MCORI Project: 22-03 **September 2022**

ShoreZone Polygon Mapping Summary Report

Bamfield Survey Area

Wizard Islet, Barkley Sound (bc21_bf_00326)

Prepared for:
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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).

Barkley Sound was one of the first parts of BC imaged with the ShoreZone protocol in the early 1990’s. A small portion, the mainland of Barkley Sound around Bamfield and down the coast to Victoria was re-imaged and re-mapped in 2007 for BC’s Ministry of Environment. In July 2021 the imagery for the Deer Group Islands and the mainland around Bamfield down to Port Renfrew was updated with funding from the Department of Fisheries and Oceans (Figure 1) (CORI, 2021; CORI, 2022). 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 in accordance with the latest ShoreZone protocol (Cook *et al*., 2017) In 2022, 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 this survey area.

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 **323 kilometers** in **1,678 along-shore segments** (units). In total, **2,306 intertidal polygons** (Section 2) covering a total of **1,150 ha** and **1,912 sensitive habitat polygons** (Section 3) covering **995.1 ha** were created.

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Figure 1. Extent of ShoreZone imagery and mapping in the Bamfield survey area.

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 Bamfield survey area, 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 this area. We then used the ShoreZone imagery, in conjunction with the best available public satellite imagery, 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 some challenges in the creation of the intertidal polygons, most of which centered around the accuracy of the high and low water lines when compared with the satellite and ShoreZone imagery. Figures 2 and 3 show examples of areas where the low water line was significantly different from reality and needed more extensive modification. These challenges mean that the quality of the intertidal polygons is variable from unit to unit; however, we feel confident that the general shape and size of the polygons are consistent with reality in the majority of units.

Small corrections were made to the original ShoreZone mapping attributes during the polygon creation process. These changes were noted in a small portion (<1%) of units and were made only where the polygon mapper noted a significant difference between the imagery and the existing ShoreZone mapping. The geodatabase that accompanies this report is now considered the most accurate ShoreZone data for the Bamfield survey area and should be used to replace any previous geodatabase from that area.

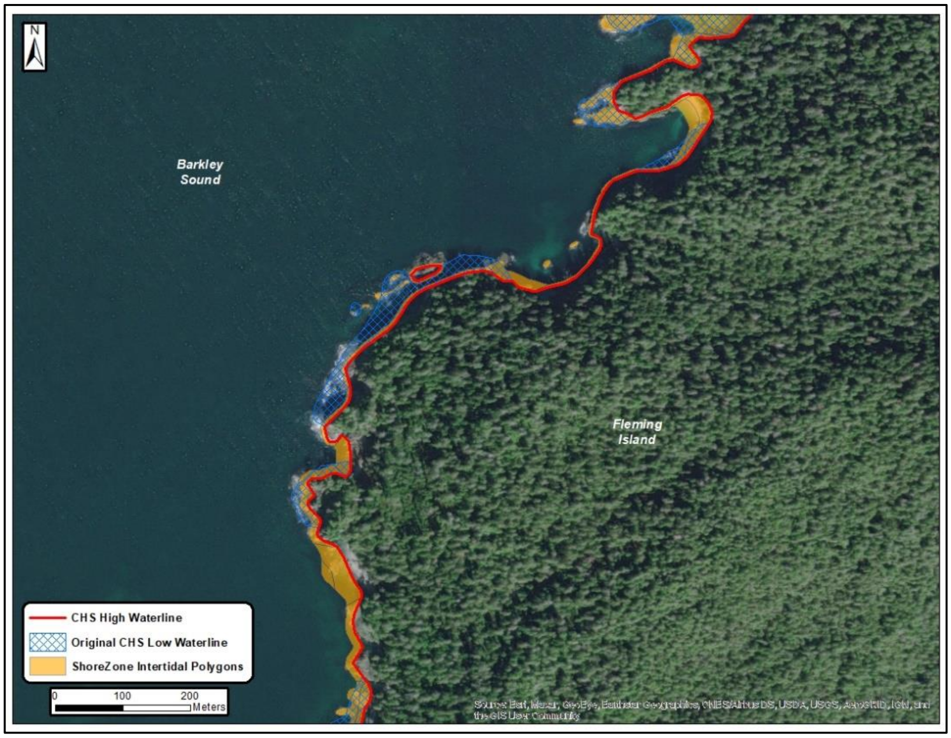

Figure 2. Example of an area where the digital HWL was slightly offset compared to the satellite imagery but did not affect the overall shape and size of the intertidal polygons so was not re-digitized.

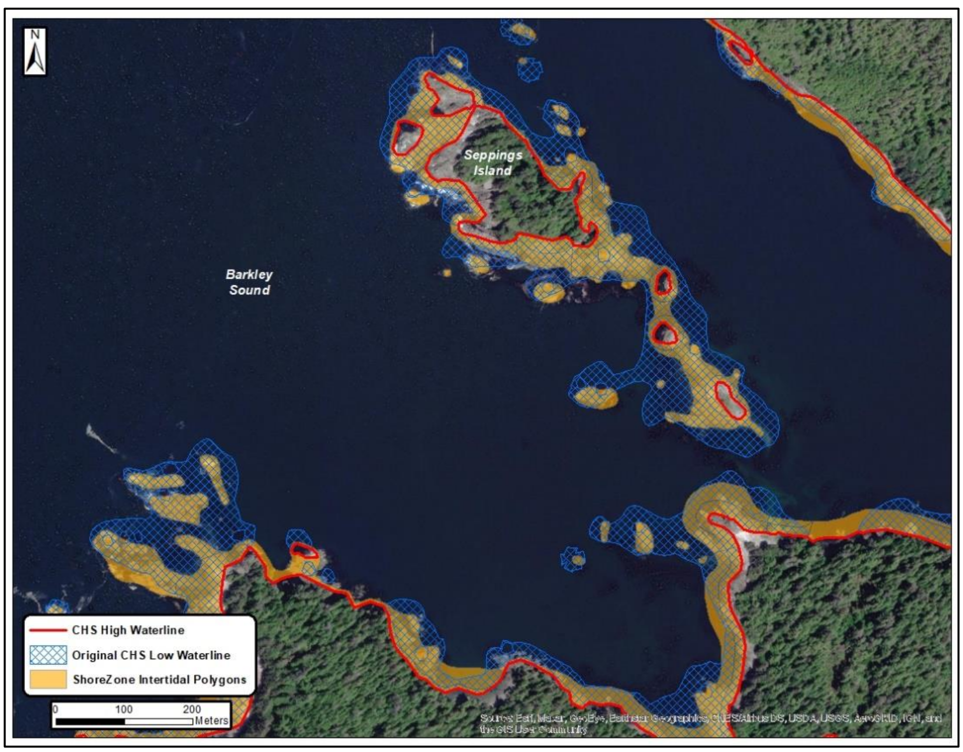

Figure 3. Example of an area where the digital HWL was complex and not necessarily reflective of reality making creation of intertidal polygons more challenging.

2.2 Results

In total, CORI created **2,306** intertidal polygons at the component level. These polygons covered **1,150 ha** of the intertidal zone in the Bamfield survey area. 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).

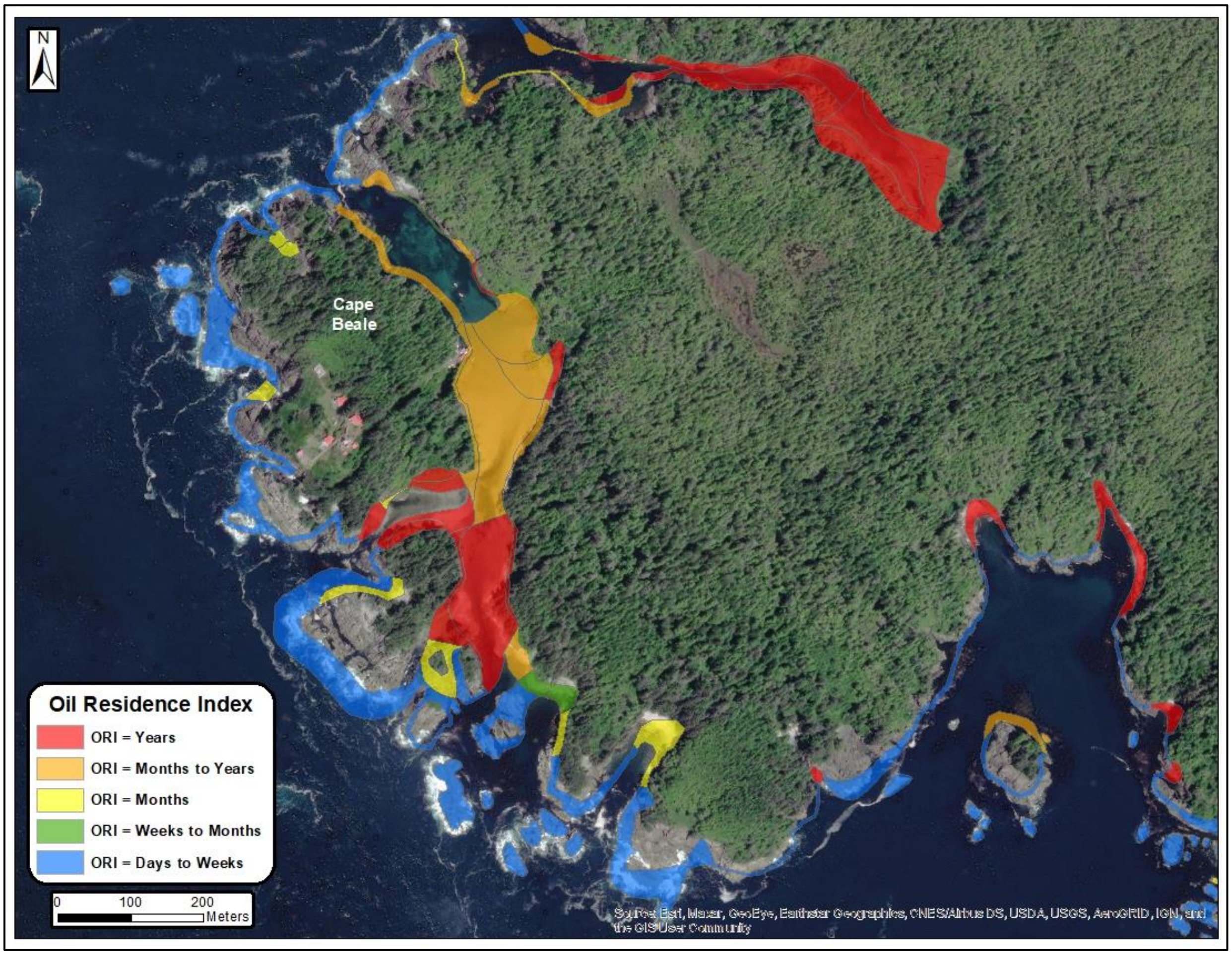

Figure 4. Example of the ShoreZone Oil Residence Index displayed as intertidal polygons near Cape Beale.

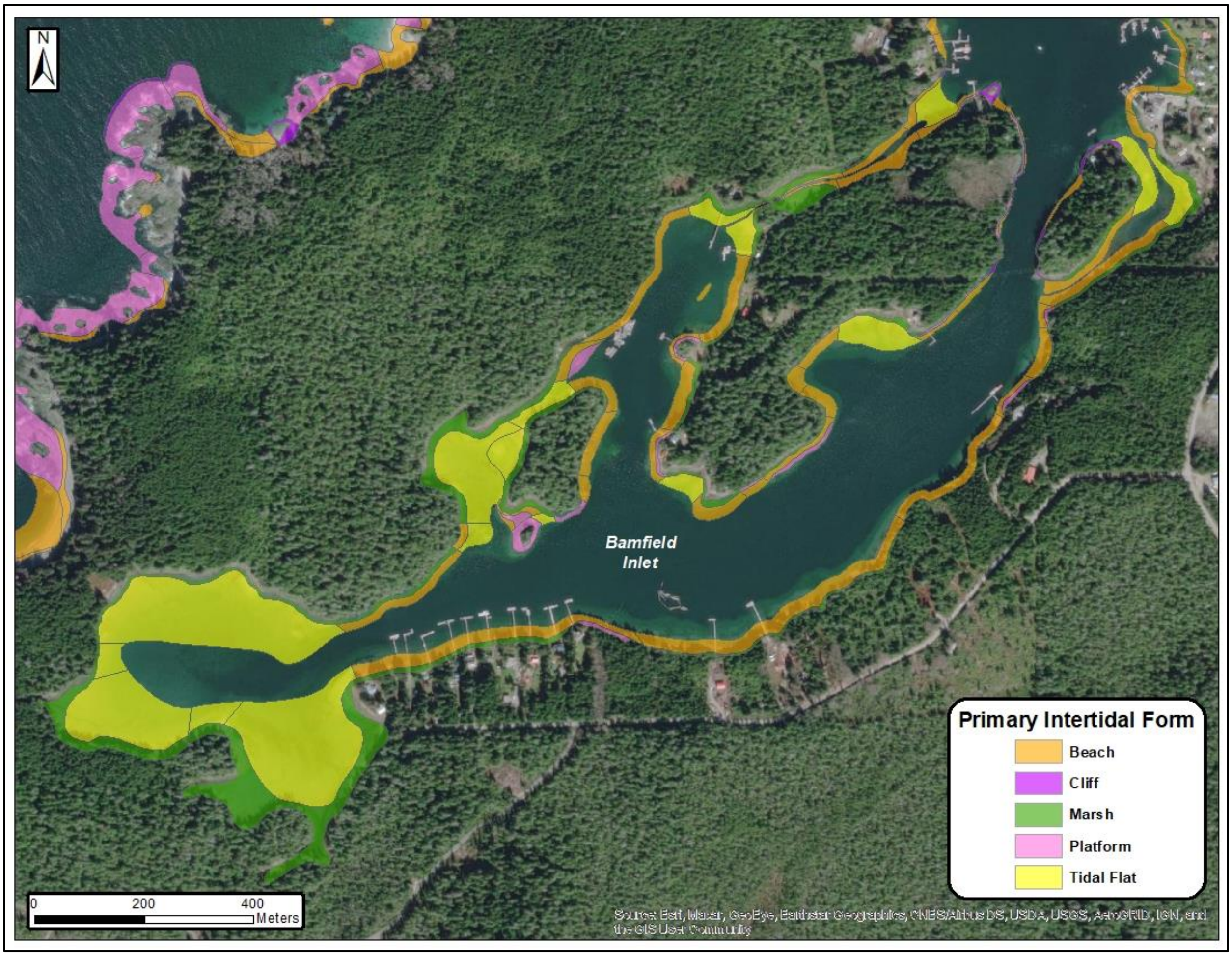

Figure 5. Example of the ShoreZone Primary Intertidal Form displayed as intertidal polygons in Bamfield Inlet.

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**. Table 1 gives the definitions of these biobands from the ShoreZone protocol and Figures 6, 7 and 8 shows photographic examples of these biobands from the survey area. Please note that Urchin Barrens were included as sensitive habitats 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 kelp forests and therefore represents the loss of sensitive habitat so it was considered important to include. Only a few units in the Barkley Sound portion of the survey area had the Urchin Barrens bioband mapped in it, although it is possible there were more in the area. Green urchins are not visible from the ShoreZone imagery so barrens dominated by *Strongylocentrotus droebachiensis* (Green Sea Urchin) would not be identified using this methodology.

Our method for creating polygons of the sensitive habitat biobands identified as part of the ShoreZone mapping of the Bamfield survey area (CORI 2022) was to take the existing high resolution ShoreZone imagery in conjunction with the best available public satellite imagery, 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 within each polygon (see Table 1). Our Density categories were Sparse (S), Moderate (M) and Dense (D). These are qualitative assessments based on classifier observations rather than quantitative assessments; however, these categories should still be useful for any calculation of biomass etc. We also added a qualitative measure of Confidence to each polygon to give the users of the data an idea of the overall accuracy of each polygon. Our Confidence categories were Low (L), Medium (M) and High (H).

Table 1. Definitions for the sensitive habitat biobands mapped as polygons in the Bamfield survey area.

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	Salt Marsh (BC & Washington State)	SAL	**SAMB**	A & upper B	Light, bright, or dusty green	*Sarcocornia pacifica*	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 bc21_bf_02532: Good example of blue-green Dune Grass (DUGR) bioband in the supratidal zone. East Clutus Point.

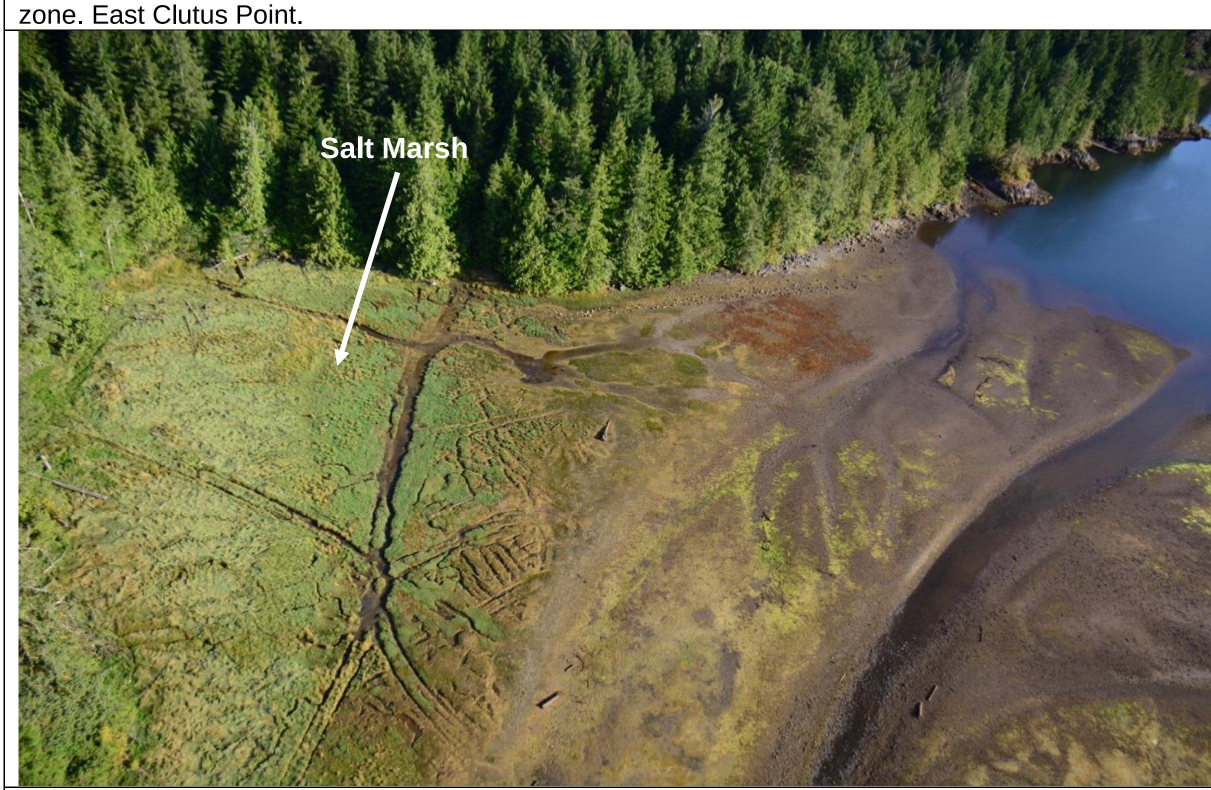

Photo bc21_bf_01607: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Poett Nook.

Figure 6. Examples of the Dune Grass and Salt Marsh sensitive habitat biobands mapped as polygons in the Bamfield survey area.

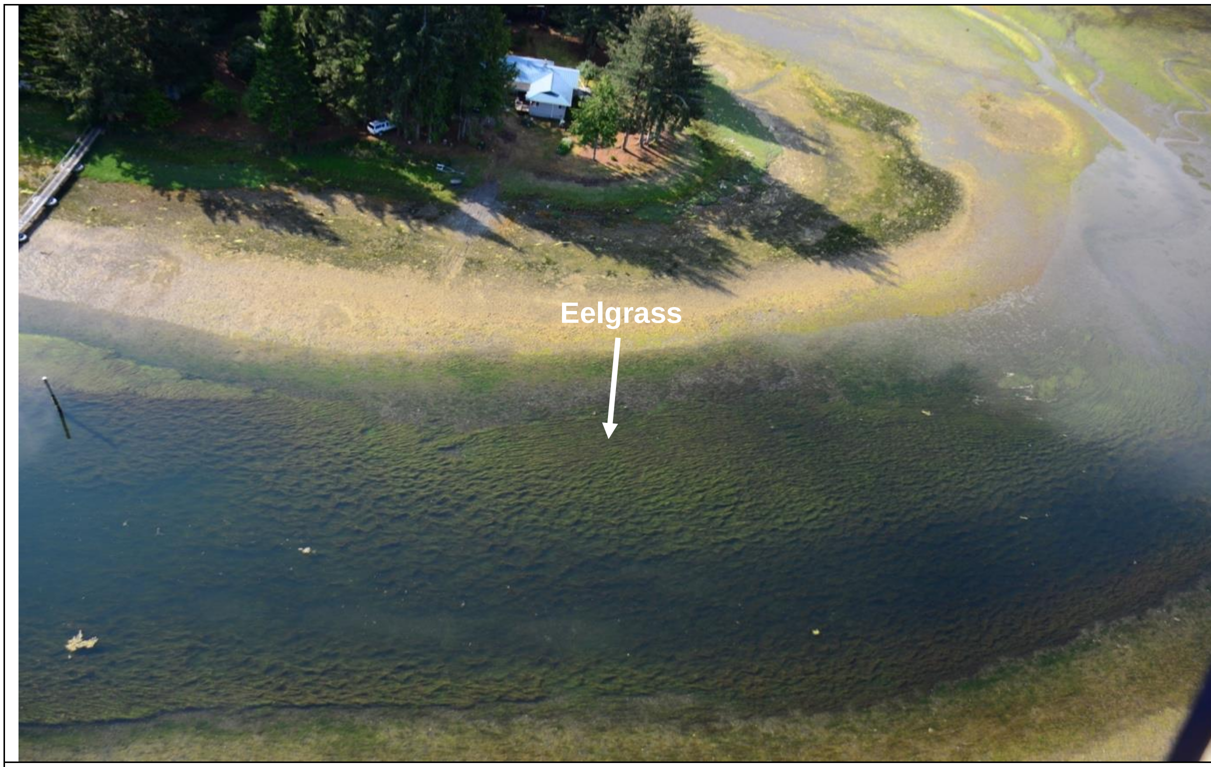

Photo bc21_bf_02052: Good example of the Eelgrass (EELG) bioband in the subtidal. Bamfield Inlet.

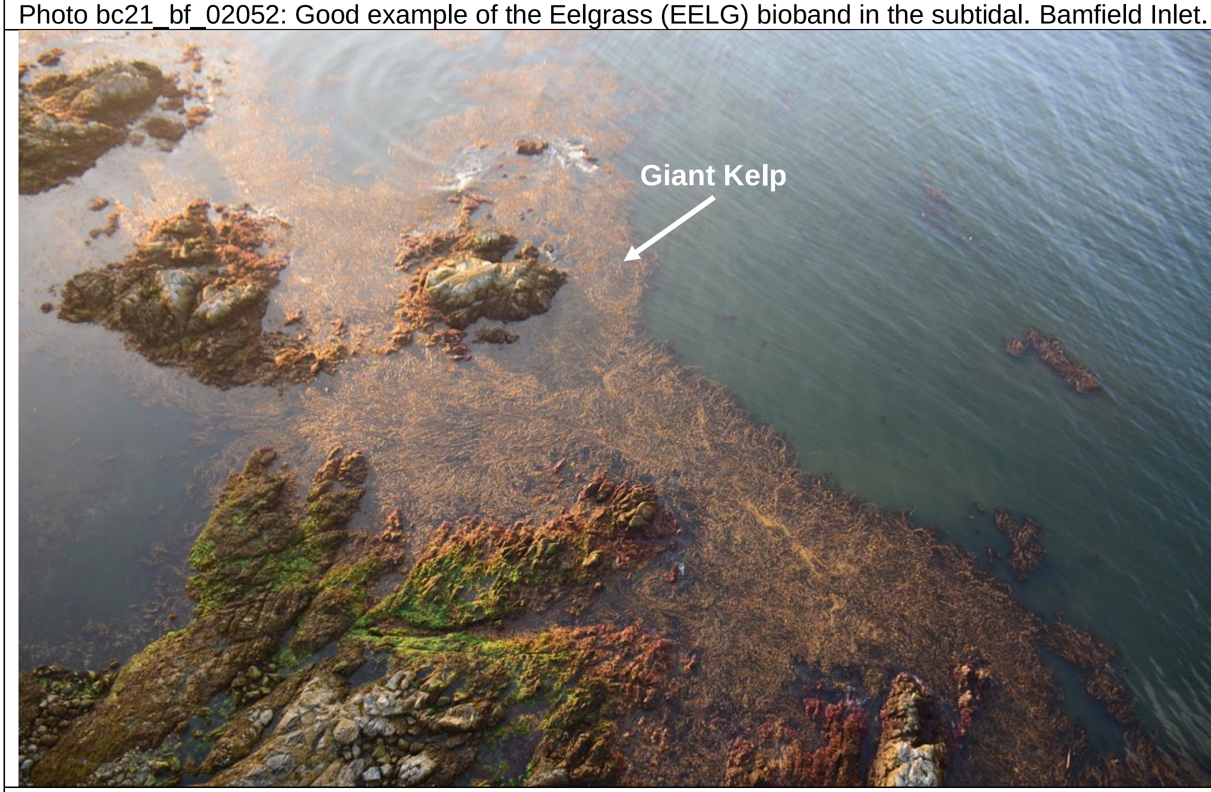

Photo bc21_bf_00101: Good example of the Giant Kelp (GIKE) bioband in the nearshore. Bordelais Islets.

Figure 7. Examples of the Eelgrass and Giant Kelp sensitive habitat biobands mapped as polygons in the Bamfield survey area.

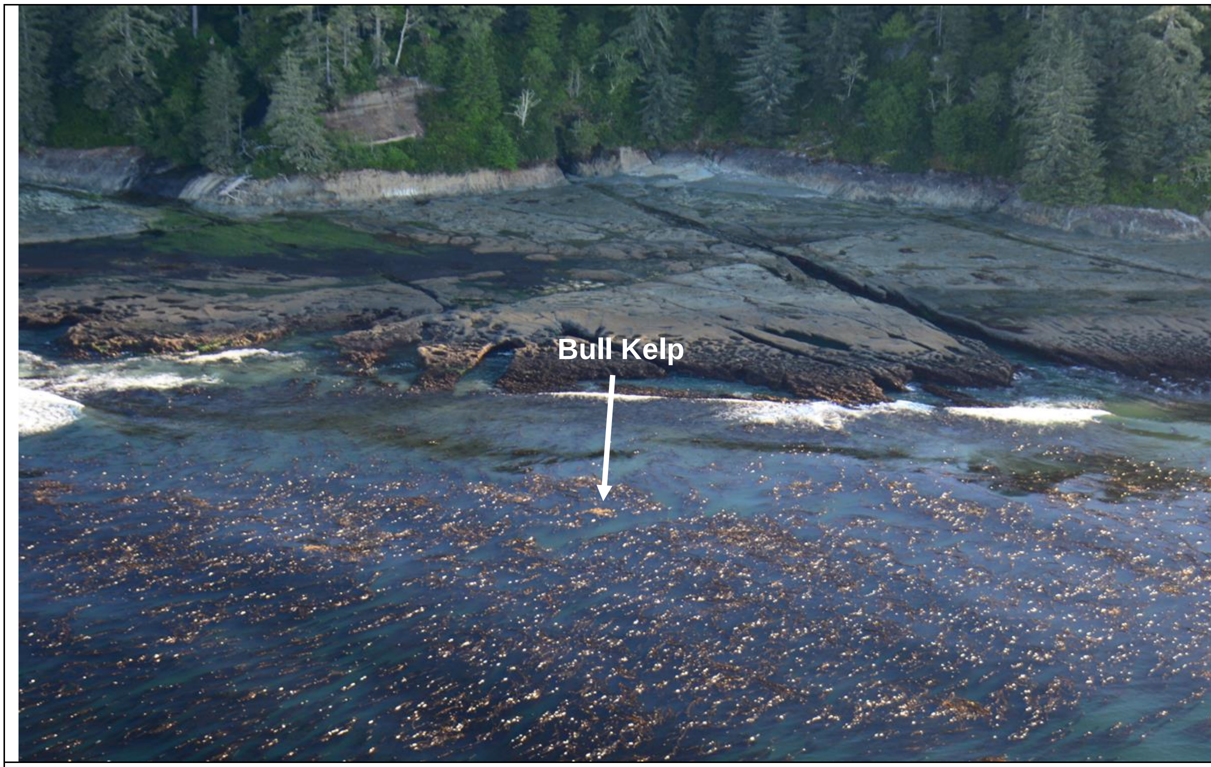

Photo bc21_bf_03207: Good example of the Bull Kelp (BUKE) bioband in the nearshore. East of Cullite Cove.

Figure 8. Example of the Bull Kelp sensitive habitat bioband mapped as polygons in the Bamfield survey area.

We did encounter challenges in the creation of the sensitive habitat polygons, most of which centered around the varying resolution and quality of the ShoreZone imagery and the satellite imagery and how the two 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 an area where the offshore kelp bed was large and complex and extended out under the helicopter, making it very challenging to define the offshore edge. This was a challenge along the outer coast and Strait of Juan de Fuca area particularly.

Another challenge we encountered were areas where biobands overlapped 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. These mixed polygons will need to be treated differently in any analyses of the data.

The challenges encountered 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. The Confidence measure will be useful in allowing users to understand the accuracy of each polygon.

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 (<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 Bamfield survey area and should be used to replace any existing geodatabase the user might have from that area.

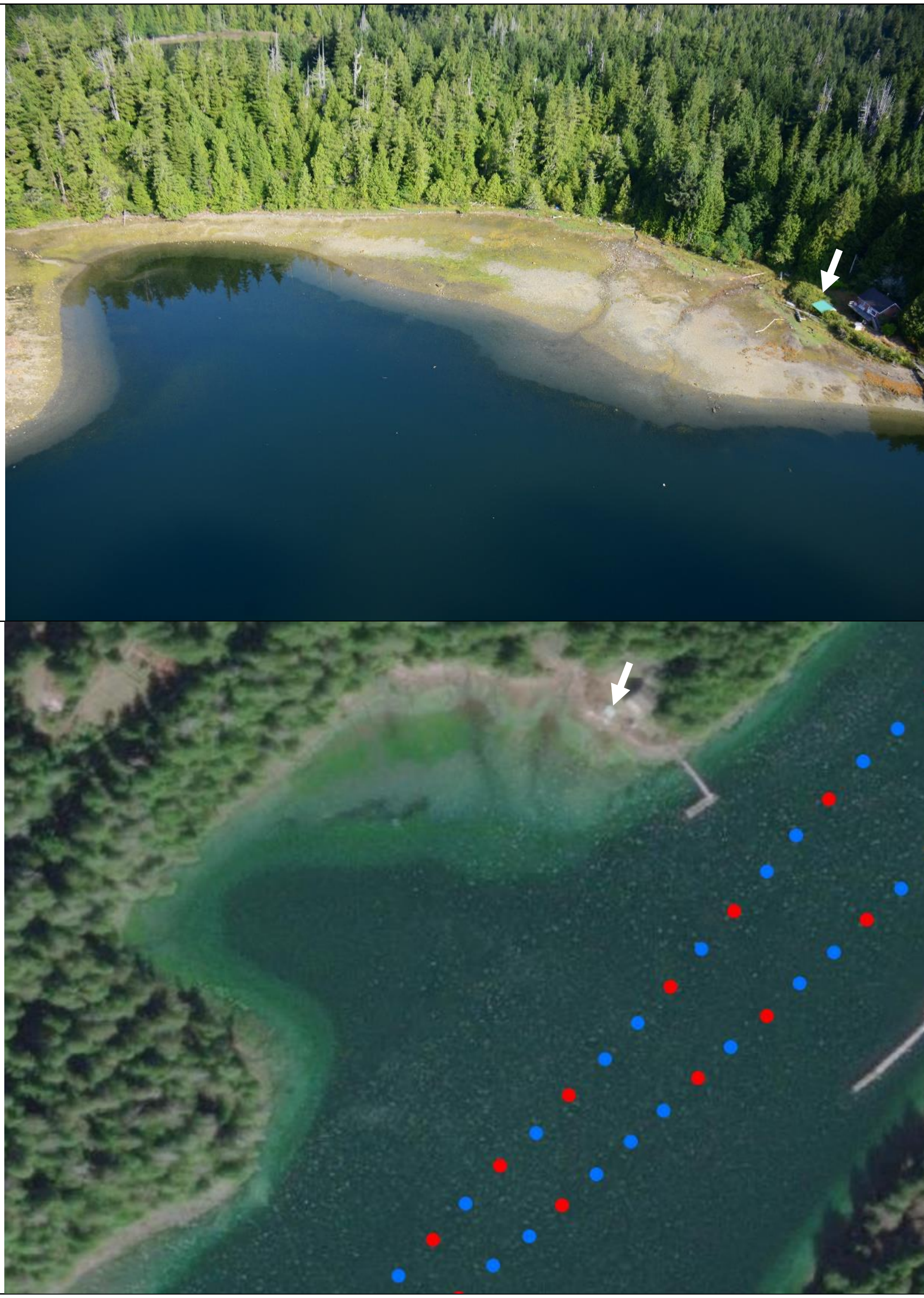

Figure 9. Example of an area where the ShoreZone image (bc21_bf_02141) (top) and the satellite image (bottom) (which show the same bay in Bamfield Inlet) has a large disparity in terms of tide level. The white arrow on each image indicates the same location.

Figure 10. Example of an area just outside Barkley Sound (ShoreZone image bc21_bf_02754) where the offshore kelp bed was large and complex and extended under the helicopter, making it challenging to define the offshore edge.

3.2 Results

In total, CORI created **1,912** sensitive habitat polygons. These polygons covered **995.1 ha** of the supratidal, intertidal and subtidal zones of the Bamfield survey area. These polygons represent the six biobands mapped as part of this project (Figures 11 and 12). 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.

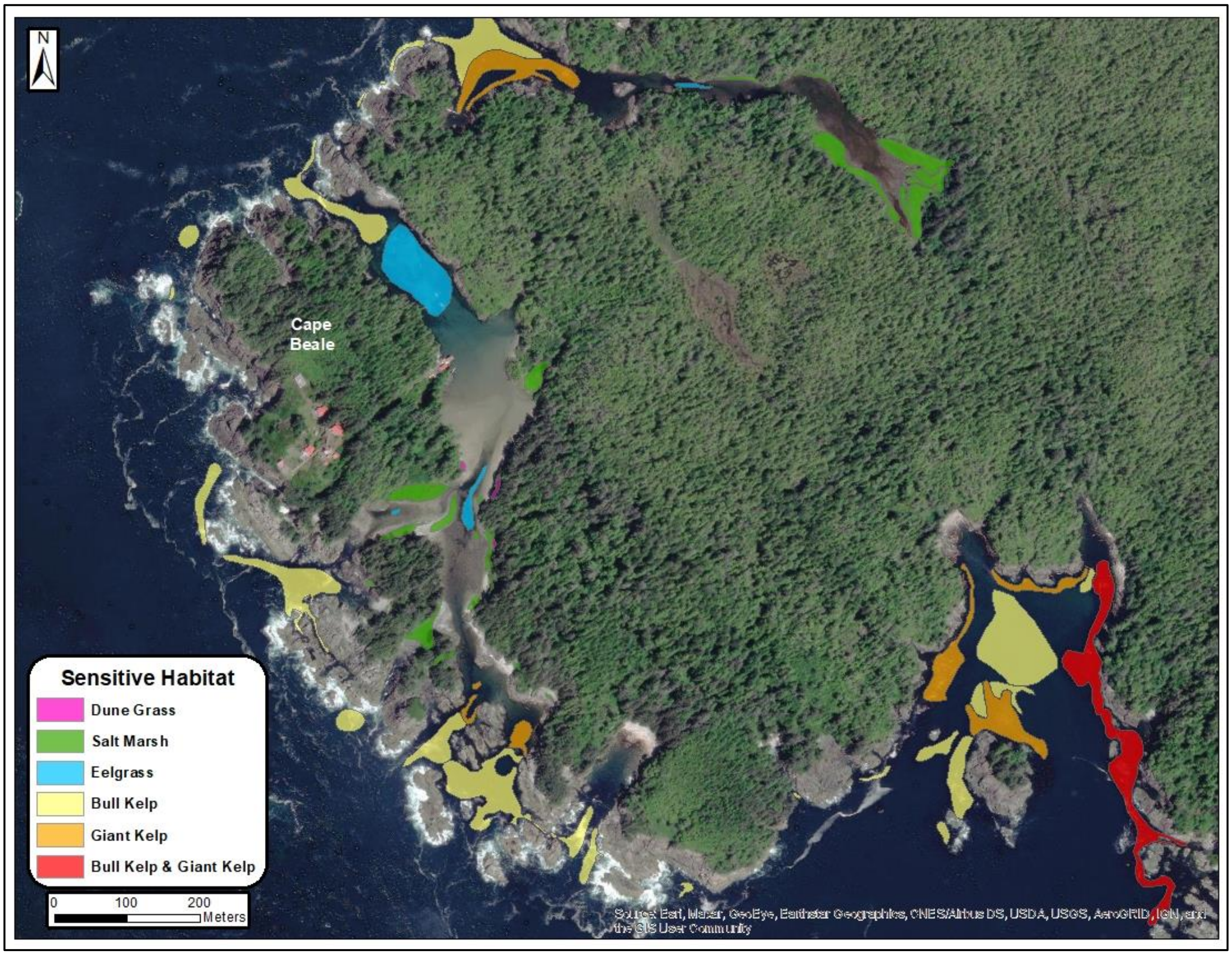

Figure 11. Example of the sensitive habitat polygons mapped around Cape Beale. This was a particularly complex and diverse area.

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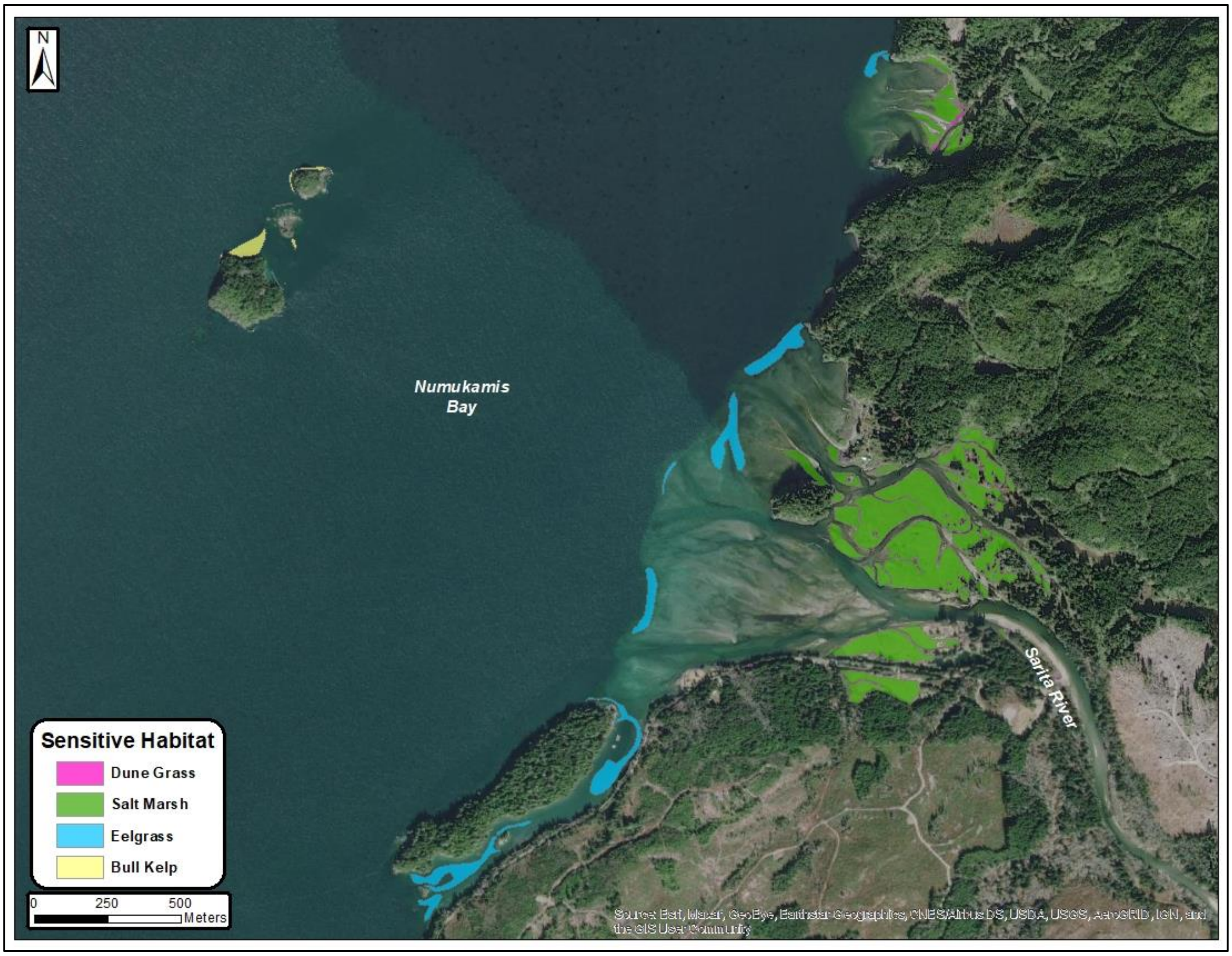

Figure 12. Example of the sensitive habitat polygons mapped in Numukamis Bay.

Table 2. Totals of sensitive habitat biobands mapped as polygons in the Bamfield survey area. 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	317	19.2
Salt Marsh	585	59.5
Eelgrass	211	35.5
Giant Kelp	225	47.2
Bull Kelp	610	854.6
Urchin Barrens	6	0.4

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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.