ShoreZone Summary Report

Campbell River Survey Area

March 2024

Prepared for:

Comox Valley Project

Watershed Society

SEACHANGE
MARINE CONSERVATION SOCIETY

ShoreZone

On the cover:

Page Lagoon

Campbell River

McNaughton Creek, Deep Bay

SeaChange Project: 23-13 **March 2024**

ShoreZone Habitat Mapping Summary Report

Campbell River Survey Area

Northwest Bay (bc23_cr_04968)

Prepared for:
Comox Valley Project Watershed Society
Courtenay, BC, Canada

Prepared by:
SeaChange Marine Conservation Society
Victoria, BC, Canada
www.seachangesociety.com

The suggested citation for this report is:
SeaChange Marine Conservation Society. 2024. ShoreZone Habitat Mapping Summary Report: Campbell River Survey Area. Produced for Comox Valley Project Watershed Society, Courtenay, BC. Produced by SeaChange Marine Conservation Society, Victoria, BC. 58p.

Campbell River Survey Area Summary

394 km of shoreline mapped

957 shoreline units created

Average unit length is **412 m**

65% of the intertidal is classified as **Sediment-dominated** and **13%** is classed as **Rock and Sediment-dominated**

90% of the shoreline has a high Oil Residence Index value (residence of days to months)

48% of the shoreline has a **Shoreline Modification** of some type

11 biobands were classified in the **intertidal** with **Green Algae (81%** of units**),** and **Rockweed (68%** of units**)** being the most common

9 biobands were classified in the **supratidal** with **Salt Marsh** (**53%** of units), **Black Lichen** (**43%** of units) and **Dune Grass** (**41%** of units) being the most common

7 biobands were classified in the **subtidal** with **Eelgrass** (**43%** of units) being the most common

Mapleguard Point

Departure Bay

Englishman River

Fanny Bay

Table of Contents

LIST OF FIGURES AND TABLES

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 123,500 km of coastal Alaska, British Columbia, New Brunswick, Nova Scotia, Washington State and Oregon (see Figure 1). Figure 2 shows the extent of the shoreline mapped around Campbell River and is the section of shoreline covered by this summary report.

The ShoreZone imaging surveys conducted around Campbell River in August 2023 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 Campbell River 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 **394 kilometers** in **957 along-shore segments** (units), averaging 412 m in length. The digital shoreline used for the ShoreZone habitat mapping was the CHS_Highwaterline_BCalbers.shp.

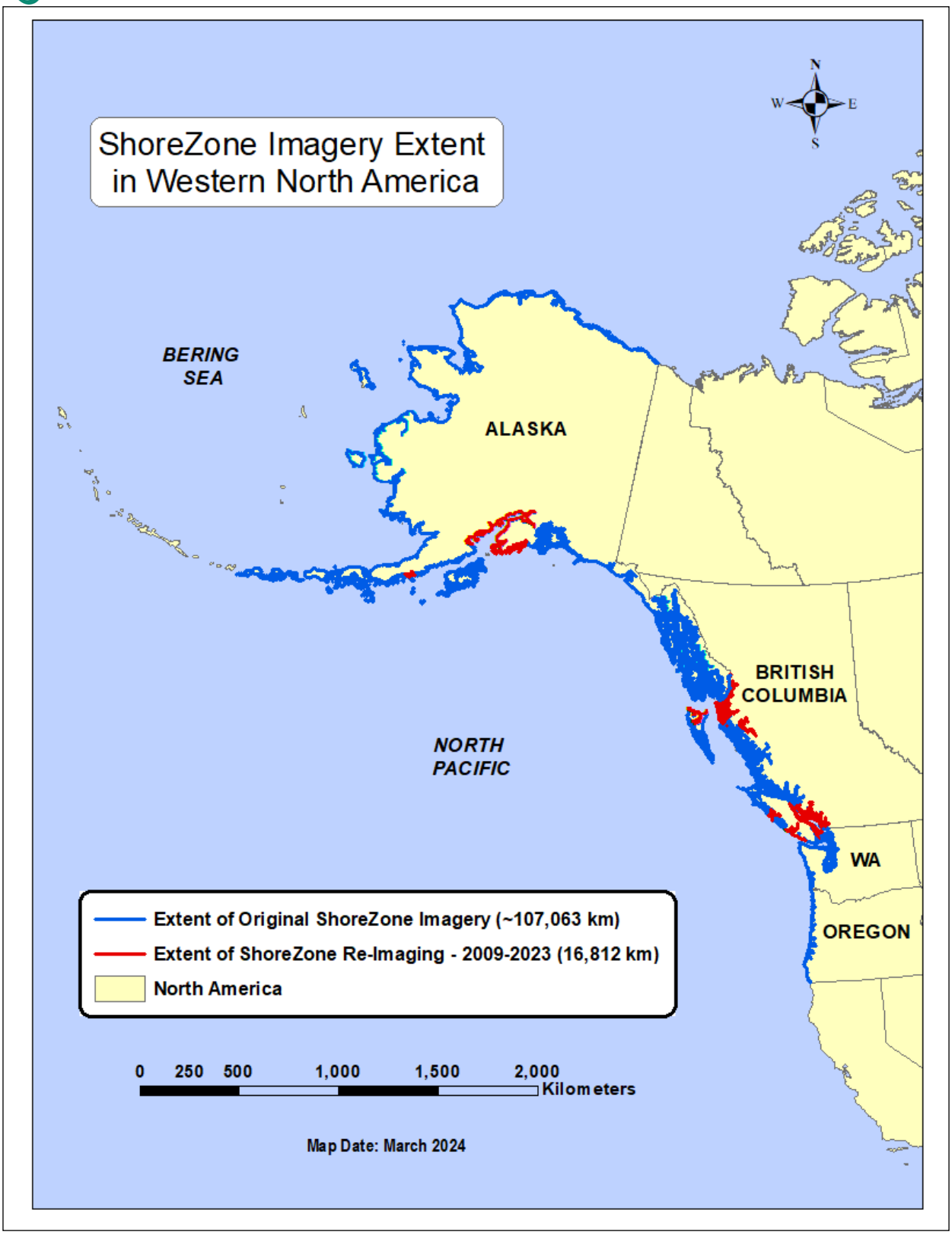

Figure 1. Extent of ShoreZone imagery in Western North America as of March 2024.

Figure 2. Extent of ShoreZone mapping for the Campbell River survey area covered in this report.

2 Physical Attribute Data Summary

2.1 Coastal Class

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. Sediment shorelines (65.4%) were dominant along with Rock and sediment shorelines (13.4%) and Anthropogenic shorelines (9.2%) in the Campbell River survey area. Riparian, Rock, and Lagoon, shorelines all comprised the rest of the coast respectively (see Figures 3 and 4 for summary and distribution 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 Campbell River survey area are found in Appendix A, Table A-1

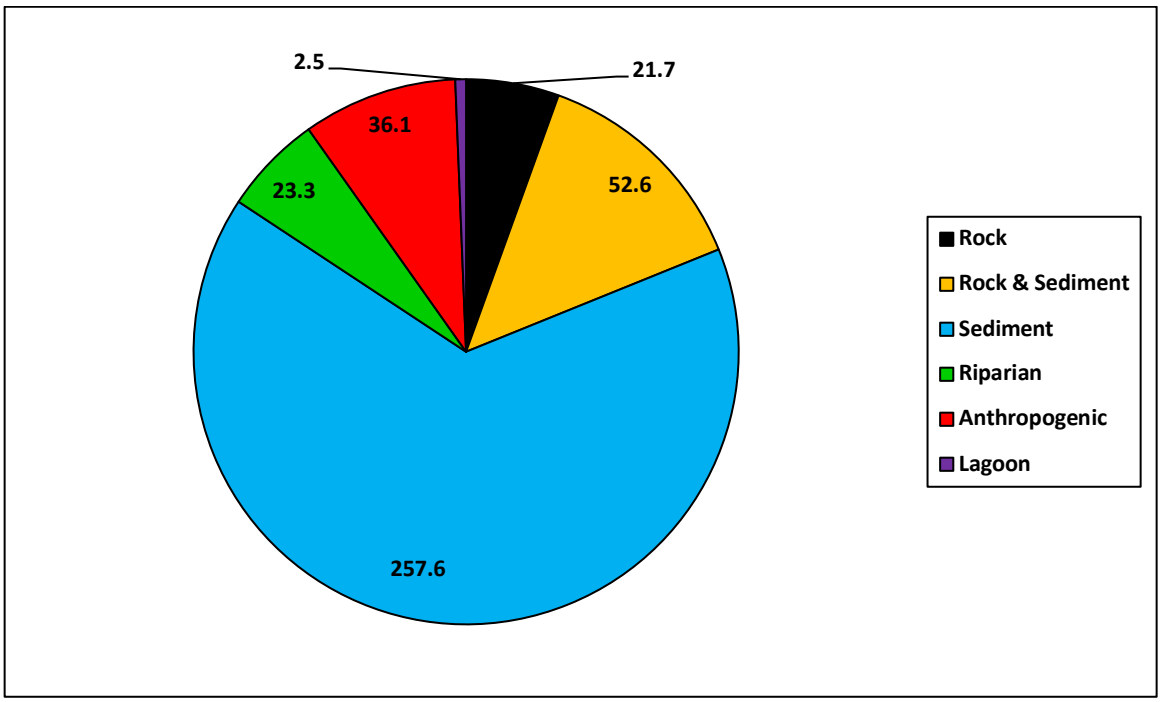

Figure 3. Grouped Coastal Class categories by shoreline length (km).

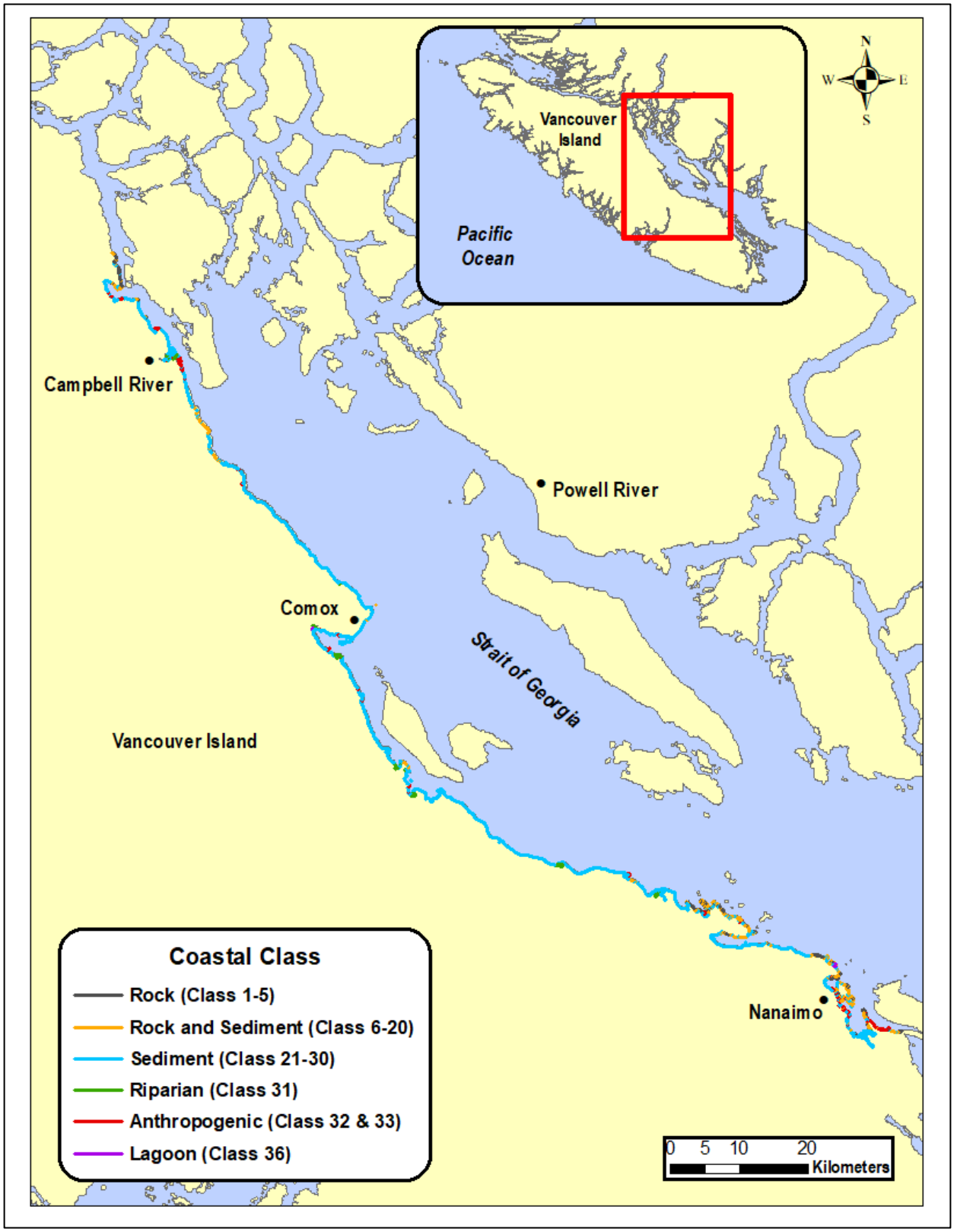

Figure 4. Map of the Coastal Class categories grouped by type (also known as Shore Type).

Table 1. Summary of Coastal Classes for the Campbell River 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	2	8	1	**6% 22 km**
	2	Rock Platform, wide	1	5	<1	
	3	Rock Cliff	13	52	3	
	4	Rock Ramp, narrow	6	32	2	
Rock & Sediment	6	Ramp w gravel beach,	1	6	<1	**13% 53 km**
	7	Platform w gravel beach, wide	1	2	<1	
	8	Cliff with gravel beach	4	24	1	
	9	Ramp with gravel beach	8	41	2	
	11	Ramp w gravel & sand beach, wide	6	32	2	
	12	Platform with G&S beach, wide	15	52	4	
	13	Cliff with gravel/sand beach	3	15	3	
	14	Ramp with gravel/sand beach	13	52	3	
	16	Ramp w sand beach, wide	1	1	<1	
	17	Platform w sand beach, wide	1	2	<1	
	18	Cliff with sand beach	1	3	<1	
	19	Ramp w sand beach, narrow	1	3	<1	
Sediment	21	Gravel flat, wide	<1	1	<1	**65% 258 km**
	22	Gravel beach, narrow	1	3	<1	
	24	Sand & gravel flat or fan	179	334	45	
	25	Sand & gravel beach, narrow	23	94	6	
	28	Sand flat	51	63	13	
	29	Mud flat	2	3	<1	
	30	Sand beach	2	8	<1	
Organics	31	Organics/Estuarine	23	22	6	**6% 23 km**
Man-made	32	Man-made, permeable	35	89	9	**9% 36 km**
	33	Man-made, impermeable	1	8	<1	
Lagoon	36	Lagoon	3	2	1	**1% 3 km**
Totals:			***394***	***957***	***100***	***100%***

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

2.2 Environmental Sensitivity Index (ESI)

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 the Campbell River coastline is represented by the grouped High and Very How categories (56.4% of shoreline length). These sections of the shoreline have a potentially high sensitivity to oil. At the other end of the spectrum, only 13.9% 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.

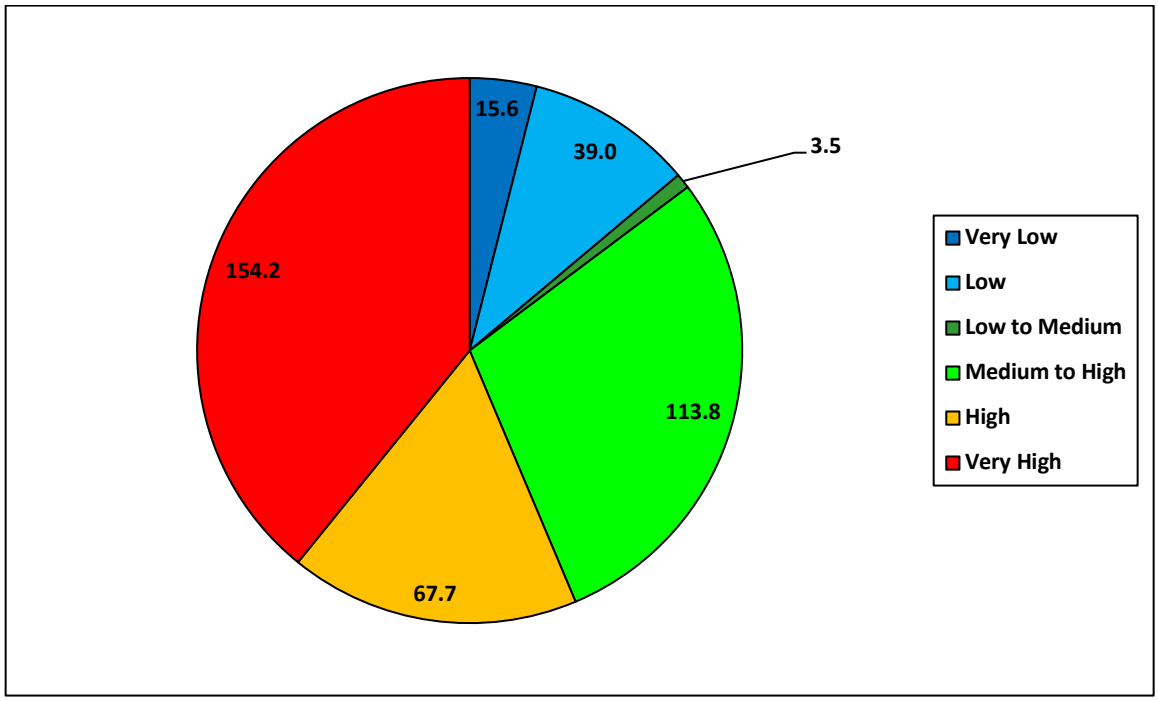

Figure 5. Grouped most sensitive ESI categories by shoreline length (km).

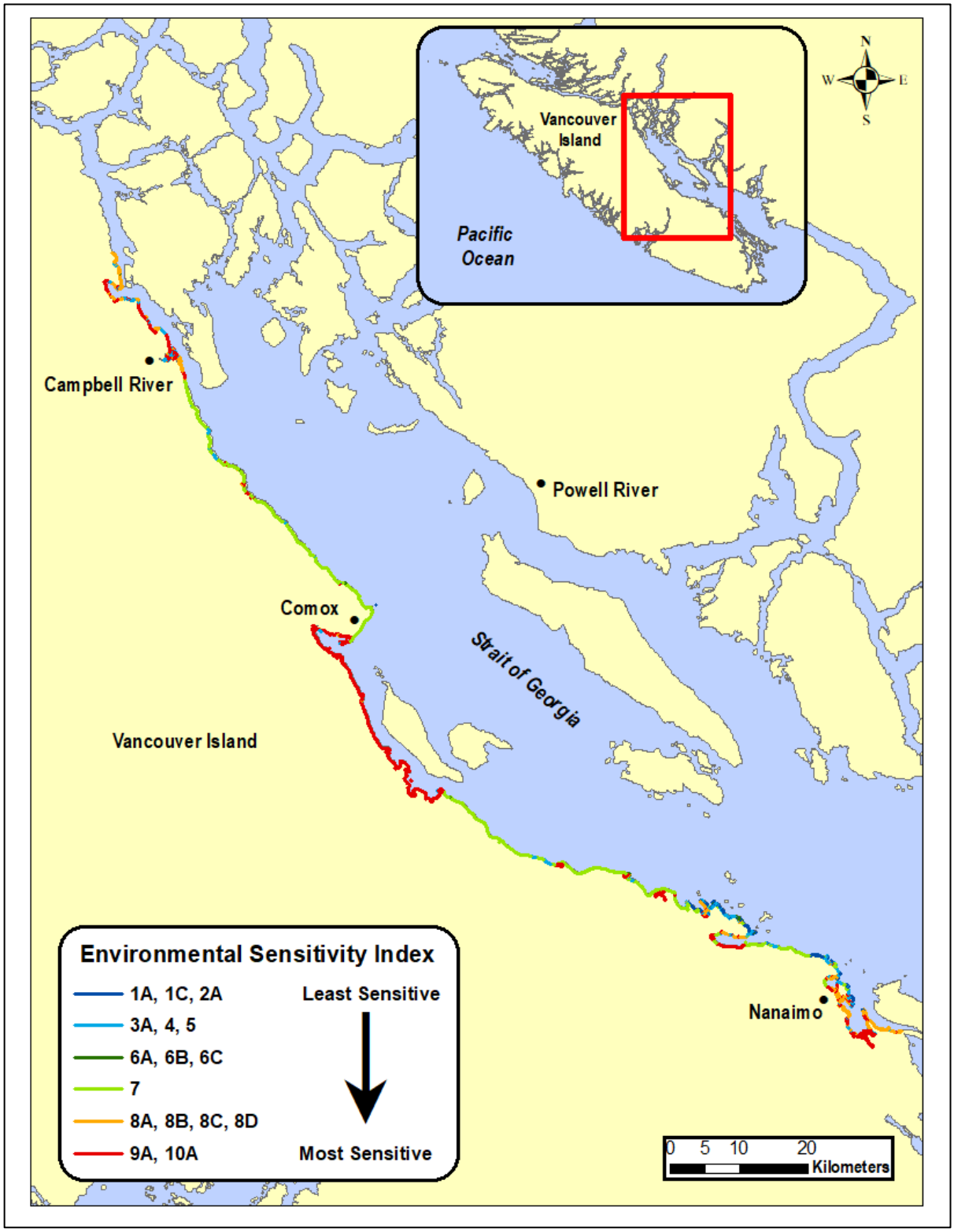

Figure 6. Distribution of the grouped ESI categories from least to most sensitive to oiling.

Table 2. Summary of Coastal Classes by ESI Class for the Campbell River 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	4	20	1
1C	Exposed rocky cliffs with boulder talus base	1	8	<1
2A	Exposed wave-cut platforms in bedrock, mud, or clay	11	54	3
3A	Fine- to medium-grained sand beaches	1	4	<1
4	Coarse-grained sand beaches	<1	1	<8
5	Mixed sand and gravel beaches	37	171	10
6A	Gravel beaches (granules and pebbles)	1	2	<1
6B	Gravel beaches (cobbles and boulders)	1	8	<1
6C	Rip rap	2	9	<1
7	Exposed tidal flats	114	203	29
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)	23	95	6
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)	6	25	2
8C	Sheltered Rip Rap	29	69	8
8D	Sheltered rocky rubble shores	10	50	2
9A	Sheltered tidal flats	51	129	13
10A	Salt- and brackish-water marshes	103	109	26
Totals:		***394***	***957***	***100***

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

2.3 Oil Residence Index (ORI)

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 sediment shorelines lead to higher ORI values for 90.3% of the shore segments in the Campbell River survey area, indicating oil residence times are on the order of months to years (see Figures 7 and 8 for summary and distribution statistics).

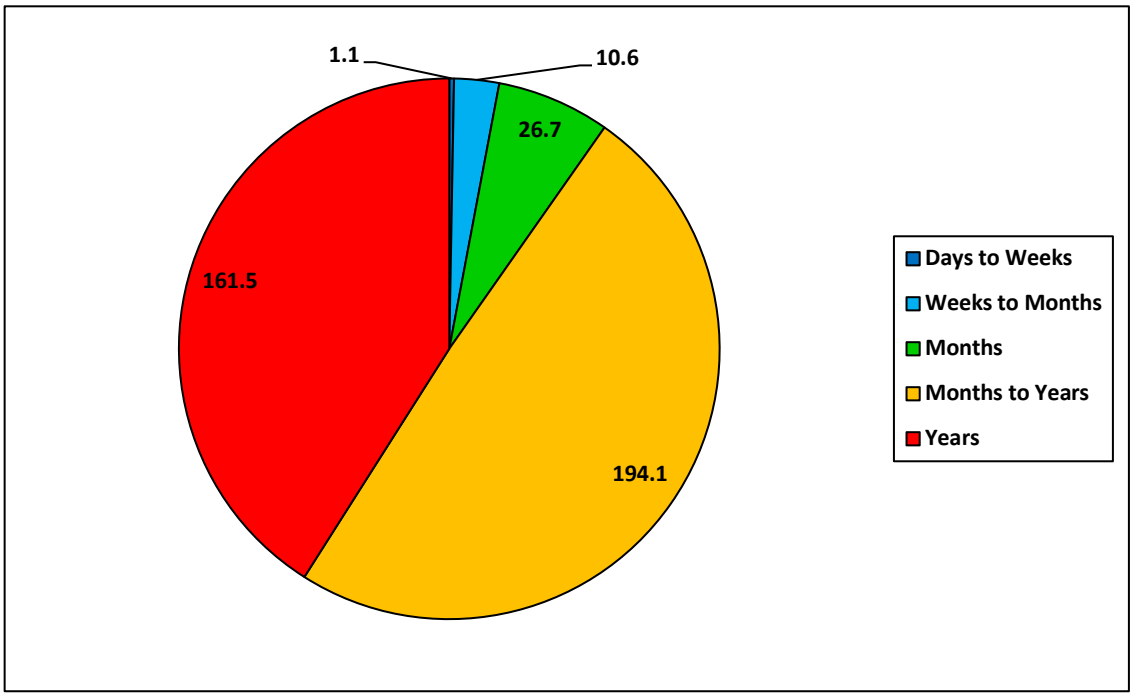

Figure 7. Oil Residence Index (ORI) categories by shoreline length (km).

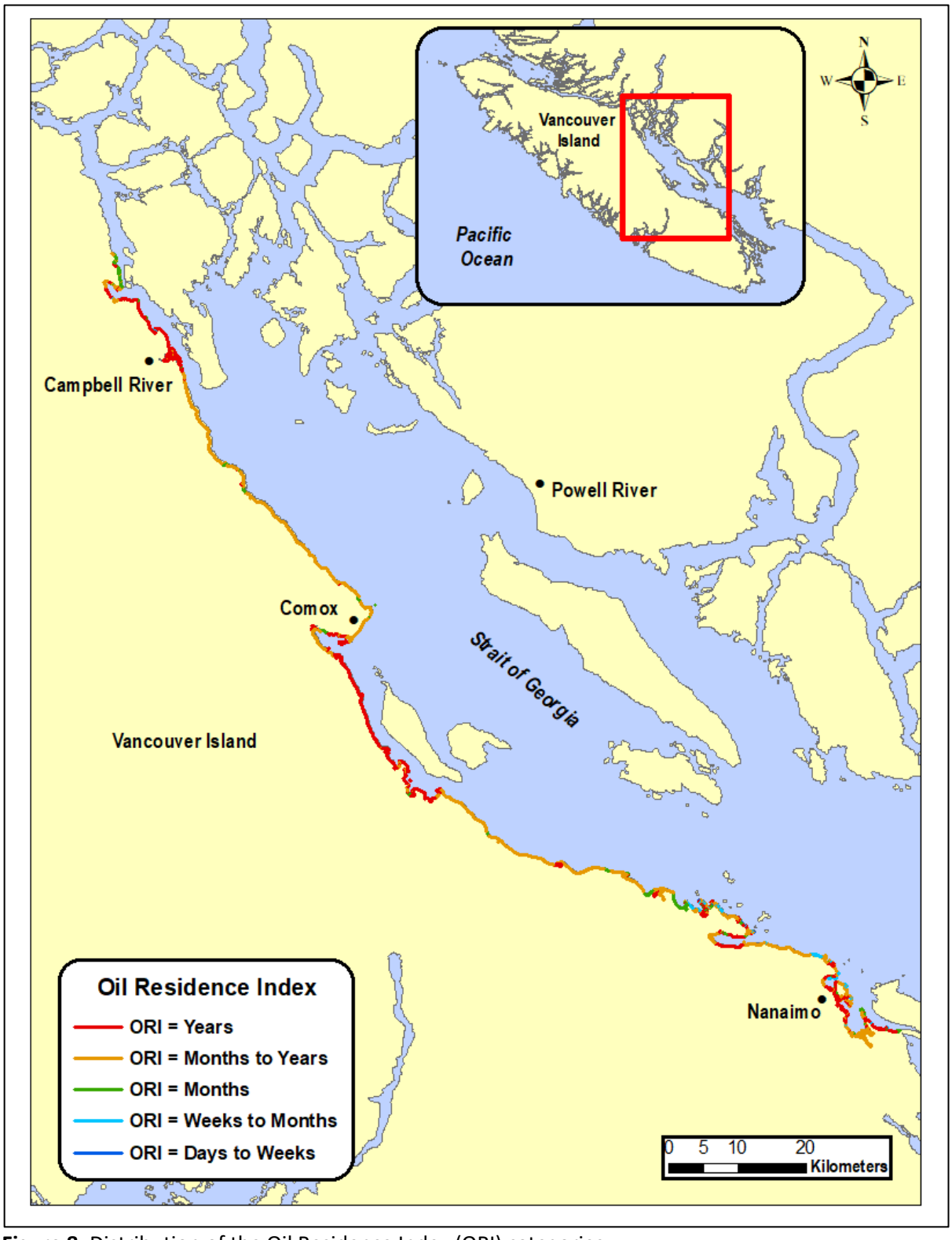

Figure 8. Distribution of the Oil Residence Index (ORI) categories.

2.4 ShoreZone Coastal Vulnerability

2.4.1 Flood Zone Width

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 Campbell River study area, with 64.4% of the shoreline at a low risk of flooding <5m from the Mean High Waterline (MHW) (see Figures 9 and 10 for summary and distribution statistics). The flooding class is a parameter of the Coastal Vulnerability Index (see Page 20).

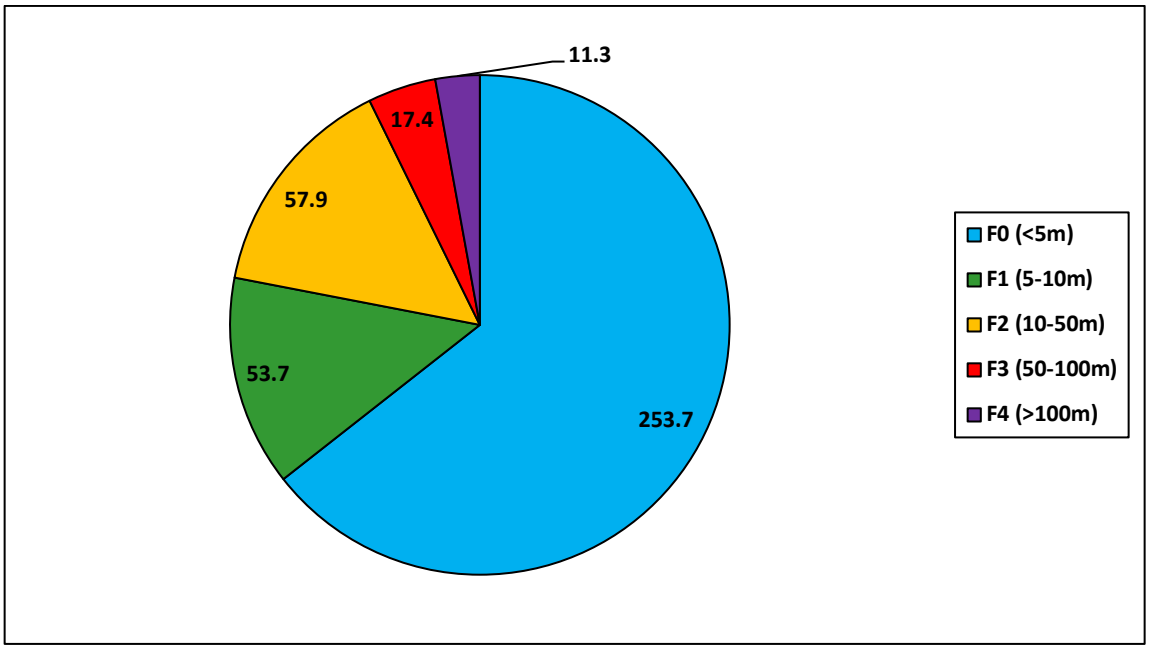

Figure 9. Flooding Class categories by shoreline length (km).

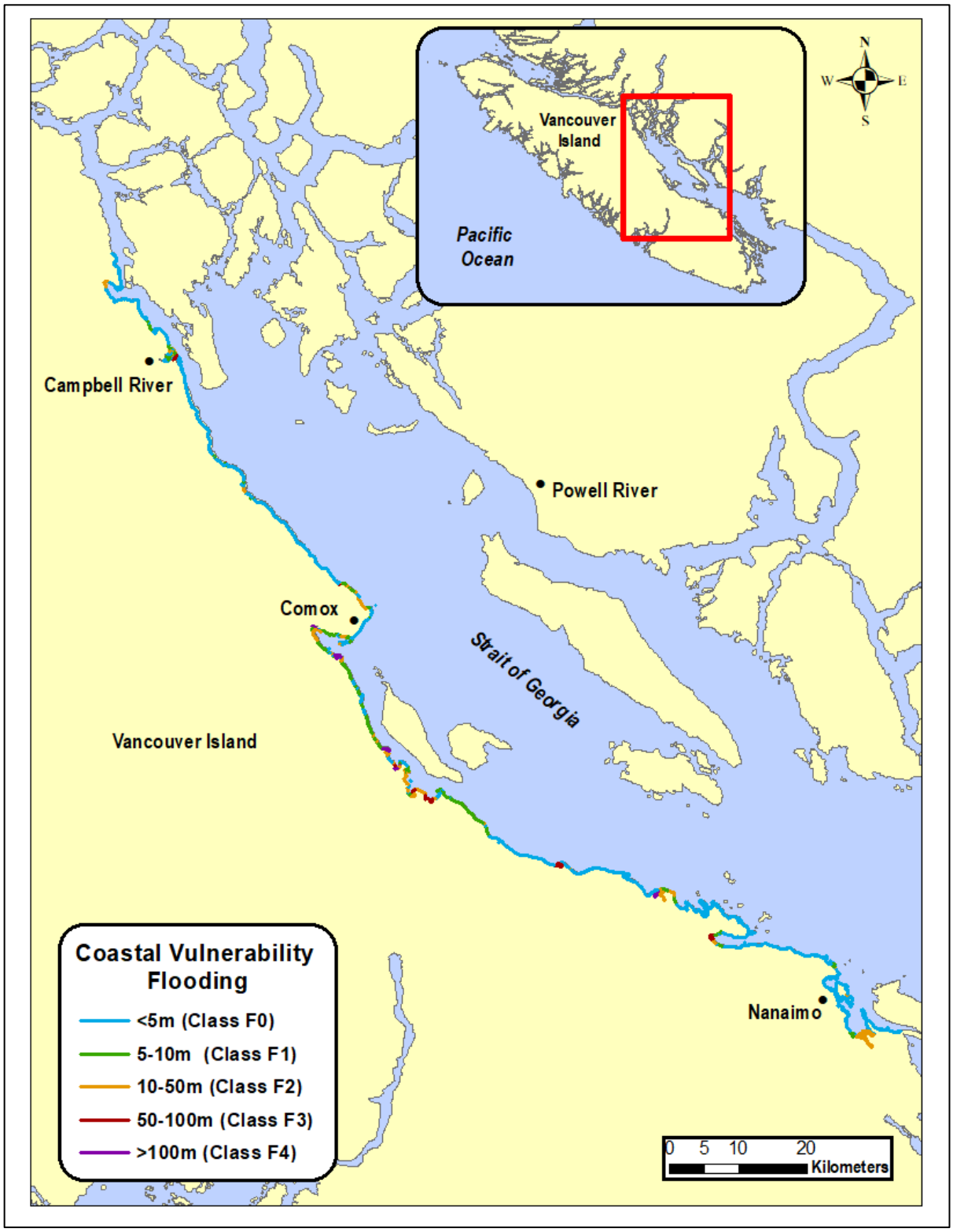

Figure 10. Distribution of the Coastal Vulnerability Flooding Class.

2.4.2 Coastal Vulnerability Observations

The Coastal Vulnerability Observations are features important for estimating the frequency and extent of coastal inundation. In the Campbell River survey area, apart from the 'None' category, the majority of observations were from the Anthropogenic category with 167.1 km. The subsequent category was the Wetland Deltaic complex category with 68.3 km (see Figures 11 and 12 for summary and distribution 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.

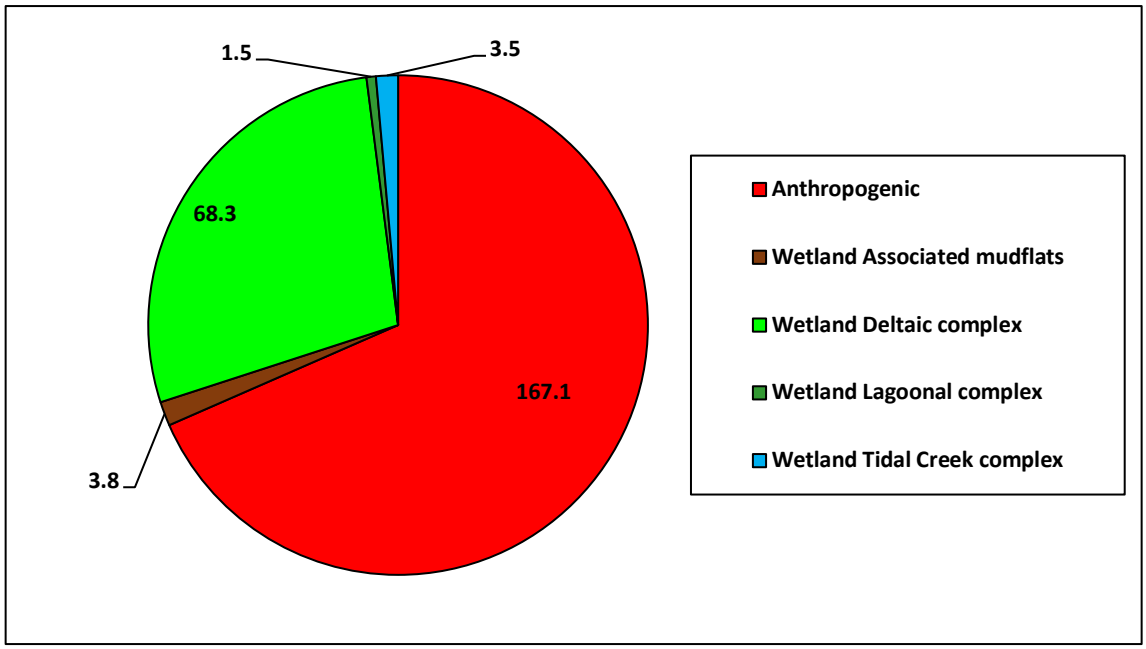

Figure 11. Coastal Vulnerability Observations categories by shoreline length (km). Category 'None' not shown.

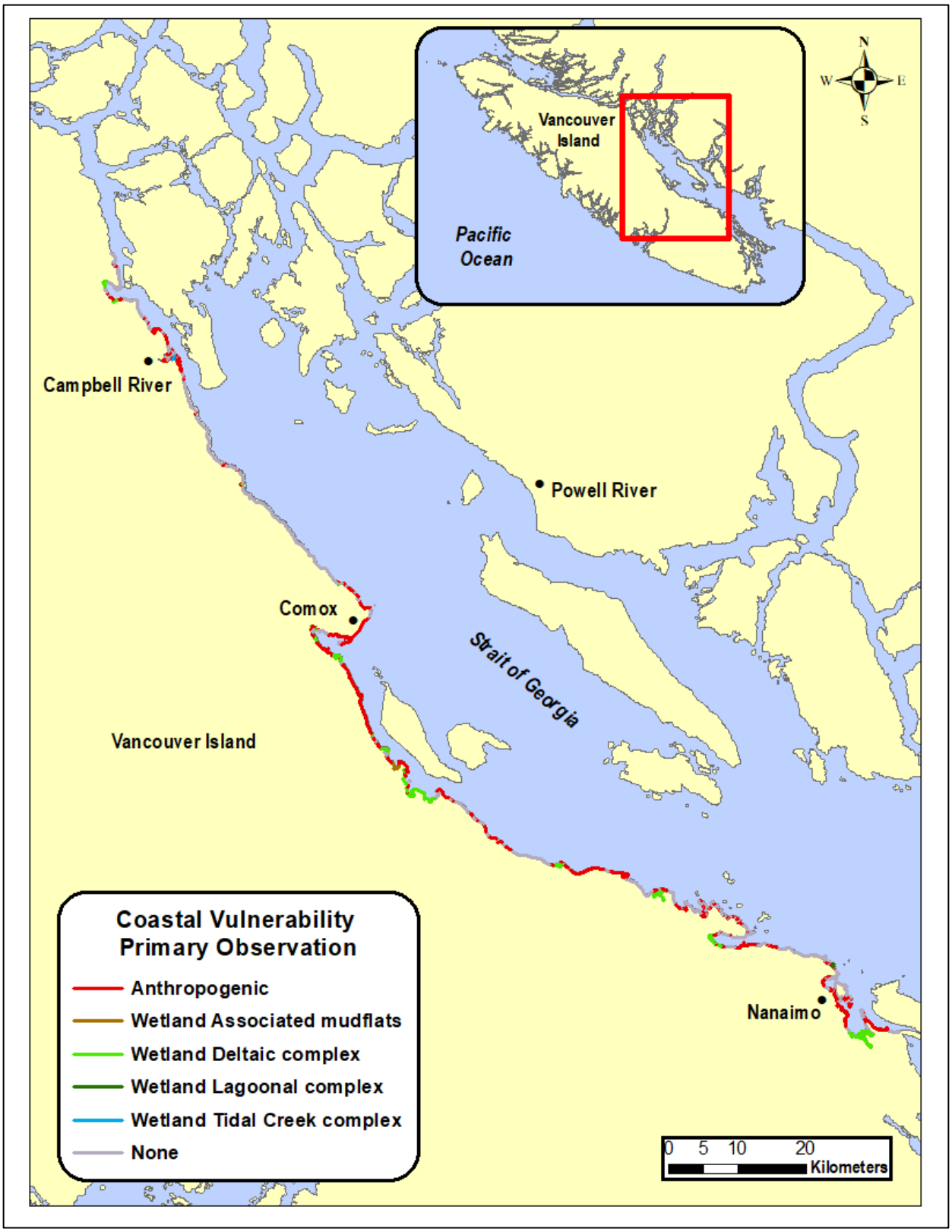

Figure 12. Distribution of the Coastal Vulnerability Observations categories.

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). The distribution of ranks in this survey area is shown in Figure 13. Due to the protected 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 along the coast in the Strait of Georgia. The Coastal Class and Wave Exposure were likely the driving factors behind the rankings in this survey area.

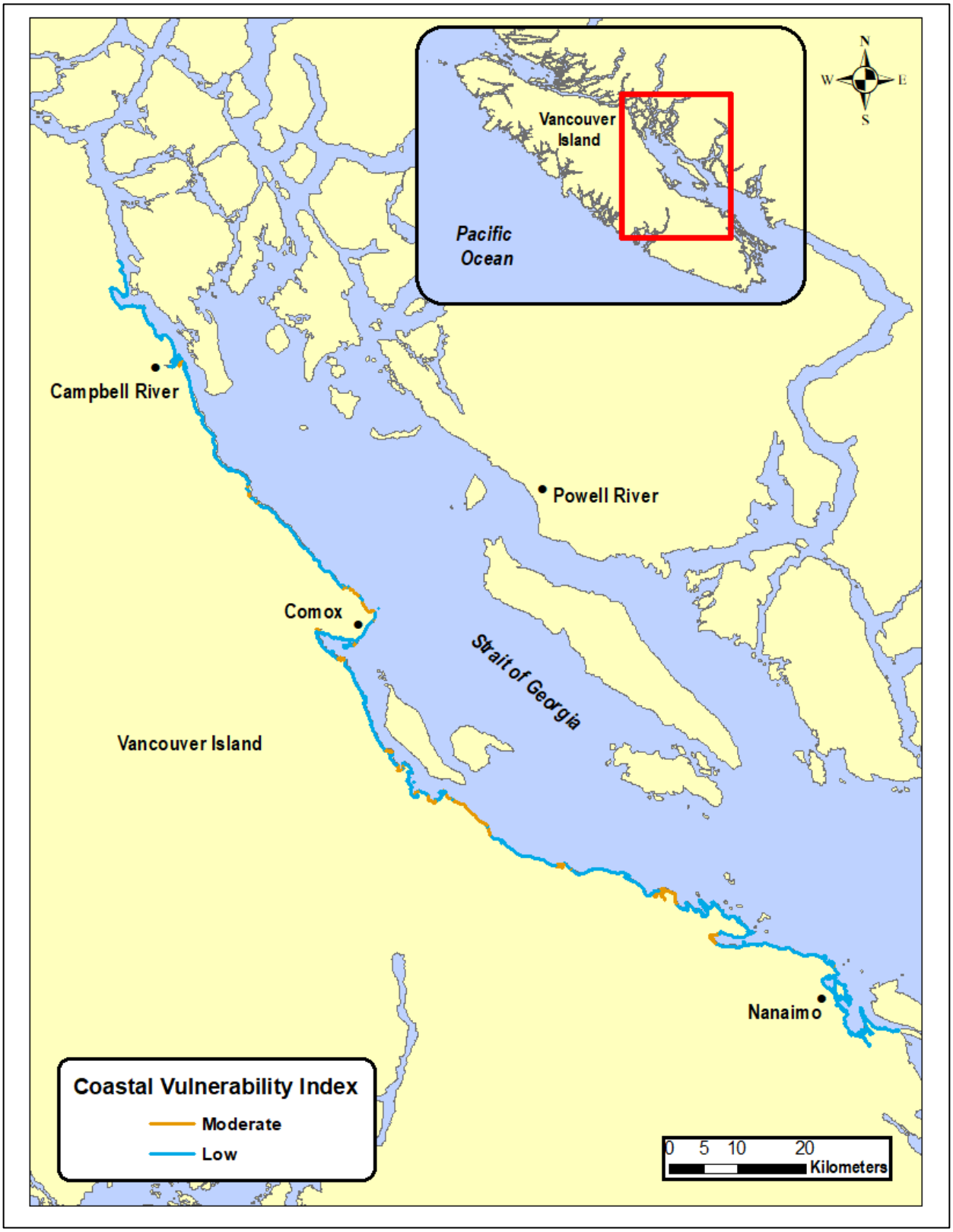

Figure 13. Distribution of Coastal Vulnerability index ranks in the Campbell River survey area.

2.5 Anthropogenic Shore Modifications

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 47.7% of the shoreline (taking the estimated length of that modification within the unit into account) exhibits shore modifications in the Campbell River study area (Figure 14). Rip Rap was the most commonly recorded observation (36.3%) with Landfill (31.4%) and Concrete Bulkhead (12.1%) rounding out the top three shoreline modifications along the coast. The associated map (Figure 15) 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.

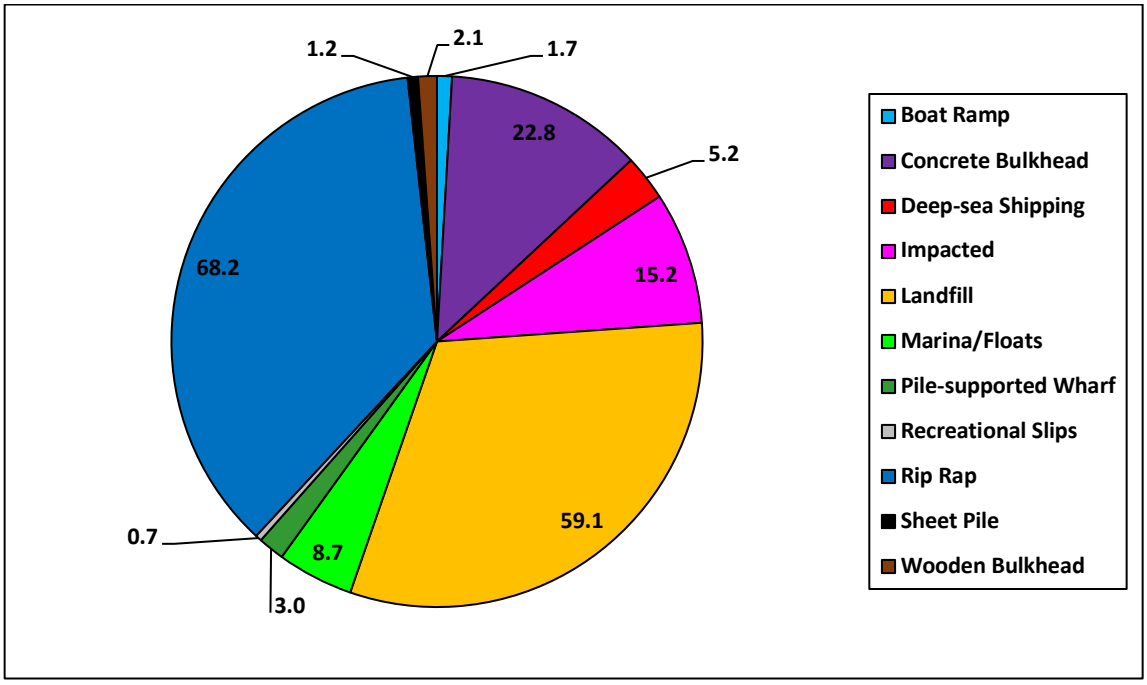

Figure 14. Shore Modifications by estimated shoreline length (km) of each modification type.

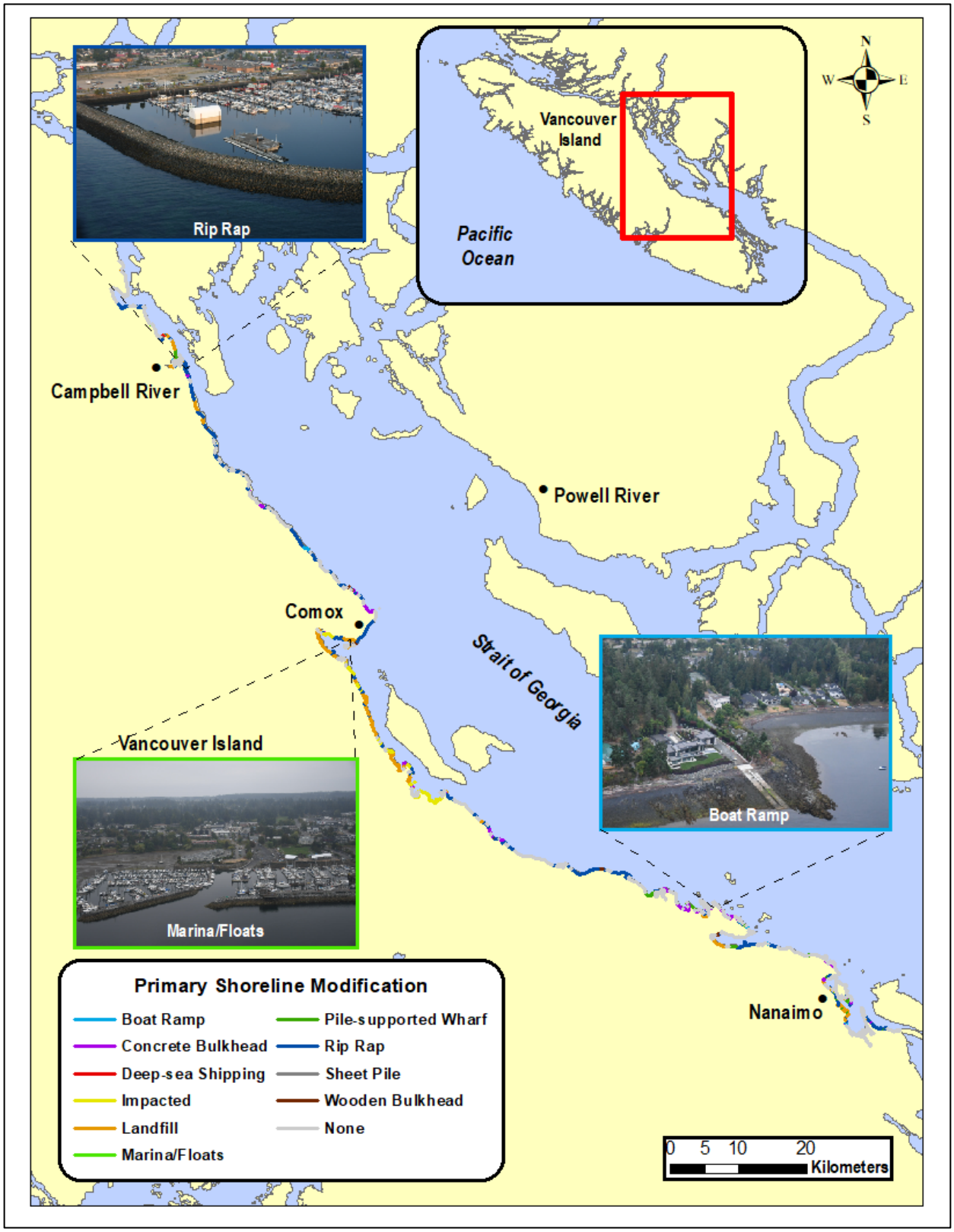

Figure 15. Distribution of types of the primary Shore Modifications.
There may be other shore modifications in any given unit. That data would be found in the Shore Modifications table in the geodatabase.

3.3 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 Campbell River 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 Campbell River survey area are summarized in Tables 3 and 4. The most common supratidal/high intertidal biobands were Salt Marsh, occurring in 53% of the units, and Dune Grass, found in 41% of the units. The supratidal Black Lichen bioband was in 43% of the units. The most commonly occurring intertidal bioband in the survey area was Green Algae in 81% of the units. Rockweed was also very common and was found in 68% of the units. The most common low intertidal/subtidal biobands were Eelgrass (43%), Filamentous and Foliose Red Algae (29%) and Brown Bladed Kelps (24%), although it should be noted that some of the Brown Bladed Kelps may include Sargassum, which would usually be classified as a Brown Non-Bladed Kelp or as the Sargassum bioband. 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 in the Campbell River survey area.

Bioband		Patchy		Continuous		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%		
Trees and Shrubs	TRSH	9	2	0	0	9	2
Terrestrial Vegetation	TEVE	10	3	0	0	10	3
Dune Grass	DUGR	143	36	19	5	162	41
Salt Marsh	SAMB	89	23	120	31	209	53
Grasses	GRAS	10	3	4	1	14	4
Barnacle	BARN	124	31	105	27	228	58
Rockweed	ROCK	182	46	87	22	269	68
Green Algae	GRAL	183	46	138	35	320	81
Oysters	OYST	29	7	9	2	38	10
Blue Mussel	BLMU	21	5	0	0	21	5
Echinoderms	ECHI	3	1	0	0	3	1
Bleached Red Algae	BRAL	0	0	0	0	1	0
Filamentous and Foliose Red Algae	FFRA	81	21	32	8	113	29
Brown Bladed Kelps	BRBA	52	13	42	11	94	24
Sargassum	SARG	1	0	0	0	1	0
Eelgrass	EELG	73	19	98	25	171	43
Bull Kelp	BUKE	10	3	14	3	24	6
Sand Dollars	SAND	0	0	<1	0	<1	0
Anemones	ANEM	<1	0	0	0	<1	0

Table 4. Bioband abundances for splash zone biobands mapped in the Campbell River survey area.

Bioband		Narrow (<1m)		Medium (1-5m)		Wide (>5m)		Not Assessed		Total (km)	% of Total Mapped
Name	Code	(km)	%	(km)	%	(km)	%	(km)	%		
Black Lichen	BLLI	109	28	55	14	1	0	4	0	169	43
Splash Zone	SPZO	15	4	5	1	0	0	0	0	20	5
White Lichen	WHLI	12	3	3	1	0	0	1	0	16	4
Yellow Lichen	YELI	4	1	0	0	0	0	0	0	4	1

Salt Marsh was the most commonly occurring supratidal, non-splash zone bioband found in 53% of units (see Figures 16 for a graph of proportion of the shoreline with that bioband and Figure 17 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. 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).

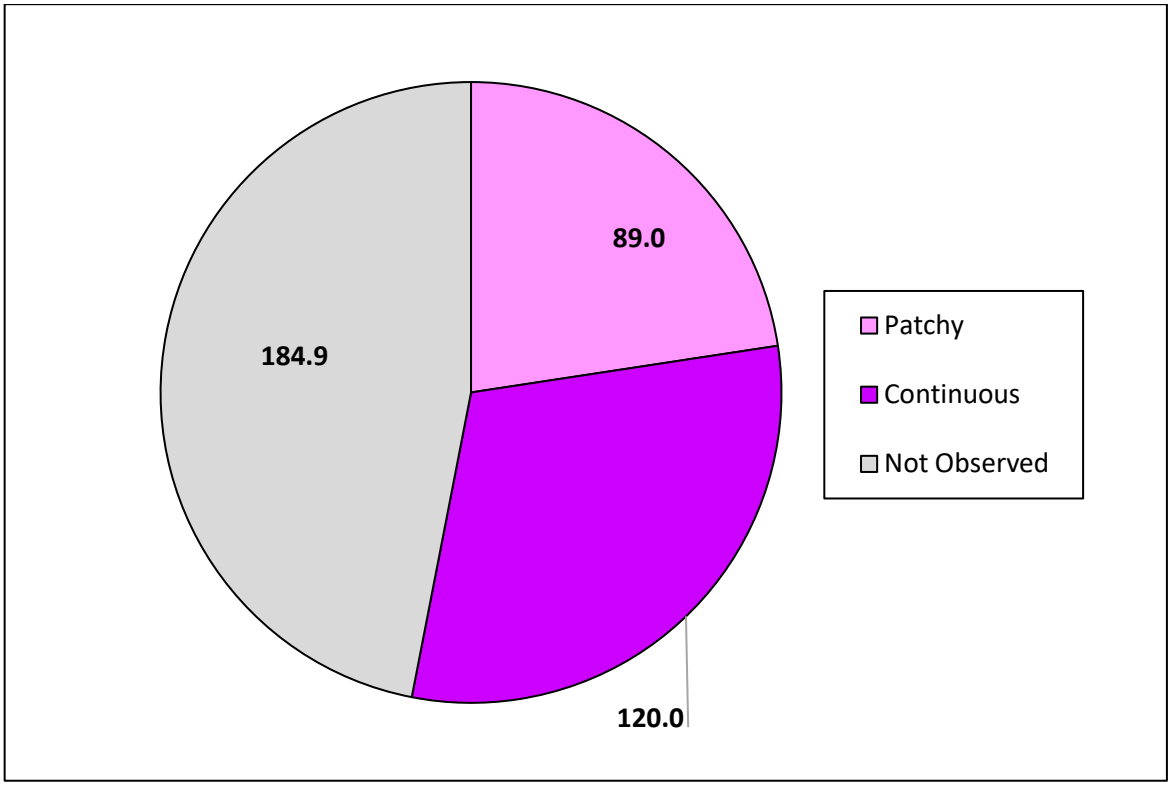

Figure 16. Distribution of the Salt Marsh (SAMB) bioband by shoreline length (km).

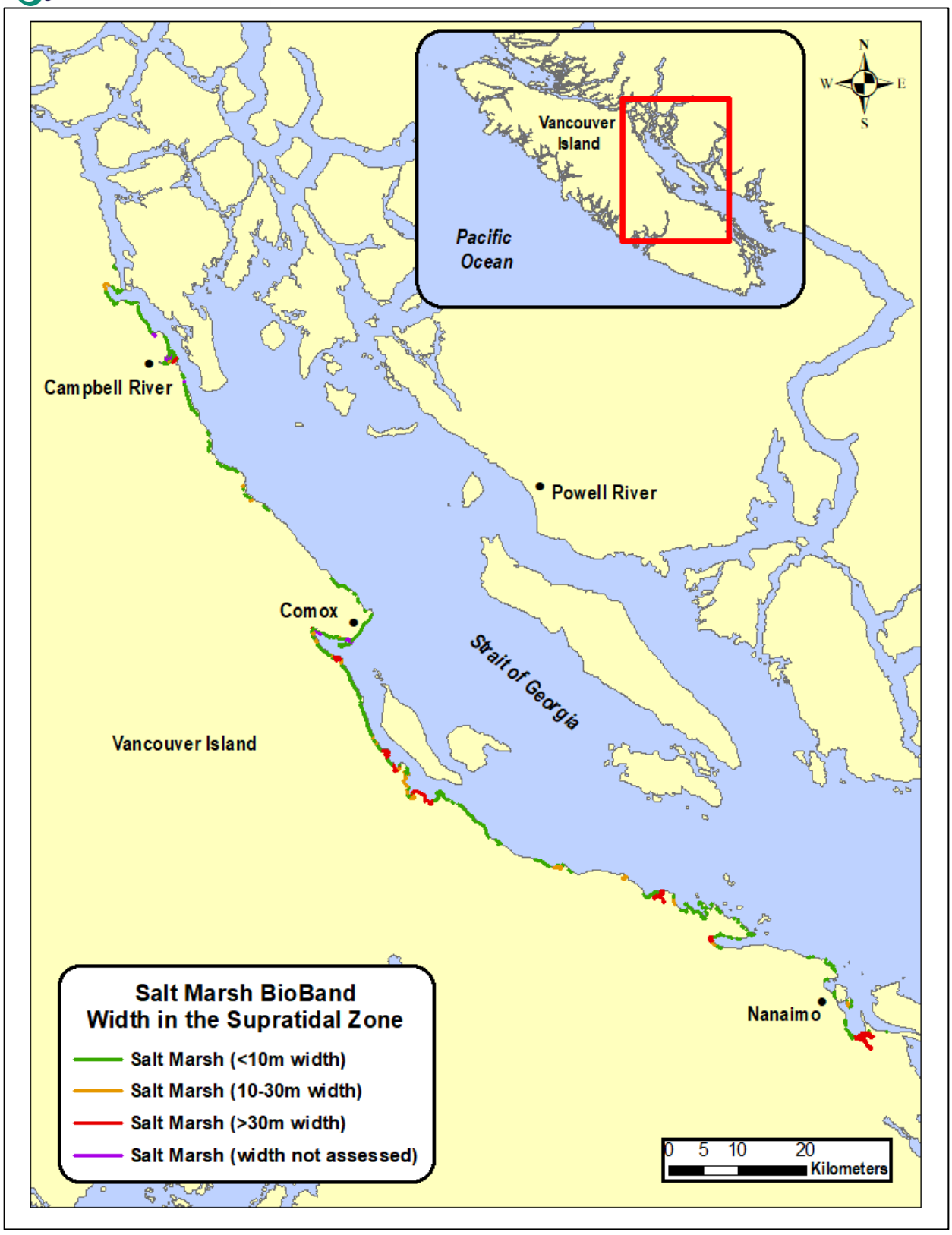

Figure 17. Distribution of the Salt Marsh (SAMB) bioband in the Campbell River survey area.

The Oyster bioband tends to be unusual in BC and is generally only seen where concentrations of the introduced Pacific Oyster (*Magallana gigas*) are 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 around the Campbell River survey area, with a concentration of observations around Fanny Bay, Nanoose Bay, and Nanaimo where there are licensed shellfish aquaculture facilities (DFO Aquaculture and Management Division, 2023). Figure 18 shows a graph of the proportion of the shoreline with the Oyster biobands, and a map of the distribution of the Oyster bioband is in Figure 19.

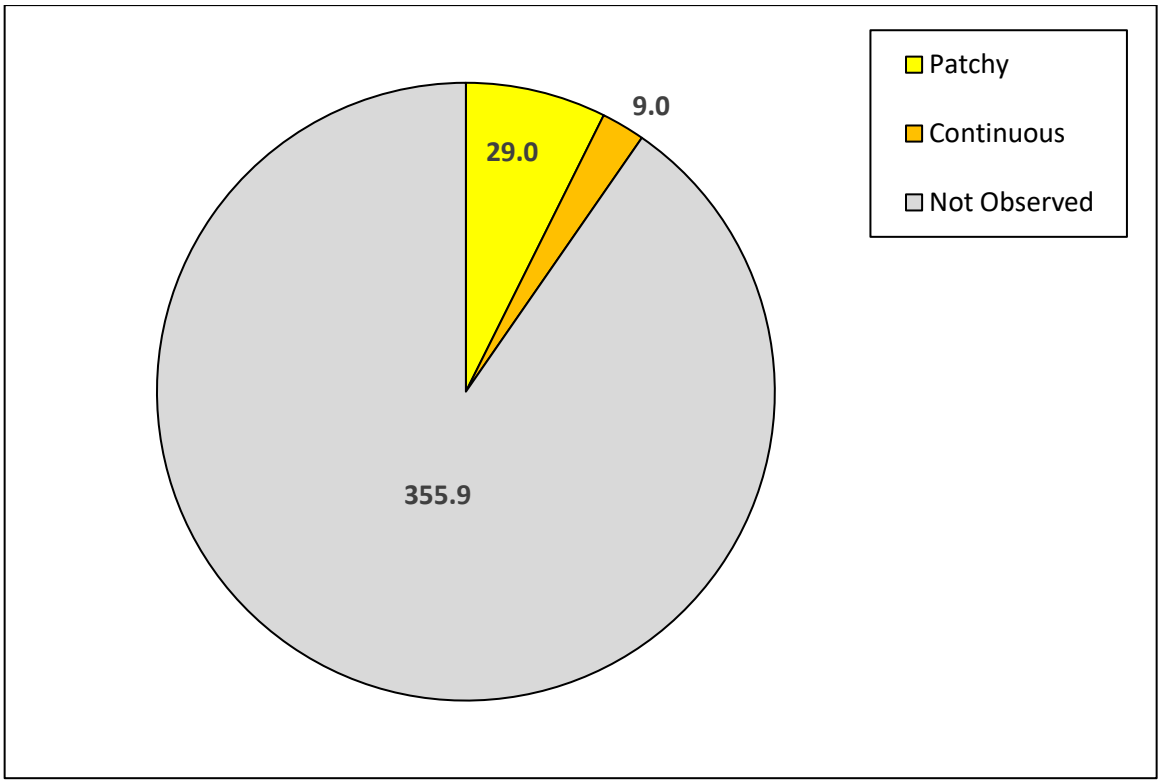

Figure 18. Proportion of shoreline length (km) of the intertidal Oyster (OYST) bioband by category.

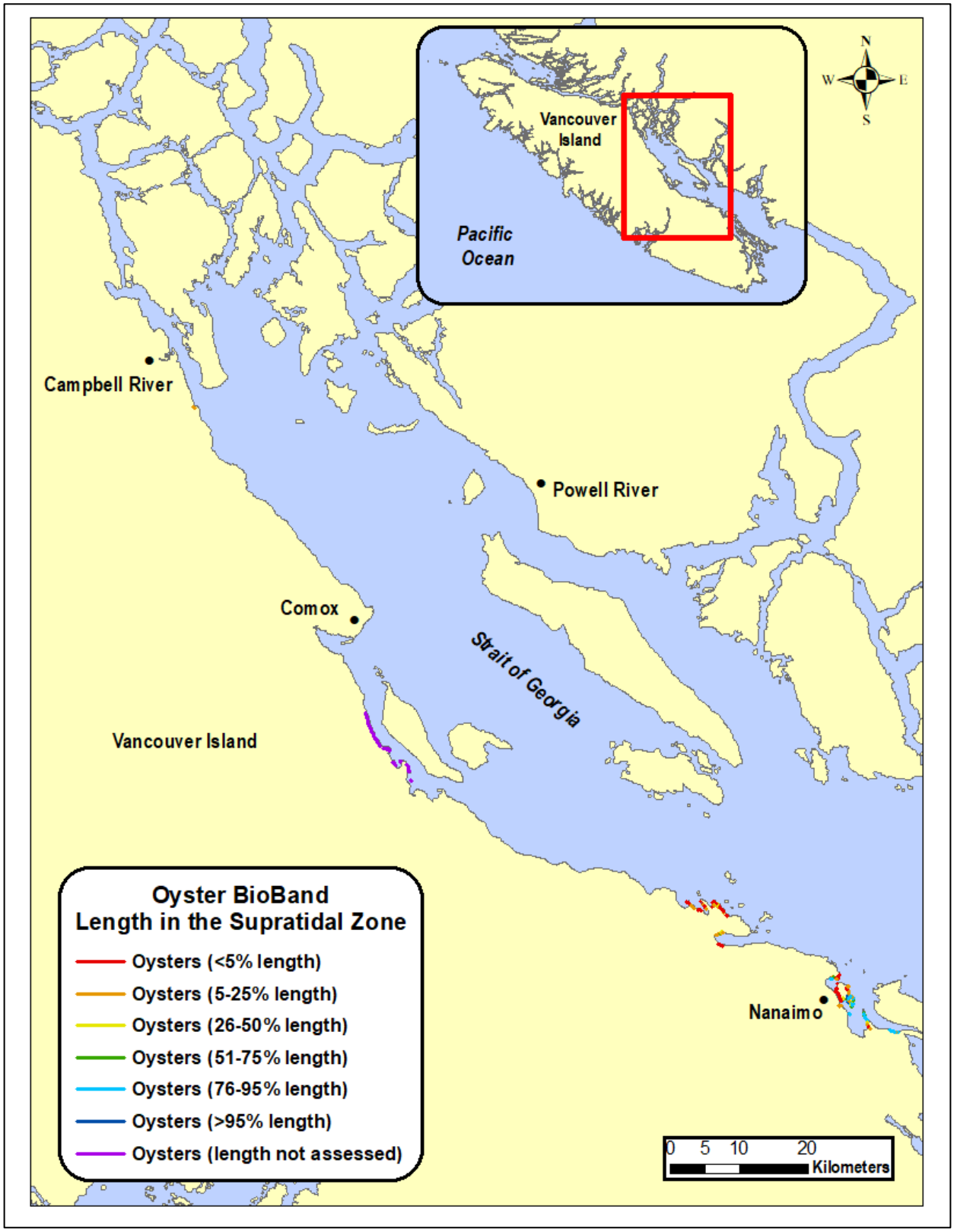

Figure 19. Distribution of the Oyster bioband in the Campbell River survey area.

Seagrasses are an important component of coastal ecosystems with Eelgrass beds forming in sandy substrates at Semi-Protected and lower exposures. In the Campbell River survey area, only Eelgrass was observed. Eelgrass beds are nursery habitats for juvenile fish and sequester and store atmospheric carbon (called 'Blue Carbon') in addition to other valuable ecosystem services. See Figure 20 for statistics on the distribution of the Eelgrass bioband and a distribution map of the bioband in Figure 21.

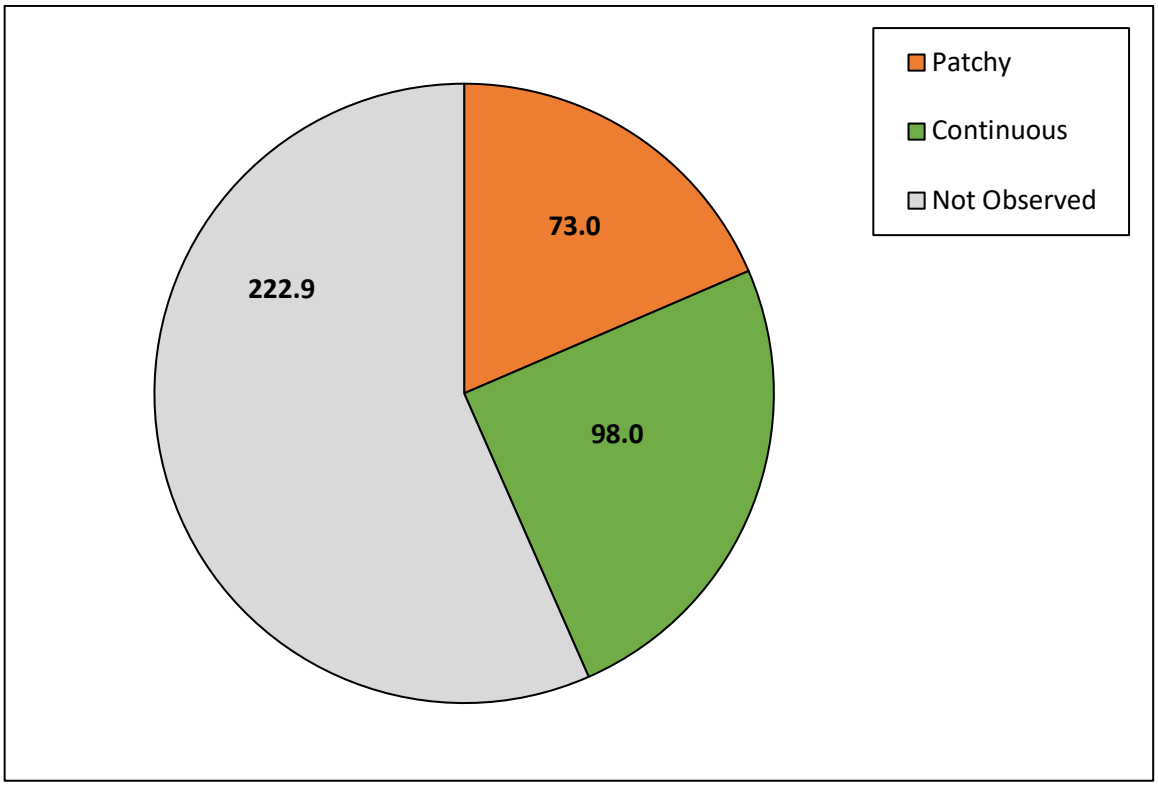

Figure 20. Distribution of the intertidal/subtidal Eelgrass (EELG) bioband by Shoreline length (km).

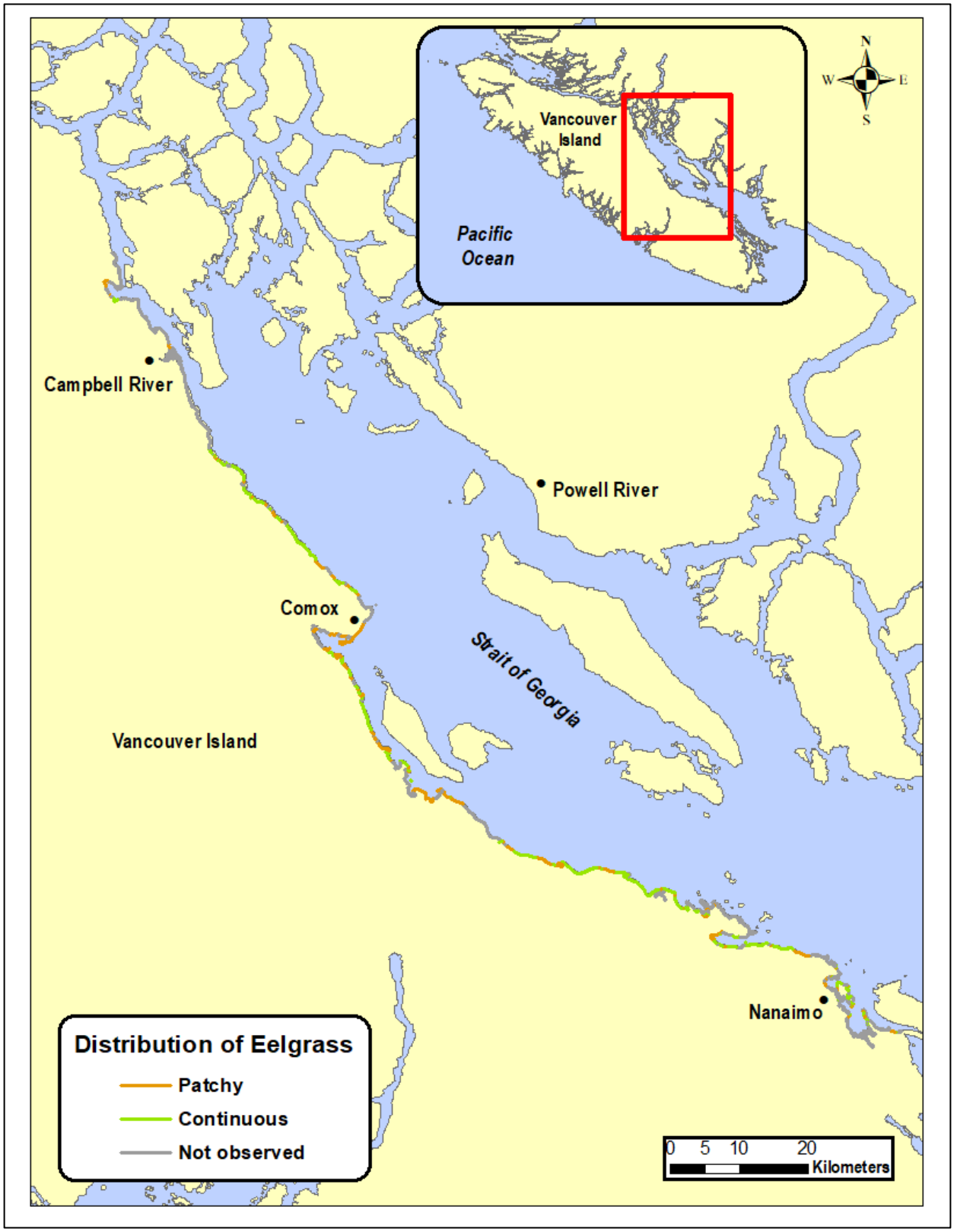

Figure 21. Distribution of the Eelgrass (EELG) bioband in the Campbell River survey area.

3.2 Biological Wave Exposure

Biological wave exposure categories range from Very Protected (VP) to Very Exposed (VE) and are usually defined in ShoreZone based on 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 in Campbell River are summarized in Figure 22 and a distribution map of the categories is shown in Figure 23. The coastline throughout the Campbell River survey area is a more Protected (52.4%) and Semi-Protected (42.6%) area with just 3.8% being Very Protected and 1.3% being Semi-Exposed.

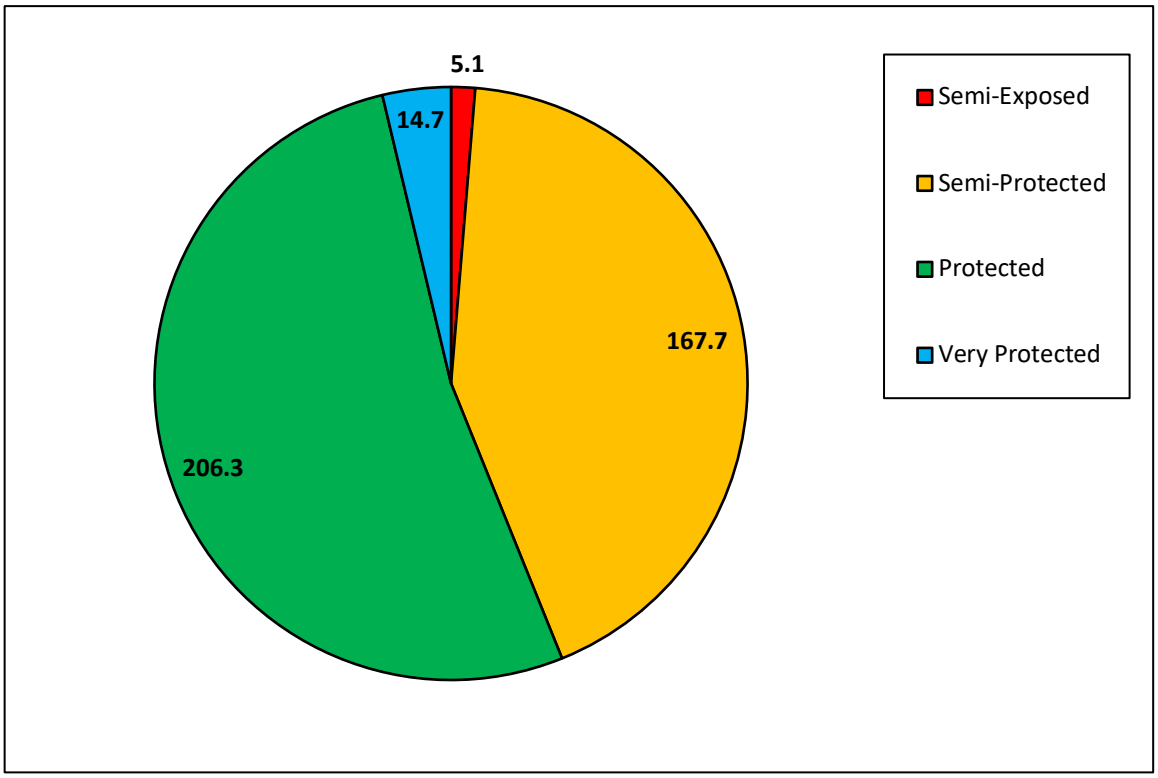

Figure 22. Distribution of Biological Wave Exposures mapped in the Campbell River survey are by shoreline length (km).

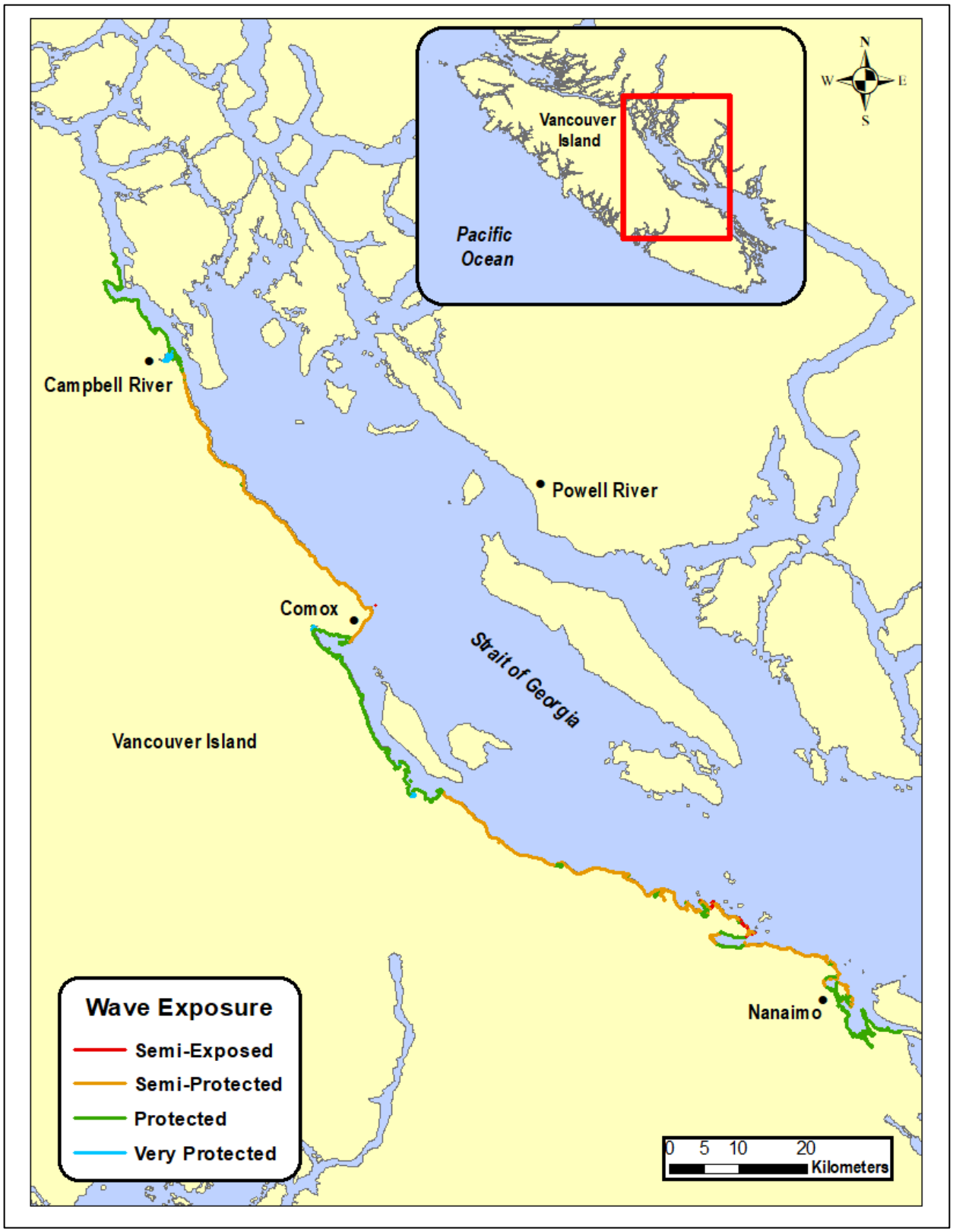

Figure 23. Distribution of the Biological Wave Exposure in the Campbell River survey area.

3.4 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 in the Campbell River survey area are summarized in Figure 24 and a distribution map of the categories is shown in Figure 25. Partially mobile substrate is the dominant shoreline type (63.5%). The Estuary classification is the second most dominant, making up 12.7% 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. The Anthropogenic classification occurred in 9.4% of units with much of that occurring near the communities of Campbell River, Comox, and Nanaimo.

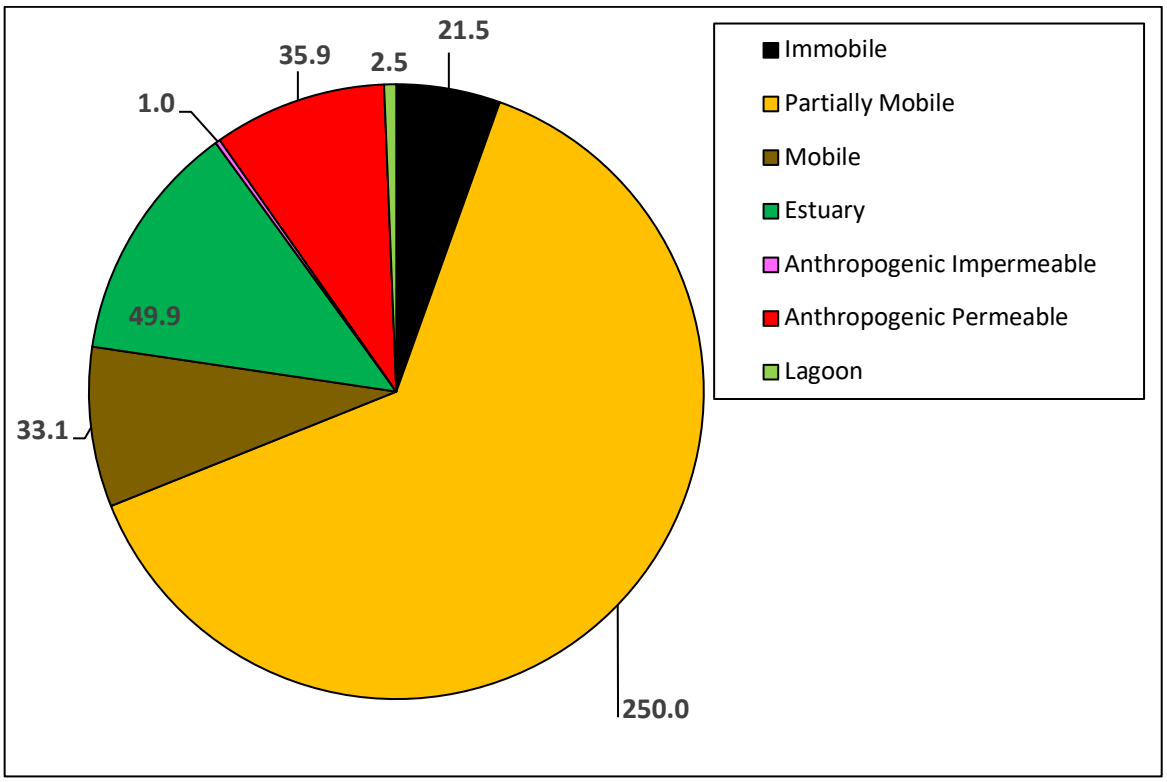

Figure 24. Distribution of Habitat Class categories in the Campbell River survey area by shoreline length (km).

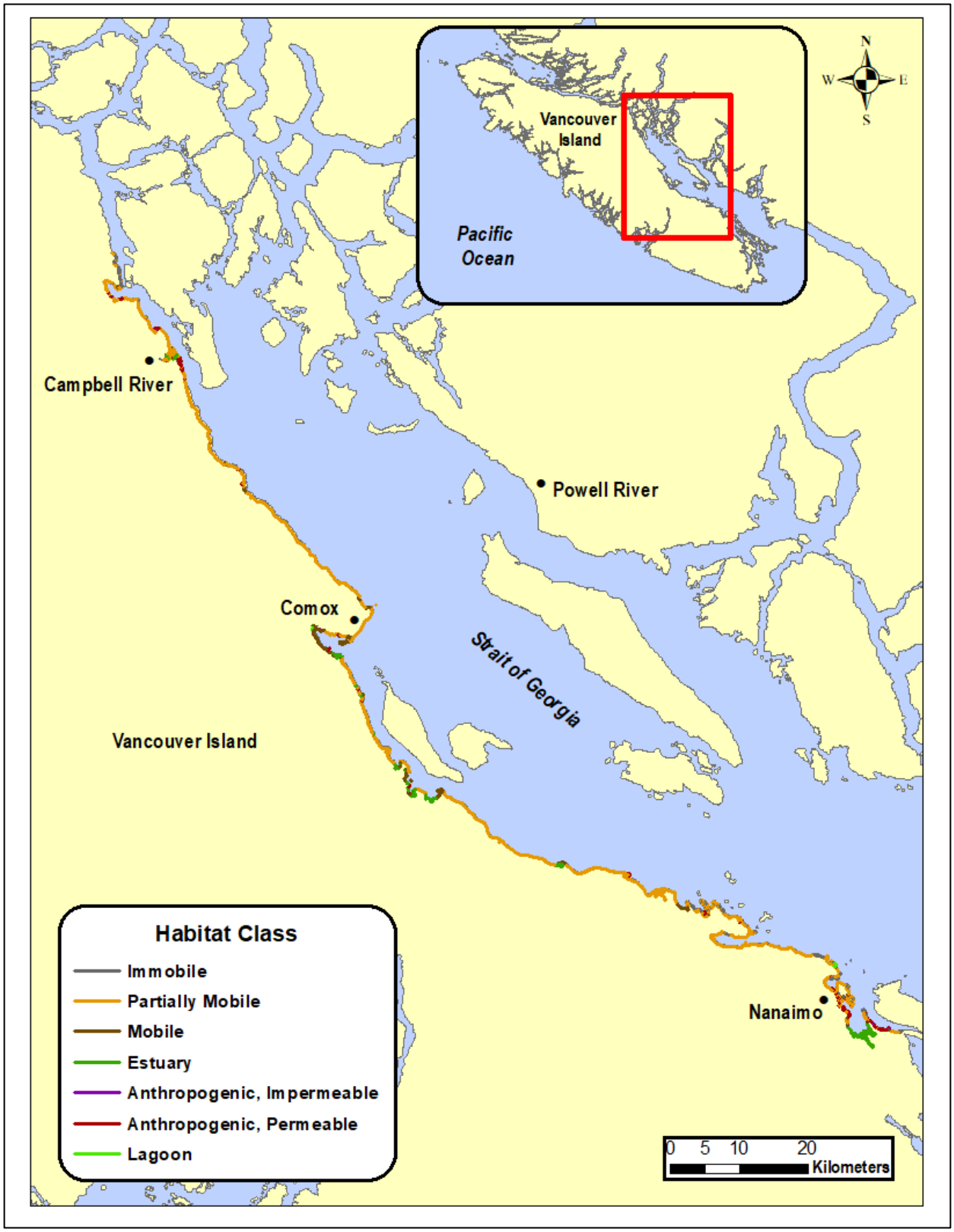

Figure 25. Distribution of Habitat Class categories in the Campbell River survey area.

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.

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

DFO Aquaculture Management Division. 2023. Shellfish Aquaculture in British Columbia. Fisheries and Oceans Canada. Accessed at Aquaculture maps | Pacific Region (dfo-mpo.gc.ca) on March 13, 2024.

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.

5 Acknowledgments

We would like to acknowledge the Comox Valley Project Watershed Society for funding the ShoreZone imaging and mapping represented in this summary report. 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. Imagery, reports, geodatabases and shapefiles for the ShoreZone dataset can be downloaded online at www.ShoreZone.org or through the links on that site.

Any hardcopies or published data sets utilizing ShoreZone products should clearly indicate their source. For questions regarding the protocols or information in this report, please contact SeaChange Marine Conservation Society at connect@seachangesociety.com.

Appendix A

Photographic Examples of Coastal Classes and Biobands

Table A-1. Examples of the Coastal Classes in the Campbell River survey area.

Photo bc23_cr_04575: Example of Coastal Class 2; Rock Platform, wide.
Brandon Islands.

Photo bc23_cr_04849: Example of Coastal Class 3; Rock Cliff.
Keel Cove.

Photo bc23_cr_04563: Example of Coastal Class 4; Rock Ramp.
Jesse Island.

Photo bc23_cr_00531: Example of Coastal Class 8; Cliff with gravel beach.
Menzies Bay.

Photo bc23_cr_04849: Example of Coastal Class 9; Ramp with gravel beach.
Strait of Georgia.

Photo bc23_cr_4627: Example of Coastal Class 11; Ramp with gravel & sand beach, wide.
Neck Point.

Photo bc23_cr_04424: Example of Coastal Class 12; Platform with gravel & sand beach, wide.
Protection Island.

Photo bc23_cr_04483: Example of Coastal Class 13; Cliff with gravel & sand beach.
Newcastle Island.

Photo bc23_cr_04279: Example of Coastal Class 14; Ramp with gravel & sand beach. Northumberland Channel.

Photo bc23_cr_00575: Example of Coastal Class 22; Gravel beach, narrow. Seymour Narrows.

Photo bc23_cr_05660: Example of Coastal Class 24; Sand & gravel flat or fan.
Baynes Sound.

Photo bc23_cr_00132: Example of Coastal Class 25; Sand & gravel beach, narrow.
Campbell River.

Photo bc23_cr_00235: Example of Coastal Class 28; Sand flat.
Baikie Slough, Campbell River.

Photo bc23_cr_05111: Example of Coastal Class 31; Organics/Fines.
Englishman River.

Photo bc23_cr_00096: Example of Coastal Class 32; Permeable man-made structures. Campbell River.

Table A-2. Examples of the Biobands in the Campbell River survey area.

Photo bc23_cr_05110: Good example of Trees and Shrubs (TRSH) bioband in the supratidal zone.
Englishman River.

Photo bc23_cr_06019: Example of Terrestrial Vegetation (TEVE) bioband in the supratidal zone. Saratoga Beach.

Photo bc23_cr_05835: Good example of the Splash Zone (SPZO) bioband which is an erosional or active A Zone without attached vegetation.
Kye Bay.

Photo bc23_cr_04841: Good example of White Lichen (WHLI) bioband in the supratidal zone, above the Black Lichen band.
North of Wallis Point.

Photo bc23_cr_4626: Good example of the Yellow Lichen (YELI) bioband which is a yellow-orange band in the supratidal zone.
Neck Point.

Photo bc23_cr_04912: Good example of the Black Lichen (BLLI) bioband which is a black band in the supratidal zone, usually caused by the lichen *Verrucaria* sp.
Dorcas Point.

Photo bc23_cr_05227: Good example of Grasses (GRAS) bioband in the supratidal zone.
Qualicum Beach.

Photo bc23_cr_05384: Good example of blue-green Dune Grass (DUGR) bioband in the supratidal zone.
Deep Bay.

Photo bc23_cr_04354: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone.
South of Jack Point.

Photo bc23_cr_04328: Good example of the Barnacle (BARN) bioband in the intertidal zone.
Jack Point.

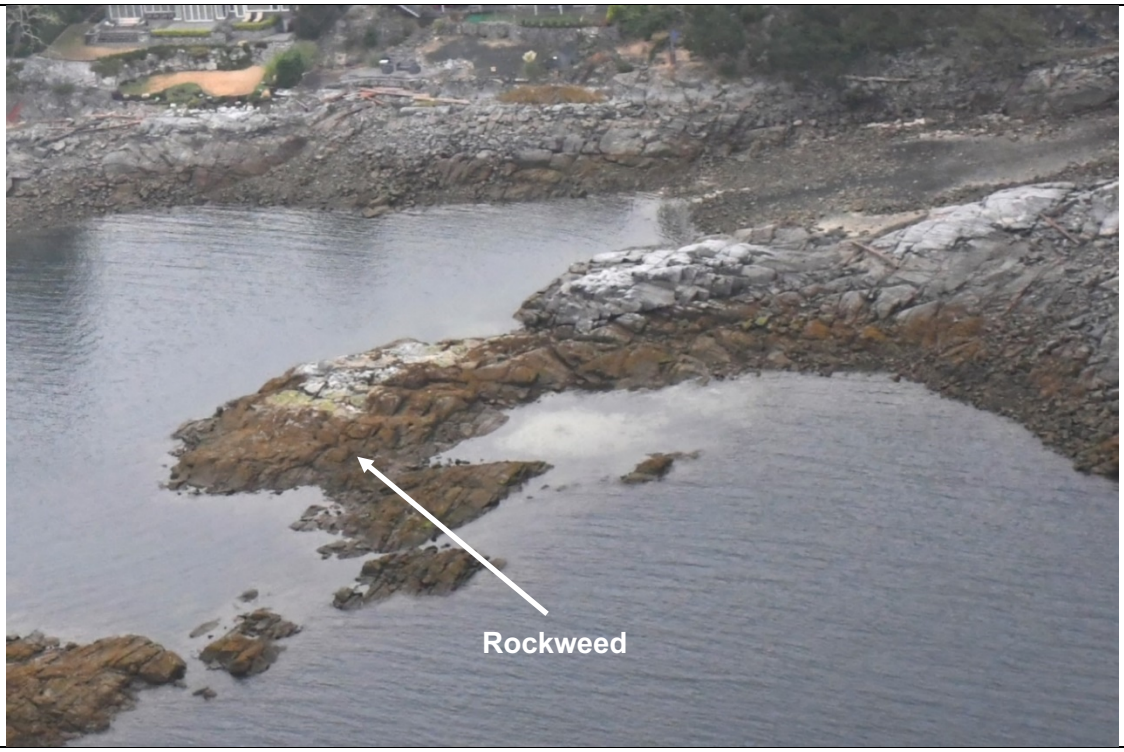

Photo bc23_cr_04840: Good example of the golden-brown Rockweed (ROCK) bioband. Wallis Point.

Photo bc23_cr_04273: Good example of the white spots of the Oyster (OYST) bioband. Northumberland Channel.

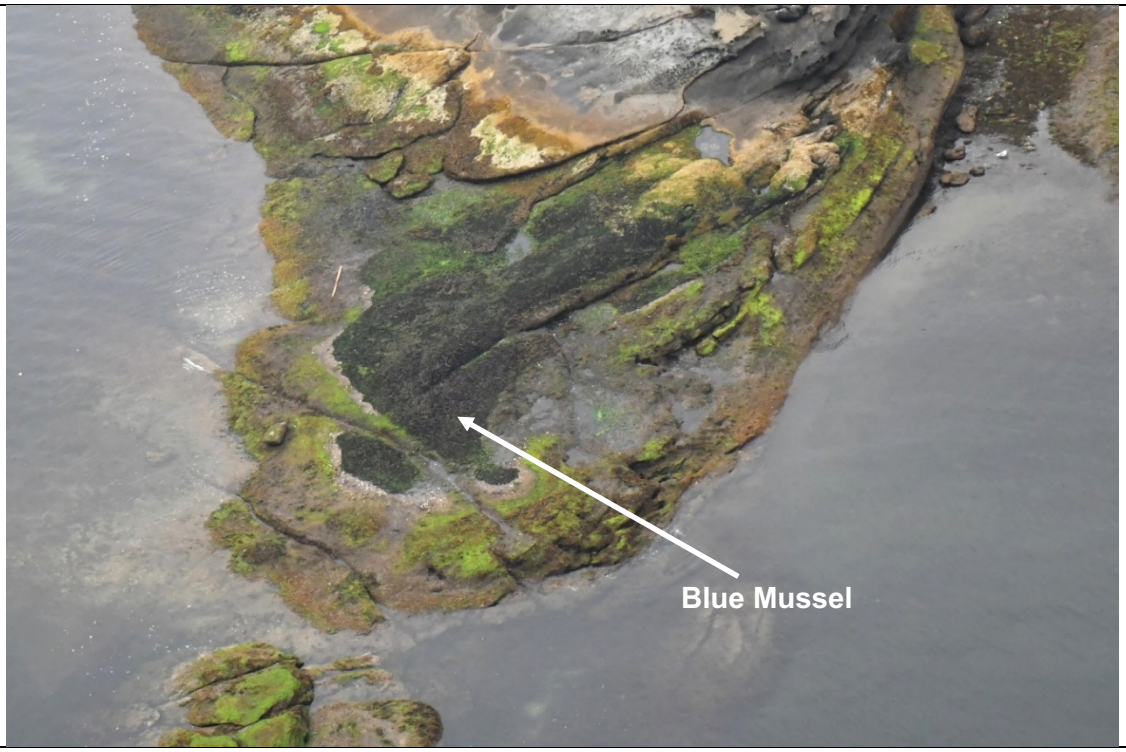

Photo bc23_cr_04563: Good example of the black Blue Mussel (BLMU) bioband in the mid-intertidal.
Jesse Island.

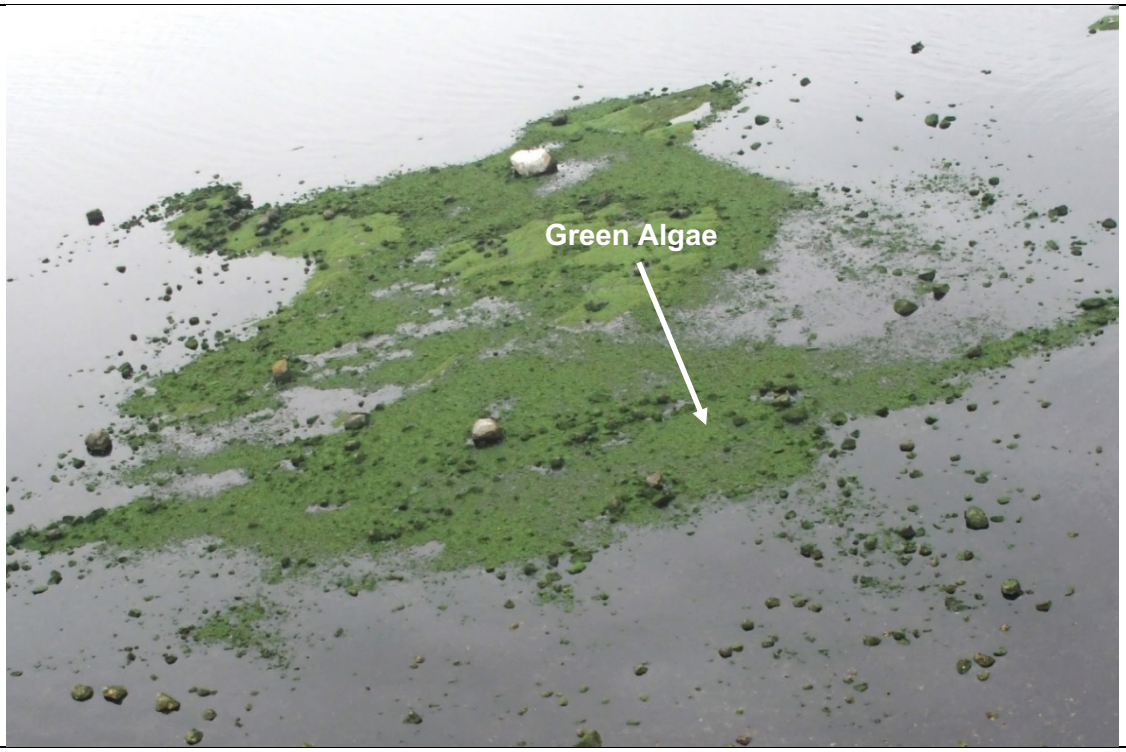

Photo bc23_cr_05830: Good example of the Green Algae (GRAL) bioband in the lower intertidal.
Near Kye Bay.

Photo bc23_cr_00376: Good example of the Echinoderm (ECHI) bioband in this study area.
North Campbell River.

Photo bc23_cr_04930: Good example of the golden Bleached Red Algae (BRAL) bioband in the lower intertidal.
Nuttal Bay.

Photo bc23_cr_04910: Good example of the Filamentous and Foliose Red Algae (FFRA) bioband in the lower intertidal.
Dorcas Point.

Photo bc23_cr_04325: Good example of the Brown Bladed Algae (BRBA) bioband in the lower intertidal.
Jack Point.

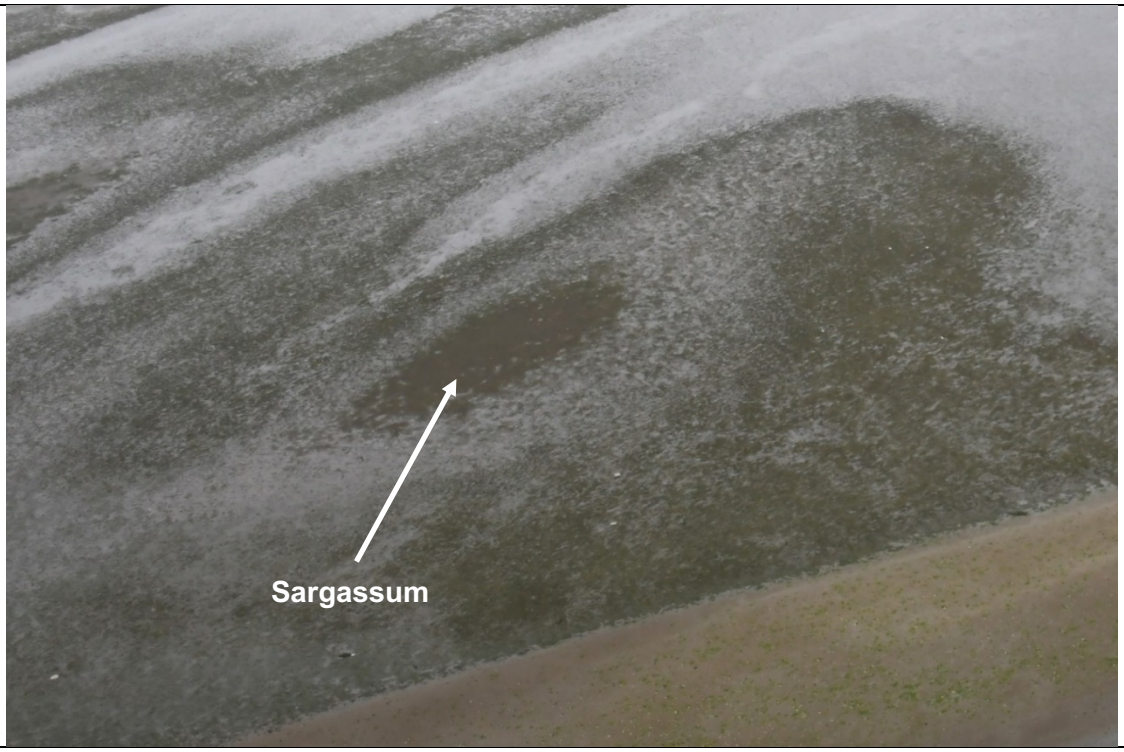

Photo bc23_cr_05755: Example of the Sargassum (SARG) bioband in the lower intertidal.
Goose Spit.

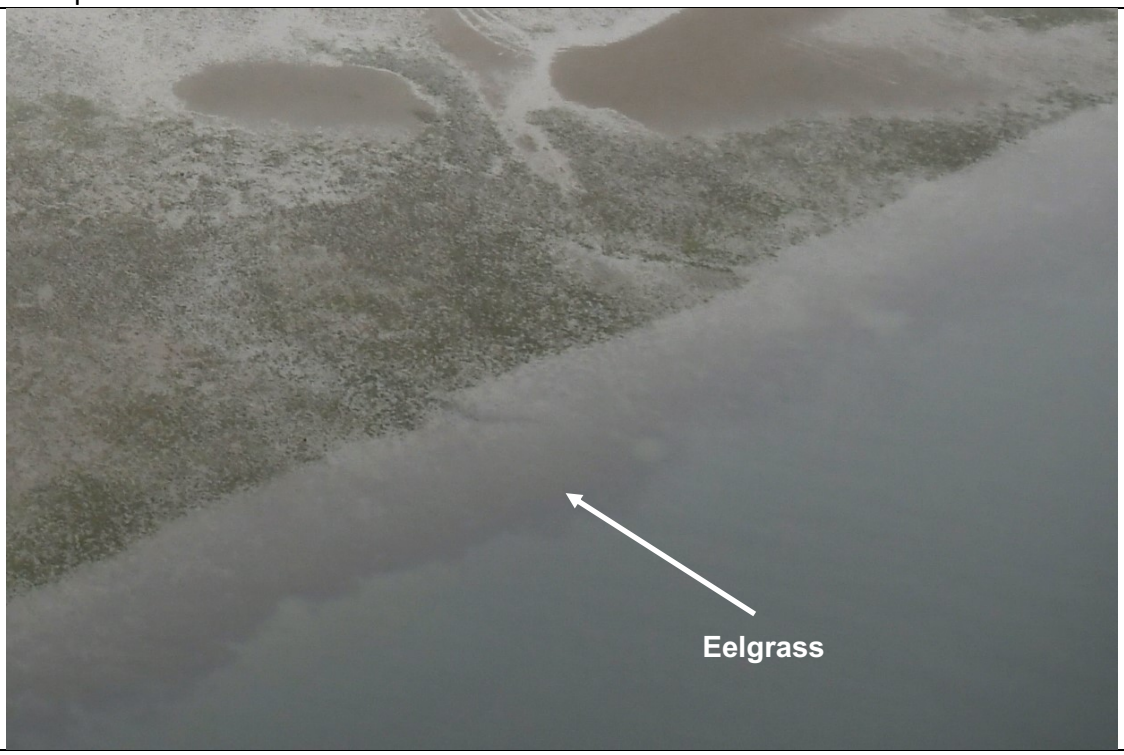

Photo bc23_cr_05694: Good example of the Eelgrass (EELG) bioband in the lower intertidal/subtidal.
East of Gartley Point.

Photo bc23_cr_04458: Good example of the Sand Dollars (SAND) bioband.
Between Newcastle Island and Protection Island.

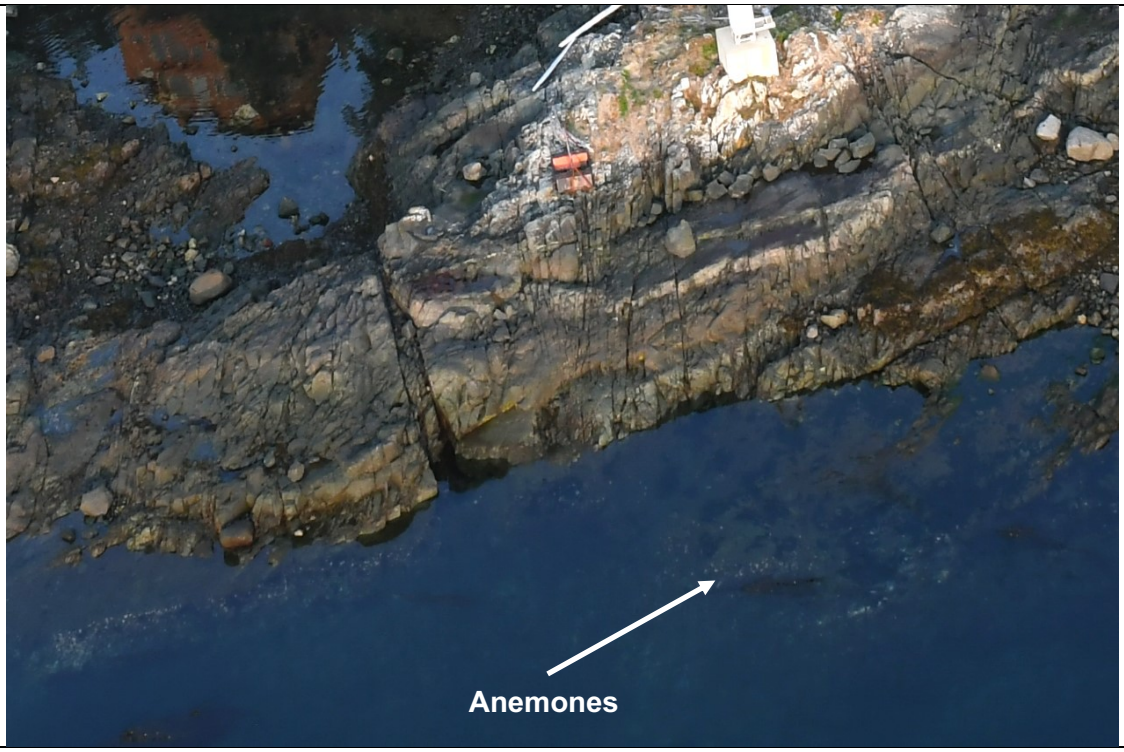

Photo bc23_cr_00610: Example of the Anemones (ANEM) bioband in the subtidal.
Discovery Passage.

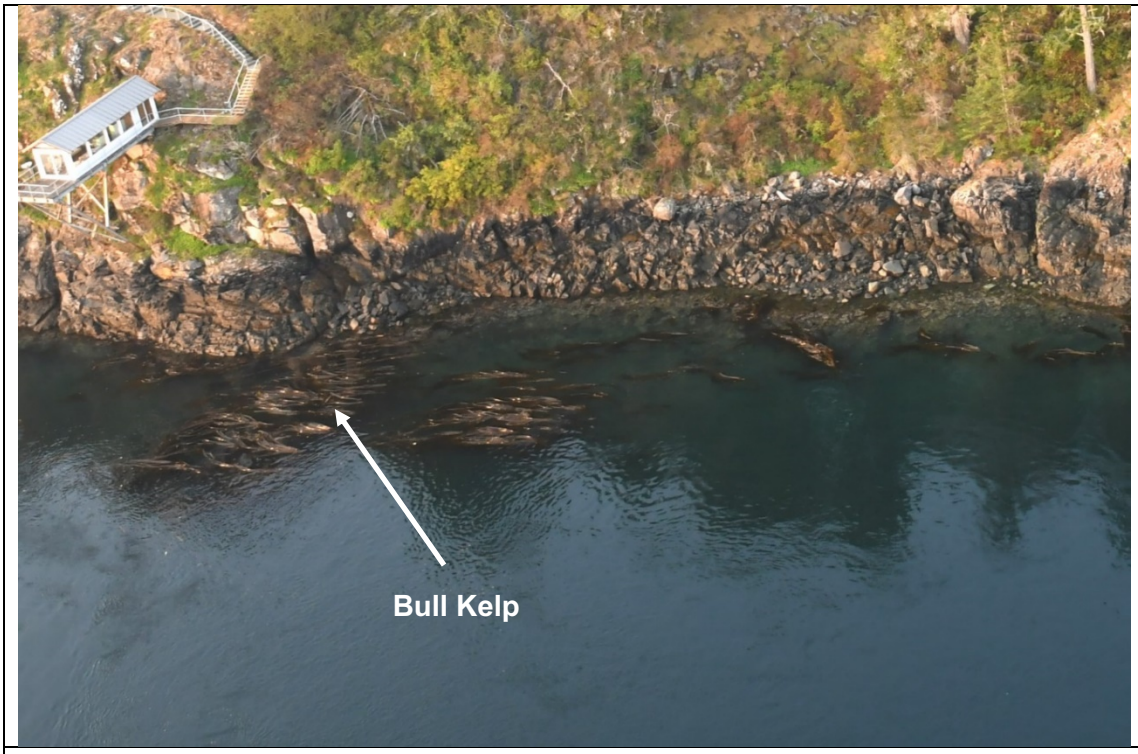

Photo bc23_cr_00420: Good example of the Bull Kelp (BUKE) bioband in the nearshore. Race Point.