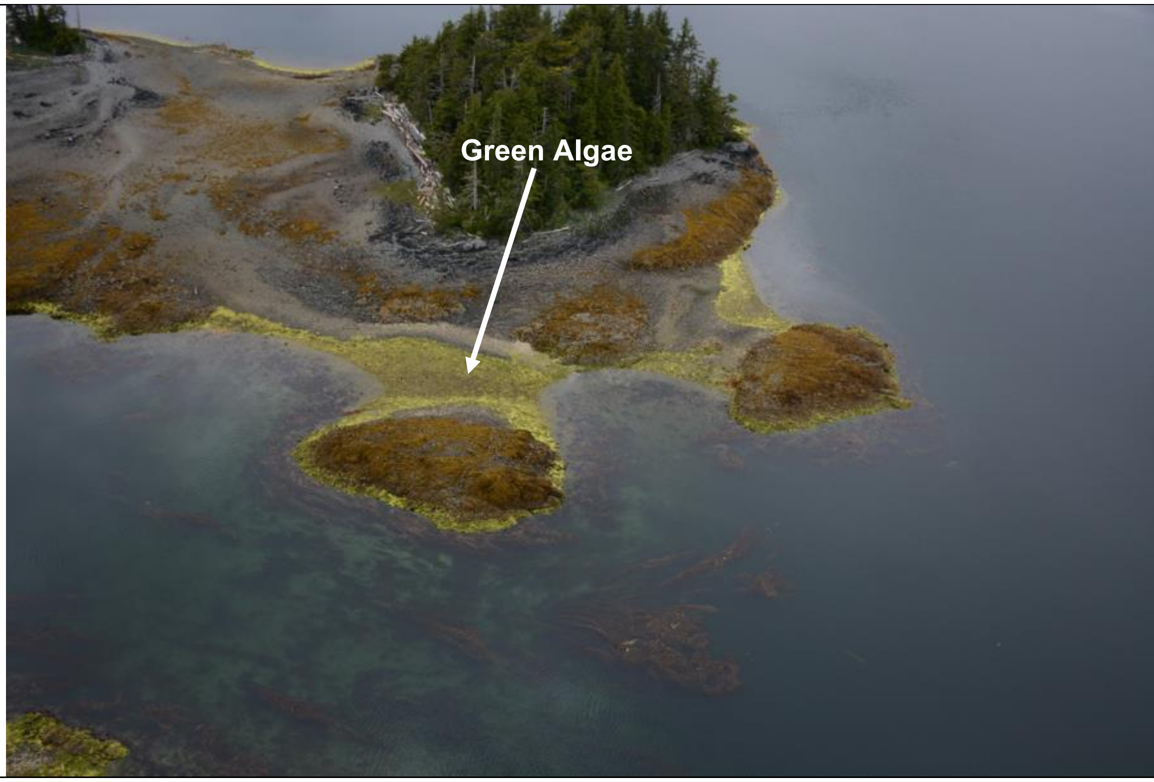

Photo bc15_sh_13705: Good example of the Green Algae (GRAL) bioband in the lower intertidal. Melville Island group.

Photo bc14_pr_16766: Good example of kelps at the waterline (BRBA or SOBK biobands). Porcher Island.

Photo bc14_pr_01538: Example of the Eelgrass (EELG) bioband in the lower intertidal/subtidal. Metlakatla pass.

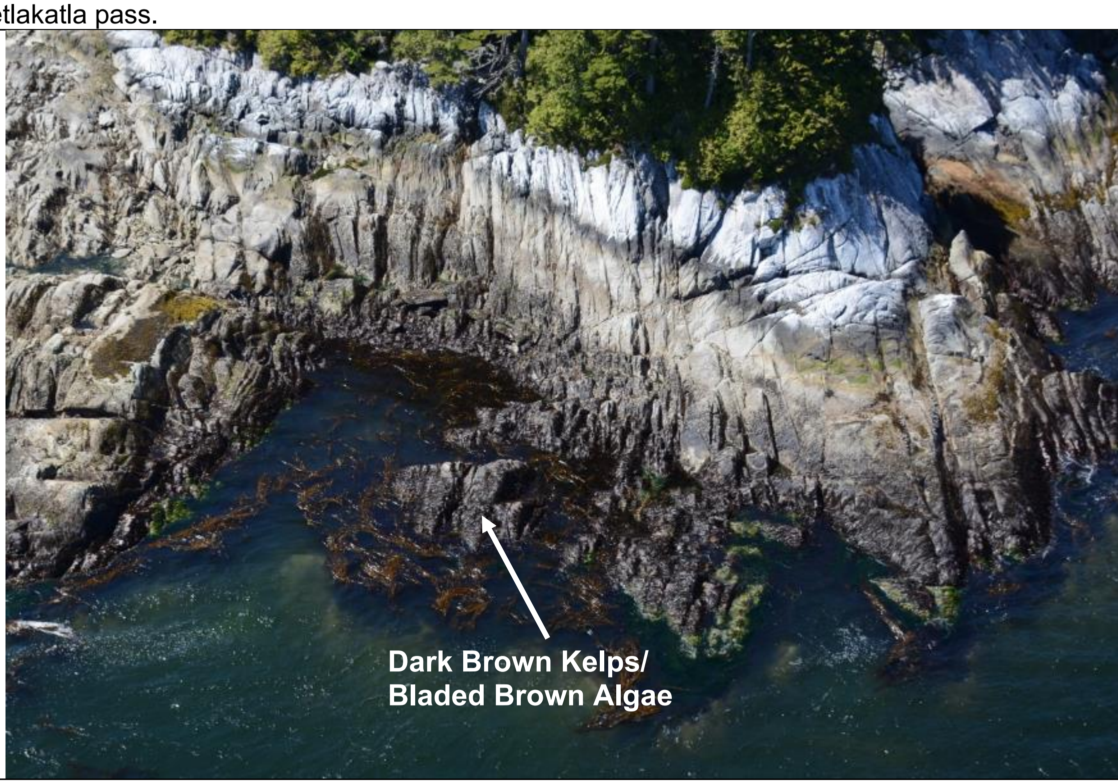

Photo bc15_pr_14515: Good example of a kelps (BRBA or DABK biobands) and Surfgrass (SURF) bioband in the lower intertidal and subtidal. Stephens Island.

Photo bc15_sh_10623: Good example of the bright green Surfgrass (SURF) bioband in the lower intertidal. Stephen Island.

Photo bc14_pr_15140: Good example of the Bull Kelp (BUKE) bioband in the nearshore. Outer Porcher Island.

Photo bc14_pr_16542: Good example of the Giant Kelp (GIKE) bioband in the nearshore. Near Porcher Island.

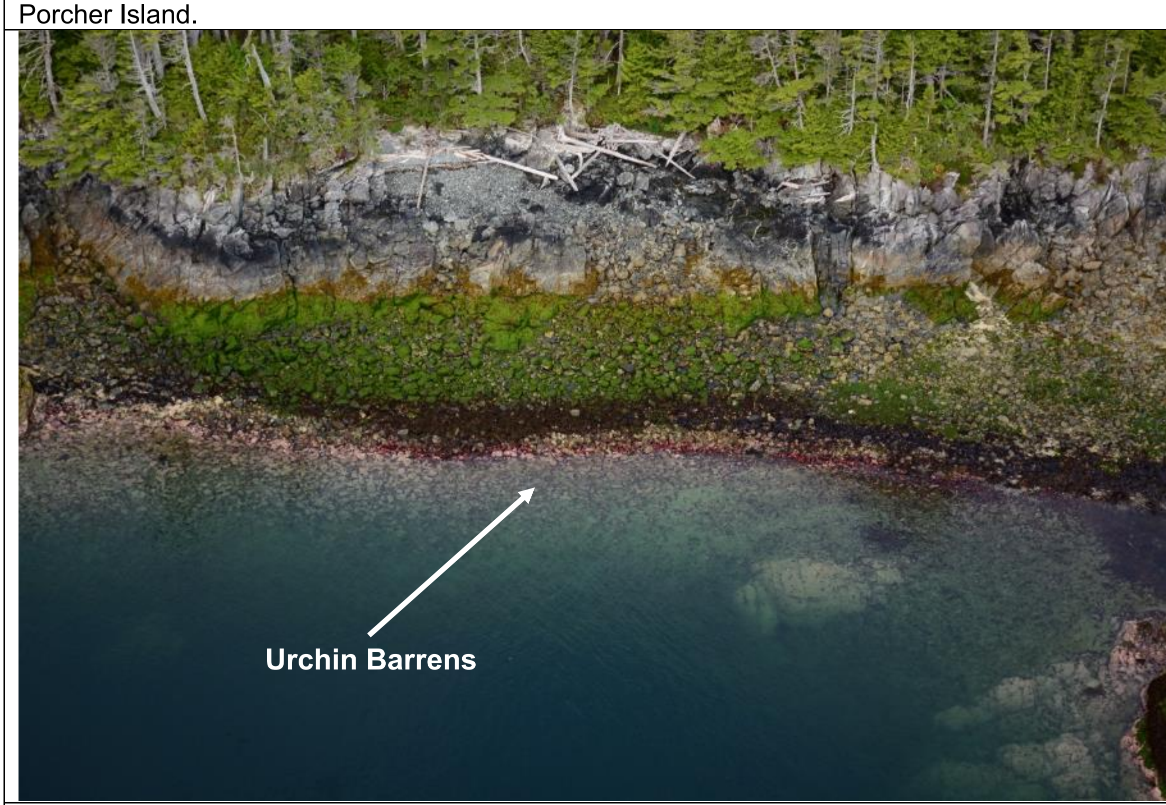

Photo bc19_dd_01224: Good example of the Urchin Barrens (URBA) bioband in the nearshore. Dundas Island.