Coastal and Ocean Resources

MCORI Project: 20-09 **May 2021**

ShoreZone Polygon Mapping Summary Report

North Coast of British Columbia

Zayas Island, Chatham Sound (bc19_dd_02290)

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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; Harper and Morris 2014). ShoreZone has since expanded to a spatially continuous database of over 122,000 km of coastal Alaska, British Columbia, Washington State and Oregon. The most current ShoreZone protocol was updated in 2017 (Cook *et al*. 2017).

The ShoreZone imaging surveys were conducted around the north coast of British Columbia in June 2014, June 2015, August 2018, and July 2019 (Figure 1) (CORI, 2018; CORI, 2019). Those surveys 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 (CORI, 2020). The ShoreZone partners on the North Coast of BC are the Prince Rupert Port Authority, Department of Fisheries and Oceans, the Metlakatla First Nation, the Gitxaala First Nation, the Nisga'a Lisims Government, Nexxen, Pacific Northwest LNG, and the BC Ministry of Environment. In 2020 the existing ShoreZone imagery and mapping, in conjunction with publicly available satellite imagery (ArcGIS Earth, ArcMap, Google Earth), was used to create intertidal and sensitive habitat polygons for the full extent of the North Coast of BC.

The purpose of this report is to detail the polygon mapping work with summaries of the data and descriptions of the challenges involved. The length of shoreline mapped is **4,151 kilometers** in **17,570 along-shore segments** (units). In total, **27,052 intertidal polygons** (Section 2) covering a total of **22,269 ha** and **21,990 sensitive habitat polygons** (Section 3) covering **8,371 ha** were created.

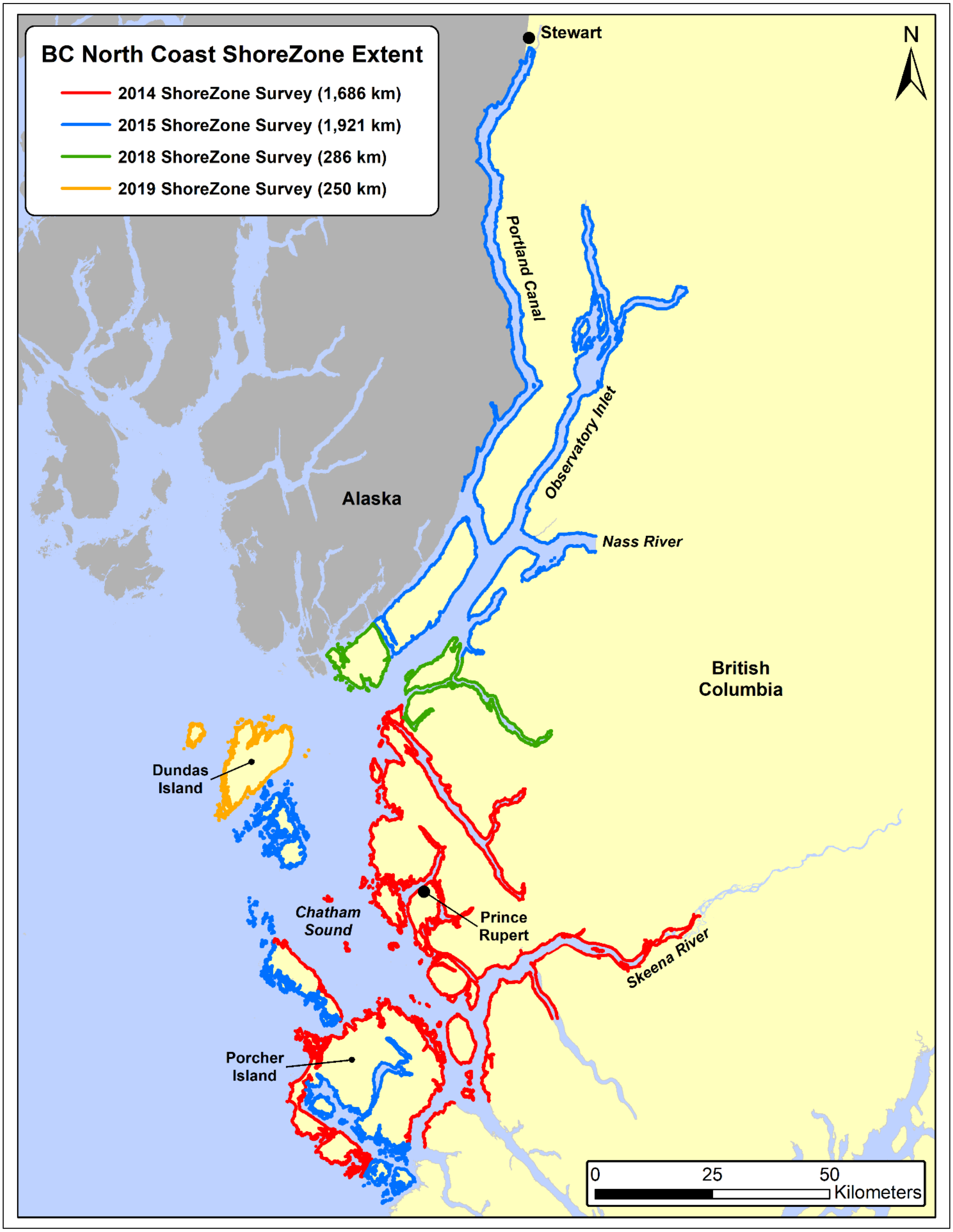

Figure 1. Extent of ShoreZone imagery and mapping on the North Coast of BC.

2 INTERTIDAL POLYGON DATA SUMMARY

2.1 Methodology

ShoreZone habitat mapping uses low-altitude (100 m elevation), high resolution aerial imagery taken from helicopters to define relatively homogenous segments of shoreline, called 'units', based on the physical characteristics of the intertidal and supratidal zones. These units are delineated on the best available digital high water line (HWL) which, in the case of the North Coast of BC, was the CHS_Highwaterline_BCalbers.shp. Each alongshore unit can also be divided into across-shore components where there is variation in the substrate and geomorphological forms from the top of the beach to the waterline. However, representing ShoreZone data as a one-dimensional line does not accurately display the complexity of the data that is collected. Representing the intertidal as a two-dimensional polygon is possible where there is both a digital HWL as well as a digital low water line (LWL).

Our method for creating polygons of the intertidal portion of each ShoreZone unit was to take the existing digital HWL with the existing unit segments and add the best available digital LWL, which is also from the Canadian Hydrographic Service for the North Coast of BC. We then used the ShoreZone imagery, in conjunction with the best available public satellite imagery (which varied depending on the area), to define the shape of each intertidal polygon. The satellite imagery (which is orthorectified) was used as a guide to provide positional data for all boundaries but the ShoreZone imagery (which is not orthorectified) was used as the final guide as it was taken at low tide while the satellite imagery was often at mid-tide or higher.

We did encounter numerous challenges in the creation of the intertidal polygons, most of which were around the accuracy of the high and low water lines. We made the decision to not edit either of these lines unless we encountered what we considered to be an error which would have significantly affected the overall size and shape of the final polygon. The overall position of each polygon in space did vary when compared to the satellite imagery in numerous areas; however, this wasn't considered a significant error unless the difference was greater than 100m (see Figure 1). In Portland Canal and Observatory Inlet, there was a significant offset with both the HWL and the LWL compared to the satellite imagery (see Figure 2) such that the LWL was actually inland of the HWL. In this case, we actually needed to completely re-digitize both to create accurate polygons. The other major challenges were around quality of the ShoreZone imagery and quality of the satellite imagery and how the two related to each other.

All of the challenges we faced in this project means that the quality of the intertidal polygons is variable; however, we feel confident that the general shape and size of the polygons are consistent with reality in the vast majority of cases. It is likely the absolute position of each polygon is less consistent with reality, particularly in the more remote portions of the coastline but it will not be inaccurate by more than 100m (if we assume the satellite imagery to be correct in terms of absolute position).

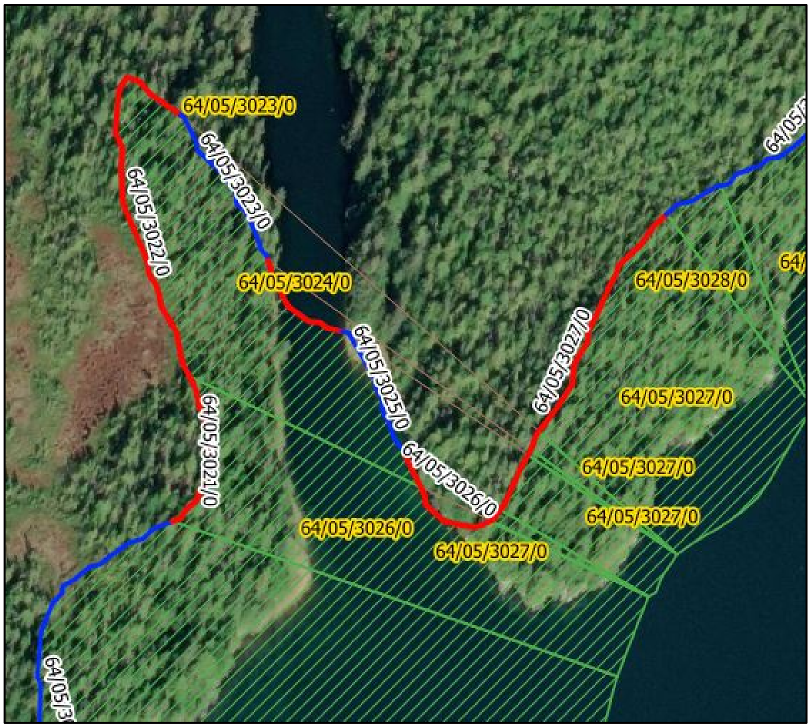

Figure 2. Example of an area where the digital HWL doesn't match the satellite imagery positioning but did not affect the overall shape and size of the intertidal polygons so was not re-digitized.

Figure 3. Example of an area where the digital HWL and LWL overlapped (with pink areas indicating an area where the LWL was upland of the HWL).

Some corrections were made to the original ShoreZone mapping during the polygon creation process which changed some of the physical attributes. These changes were only made to a small portion (<1%) of units and were made only where the polygon mapper noticed a significant difference between the imagery and the existing ShoreZone mapping. This means the geodatabase that accompanies this report is now considered the most accurate ShoreZone data for the North Coast of BC and should be used to replace any existing geodatabase the user might have from that area.

2.2 Results

In total, CORI created **27,052** intertidal polygons at the component level. These polygons covered **22,269 ha** of the intertidal zone on the North Coast of BC. The final intertidal polygons add a number of attributes to the ShoreZone dataset and are part of the final geodatabase product for this area. These polygons represent the across-shore components and can therefore represent both unit level and component level attributes such as the Oil Residence Index (Figure 4) and the Primary Intertidal Form (Figure 5). All ShoreZone attributes are detailed in the current protocol (Cook *et al*. 2017).

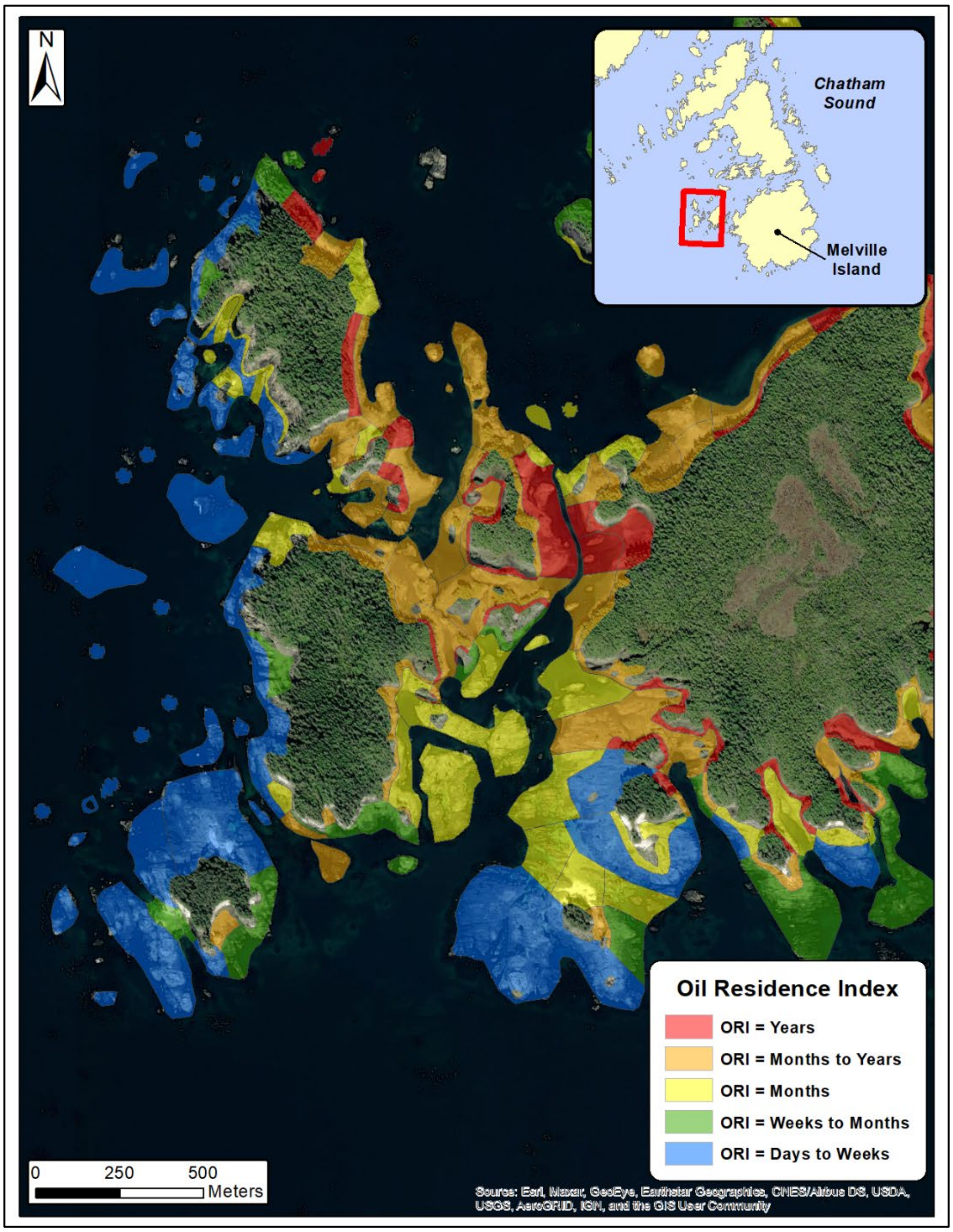

Figure 4. Example of the ShoreZone Oil Residence Index displayed as intertidal polygons just off Melville Island on the North Coast of BC.

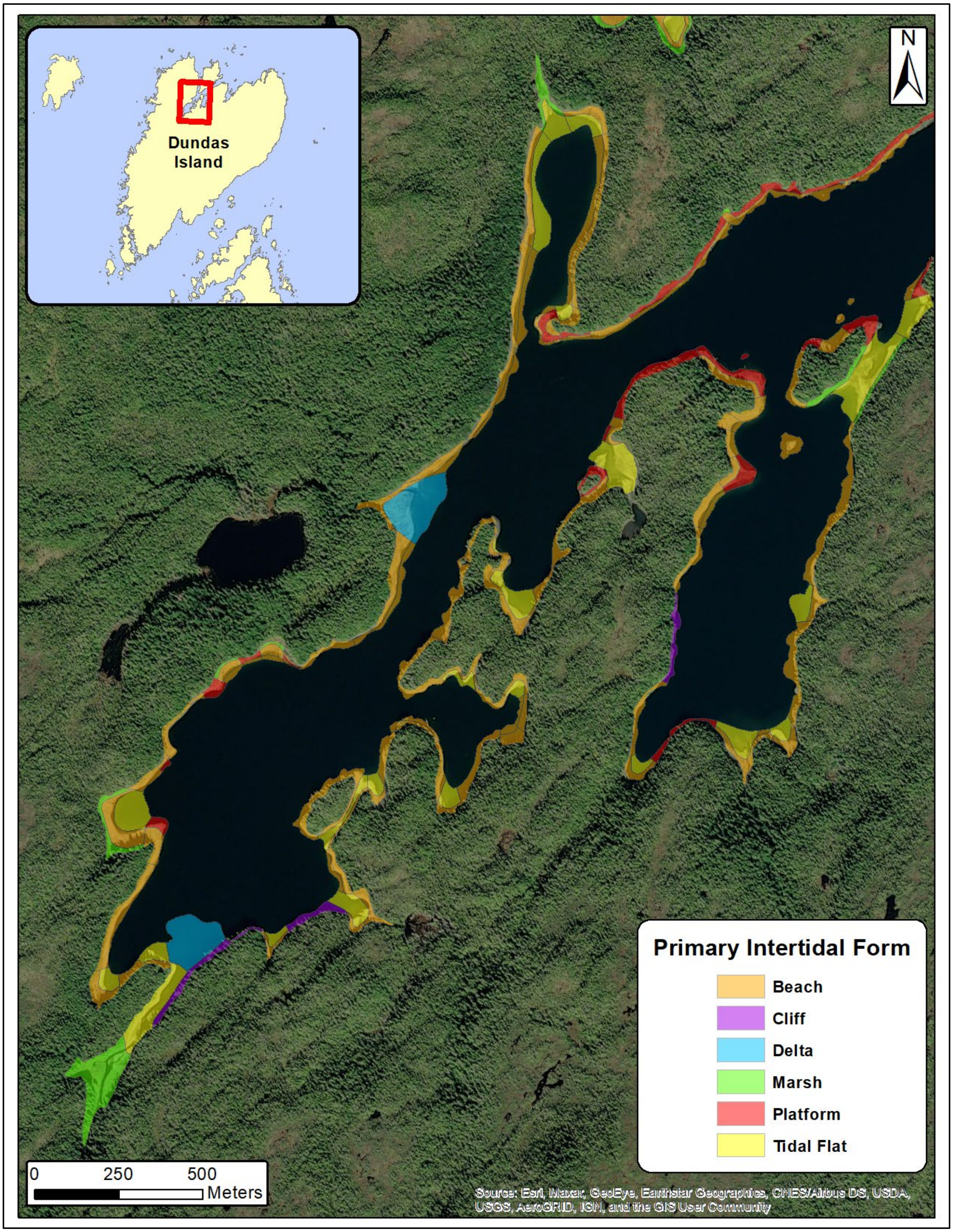

Figure 5. Example of the ShoreZone Primary Intertidal Form displayed as intertidal polygons in one of the islets on Dundas Island on the North Coast of BC.

3 SENSITIVE HABITAT POLYGON DATA SUMMARY

3.1 Methodology

ShoreZone habitat mapping uses low-altitude (100 m elevation), high resolution aerial imagery taken from helicopters to classify the biological attributes in each ShoreZone unit. These attributes are called **biobands** and are defined by a typical tide height, colour and texture. For the purposes of this project, we proposed to map the biobands that we defined as 'sensitive habitats', meaning those that are productive ecosystems upon which many other species rely for food or shelter and which may be adversely affected by pressures arising from human activities (including climate change, fisheries and development). The 6 biobands that fit these criteria were: **Dune Grass**, **Salt Marsh**, **Eelgrass**, **Bull Kelp**, **Giant Kelp** and **Urchin Barrens** (Figure 6,7 and 8 shows photographic examples of these biobands). We also mapped the **Wetland Vegetation** bioband in the non-tidal portion of the Skeena River, rather than the Salt Marsh bioband. See Table 1 for the definitions of these biobands from the ShoreZone protocol. Please note that Urchin Barrens were included even though they are defined as visible sea urchins in the nearshore that have grazed down all the kelps in a given area. This bioband is thus the absence of previously abundant kelp and therefore represents the loss of sensitive habitat so it was considered important to include. The Urchin Barrens on the North Coast of BC have been present for many years due to the loss of sea otters, which were extirpated due to hunting pressure, but they appear to have recently expanded likely due to the loss of Sunflower Stars and other sea star predators due to Sea Star Wasting Disease (personal observation of Sarah Cook, CORI).

Our method for creating polygons of the sensitive habitat biobands identified as part of the ShoreZone mapping on the North Coast of BC (CORI 2020) was to take the existing high resolution ShoreZone imagery in conjunction with the best available public satellite imagery (which varied depending on the area), to define the shape and position of each polygon. The satellite imagery (which is orthorectified) was used as a guide to provide positional data for all boundaries but the ShoreZone imagery (which is not orthorectified) was used as the final guide for shape and extent of the polygon. We attached the unique unit identifier(s) (PHY_IDENT) to each polygon as applicable and also provided an estimate of the density of the Indicator Species defined for each bioband (see Table 1). Our density categories were Sparse (S), Moderate (M) and Dense (D). These are qualitative assessments based on the classifier observations rather than quantitative assessments; however, these categories should still be useful for any calculation of biomass etc.

Table 1. Definitions for the sensitive habitat biobands mapped as polygons on the North Coast of BC.

Bioband Name			Prior Code	Current Code	Zone	Typical Color	Indicator Species	Description	Biological Wave Exposure
Primary Level	**Secondary Level**	**Tertiary Level**							
Terrestrial Vegetation	Grasses	Dune Grass	GRA	**DUGR**	A	Pale blue-green	*Leymus mollis*	Found in the upper intertidal zone, tall grasses observed as clumps continuous on dunes, in logline or on beach berms. This band may be the only band present on high-energy beaches.	VP to E
Intertidal/ Subtidal Vegetation	Wetland Vegetation			**WEVE**	A & upper B	Greens and browns	N/A	Non-specific wetland vegetation in the supratidal zone that does not fit into any more specific wetland bioband or cannot be clearly identified from the imagery.	VP to E
Intertidal/ Subtidal Vegetation	Wetland Vegetation	Salt Marsh (BC & Washington State)	SAL	**SAMB**	A & upper B	Light, bright, or dusty green	*Salicornia virginica*	Salt-tolerant herbs and grasses associated with freshwater. This band is often associated with estuaries, marshes, and lagoons although it is not uncommon as a fringing meadow in the supratidal. Used to describe a 'low marsh' in Washington State and generally lacking associated grass species in that classification. Specific to BC and Washington State.	SE to VP
Intertidal/ Subtidal Vegetation	Rooted Vegetation	Eelgrass	ZOS	**EELG**	B & C	Bright to dark green	*Zostera marina*	Commonly visible in estuaries, lagoons or channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or thick dense meadows.	VP to SP
Intertidal/ Subtidal Vegetation	Brown Canopy-Forming Algae	Giant Kelp	MAC	**GIKE**	C	Dark brown to golden-brown	*Macrocystis pyrifera*	Canopy-forming giant kelp, long stipes with multiple floats and fronds. If associated with NER, it occurs inshore of the bull kelp. Range: Baja California, Mexico to Kodiak Islands, AK.	P to SE
Intertidal/ Subtidal Vegetation	Brown Canopy-Forming Algae	Bull Kelp	NER	**BUKE**	C	Dark brown	*Nereocystis luetkeana*	Distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Eularia fistulosa* and *Macrocystis pyrifera*. Often indicates higher current areas if observed at lower wave exposures. Range: Point Conception, CA to Unimak Island, AK.	SP to VE
Invertebrate	Echinoderms	Urchin Barrens	URC	**URBA**	C	Coralline pink/white	*Strongylocentrotus franciscanus*	Shows rocky substrate clear of macroalgae. Often has a pink-white color of encrusting coralline red algae. May or may not see urchins.	SP to E

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

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

Figure 6. Examples of the Dune Grass and Salt Marsh sensitive habitat biobands mapped as polygons on the North Coast of BC.

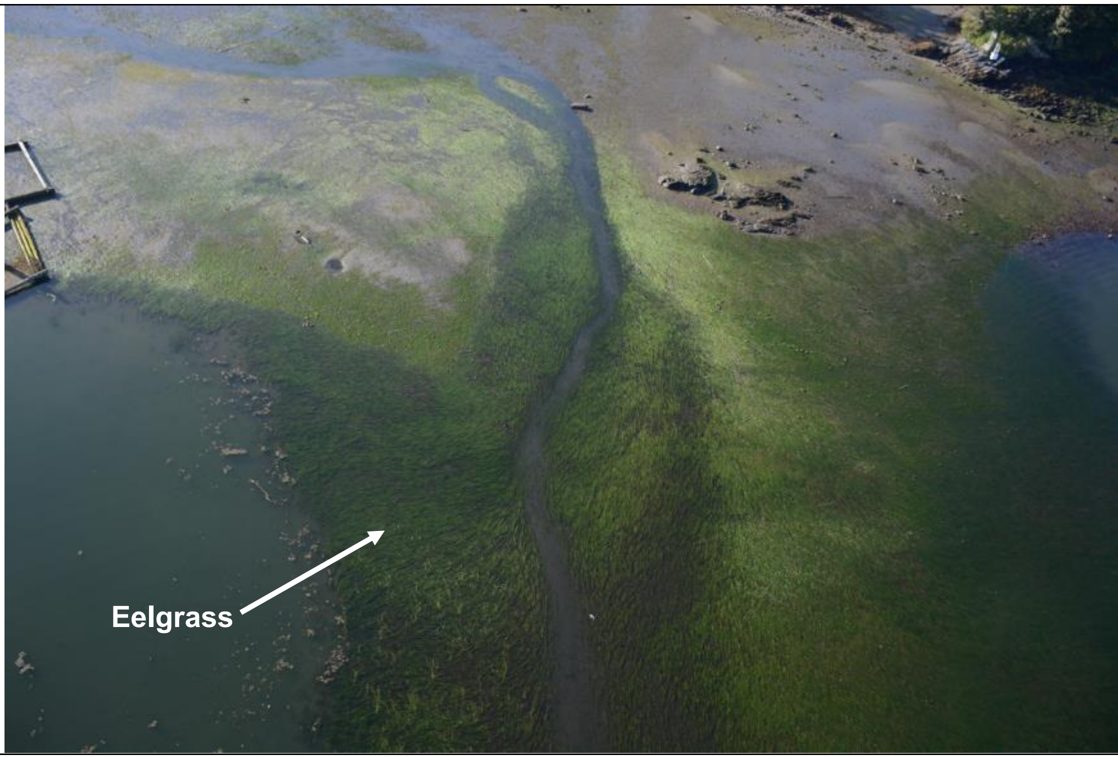

Photo bc14_pr_01538: Example of the Eelgrass (EELG) bioband in the lower intertidal/subtidal. Metlakatla pass.

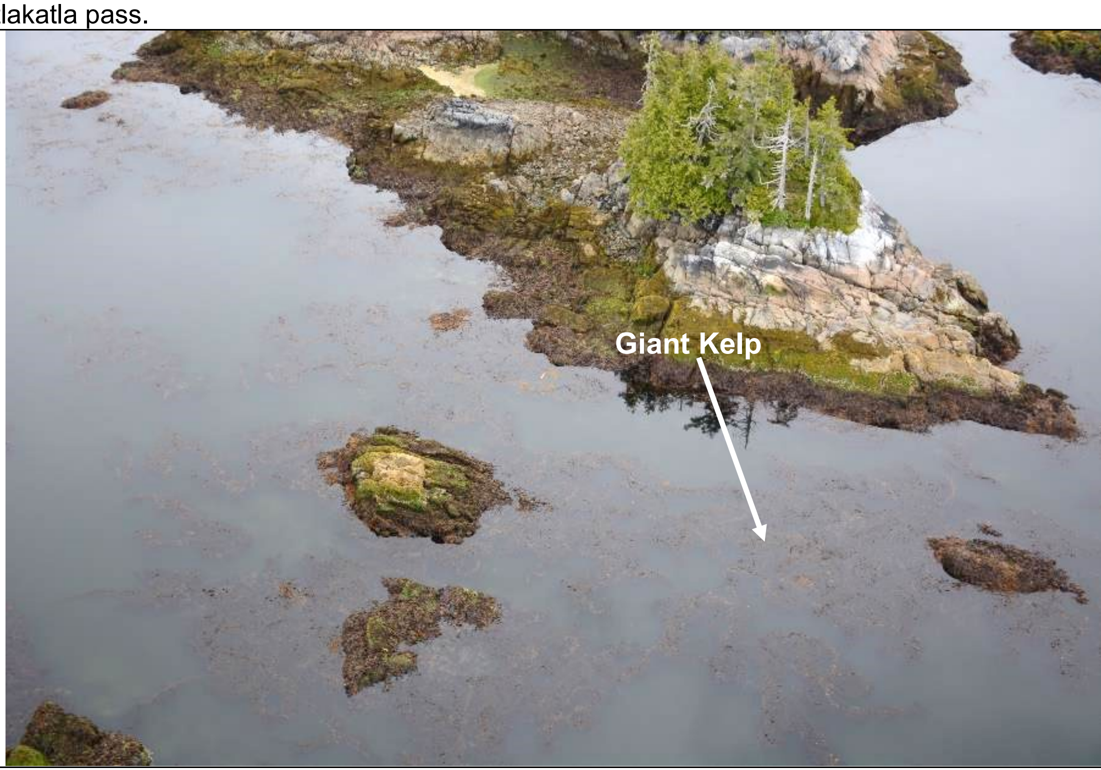

Photo bc14_pr_16542: Good example of the Giant Kelp (GIKE) bioband in the nearshore. Near Porcher Island.

Figure 7. Examples of the Eelgrass and Giant Kelp sensitive habitat biobands mapped as polygons on the North Coast of BC.

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

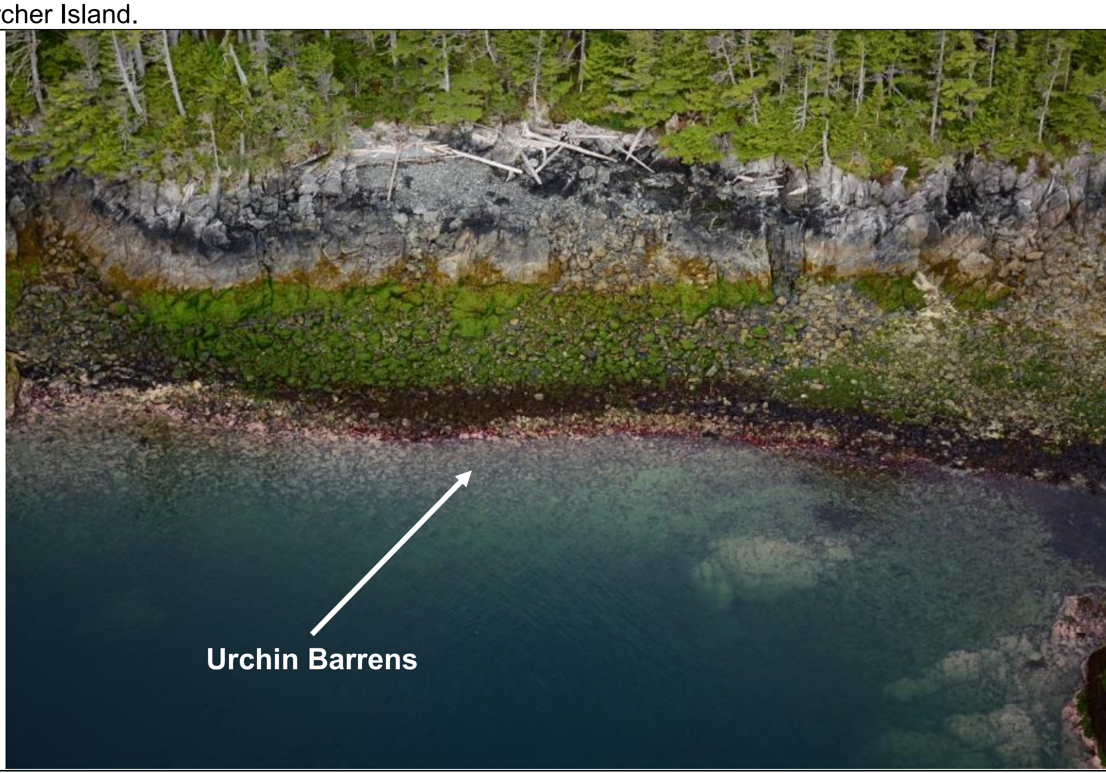

Photo bc19_dd_01224: Good example of the Urchin Barrens (URBA) bioband in the nearshore. Dundas Island.

Figure 8. Examples of the Bull Kelp and Urchin Barrens sensitive habitat biobands mapped as polygons on the North Coast of BC.

We did encounter numerous challenges in the creation of the sensitive habitat polygons, most of which were around the varying resolution and quality of the ShoreZone images and the satellite imagery and how those two things interacted. Figure 9 shows an example where the ShoreZone image and the satellite image had a large disparity in the tide level, which made it challenging to see landmarks that allowed for accurate location of any sensitive habitat polygons. Figure 10 shows an example of a ShoreZone image in a complex area where the units in the back portion of the image are difficult to see.

Another challenge we encountered were areas where biobands were overlapping each other. If it was possible, we created overlapping polygons that indicated where the separate biobands interacted; however, where it was not possible (areas where the imagery made it too time consuming or potentially inaccurate to separate the biobands) we created mixed polygons (see Figures 11 and 12 for examples of both types of polygons). These mixed polygons will need to be treated differently in any analyses of the data.

All of the challenges we faced in this project means that the quality of the sensitive habitat polygons is variable; however, we feel confident that the general shape and size of the polygons are consistent with reality in the majority of cases. The more complex the coastline and the more complex the biology of the area, the more variable the polygons might be.

Some corrections were made to the original ShoreZone mapping during the polygon creation process which changed the presence and/or abundance of biobands in some units. These changes were only made to a small portion (<2%) of units and were made only where the polygon mapper noticed a significant difference between the imagery and the existing ShoreZone mapping. This means the geodatabase that accompanies this report is now considered the most accurate ShoreZone data for the North Coast of BC and should be used to replace any existing geodatabase the user might have from that area.

Figure 9. Example of an area where the ShoreZone image (bc15_sh_15076) (top) and the satellite image (bottom) (which shows the same bay in Portland Canal) has a large disparity in terms of tide level. The white arrow on each image indicates the same location.

Figure 10. Example of an area where the ShoreZone image (bc15_sh_11780) (top) was taken in a very complex area which meant some units in the background (image on the bottom) were challenging to see. The white arrow on each image indicates the same location.

3.2 Results

In total, CORI created **21,990** sensitive habitat polygons. These polygons covered **8,371 ha** of the supratidal, intertidal and subtidal zones on the North Coast of BC. Table 2 shows a breakdown of the number and area of polygons of each type. The final sensitive habitat polygons are part of the final geodatabase product for this area. These polygons represent the six biobands mapped as part of this project (Figures 11 and 12).

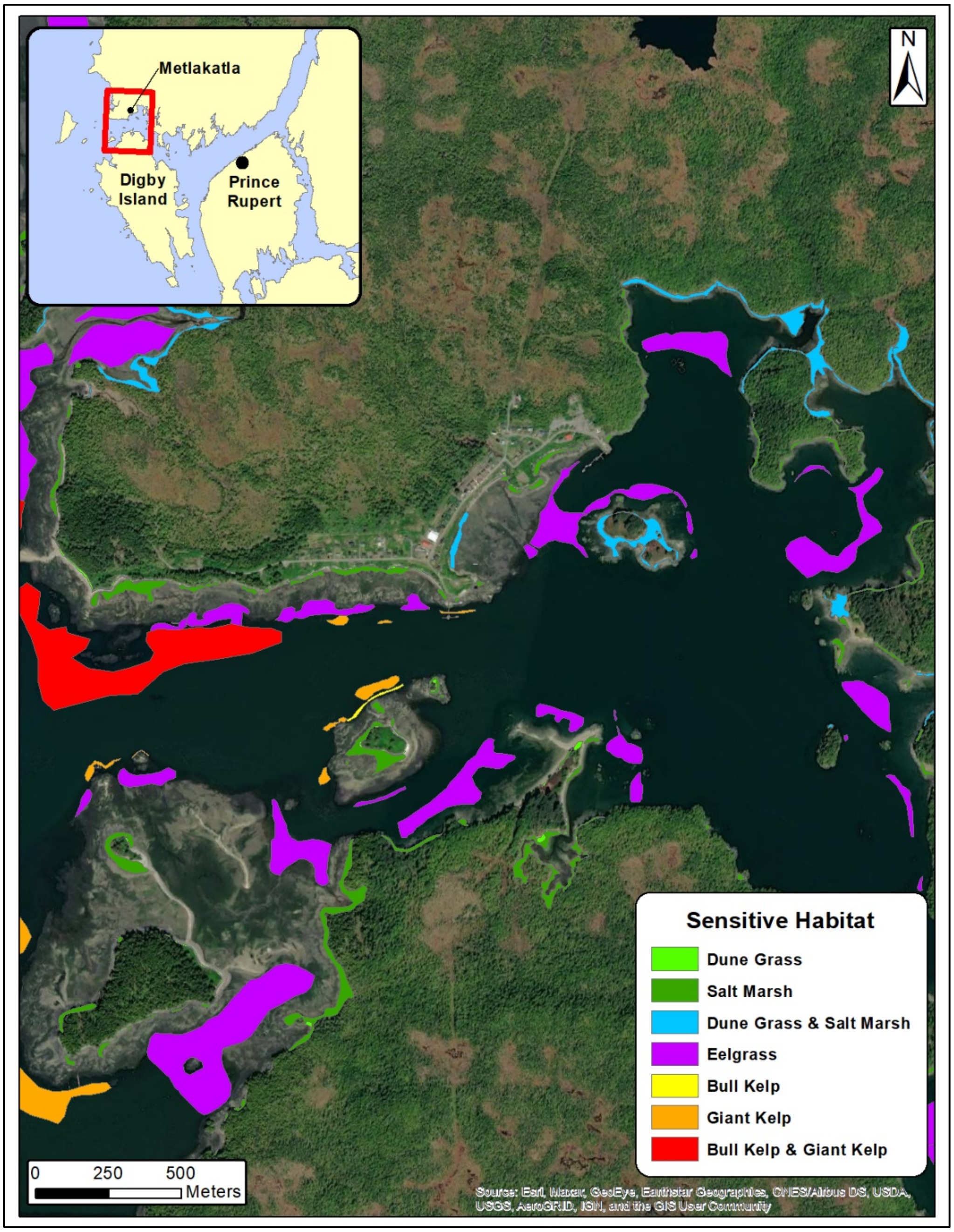

Figure 11. Example of the sensitive habitat polygons mapped in Metlakatla Pass on the North Coast of BC.

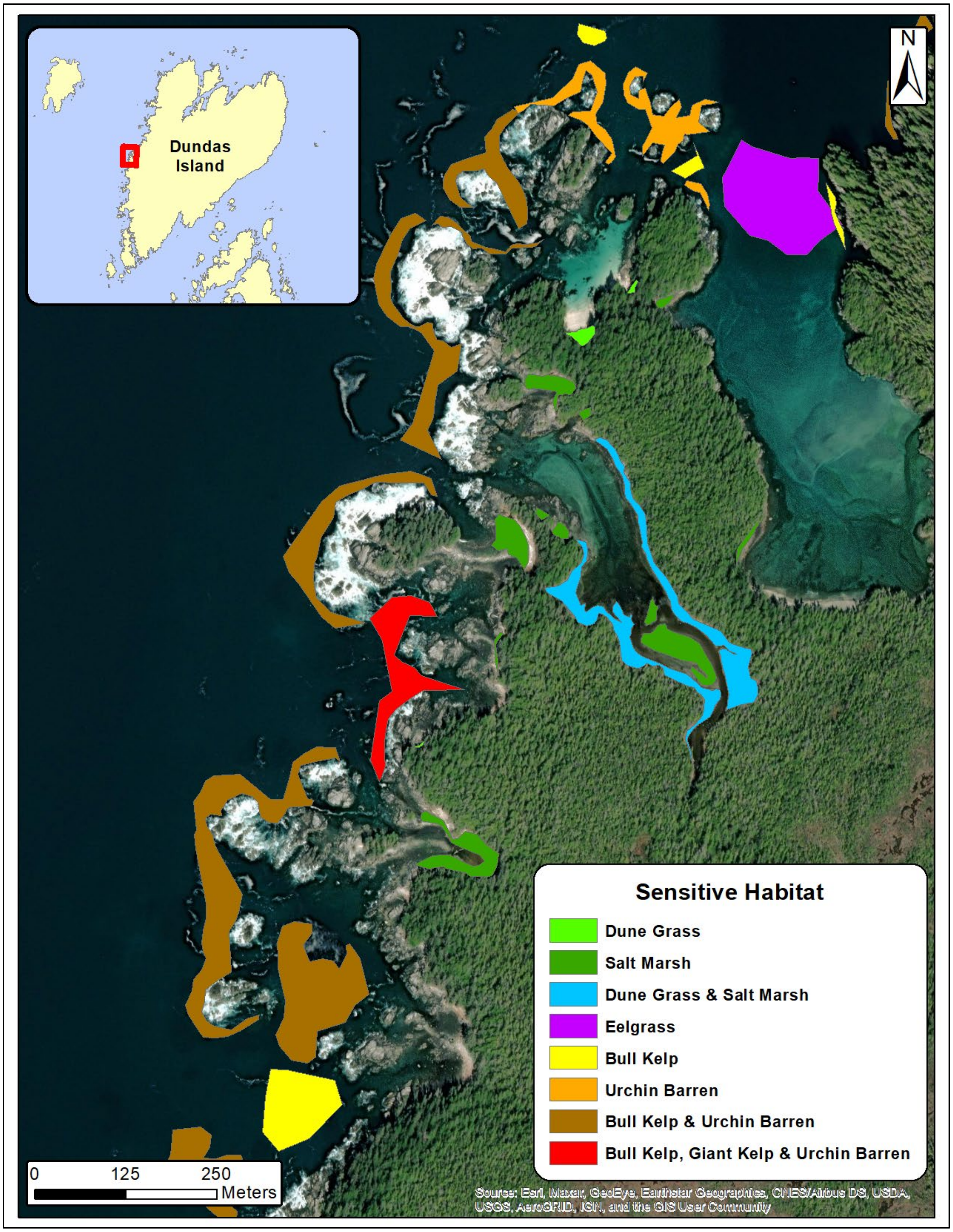

Figure 12. Example of the sensitive habitat polygons mapped on the west side of Dundas Island on the North Coast of BC. This was a particularly complex and diverse area.

Table 2. Totals of sensitive habitat biobands mapped as polygons on the North Coast of BC. Please note that the totals in this table will equal more than the overall total number or overall total area as there are mixed polygons that include multiple biobands.

Sensitive Habitat Bioband	Number of Polygons Created (including mixed polygons with multiple biobands)	Area of Polygons (ha) (including mixed polygons with multiple biobands)
Dune Grass	1,367	248
Salt Marsh	11,332	1,863
Wetland Vegetation	93	88
Eelgrass	1,887	1,888
Giant Kelp	2,700	2,347
Bull Kelp	4,509	2,599
Urchin Barrens	2,635	1,301

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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.