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ShoreZone Polygon Mapping Summary Report

Bull Kelp in the Islands Trust Area

Imrie Island (bc21_gi_11178)

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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 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).

A ShoreZone imaging survey was conducted in the local trust areas administered by the Islands Trust Council (Figure 1). This survey acquired aerial video and digital still imagery of the coast during the August 6-9, 2021, low-tide window where the tides were lower than 1m in elevation. This imagery was then used, in conjunction with other data sources such as satellite imagery, to create polygons that delineate the boundaries of the Bull Kelp (*Nereocystis leutkeana*) canopy kelp beds in the survey area. Canopy kelps form valuable habitat for fish, invertebrates and other algae and are an important part of a healthy coastline and healthy fisheries. This information can be used to inform management and planning decisions that may impact Bull Kelp in the Islands Trust area as well as to provide a baseline for monitoring of the extent and health of these habitats in the future.

The purpose of this report is to detail the Bull Kelp polygon mapping work with summaries of the data and descriptions of the challenges involved. The length of shoreline imaged was **1,360 kilometers** according to the CHS Highwater line shapefile.

Full ShoreZone (linear and polygon) mapping of this survey area has been funded by DFO Science in support of the PIER program and this mapping is currently underway. That data will be made publicly available on the CORI Download site in April or May 2022.

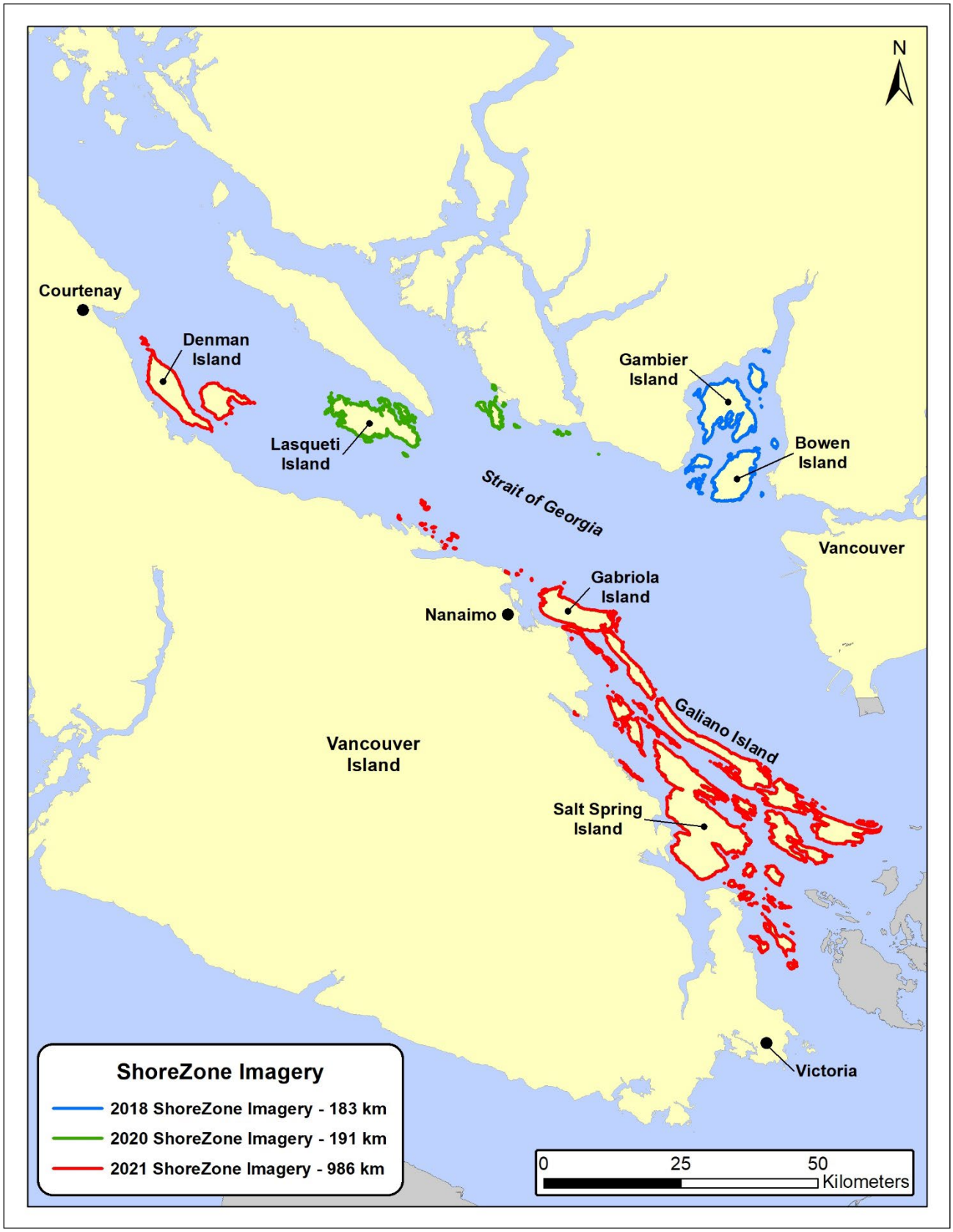

Figure 1. Extent and year of ShoreZone imagery within the Islands Trust area.

2 BULL KELP POLYGON DATA SUMMARY

2.1 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 this project, we focused on the Bull Kelp bioband, the definition of which is provided in Table 1 (taken from Cook *et al*., 2017).

Table 1. Definition of the Bull Kelp bioband.

ShoreZone Code	Zone	Typical Color	Indicator Species	Description	Biological Wave Exposure Range
BUKE	C (subtidal)	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. Often indicates higher current areas if observed at lower wave exposures. Range: Point Conception, CA to Aleutian Islands, AK.	Semi-Protected to Very Exposed

Our method for creating polygons of the Bull Kelp bioband was to take the 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 provided an estimate of the density of the Bull Kelp plants with each polygon. Our density categories were Sparse (S), Moderate (M) and Dense (D). Sparse indicates few or scattered plants within the polygon, Moderate indicates plants are loosely packed or patchy within the polygon, and Dense indicates the plants were tightly packed with little space between. Figures 2 through 4 provide photographic examples of these categories from the Islands Trust ShoreZone imagery. There was also an Undetermined density category for areas where the imagery did not allow for density estimation. This only occurred for polygons assigned a 'Low' Confidence value (see paragraph below for Confidence value definitions). These density estimates are qualitative and are based on the classifier observations rather than quantitative assessments; however, these categories should still be useful for any calculation of biomass or for monitoring efforts, understanding that Bull Kelp distribution and density can vary on an annual and a seasonal basis.

Each polygon was also assigned a Confidence value (Low, Medium or High) which indicates how certain the classifier was that they accurately captured the extent and location of that polygon. This could vary depending on such things as imaging conditions (glare, shade), water conditions (turbidity, waves), and satellite image quality.

Figure 2. Example of Sparse Density category Bull Kelp in the Islands Trust area. Photo bc21_gi_11387 at Ker Island.

Figure 3. Example of Moderate Density category Bull Kelp in the Islands Trust area. Photo bc21_gi_11052 at Rum Island.

Figure 4. Example of Dense Density category Bull Kelp in the Islands Trust area. Photo bc21_gi_10682 at D'arcy Island.

We did encounter some challenges in the creation of the Bull Kelp polygons using this methodology, 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 5 shows an example where the ShoreZone image and the satellite image had a large disparity in the tide level and also where the satellite tiles were from two different time periods, which made it challenging to see landmarks that allowed for accurate location of any sensitive habitat polygons in that area.

We do not yet have any ground-truthing data for the polygons created from ShoreZone imagery, making it challenging to quantify potential classifier error. There was a QAQC process completed wherein each classifier had 10% of their work reviewed by another classifier with comments made about any disagreement in placement, size, or density of the polygons. This was done to reduce inter-classifier variability and to identify and correct any issues. The most common issues were disagreements in the beginning and end points of more sparse beds of Bull Kelp beds, as well as determination of the overall bed width for narrower beds, particularly along steep slopping (cliff) shorelines. These disagreements were generally minor in nature and corrections were made by the original classifier where needed.

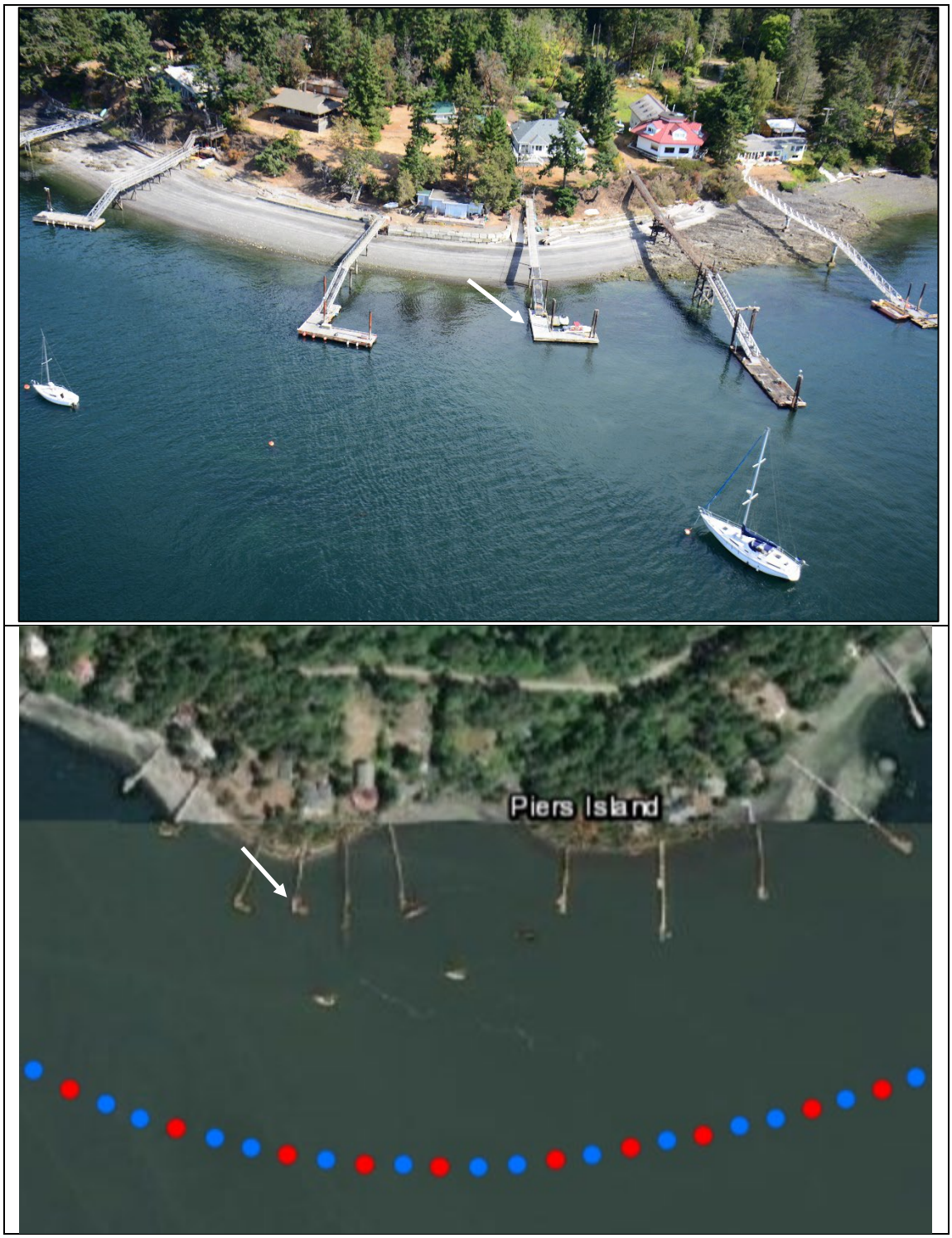

Figure 5. Example of an area where the ShoreZone image (bc21_gi_11717) (top) and the satellite image (bottom) (which shows the same headland on Piers Island) has a large disparity in terms of tide level and also where the satellite image was poor quality. The white arrow on each image indicates the same location. The blue and red dots in the lower image represent the ShoreZone imaging survey helicopter flightline.

2.2 Results

In total, CORI created **1,032** Bull Kelp habitat polygons. These polygons covered 385.3 **ha** of the subtidal area of the Islands Trust area. These polygons were delivered as a shapefile along with this report. Some examples of the polygons created are presented in Figures 6 and 7 while Tables 2 and 3 give a breakdown of the number and area of the Bull Kelp polygons by Density and Confidence categories.

Figure 6. Example of the Bull Kelp habitat polygons mapped around D'arcy Island in the Islands Trust Area.

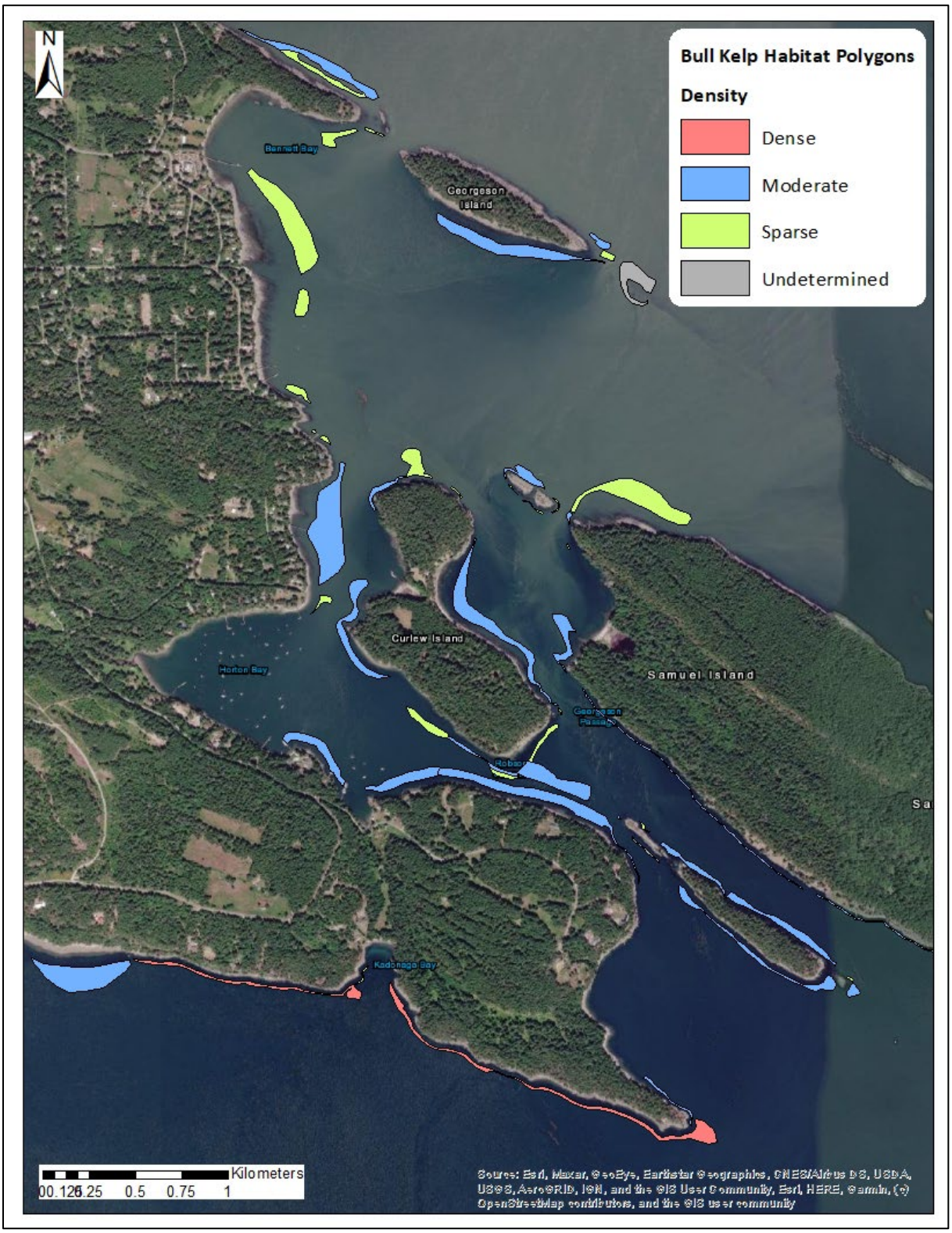

Figure 7. Example of the Bull Kelp habitat polygons mapped in Georgeson Passage, between Mayne and Saturna Islands. This was a particularly complex area.

Table 2. Totals of Bull Kelp habitat polygons mapped in the Islands Trust area by Density category.

Density Category	Number of Polygons	Area of Polygons (ha)
Dense	44	45.3
Moderate	425	249.2
Sparse	551	80.9
Undetermined	12	9.9

Table 3. Totals of Bull Kelp habitat polygons mapped in the Islands Trust area by Confidence category.

Confidence Category	Number of Polygons	Area of Polygons (ha)
High	445	138.3
Medium	575	237.2
Low	12	9.9

There were some trends noted in the distribution of Bull Kelp over the whole survey area. Bull Kelp was far more abundant in the southern portion of the Gulf Islands area with very little being noted north of Galiano Island except in areas with high current, such as Porlier Pass (between Galiano and Valdes Islands) and False Narrows (between Mudge and Gabriola Islands). There was no Bull Kelp observed around Lasqueti, Denman or Hornby Islands or off any of the islands in Howe Sound, despite there being rocky habitat and wave exposures conducive to canopy kelp growth. It is possible this distribution pattern has changed over time, and it may be possible to analyze any changes using historic ShoreZone datasets from the area or from other monitoring datasets collected by Islands Trust, governmental organizations and non-profit or citizens groups.

3 REFERENCES

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