

ShoreZone Polygon Mapping Summary Report

Gulf Islands



Bull Kelp, Imrie Island, Southern Gulf Islands (bc21_gi_11178)

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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 siting, 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 Gulf Islands were first imaged and mapped in the 1990s with the Southern Gulf Islands and the Victoria shoreline being re-imaged and re-mapped in 2004. In August 2021 the Gulf Islands in the Strait of Georgia were re-imaged with funding from The Islands Trust Council and the islands on the western side of the Strait were re-mapped with funding from 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 2021/22, 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 Gulf Islands on the western side of the Strait of Georgia (Figure 1).

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 **989 kilometers** in **4,953 along-shore segments** (units). In total, **6,537 intertidal polygons** (Section 2) covering a total of **3,175 ha** and **3,539 sensitive habitat polygons** (Section 3) covering **1,728 ha** were created.



Figure 1. Extent of ShoreZone imagery and mapping in the Gulf Islands on the western side of the Strait of Georgia.

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 Gulf Islands, 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 Gulf Islands. 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. We made the decision to not edit the HWL unless we encountered what we considered to be an error which would significantly affect the overall size and shape of the final polygon. Figures 2 and 3 shows examples of areas where the original CHS high water used for the linear mapping needed to be modified in order to accurately create intertidal polygons. The LWL did vary significantly from both the satellite imagery and the ShoreZone imagery along much of the coastline so it was edited more liberally to better reflect reality.

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 Gulf Islands and should be used to replace any previous geodatabase from that area.



Figure 2. Example of an area around Forrest Island where the digital HWL was deemed to be significantly different from reality and needed to be re-digitized using the satellite and ShoreZone imagery.

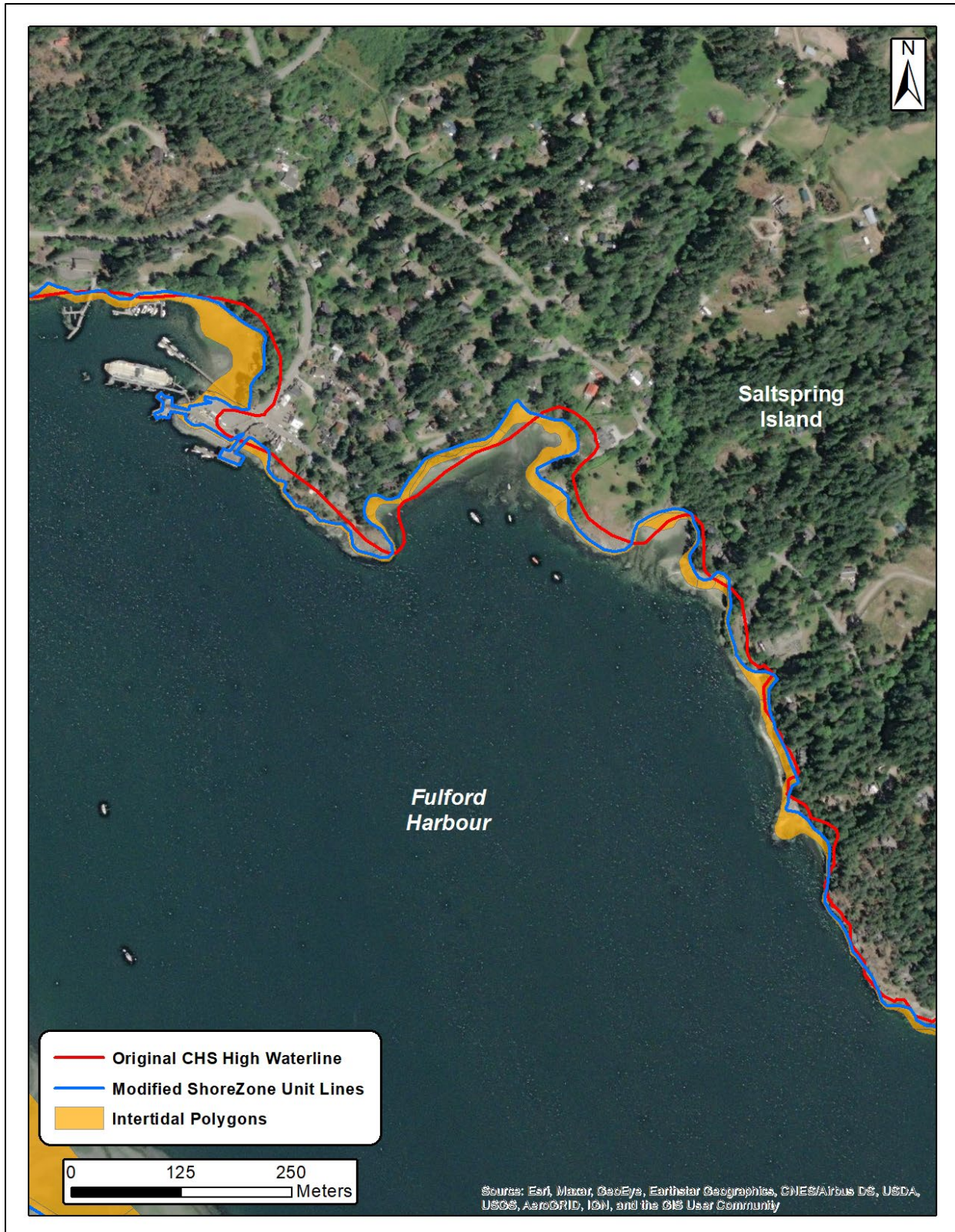


Figure 3. Example of an area on Saltspring Island where the digital HWL was deemed to be significantly different from reality and needed to be re-digitized using the satellite and ShoreZone imagery.

2.2 Results

In total, CORI created **6,537** intertidal polygons at the component level. These polygons covered **3,175 ha** of the intertidal zone in the Gulf Islands. 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).

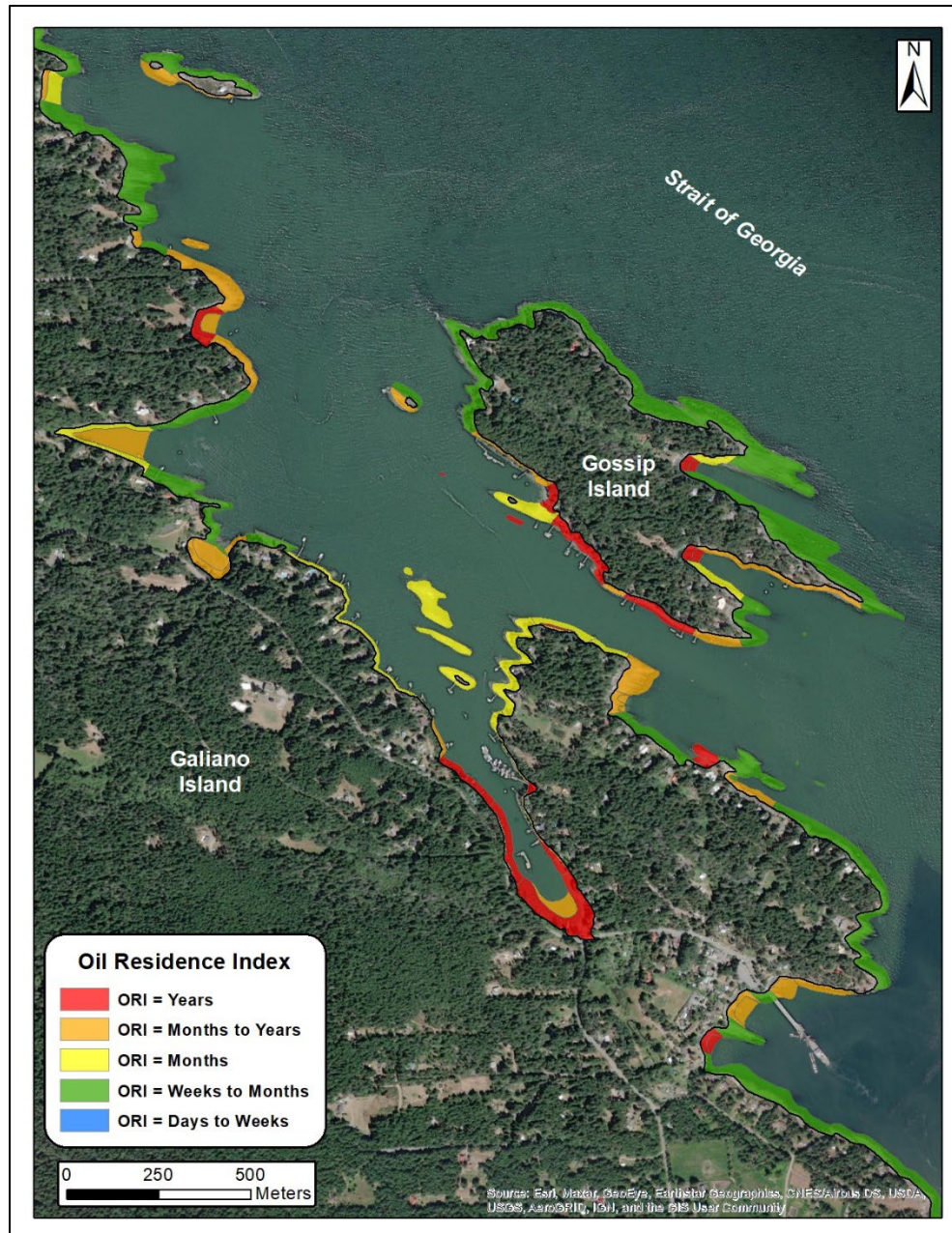


Figure 4. Example of the ShoreZone Oil Residence Index displayed as intertidal polygons on Galiano Island.

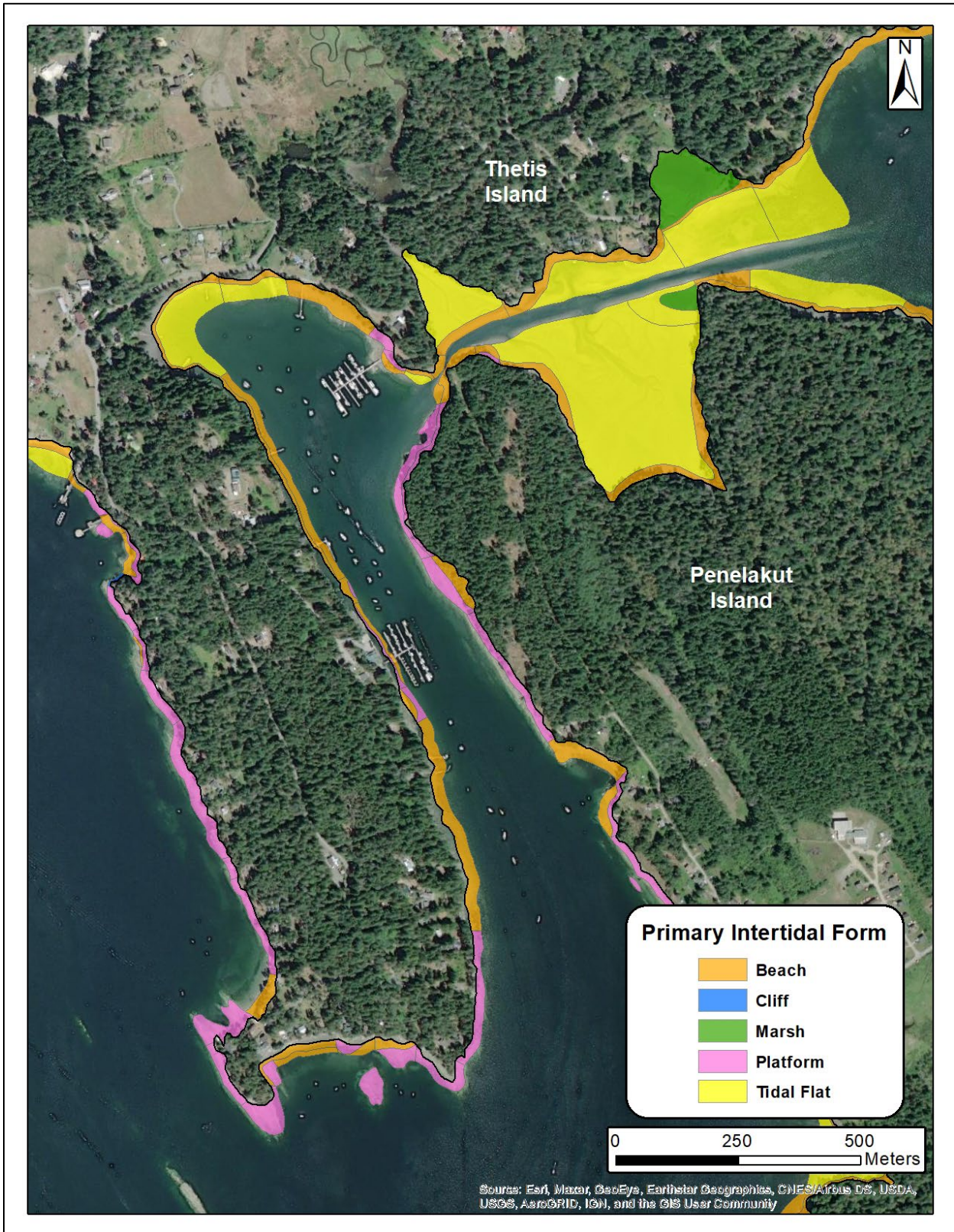


Figure 5. Example of the ShoreZone Primary Intertidal Form displayed as intertidal polygons around Penelakut and Thetis Islands.

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 4 biobands that fit these criteria and were present in the Gulf Islands area were: **Dune Grass**, **Salt Marsh**, **Eelgrass**, and **Bull Kelp**. See Table 1 for the definitions of these biobands from the ShoreZone protocol and Figures 6 and 7 show photographic examples of these biobands. In other areas the Giant Kelp and Urchin Barren biobands are also mapped as sensitive habitat polygons; however, they were not present in this survey area. It is likely there were Urchin Barrens in this region; however Green Sea Urchins (*Strongylocentrotus droebachiensis*) would likely be the dominant urchin species in any barrens in the Strait of Georgia and they are not visible from the ShoreZone imagery so barrens dominated by 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 Gulf Islands (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 Gulf Islands.

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	<i>Leymus mollis</i>	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 & Washingt on State)	SAL	SAMB	A & upper B	Light, bright, or dusty green	<i>Sarcocornia pacifica</i>	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	<i>Zostera marina</i>	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	Bull Kelp	NER	BUKE	C	Dark brown	<i>Nereocystis luetkeana</i>	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 <i>Eularia fistulosa</i> and <i>Macrocystis pyrifera</i> . Often indicates higher current areas if observed at lower wave exposures. Range: Point Conception, CA to Unimak Island, AK.	SP to VE



Photo bc21_gi_11384: Good example of the blue-green Dune Grass (DUGR) bioband. Little Group Ker Island.



Photo bc21_gi_06362: Good example of Salt Marsh (SAMB) bioband in the supratidal/intertidal zone. Walker Hook, Saltspring Island.

Figure 6. Examples of the Dune Grass (top) and Salt Marsh (bottom) sensitive habitat biobands mapped as polygons in the Gulf Islands.

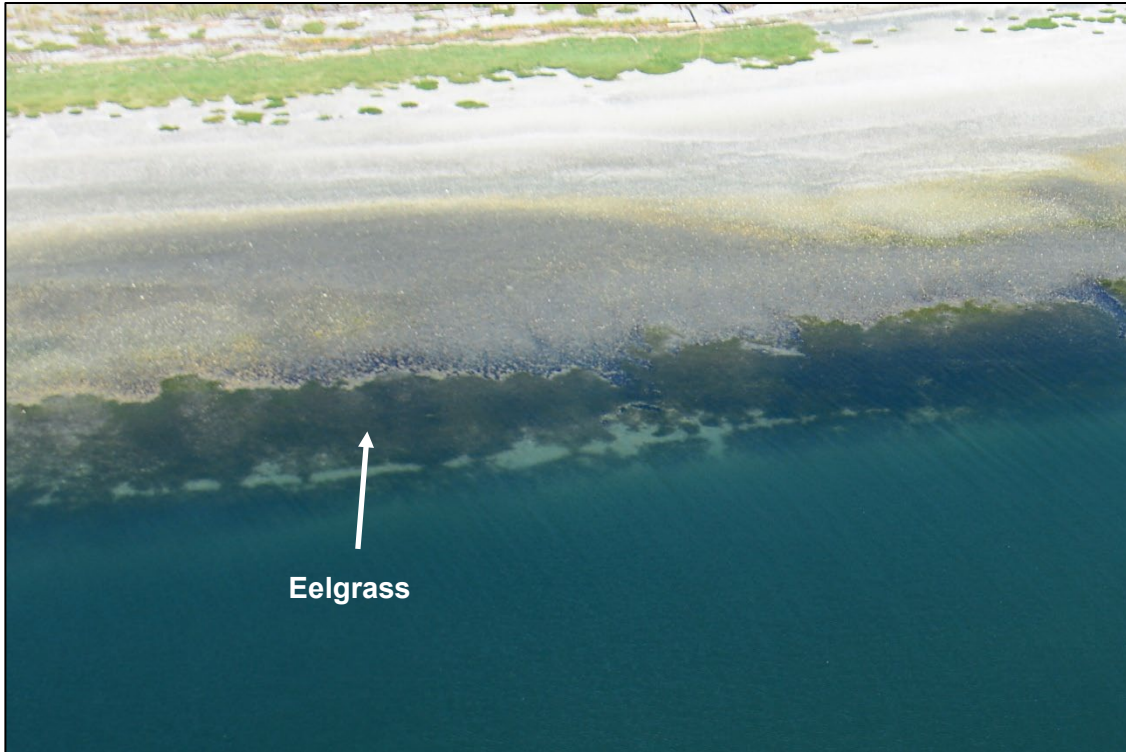


Photo bc21_gi_09117: Example of the Eelgrass (EELG) bioband in the lower intertidal/subtidal. Sandy Island Marine Provincial Park, Denman Island.

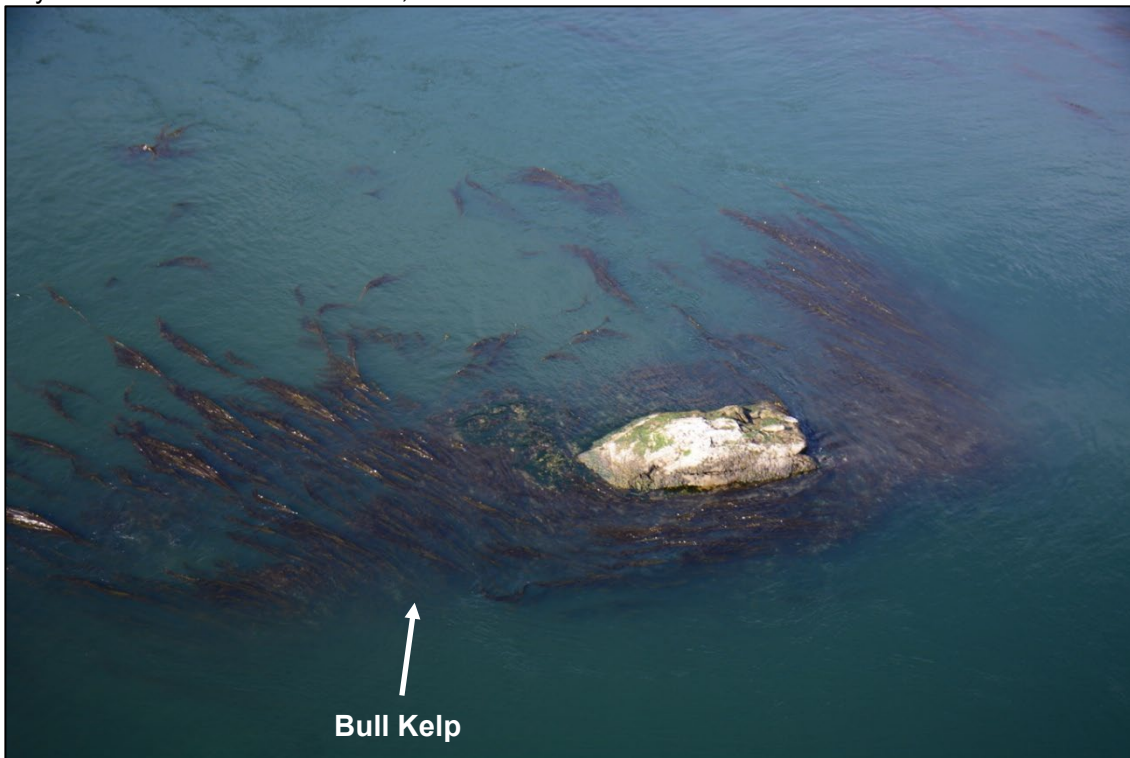


Photo bc21_gi_11299: Good example of the Bull Kelp (BUKE) bioband in the nearshore. Forrest Island.

Figure 7. Examples of the Eelgrass (top) and Bull Kelp (bottom) sensitive habitat biobands mapped as polygons in the Gulf Islands.

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 8 shows an example where the satellite image was of poor quality and even had some cloud cover, which made it challenging to see landmarks that allowed for accurate location of any sensitive habitat polygons. Figure 9 shows an example of a ShoreZone image of poorer quality due to the shading of the shoreline and the glare of the sun off the water. Weather conditions and the timing of the tide windows can cause challenging imaging conditions during any ShoreZone survey.

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. 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 for analysis and management decisions.

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 Gulf Islands and should be used to replace any existing geodatabase the user might have from that area.

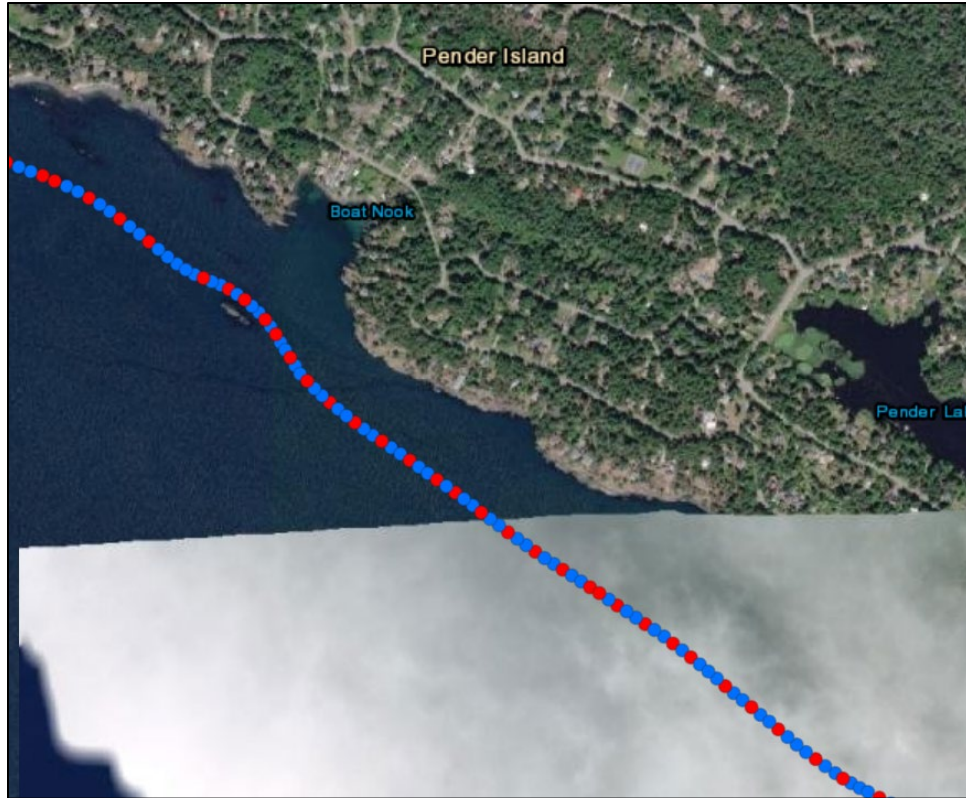


Figure 8. Example of an area where the satellite image was of poor quality and where cloud cover was obscuring part of the shoreline.



Figure 9. Example of an area where the ShoreZone image (bc21_gi_00001 on Galiano Island) was of poorer quality due to the shading of the shoreline and sun glare off the water.

3.2 Results

In total, CORI created **3,539** sensitive habitat polygons. These polygons covered **1,728 ha** of the supratidal, intertidal and subtidal zones of the Gulf Islands. These polygons represent the four biobands mapped as part of this project (Figures 10 and 11). 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.

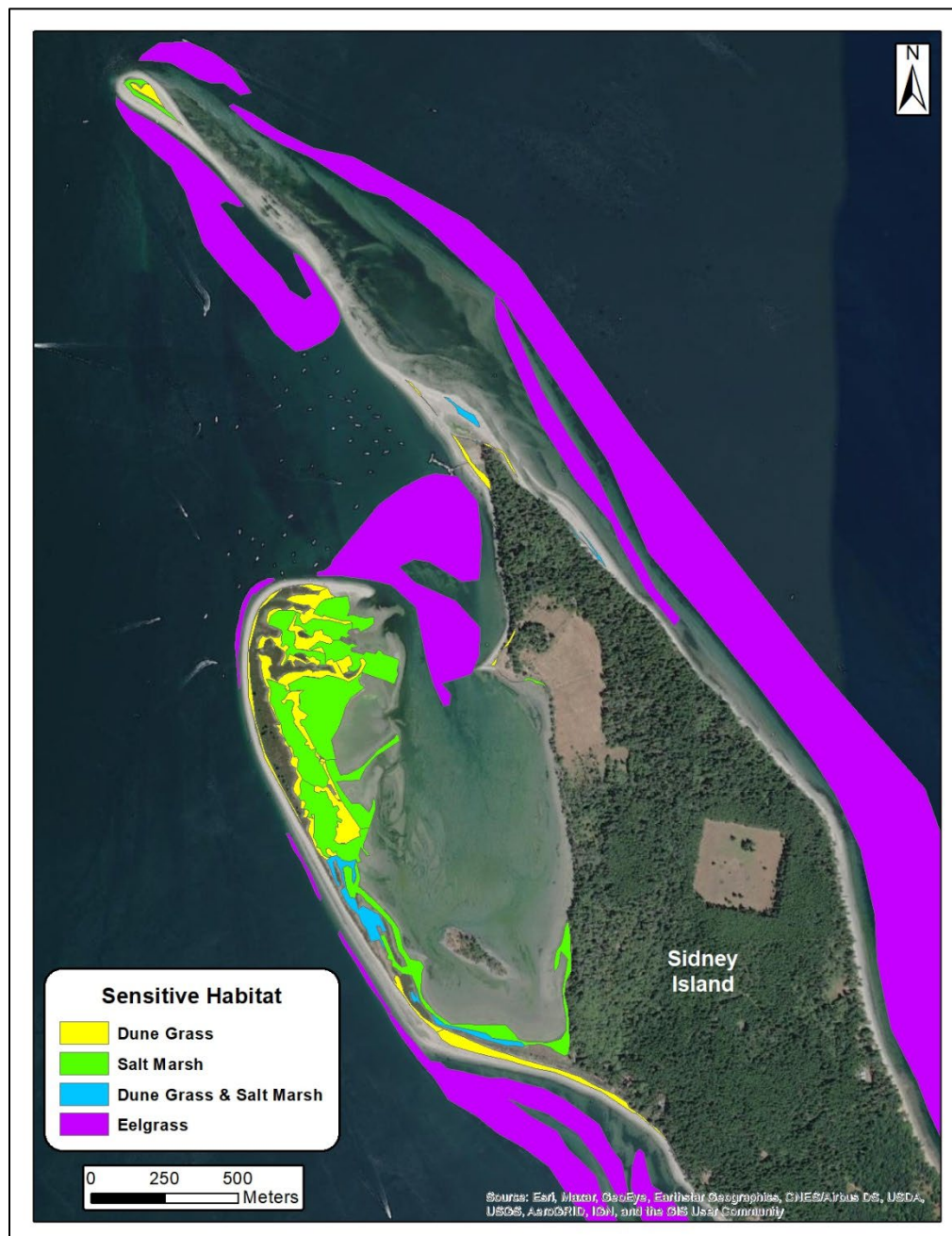


Figure 10. Example of the sensitive habitat polygons mapped around Sidney Island. This was a particularly complex and diverse area.

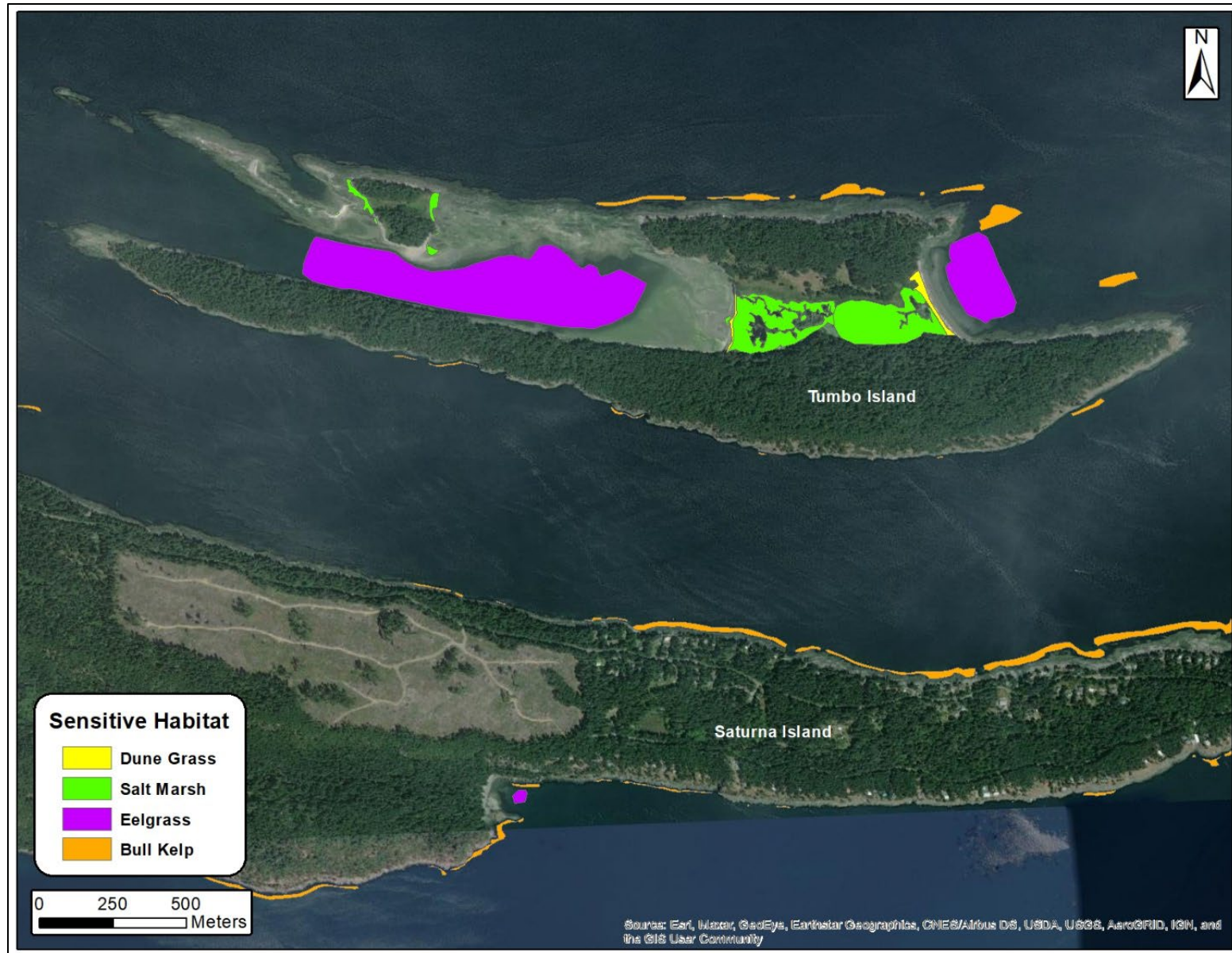


Figure 11. Example of the sensitive habitat polygons mapped around Saturna and Tumbo Islands.

Table 2. Totals of sensitive habitat biobands mapped as polygons in the Gulf Islands. 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	547	26
Salt Marsh	1079	94
Eelgrass	927	1218
Bull Kelp	1117	399

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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.