Coastal and Ocean Resources
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ShoreZone Summary Report

Nisga’a Survey Area

April 2020

Prepared for:

Nisga’a Lisims Government

ShoreZone

On the cover:

Tombstone Cove, Portland Canal

Paddy Passage

Portland Canal

Coastal and Ocean Resources

MCORI Project: 19-18 **March 2020**

ShoreZone Habitat Mapping Summary Report

Nisga'a Survey Area


Estuary near Hans Point at the entrance to Alice Arm

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Nisga’a Area Summary

908 km of shoreline mapped

3,987 shoreline units created

Average unit length is **228 m**

40% of the intertidal is classified as **Rock dominated** and **31%** is classed as **Sediment-dominated**

59% of the shoreline has a high Oil Residence Index value (residence of months to years)

2% of the shoreline has a **Shoreline Modification** of some type

9 intertidal biobands were classified, with **Rockweed** and **Barnacle** being the most common (**95% and 85%** of units respectively)

6 supratidal biobands were classified, with **Black Lichen and White Lichen** being the most common (**92% and 61%** of units respectively)

4 subtidal biobands were classified, with **Bladed Brown Algae** being the most common (**32%** of units)


Pearse Island


Gingolx


West Observatory Inlet


Grandby Bay

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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 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 and managers. 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 75,000 km of coastal Alaska and 45,000 km of British Columbia, Washington and Oregon (see Figure 1). Figure 2 shows the extent of the shoreline mapped around the Nisga'a area and is the section of shoreline covered by this summary report.

The ShoreZone imaging survey conducted around Prince Rupert in June 2015 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 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 around the Nisga'a survey area.

The length of shoreline mapped is 908 kilometers in 3,987 along-shore segments (units), averaging 228 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 April 2020.

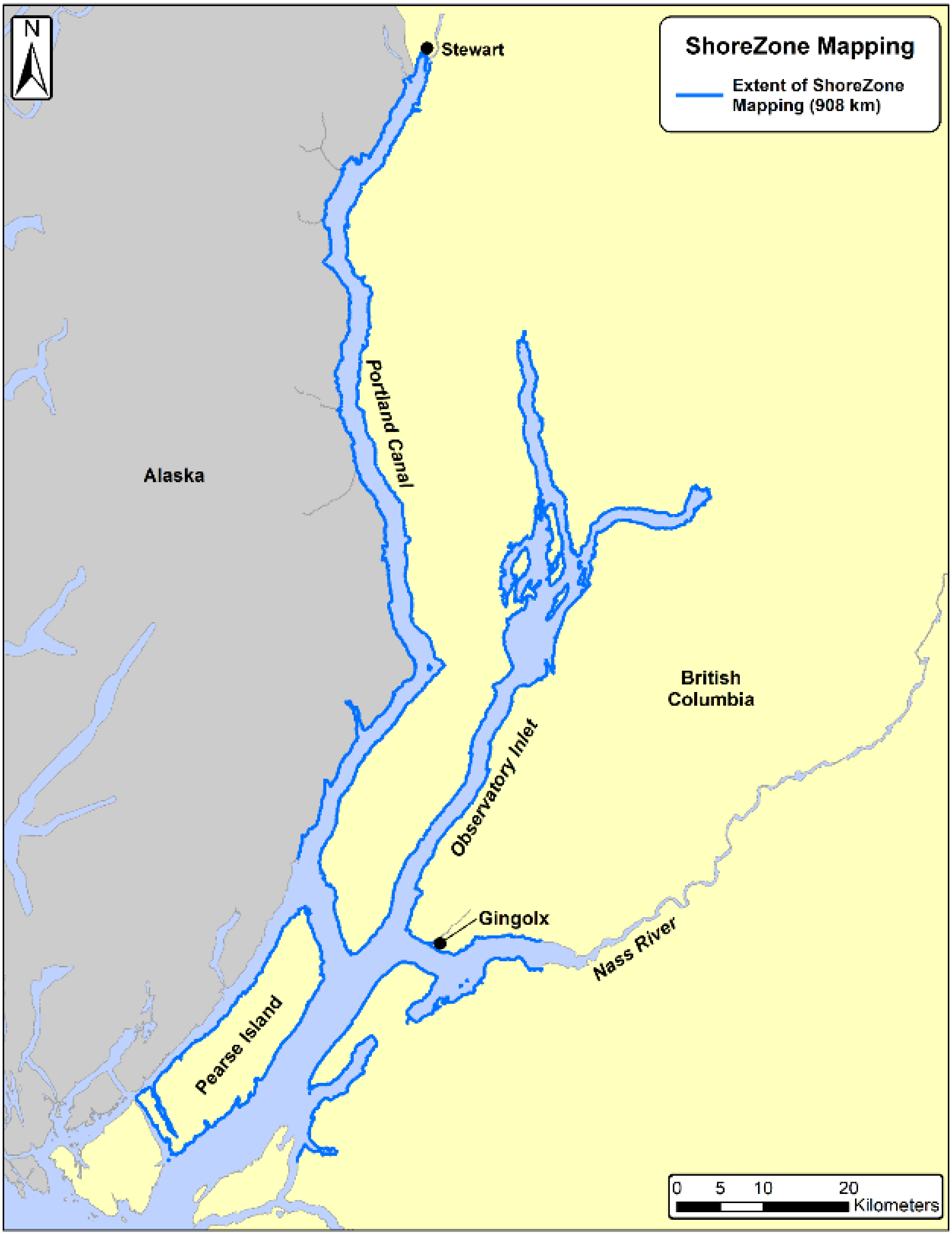

Figure 2. Extent of mapping for the Nisga'a survey area.

2 PHYSICAL ATTRIBUTE DATA SUMMARY

2.1 Coastal Class

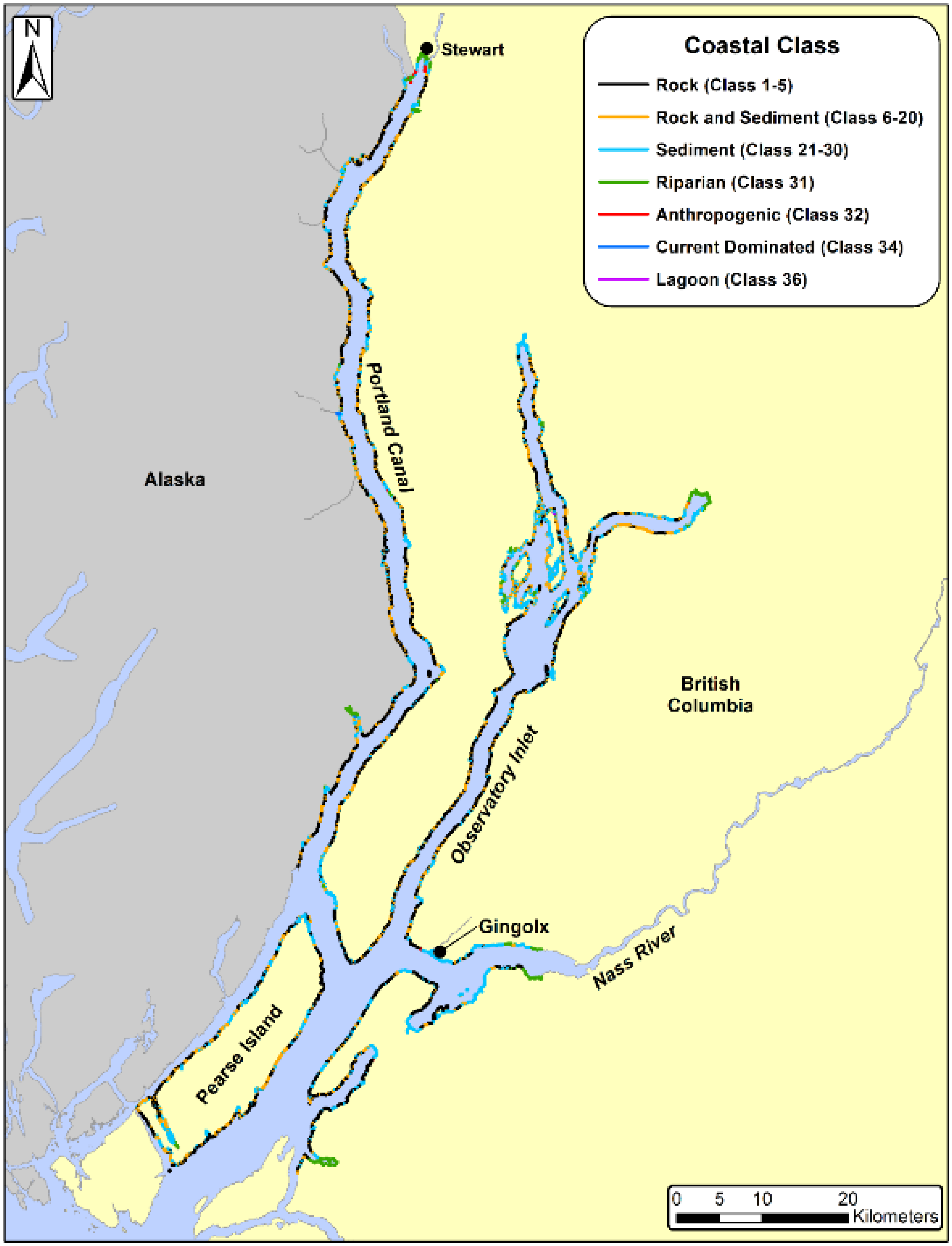

Figure 3. Map of the Coastal Class categories grouped by type (also known as Shore Type).

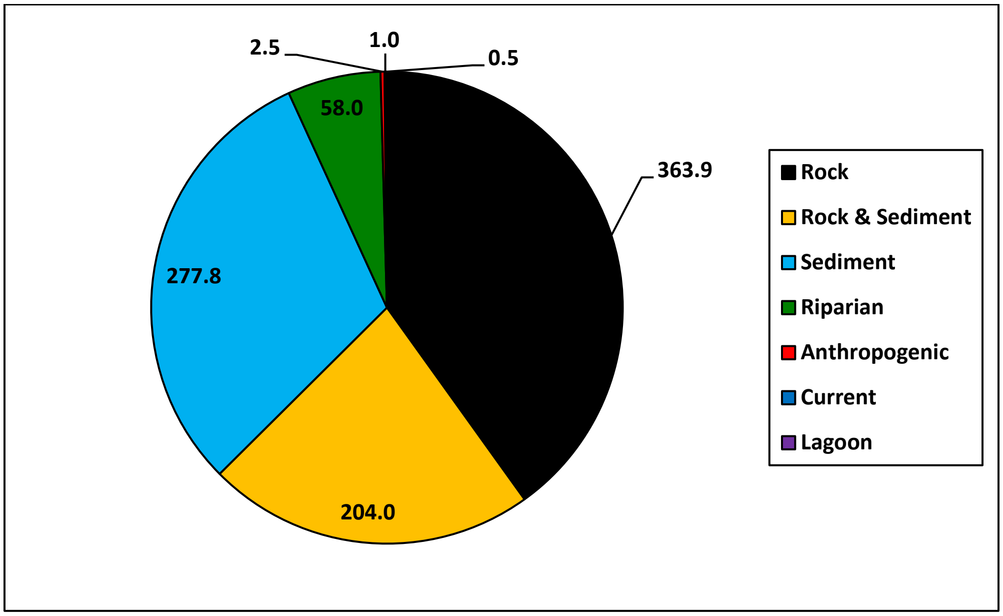

Figure 4. Grouped Coastal Class categories by shoreline length (km).

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 (40.1%) with Sediment shorelines (30.6%) dominated the Nisga'a survey area. Rock and sediment shorelines followed with 22.5% 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 Nisga'a survey area are found in Appendix A, Table A-1.

Table 1. Summary of Coastal Classes for the Nisga'a survey area.

Substrate Type	Shore Type		Sum of Unit Length (km)	# of Units	% Occurrence (by length)	Cumulative Occurrence (%, km)
	No.	**Description**				
Rock	1	Rock Ramp, wide	<1	2	<1	**40% 364 km**
	2	Rock Platform, wide	1	5	<1	
	3	Rock Cliff	350	1234	38.6	
	4	Rock Ramp, narrow	13	115	1	
Rock & Sediment	6	Ramp w gravel beach, narrow	2	13	<1	**23% 204 km**
	7	Platform w gravel beach, wide	<1	3	<1	
	8	Cliff with gravel beach	11	589	11	
	9	Ramp with gravel beach	2	163	2	
	10	Platform with gravel beach	<1	1	<1	
	11	Ramp w gravel & sand beach, wide	2	105	2	
	12	Platform with G&S beach, wide	<1	14	<1	
	13	Cliff with gravel/sand beach	32	250	4	
	14	Ramp with gravel/sand beach	32	255	4	
	15	Platform with gravel/sand beach	<1	1	<1	
	16	Ramp w sand beach, wide	1	3	<1	
	18	Cliff with sand beach	2	8	<1	
	19	Ramp w sand beach, narrow	<1	1	<1	
	20	Platform w sand beach, narrow	<1	2	<1	
Sediment	21	Gravel flat, wide	1	5	<1	**31% 277 km**
	22	Gravel beach, narrow	29	200	3	
	24	Sand & gravel flat or fan	142	456	16	
	25	Sand & gravel beach, narrow	71	424	8	
	27	Sand beach	<1	1	<1	
	28	Sand flat	25	38	3	
	29	Mudflat	10	13	1	
Organics	31	Organics/Estuarine	58	69	6	**6% 58 km**
Man-made	32	Man-made, permeable	3	12	<1	**<1% 3 km**
Current	34	Channel	1	4	<1	**<1% 1 km**
Lagoon	36	Lagoon	1	1	<1	**<1% 1 km**
Totals:			***908***	***3,987***	***100***	***100%***

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

2.2 Environmental Sensitivity Index (ESI)

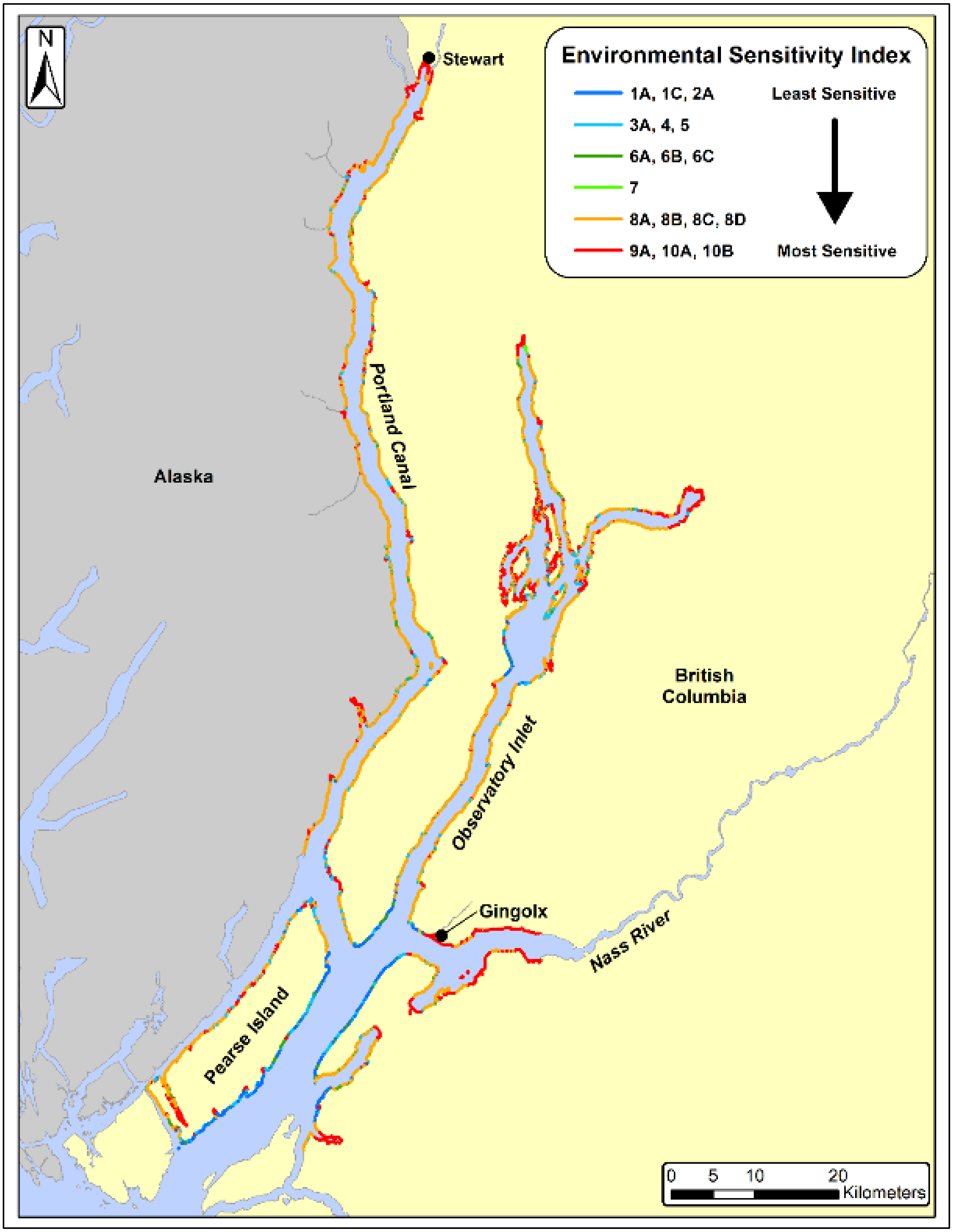

Figure 5. Distribution of the grouped ESI categories from least to most sensitive to oiling.

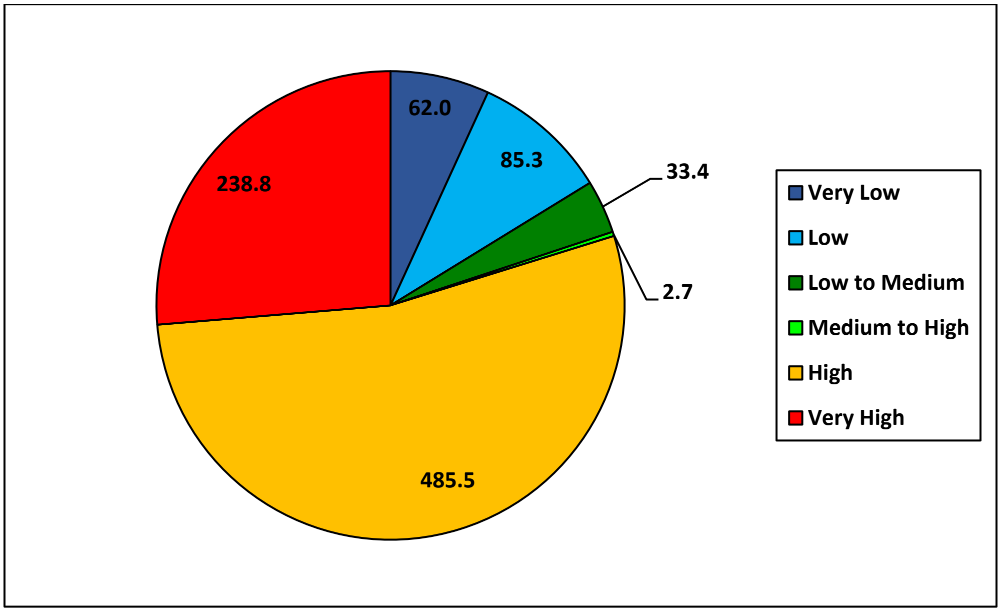

Figure 6. Grouped most sensitive ESI categories by shoreline length (km).

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 the Nisga'a area is represented by the grouped High and Very High categories (79.8% of shoreline length). These sections of the shoreline have a potentially high sensitivity to oil. At the other end of the spectrum, only 16.2% 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 Nisga'a 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	47	150	5
1C	Exposed rocky cliffs with boulder talus base	5	23	1
2A	Exposed wave-cut platforms in bedrock, mud, or clay	10	64	1
3A	Fine- to medium-grained sand beaches	<1	2	<1
4	Coarse-grained sand beaches	<1	2	<1
5	Mixed sand and gravel beaches	85	470	9
6A	Gravel beaches (granules and pebbles)	<1	1	<1
6B	Gravel beaches (cobbles and boulders)	33	223	4
6C	Rip rap	<1	1	<1
7	Exposed tidal flats	3	7	<1
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	345	1,563	38
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	1	7	<1
8C	Sheltered Rip Rap	1	6	<1
8D	Sheltered rocky rubble shores	138	812	15
9A	Sheltered tidal flats	29	73	3
10A	Salt- and brackish-water marshes	205	578	23
10B	Freshwater marshes	5	6	1
	Totals:	***908***	***3,987***	***100***

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

2.3 Oil Residence Index (ORI)

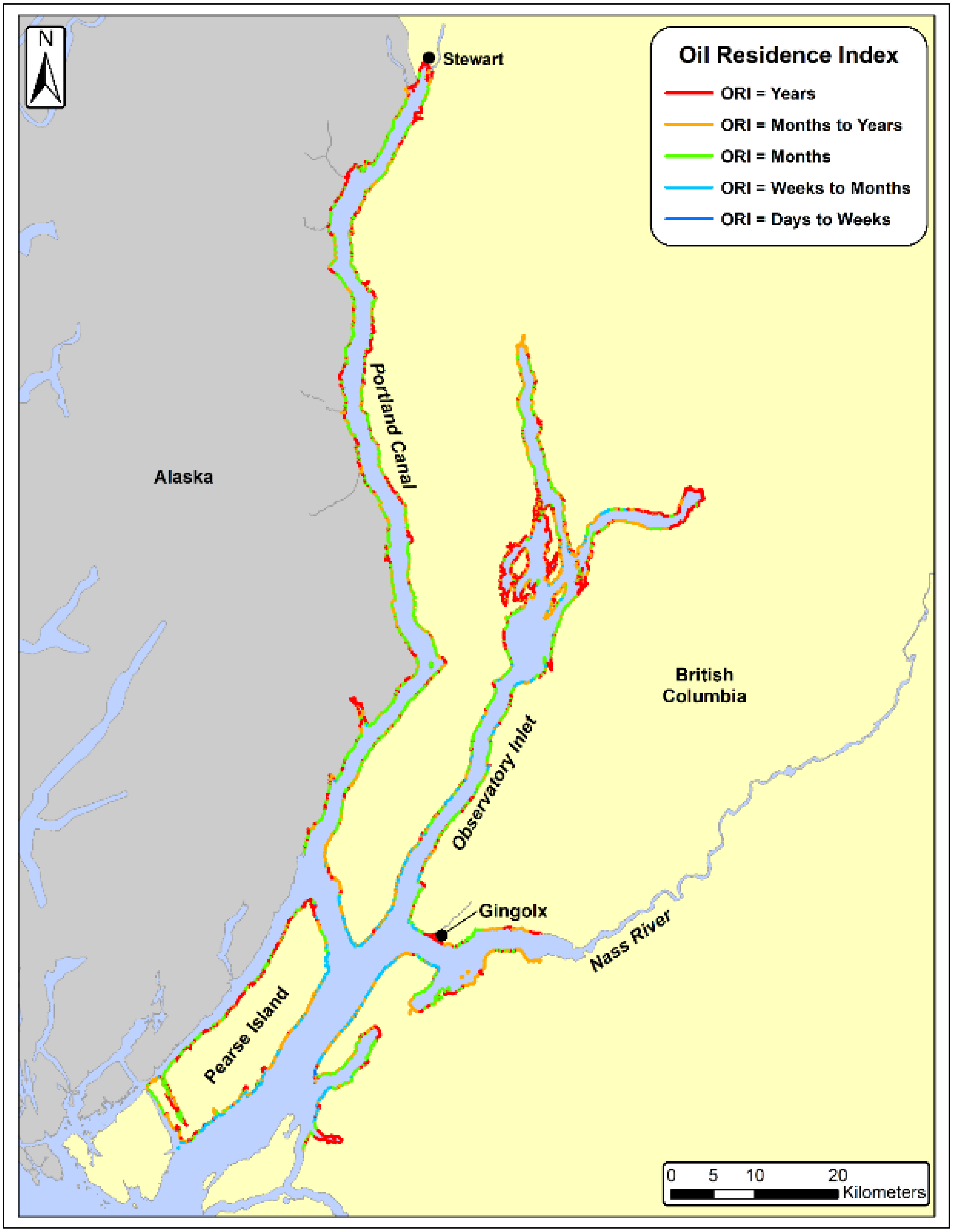

Figure 7. Distribution of the Oil Residence Index (ORI) categories.

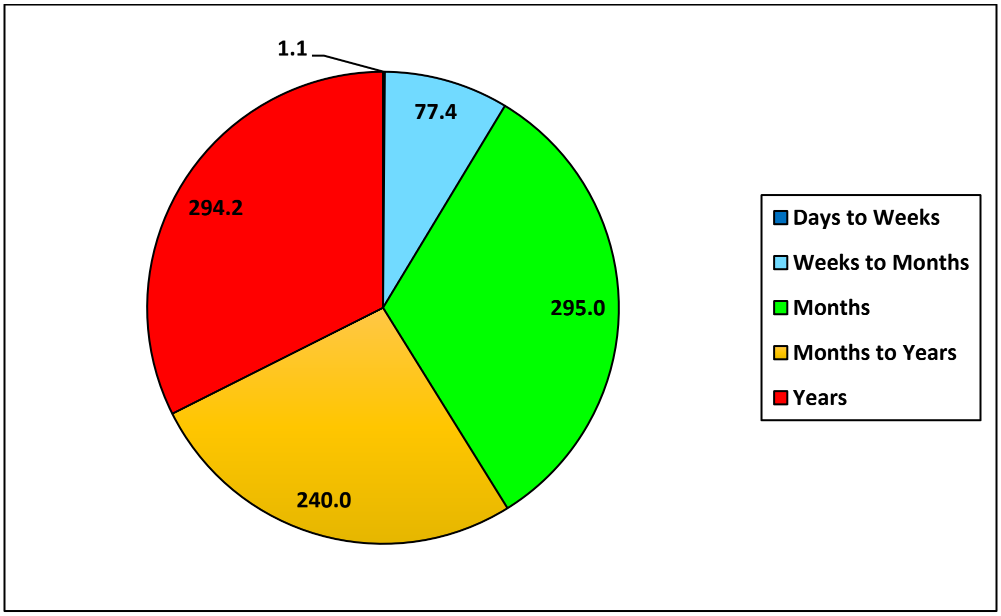

Figure 8. Oil Residence Index (ORI) categories by shoreline length (km).

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 58.8% of the shore segments in the Nisga’a 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

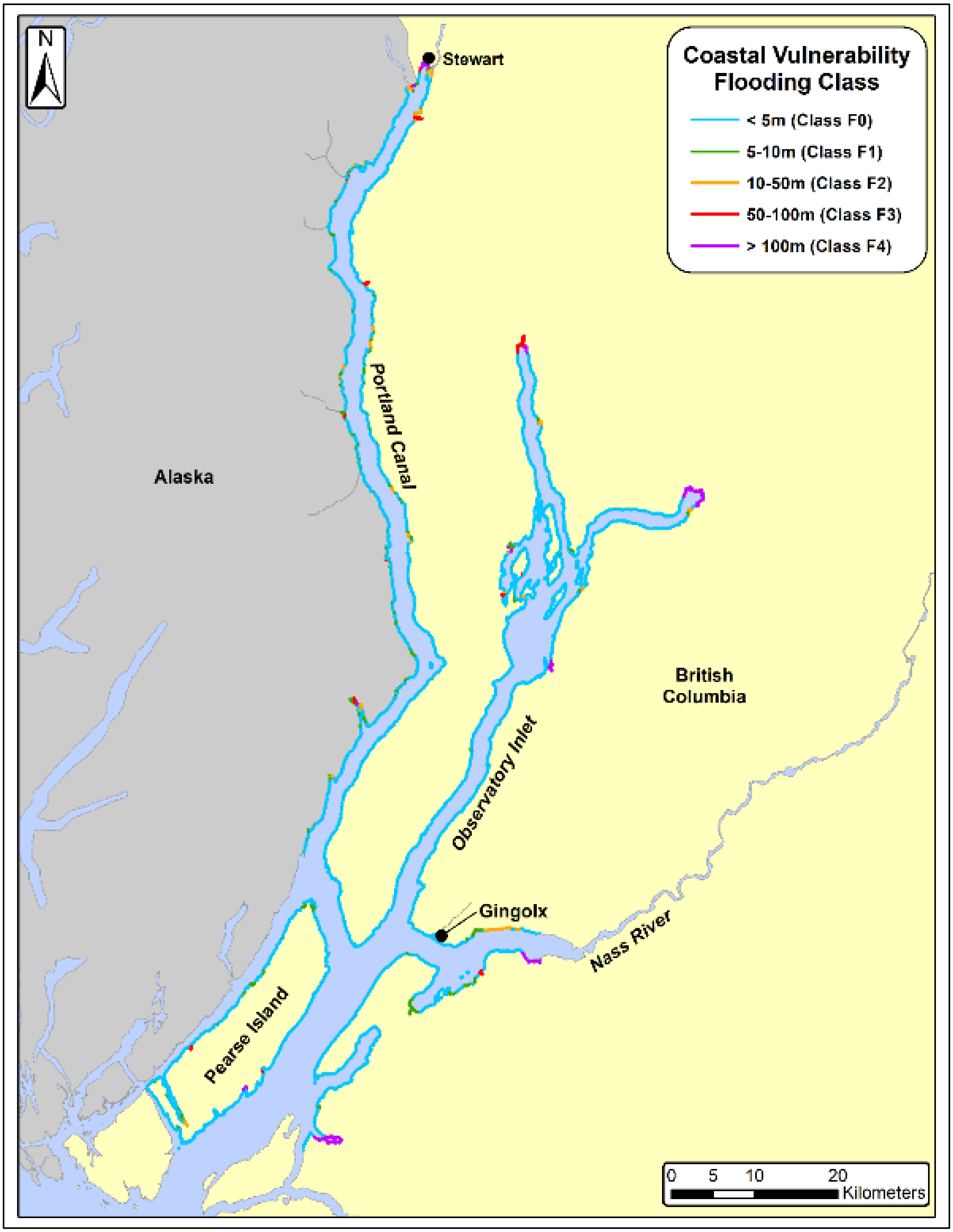

Figure 9. Distribution of the Coastal Vulnerability Flooding Class.

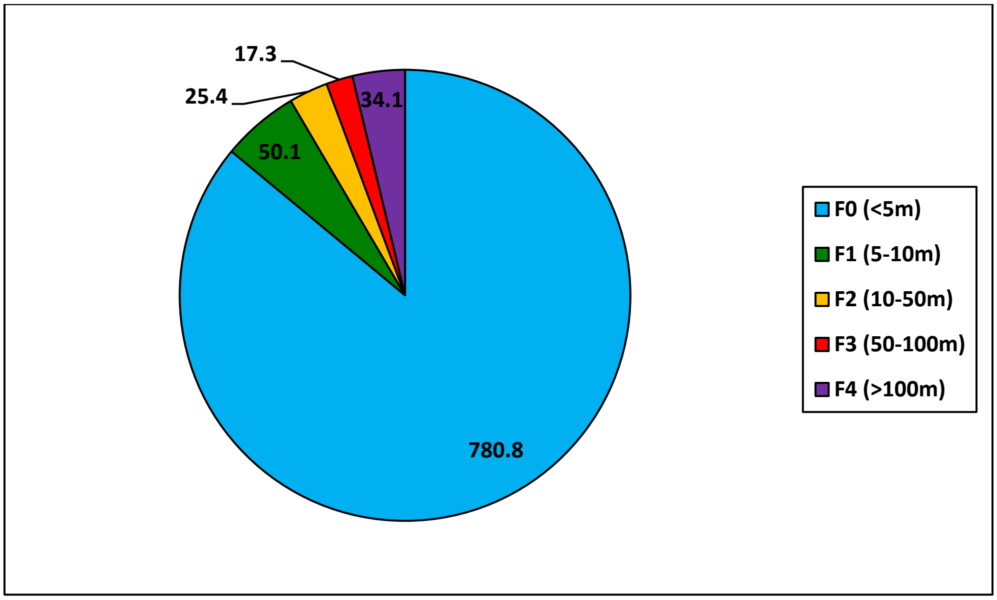

Figure 10. Flooding Class categories by shoreline length (km).

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 damage due to flooding is generally low in the Nisga'a study area, with 86.0% 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).

2.4.2 Coastal Vulnerability Observations

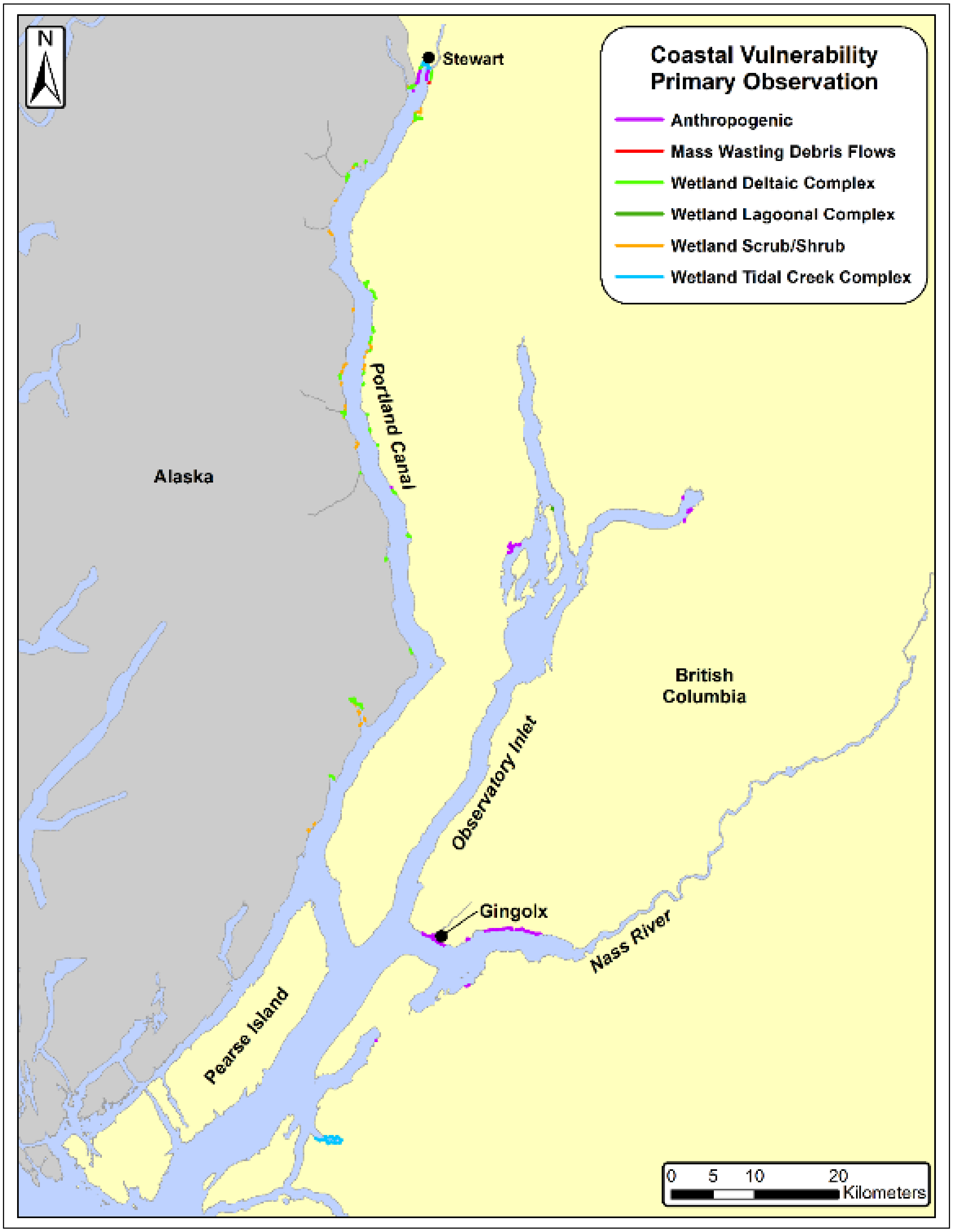

Figure 11. Distribution of the Coastal Vulnerability Observations categories.

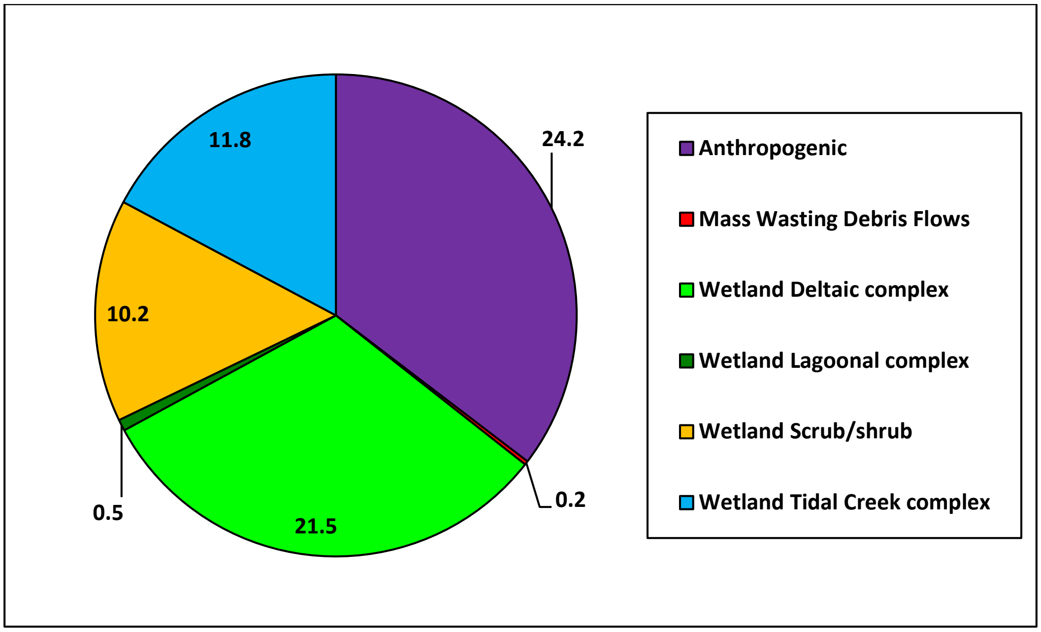

Figure 12. Coastal Vulnerability Observations categories by shoreline length (km). Category 'None' not shown.

The CVM Observations are features important for estimating the frequency and extent of coastal inundation. In the Nisga'a survey area, apart from the 'None' category, the majority of observations were from Anthropogenic category with 24.2 km and the Wetland Deltaic complex category with 21.5 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

The methods of Thieler and Hammer-Klose (2000) ((http://woodshole.er.usgs.gov/project-pages/cvi/) were adapted to calculate the Coastal Vulnerability Index (CVI) using five ShoreZone attributes: Shore Type, Max Tide Range, Shoreline Erosion index, Flood Zone Width, and Wave Height. See the most recent ShoreZone protocol for more details (Cook *et al*., 2017). 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 using 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). The distribution of ranks in the survey area is shown in Figure 13. Under the absolute ranking system, all the shoreline mapped for this project is ranked as Low vulnerability to sea level rise. This is a consistent with the rocky nature of the shoreline in the fjordal areas of the survey area. Large marshes are also not generally considered to be highly vulnerable to sea level rise unless there is no where for the marsh to retreat to or the levels rise too quickly. The large tidal range in this area (>6m) also provides a buffer as there is less time in any tide window for storm surges or other short-term changes in sea level to affect the backshore.

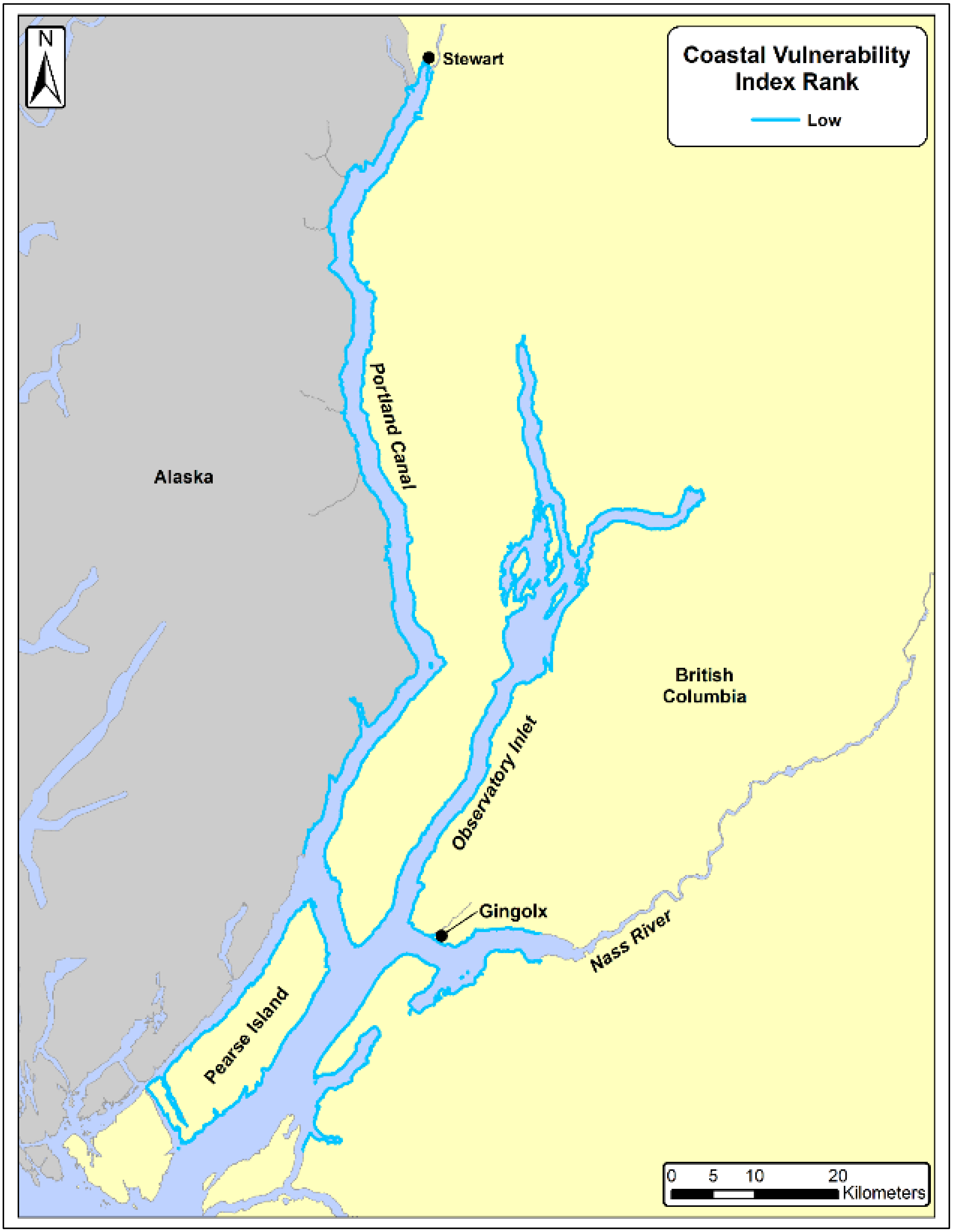

Figure 13. Distribution of Coastal Vulnerability index ranks.

2.5 Anthropogenic Shore Modifications

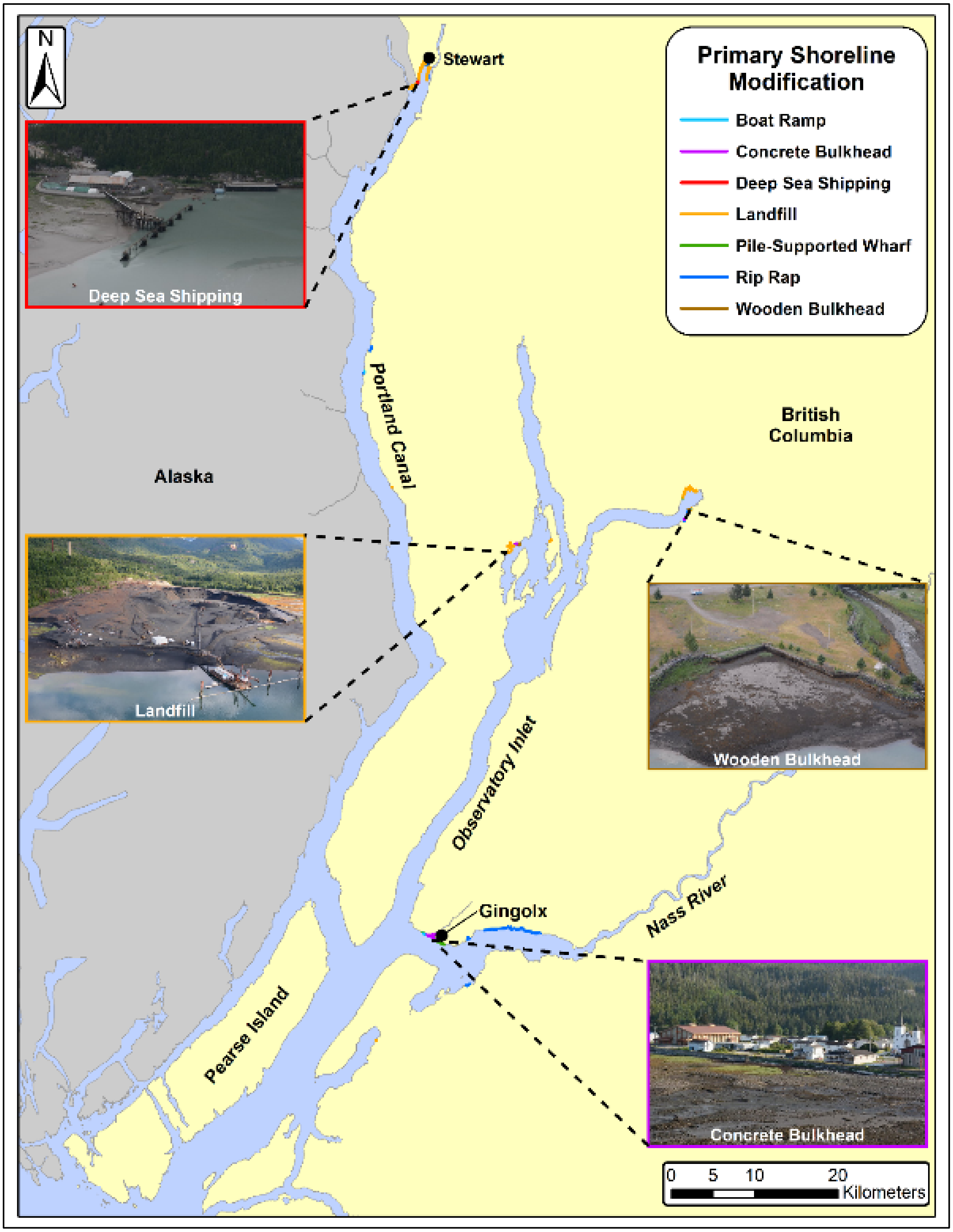

Figure 14. Distribution of types of the primary Shore Modifications. There may be other shore modifications in any given unit. That data would be found in the Shore Modifications table in the geodatabase.

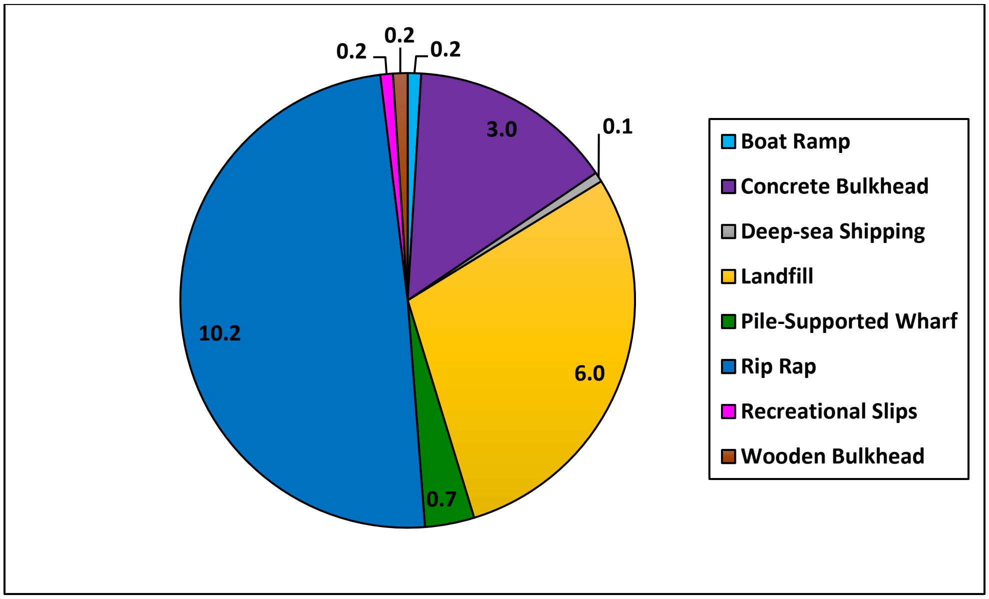

Figure 15. Shore Modifications by estimated shoreline length (km) of each modification type.

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 2.3% of the shoreline (taking the estimated length of that modification within the unit into account) exhibits shore modifications in the Nisga'a study area (Figure 14). Rip Rap was the most commonly recorded observation (49.3%) with Landfill (29.1%) and Concrete Bulkheads (14.6%) 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 Nisga'a survey area). Full descriptions of all biobands, including indicator and associated species can be found in the ShoreZone protocol (Cook *et al*. 2017). For the bioband metrics, the specific elevation or zone of the intertidal 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 16 biobands mapped in the Nisga'a survey area are summarized in Tables 3 and 4. The Rockweed, Barnacle and Blue Mussel were often the only biobands present on some of the rock cliff/ramp dominated areas up Portland Canal and Observatory Inlet. The water was quite turbid in many parts of this survey area, with obvious influence from a number of major fresh water sources: the Nass River (near Kincolith), the Kshwan River (at the head of Observatory Inlet), the Kitsault River (at the head of Alice Arm) and the Bear River (at the head of Portland Canal). The overall diversity of biobands in this survey area was low compared to the rest of the North Coast area (Coastal and Ocean Resources, 2019). It should also be noted that the intertidal Filamentous and Foliose Red Algae (FFRA) and Bladed Brown Algae (BRBA) biobands in this survey area were difficult to distinguish from each other and were likely mixed together. The FFRA was classified as the brownish bioband in the mid-intertidal while the BRBA band was classified as the brownish bioband in the low intertidal, right at the waterline (see Table 2, Appendix A for photographic examples).

Table 3. Percent cover category for the intertidal biobands in the Nisga'a survey area.

Bioband		**Zone**	**Number of Units**							**Total Number of Units* With Bioband Present**	**% of Total Units* with Bioband Present**
			Percent Cover Category (Intertidal Zone)								
Name	**Code**		**<5%**	**5-25%**	**26-50%**	**51-75%**	**76-95%**	**>95%**	**Bioband present, Percent Cover Not Assessed**		
Salt Marsh (BC)	SAMB	**Upper to Mid Intertidal**	15	538	20	7	4	1	0	**585**	**14.7%**
Barnacle	BARN		10	2735	605	41	1	1	0	**3393**	**85.1%**
Rockweed	ROCK		53	2965	681	83	2	1	0	**3785**	**94.9%**
Blue Mussel	BLMU		52	2944	146	2	0	0	0	**3144**	**78.9%**
Green Algae	GRAL		406	2386	22	2	0	0	0	**2816**	**70.6%**
Filamentous and Foliose Red Algae	FFRA	**Mid to Lower Intertidal**	76	1500	6	2	0	0	0	1584	39.73%
Brown Bladed Algae	BRBA		149	1563	1	0	0	0	0	1713	42.96%
Coralline Red Algae	CORA		0	5	0	0	0	0	0	5	0.13%
Eelgrass	EELG		0	1	3	0	0	0	0	4	0.10%

*Please note that Total Number of Units is used to describe the distribution of biobands rather than length (in kilometers) because biobands are usually not continuous along the entire length of a unit. A calculation could be performed to estimate length of a bioband over a region using the percent length metric in the geodatabase.

Table 4. Width category of supratidal and subtidal biobands in the Nisga'a survey area.

Bioband		**Zone**	**Number of Units**				**Total Number of Units* With Bioband Present**	**% of Total Units* with Bioband Present**
			Width Category					
Name	**Code**		**<1 m**	**1-5 m**	**>5 m**	**Bioband present, Width Not Assessed**		
Splash Zone	SPZO	**Splash Zone (A)**	3	2	0	0	**5**	**0.1%**
White Lichen	WHLI		1039	1363	23	0	**2425**	**60.8%**
Yellow Lichen	YELI		3	0	0	0	**3**	**0.1%**
Black Lichen	BLLI		2186	1443	18	0	**3647**	**91.5%**
			<10 m	**10-30 m**	**>30 m**	**Bioband present, Width Not Assessed**		
Dune Grass	DUGR	**Supratidal (A)**	366	31	0	0	**397**	**10.0%**
Salt Marsh (BC)	SAMB		1662	109	45	0	**1816**	**45.5%**
Bladed Brown Algae	BRBA	**Subtidal (C)**	904	13	2	362	**1281**	**32.1%**
Eelgrass	EELG		1	3	1	0	**5**	**0.1%**
Bull Kelp	BUKE		543	46	1	0	**590**	**14.8%**
Urchin Barrens	URBA		1	0	0	0	**1**	**0.0%**

*Please note that Total Number of Units is used to describe the distribution of biobands rather than length (in kilometers) because biobands are usually not continuous along the entire length of a unit. A calculation could be performed to estimate length of a bioband over a region using the percent length metric in the geodatabase.

The most common Splash Zone bioband was Black Lichen (BLLI), occurring in 92% of the units, while Salt Marsh (SAMB) was the most common supratidal bioband in 46% of units (see Figures 16 and 18 for graph of proportion of units by width category and distribution map). 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 inhabitants and can provide important ecological functions, such as filtering land-based nutrients which can help maintain the balance of other habitats such as eelgrass meadows (Valiela *et al*., 2000).

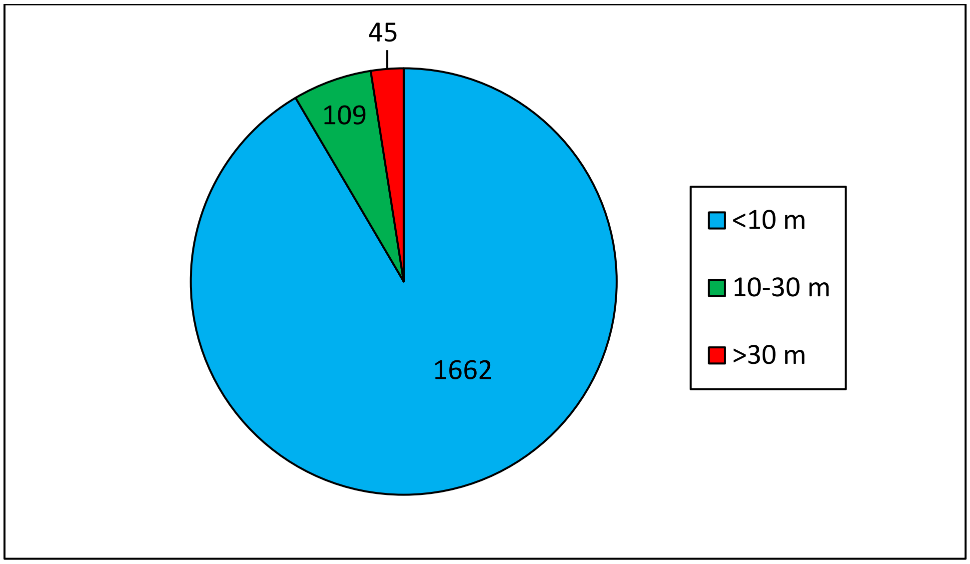

Figure 16. Proportion of units with the supratidal Salt Marsh (SAMB) bioband by width category.

Figure 17. Photo of the Salt Marsh bioband in Halibut Bay off Portland Canal.

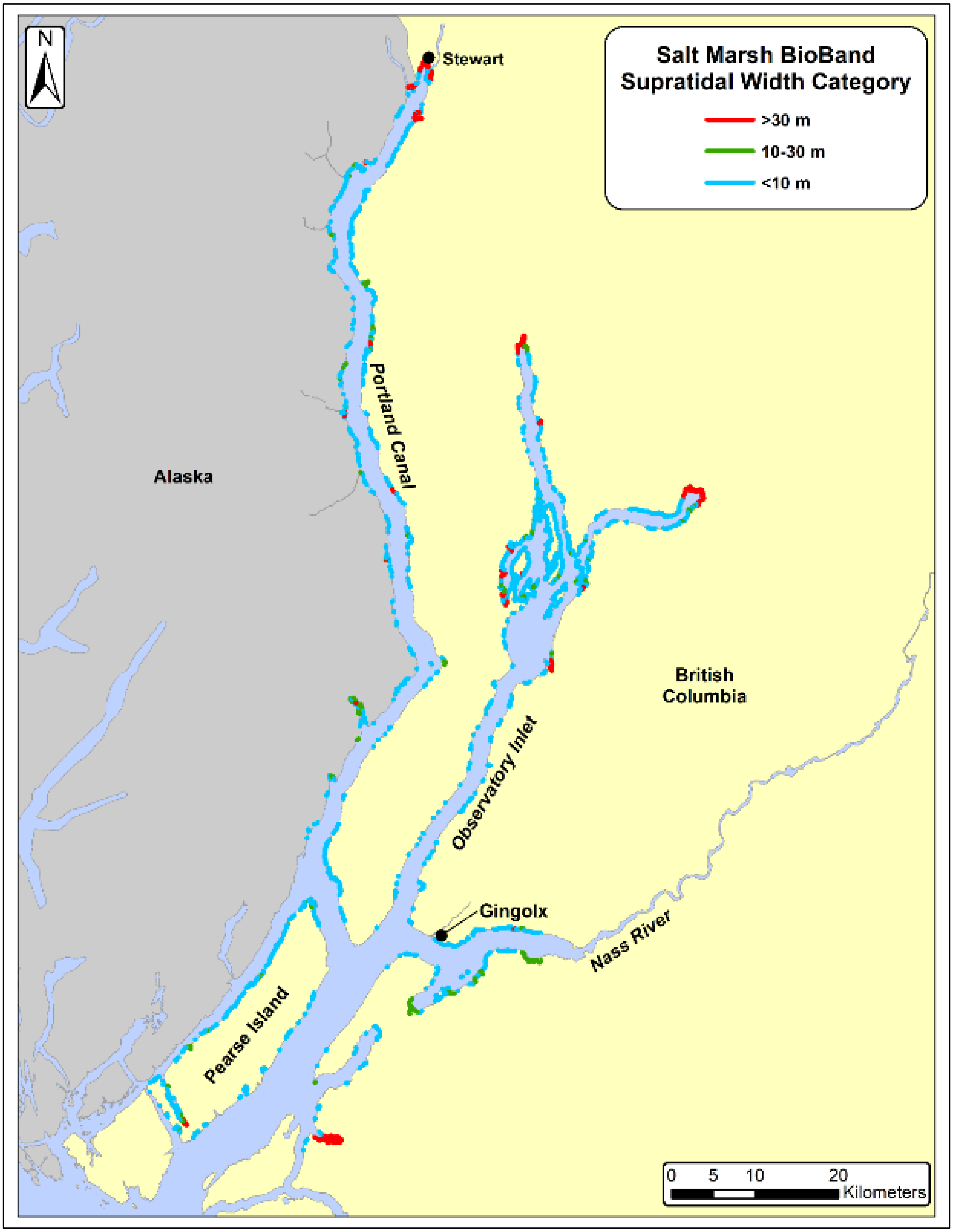

Figure 18. Distribution of the Salt Marsh (SAMB) bioband by width category in the Nisga'a survey area.

The most commonly occurring intertidal biobands in the survey areas were Rockweed, Barnacle, Blue Mussel and Green Algae (found in 95%, 85%, 79% and 71% of units respectively). Blue Mussels (*Mytilus edulis*) are the most widely consumed mussel in North America and are harvested commercially on many parts of the coast (see Figures 19 for graph of proportion of units by percent cover category, Figure 20 for a photographic example of the bioband and Figure 21 for a distribution map). Mussels also serve a vital ecological role by filtering bacteria and toxins from the water.

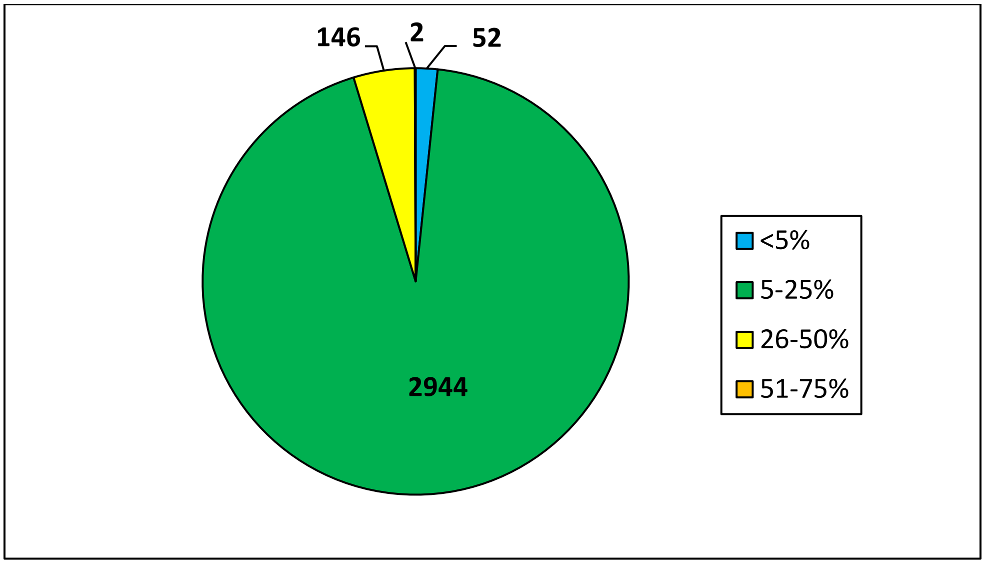

Figure 19. Proportion of units with the supratidal Blue Mussel (BLMU) bioband by percent cover category.

Figure 20. Example of the Blue Mussel bioband as a black strip in the upper/mid intertidal.

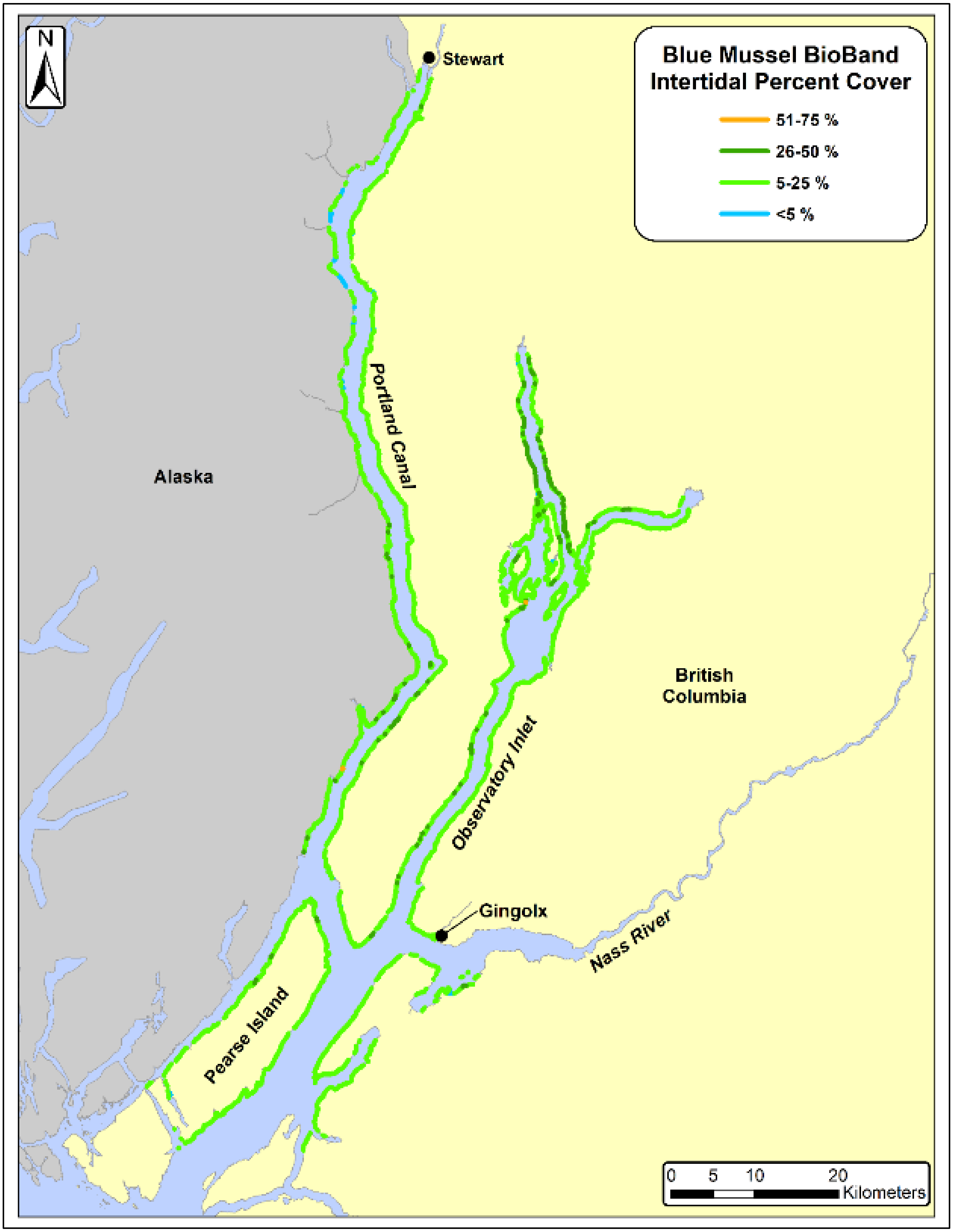

Figure 21. Distribution of the Blue Mussel (BLMU) bioband by percent cover in the Nisga'a survey area.

The most common subtidal bioband was Brown Bladed Algae (32% of units). Eelgrass was only observed in 0.1% of units and was, in fact, only classified in one bay (Winter Inlet on Pearse Island). Bull Kelp (BUKE) was the only canopy kelp observed in the Nisga’a survey area, in 15% of units. Most of those Bull Kelp beds were classed as Narrow (<10) (Figure 22). This is in contrast to the larger North Coast area that has been mapped, where both Bull Kelp and Giant Kelp (GIKE) are common. The exception is around the mouth of the Skeena River where only Bull Kelp was observed because Giant Kelp is known to be intolerant of less saline water. The influence of the Nass River, as well as the other large rivers that drain into the area, is the likely explanation for the lack of Giant Kelp. Canopy kelps form valuable habitat for other algae, fish and invertebrates and are an important part of a healthy coastline. See Figures 23 for a photographic example of a Narrow Bull kelp bed and Figure 24 for a distribution map.

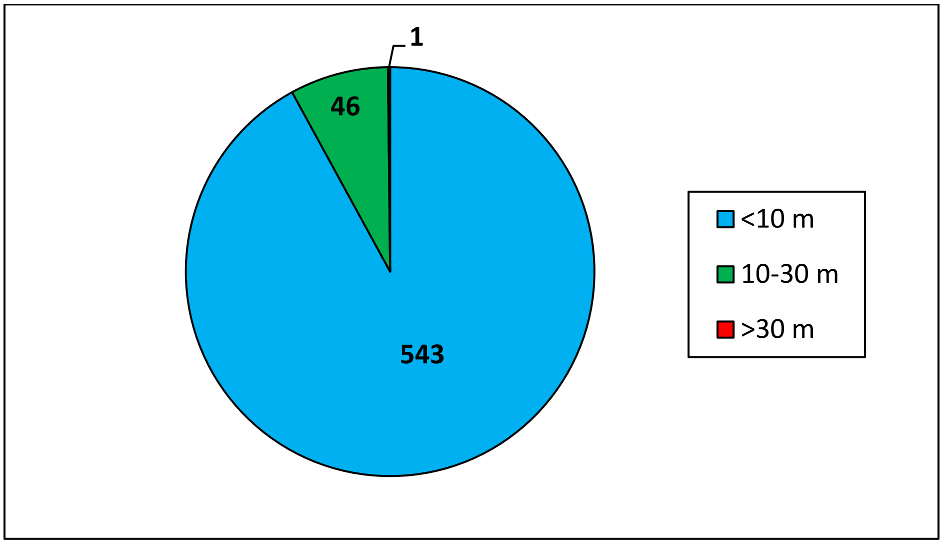

Figure 22. Proportion of units with the subtidal Bull Kelp (BUKE) bioband by width category.

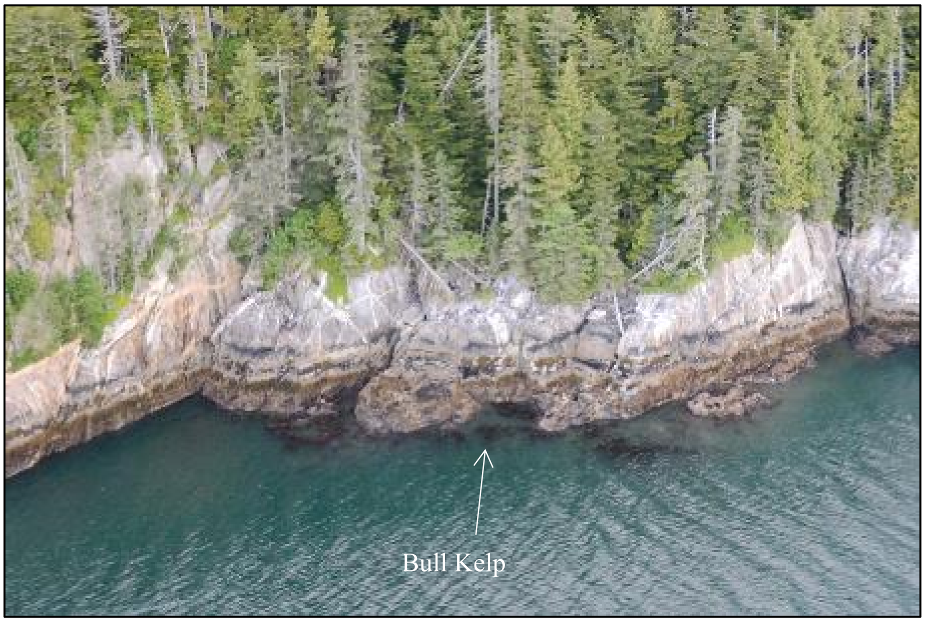

Figure 23. Example of a narrow band of Bull Kelp in the subtidal.

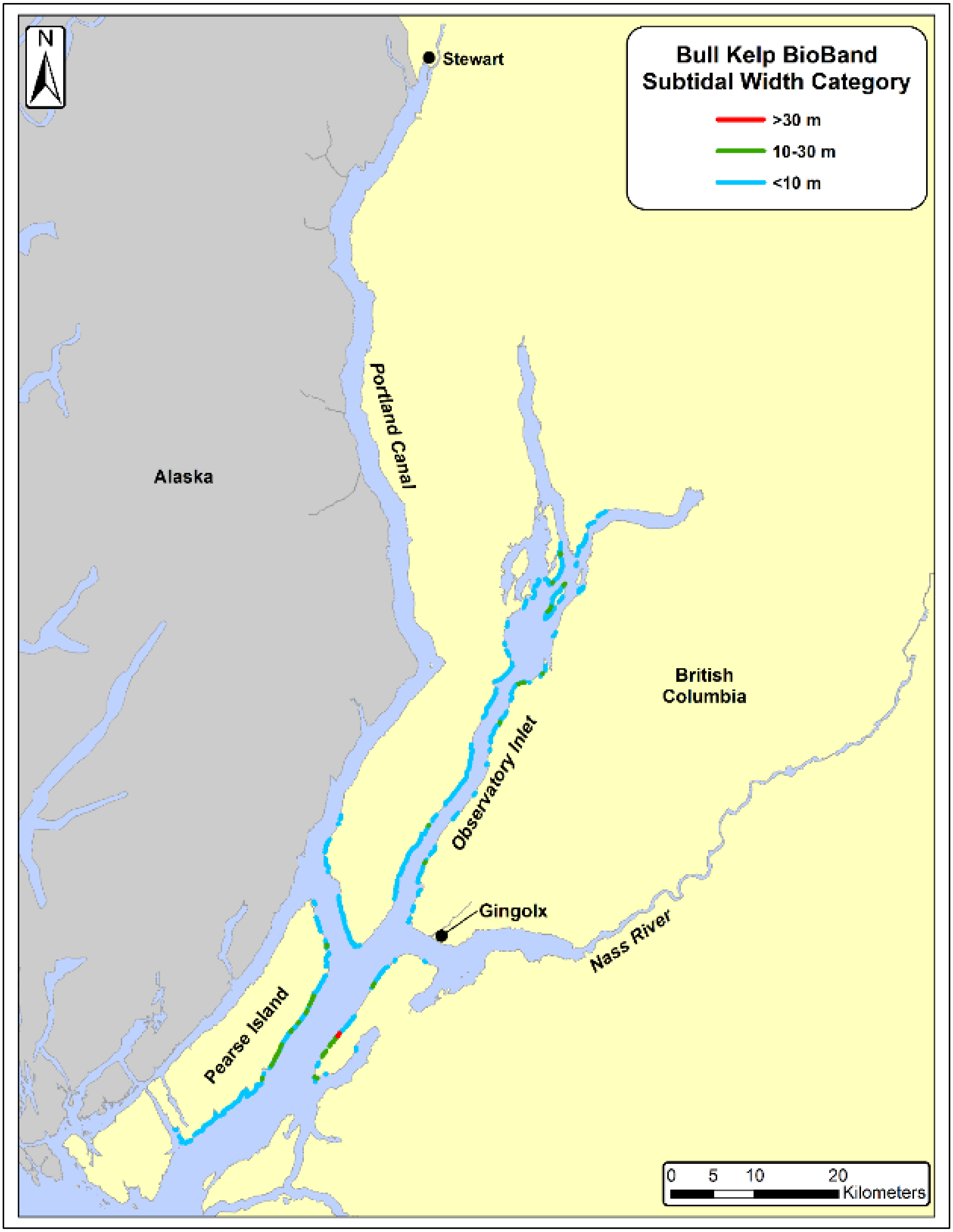

Figure 24. Distribution of the Bull Kelp (BUKE) bioband by width category in the Nisga'a survey area.

3.2 Biological Wave Exposure

Biological wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are defined in ShoreZone on the basis of a typical set of biobands. When present, the observation and relative abundance of biota in each alongshore unit is used to determine the classification for the biological wave exposure. The assemblages of biota observed are then used as a proxy for the 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 in the Nisga'a survey area are summarized in Figure 25 and a distribution map of the categories is shown in Figure 26. Most of the coastline (81.8%) was in the low to wave exposure categories (Very Protected and Protected), with most of that Protected (79.6%). There was no Exposed or Very Exposed coastline in this survey area.

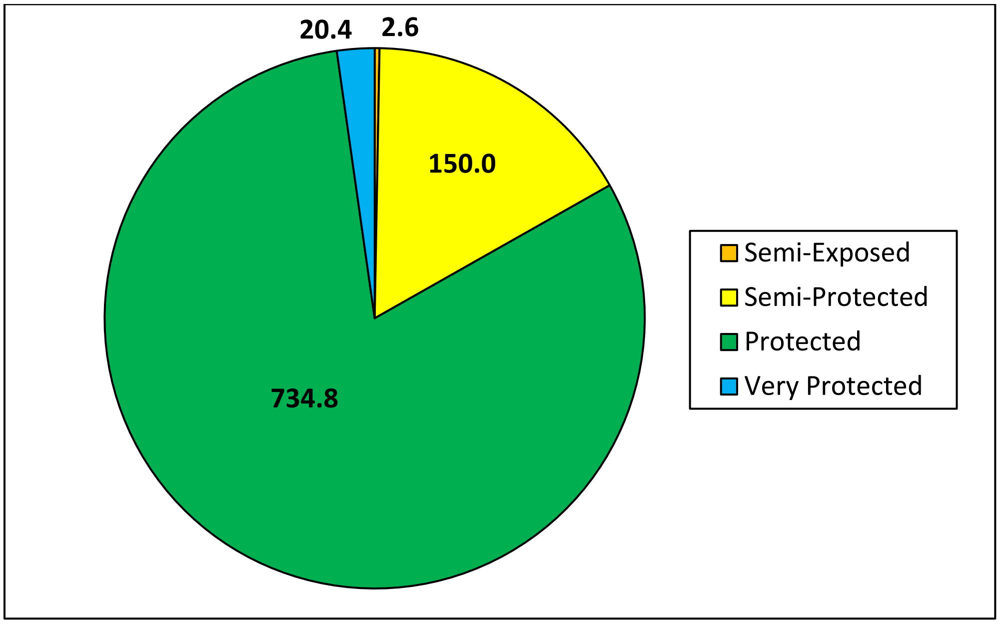

Figure 25. Distribution of Biological Wave Exposures mapped in the Nisga'a area to date by shoreline length (km).

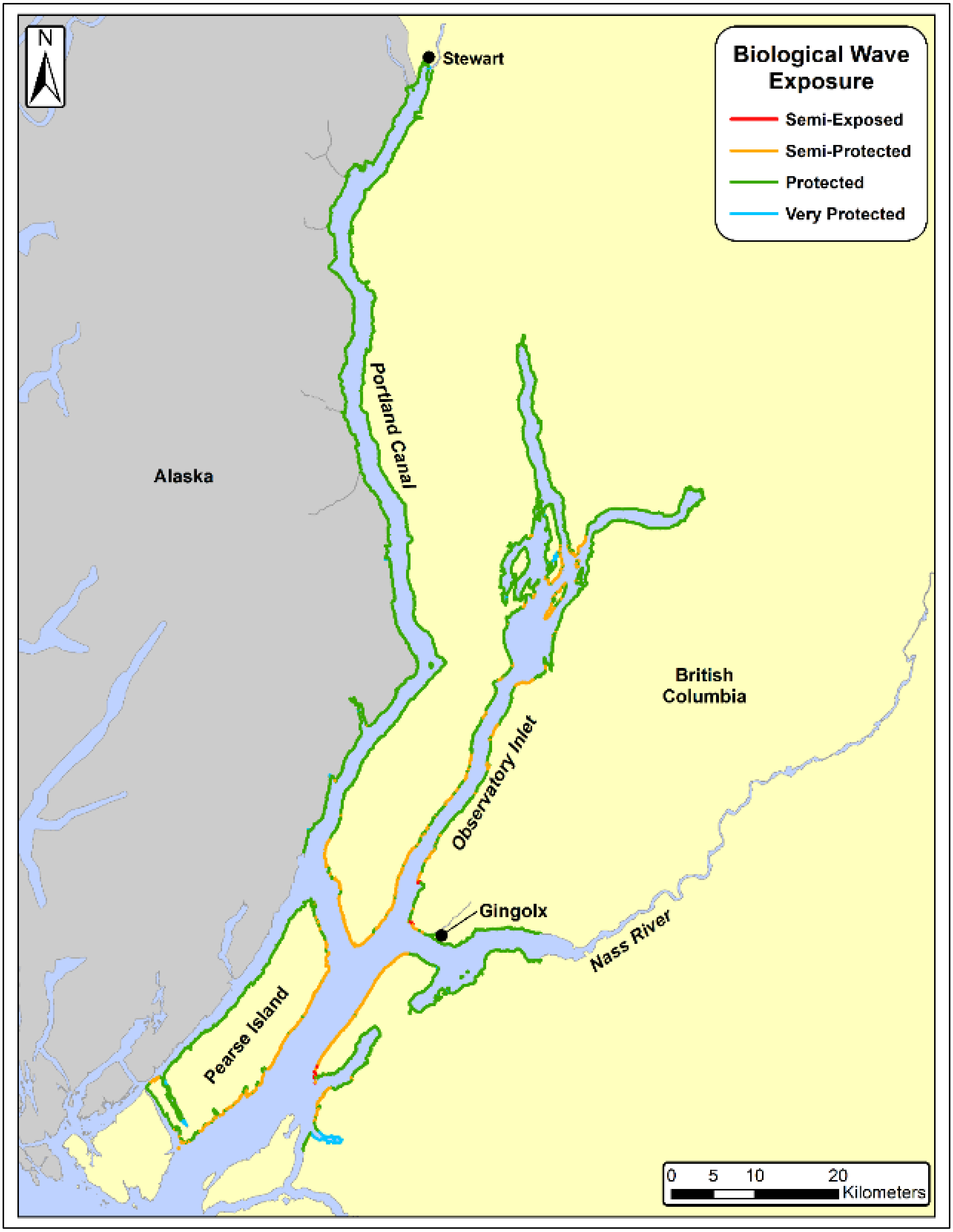

Figure 26. Distribution of the Biological Wave Exposure in the Nisga'a survey area.

3.3 Habitat Class

Habitat Class is a classification based on wave exposure and geomorphic characteristics observed on 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 exposure is the most common structuring process, and less commonly observed habitats are those structured by current, estuarine/fluvial processes, and anthropogenic structures. For habitat classes structured by wave exposure, 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 habitat class categories mapped for the Nisga'a survey area are summarized in Figures 27 and 28. Partially mobile is the dominant shoreline type (53.4%) with Immobile the next most common at 35.6%. Estuaries are not very common in this area with only 7.7% of the shoreline in that classification. Those estuaries tended to be large river mouths at the ends of the inlets and fjords. 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 Nass River (and several other significant rivers) is a significant influence and much of the survey area could be considered to be estuarine in nature. The Anthropogenic habitat occurred in 1.9% of units.

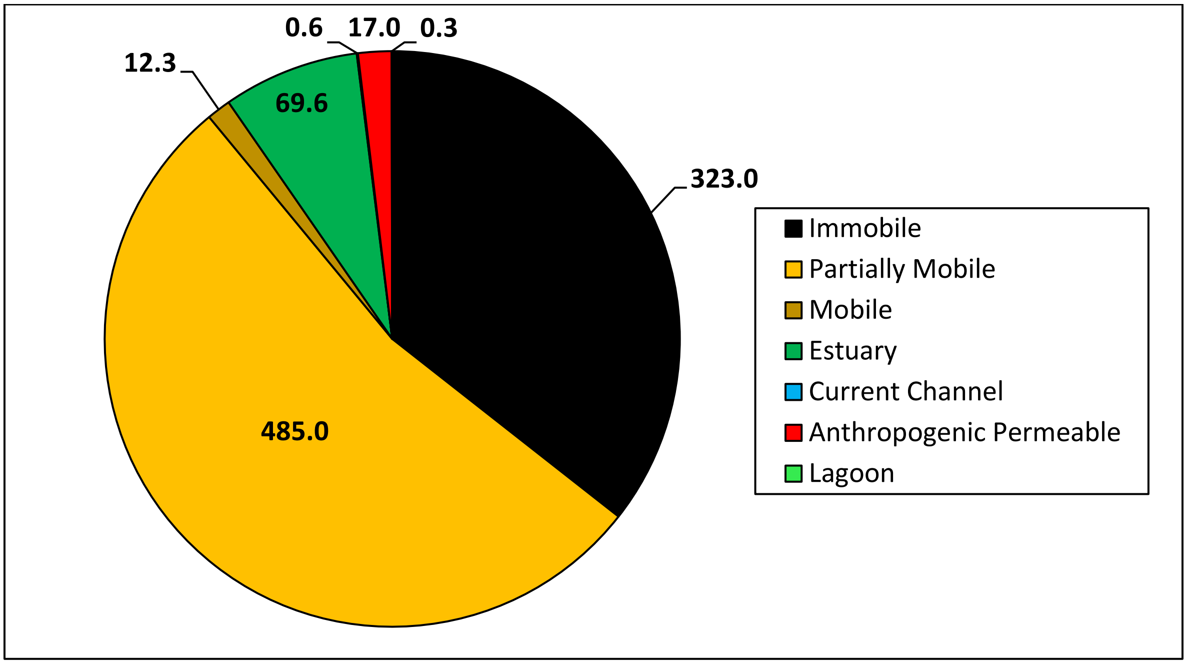

Figure 27. Distribution of Habitat Class categories in the Nisga'a survey area by shoreline length (km).

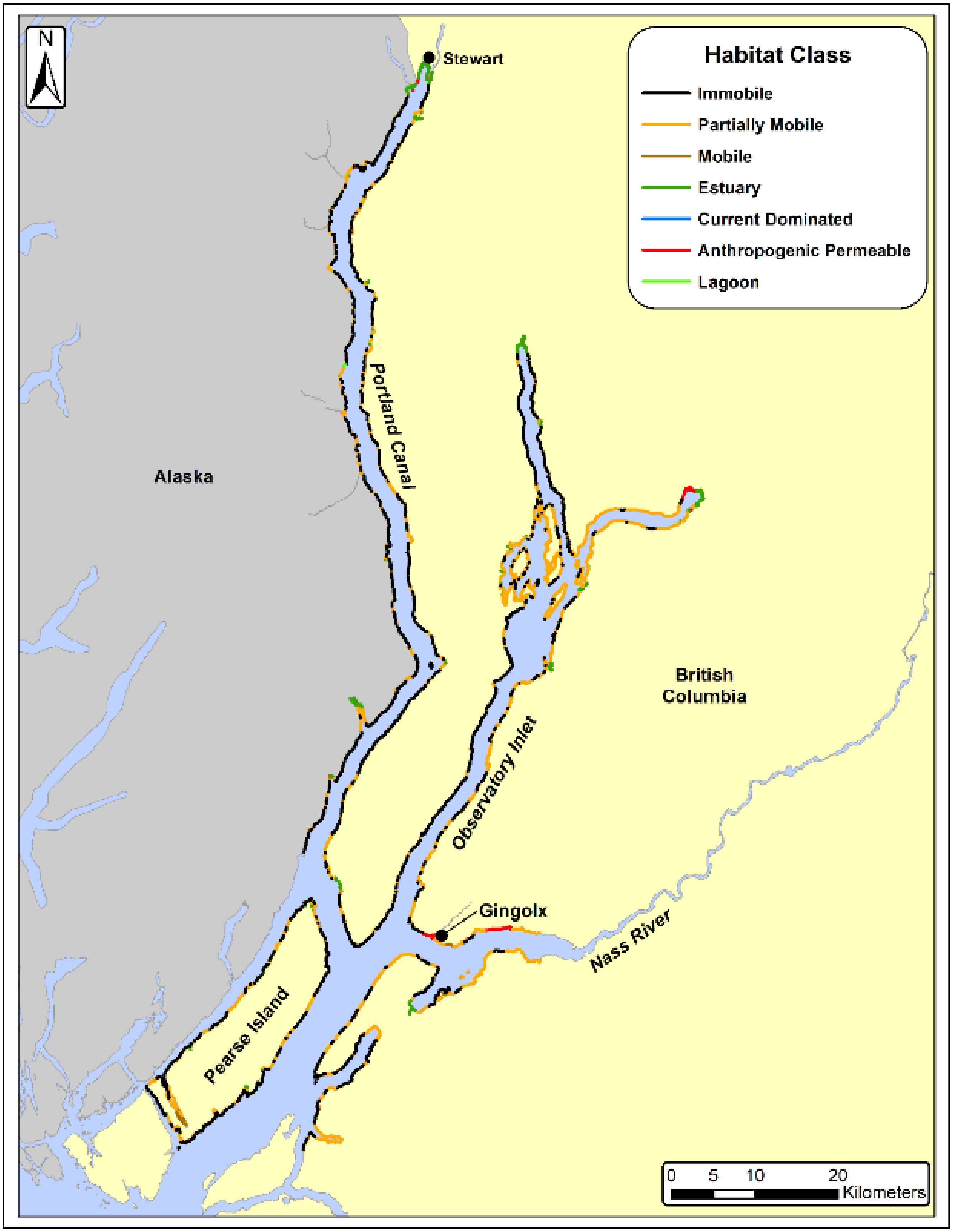

Figure 28. Distribution of Habitat Class categories in the Nisga'a survey area.

4 REFERENCES

Berry, H.D., J.R. Harper, T.F. Mumford, Jr., B.E. Bookheim, A.T. Sewell and L.J. Tamayo, 2004. Washington State ShoreZone Inventory User's Manual, Summary of Findings, and Data Dictionary. Reports prepared for the Washington State Dept. of Natural Resources Nearshore Habitat Program.

Coastal and Ocean Resources, 2019. ShoreZone Habitat Mapping Summary Report for the Prince Rupert survey area. Produced for the Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, British Columbia, 46p.

Cook, S., S. Daley, K. Morrow and S. Ward. 2017. ShoreZone Coastal Imaging and Habitat Mapping Protocol. Coastal and Ocean Resources, Victoria, BC. 78p.

Harper, J.R., and M.C. Morris, 2004. ShoreZone Mapping Protocol for the Gulf of Alaska. Report prepared for the Exxon Valdez Oil Spill Trustee Council (Anchorage, AK). 61 p.

Harper, J.R. and M.C. Morris, 2014. Alaska ShoreZone Coastal Habitat Mapping Protocol. Report prepared by Nuka Research and Planning LCC of Seldovia for the Alaska Bureau of Ocean Energy Management (BOEM), Anchorage, AK, 144 p.

Howes, D.E., 2001. British Columbia biophysical ShoreZone mapping system – a systematic approach to characterize coastal habitats in the Pacific Northwest. Puget Sound Research Conference, Seattle, Washington, Paper 3a, 11p.

Petersen, J., J. Michel, S. Zengel, M. White, C. Lord, C. Plank, 2002. Environmental Sensitivity Index Guidelines. Version 3.0. NOAA Technical Memorandum NOS OR&R 11. Hazardous Materials Response Division, Office of Response and Restoration, NOAA Ocean Service, Seattle, Washington 98115 89p + App.

Thieler, E.R. and E.S. Hammar-Klose, 2000. National Assessment of Coastal Vulnerability to Sea-Level Rise: Preliminary Results for the U.S. Pacific Coast. U.S. Geological Survey. Accessed at http://pubs.usgs.gov/dds/dds68/reports/westrep.pdf on September 19th, 2016.

Valiela I., Cole M.L., McClelland J., Hauxwell J., Cebrian J. and S.B. Joye. 2002 Role of Salt Marshes as Part of Coastal Landscapes. In: Weinstein M.P., Kreeger D.A. (eds) Concepts and Controversies in Tidal Marsh Ecology. Springer, Dordrecht.

5 ACKNOWLEDGMENTS

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Protocols for data access and distribution are established by the program partner agencies. Please see www.ShoreZone.org for a list of partner agencies and related web sites. Video imagery can be viewed and digital stills downloaded online at www.ShoreZone.org and Coastal and Ocean Resources' ArcGIS site. 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 for the Nisga'a area. (Page 35).
Table A-2. Examples of the most common Biobands for the Nisga'a area (Page 39).

Table A-1. Examples of the Coastal Classes in the Nisga'a Survey Area.

Photo bc15_sh_00016: Example of Coastal Class 3; Rock Cliff.
Pearse Island.

Photo bc15_sh_00604: Example of Coastal Class 8; Cliff with gravel beach.
Pearse Island.

Photo bc15_sh_01708: Example of Coastal Class 11; Ramp with gravel and sand beach, wide. West Observatory Inlet.

Photo bc15_sh_17421: Example of Coastal Class 14; Ramp with gravel and sand beach. Hattie Island.

Photo bc15_sh_00274: Example of Coastal Class 24; Sand and gravel flat or fan. Pearse Island.

Photo bc15_sh_02616: Example of Coastal Class 25; Sand and gravel beach, narrow. Hastings Arm.

Photo bc15_sh_15302: Example of Coastal Class 31; Organics/Fines.
Portland Canal.

Photo bc15_sh_16416: Example of Coastal Class 32; Permeable man-made structures.
Stewart, BC.

Table A-2. Examples of the most common Biobands in the Nisga'a survey area.

Photo bc15_sh_00848: Good example of the Black Lichen (BLLI) bioband which is a black band in the supratidal zone, usually caused by the lichen *Verrucaria* sp. Southwest corner of Pearse Island.

Photo bc15_sh_15239: Good example of White Lichen (WHLI) bioband in the supratidal zone, above the Black Lichen band. Lower East side of Portland Canal.

Photo bc15_sh_03088: Good example of the blue-green Dune Grass (DUGR) bioband in the supratidal. Larcom Island.

Photo bc15_sh_15314: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Halibut Bay, off Portland Canal.

Photo bc15_sh_17664: Good example of the white/beige Barnacle (BARN) bioband in the high and mid intertidal zones. This is also a very nice example of the banding in the fjordal/cliff habitat in the survey area. Canadian side of Portland Canal.

Photo bc15_sh_15619: Good example of the Rockweed (ROCK) bioband. Tongass National Forest, US side of Portland Canal.

Photo bc15_sh_15159: Good example of the Blue Mussels (BLMU) bioband in the mid/lower intertidal. Lower US side of Portland Canal.

Photo bc15_sh_15937: Good example of the Green Algae (GRAL) bioband. Tongass National Forest, US side of Portland Canal.

Photo bc15_sh_00006: Example of the Filamentous and Foliose Red Algae (FFRA) bioband in the lower intertidal/subtidal. In this area it was a more diffuse colour in the mid intertidal. Pearse Island.

Photo bc15_sh_17569: Good example of the Bladed Brown Algae (BRBA) bioband in the lower intertidal and subtidal. Lower Canadian side of Portland Canal.

Photo bc15_sh_02873: Good example of the Bull Kelp (BUKE) bioband in the nearshore subtidal. Larcom Island.