NATURAL RESOURCES

Wildcat Cove Mapping Report

Survey Conducted for the Whatcom County Marine Resources Committee

Washington Department of Natural Resources

November 7, 2023

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Cover Photo: Wildcat Cove from Above.

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Aquatic Assessment and Monitoring Team
Aquatic Resources Division

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Contents

Executive Summary

Wildcat Cove is located within Larrabee State Park, and is the site of a popular small craft public boat launch. The cove also houses a bed of native (*Zostera spp.*) eelgrass. In an effort to understand the current extent of eelgrass within Wildcat Cove and how it may be affected by boat launch activity there, the Washington State Parks (WSP) and Whatcom County Marine Resources Committee (MRC) contracted with DNR's Aquatic Assessment and Monitoring team (AAMT) to map submerged vegetation and bathymetry.

Eelgrass at the deep edge of Wildcat Cove was found to be dense and long, whereas eelgrass above -2 ft. MLLW was short and patchily fragmented. There were obvious omissions of eelgrass within the trajectory of the boat launch, and also reduced percent cover and canopy height at fringing locations adjacent to the intertidal boat launch impact zone.

Recognition of Funding

This report was prepared by DNR using Federal funds under award NA22NMF4690358 from National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author and do not necessarily reflect the views of the U.S. Department of Commerce.

1 Introduction

1.1 Background and Project Description

Wildcat Cove is the site of a popular boat launch within Larrabee State Park. It accommodates the launching of small-motorized boats as well as small non - motorized craft such as paddleboards and kayaks. As the only public boat launch along Chuckanut Drive, it provides high value to the local community.

The Whatcom County MRC has been monitoring the status of native eelgrass within the cove in an attempt to understand more about how the boat launch may impact it. At high tides (greater than 1 ft. mean lower low water (MLLW), boaters can utilize a concrete pad, and back their vehicle and trailer down to the water's edge without posing a risk to the eelgrass bed there. During tides lower than 1 ft. MLLW however, boaters must back vehicles and trailers across the shallow cove until they reach the water's edge. This appears to negatively impact a narrow corridor of eelgrass high in the intertidal between -3 and 1 ft. MLLW.

Seagrasses such as Washington State's native eelgrass *Zostera marina (Z. marina)* play a key role in the nearshore ecosystem. Beds provide food, shelter, and nursery habitat to a wide range of organisms ranging from small invertebrates to commercially important fish species and wading birds. Eelgrass also helps prevent erosion and maintain shoreline stability by anchoring seafloor sediment with its spreading roots and rhizomes (WA DNR 2023).

To this point, a boat based sonar survey has not been carried out to understand baseline subtidal eelgrass cover. To further understand this distribution, the Whatcom County MRC and Washington State Parks contracted with the Washington Department of Natural Resource's Aquatic Assessment and Monitoring Team (AAMT).

On August 7th and 8th, 2023 AAMT mapped Wildcat Cove and the surrounding area for bathymetry and vegetation. This boat based work was accomplished by utilizing a single beam echosounder (Biosonics DTX) and a Multibeam Sonar (R2Sonic). Submerged video was collected to truth the sonar data that was collected.

In addition to the surveys that DNR completed, Western Washington University and other partners have established monitoring to both photo document the effects of launching boats at the site as well as to understand how and when the boat launch is utilized. This additional data is not represented in this report. More information can be found at the Whatcom Marine Resources website: Whatcom County MRC.

1.2 Site Description

Wildcat Cove is located approximately 8.4 miles from Bellingham. A wide range of community members including state park visitors, boaters, and rock-climbing enthusiasts etc. utilize the site. The boat launch here consists of a cement pad which extends into the protected cove approximately to the 1 ft. MLLW tidal line. The shallow cove is guarded by two large Chuckanut sandstone blocks positioned at its mouth.

Figure 1. Wildcat Cove at a relatively high tide. Within the zone of intertidal truck/ trailer travel (hashed line) there is a visible lack of eelgrass. Satellite photo from Google Earth.

Figure 2. Wildcat Cove during summertime (July 2017) low tide. The tide is at an approximate low of -2 ft. MLLW, and tire depressions are obvious within the trajectory of the boat launch (within hashed box). Satellite photo from Google Earth.

Figure 3. Another view of Wildcat Cove. Visible is a strip of missing eelgrass in the trajectory of the boat launch. Image from Department of Ecology Shoreline Photo Viewer.

1.3 Specific Study Objectives

As a project partner, DNR was contracted to map the area around Wildcat Cove. Mapping was completed to delineate the following:

1. The current extent of eelgrass within Wildcat Cove (both shallow and deep edges).

2. The current extent of eelgrass surrounding the Wildcat Cove Boat launch.

3. Seafloor surface morphology (or bathymetry) surrounding and within Wildcat Cove.

2 Methods

Two different hydrographic surveys were carried out over two days at Wildcat Cove. Both single beam and multibeam sonar were collected to reveal the total vegetative cover as well as the bathymetry of the cove and area surrounding the boat launch.

2.1 Survey Design

Single beam sonar transect lines were set up to cover the entire cove at a resolution of 10 meters. Focused survey lines at 3 meters were planned around the boat launch (Figure 4). ArcGIS Pro was used in the planning process to create transect lines using the create fishnet tool (Figure 4). Transect lines were transferred to a survey computer for the boat operator to use as a guide.

A multibeam sonar area was identified to cover Wildcat Cove and extend approximately 200 meters past its mouth.

2.1.1 Boat launch Impact Zone

To reference field data to the area of expected impact, a polygon feature class was created in Google Earth and exported to a feature class using the .kml to feature class tool in ArcPro. This polygon “Intertidal Boat Launch Impact Zone” was defined to include where truck and trailer tire imprints were visible at low tide in satellite imagery from July 2017 (Figure 12).

Figure 4. Single beam sonar transects, Wildcat Cove - Larrabee State Park.

2.2 Hydrographic Survey – Mapping Vegetation and Bathymetry

On August 7^{th} and 8^{th}, 2023, 5.26 acres within and surrounding Wildcat Cove were mapped for vegetation and shoreline bathymetry. The Research Vessel (RV) Neap surveyed as close to shore as was possible during the high tide on August 7th (5.75 ft. MLLW high) and August 8^{th} (5.87 ft. MLLW high).

2.2.1 Field Collection – Single Beam Sonar

WADNR Aquatic Assessment and Monitoring Team (AAMT) staff utilize a BioSonics DTX single beam transducer onboard AAMT's 21-foot research vessel to accurately and efficiently collect eelgrass (*Zostera spp.*) presence absence, and canopy height as well as bathymetric data (Gumusay et al., 2019).

This BioSonics DTX system is a proven and accurate platform for aquatic vegetation delineation and mapping (Gumusay et al., 2019; Stevens et al., 2008). It emits a 420 kHz sound pulse with a width of 6 degrees, collects a sound signal reflected from the surrounding environment, and converts the signal into electrical energy. A BioSonics surface unit is used in tandem to interpret the incoming electrical signal, associate each ping to positional GPS in an interface for users to observe incoming data, adjust settings, and store raw data as digital files.

The transducer head (Figure 5) is mounted on an aluminum pivot arm off the starboard side of the vessel and when vertically deployed sits approximately .39 m underneath the water's surface (Figure 5). This pole and mounting bracket have been designed to reduce vibration and to maintain a level position while collecting data thereby minimizing distortion in backscatter readings (Figure 4). A Trimble Pro 6H GPS is mounted on the top of this pole and directly overhead the sonar transducer (Figure 5). This GPS feeds position data (accurate up to 10cm) to both the Biosonics surface unit as well as a tethered towable camera.

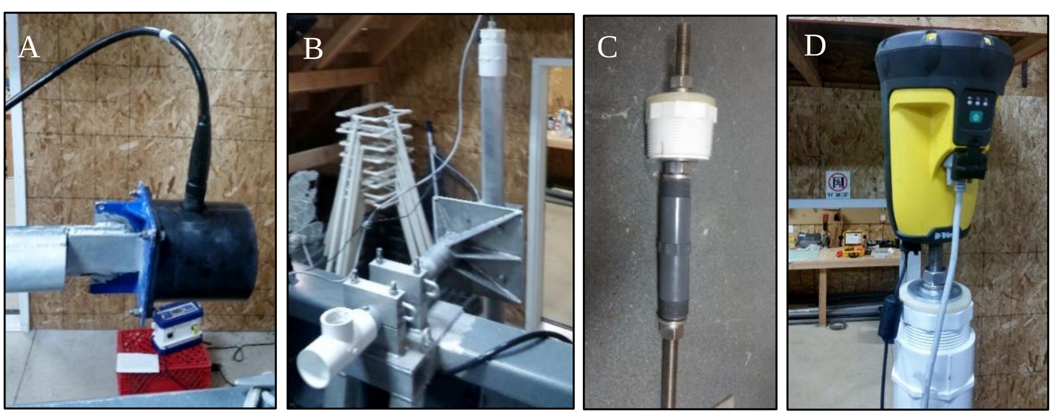

Figure 5. A. Single Beam Sonar transducer with deck cable connected B. SBS mount in survey positions C. GPS mount. D. GPS with RS232 and micro USB cables attached

2.2.2 Settings

A sound pulse ping rate is set at a standard of 10 pings per second and the duration for each pulse is set to 0.1 millisecond. These values have been found to be best when collecting data for eelgrass delineation (Stevens 2008). The maximum depth at which data is collected varies per site but averages 15 m. Eelgrass rarely grows beneath 12m in Puget Sound (Christiaen 2022). Data is collected at a rate equal to the ping rate, 10 data points per second.

2.2.3 Video

BioSonics software interprets a unique sound return for eelgrass; however, there are anomalous features that may be misinterpreted as eelgrass when post-processing (Sabol et al., 2002; Shuai Xu, 2019). To verify eelgrass presence, we collect underwater video along 10% of the transects surveyed. For these transects, video can be collected while the sonar is also running by towing a SeaViewer Sea-Drop 950 video camera weighted and suspended by line off the port side of the boat. In real-time, a SeaViewer Sea-Trak GPS overlay displays time and GPS locations onto the video image (
Figure 7). Video data is recorded digitally on an SD card with a SeaViewer DVR-SD.

The towed camera is housed within a PVC enclosure which orients it at a 45 degree angle to the bottom, protects the camera from potential damage, and allows the camera to track straight with the use of fins and weights (Figure 6). To maintain a constant field of view, the camera is held about 1 m from the benthos.

Figure 6. Left: Seaviewer Camera. Right: Seaviewer Surface Unit and Recorder Interface

Figure 7. View of real-time video collection and attributes

2.2.4 Post-processing

BioSonics data is processed for each transect using BioSonics Visual Aquatic software. This software allows a trained technician to correct inaccuracies in bottom detection and eelgrass delineation after algorithms within Visual Aquatic have been applied. These algorithms are a starting point at providing a rough classification of seafloor bathymetry and eelgrass presence or absence by sonar ping (BioSonics 2023). Eelgrass presence is determined by a unique backscatter or "bearding" pattern in the data (Figure 8). This pattern is caused by the structure of seagrass is unique from other functional groups of marine vegetation (Shuai Xu, 2019).

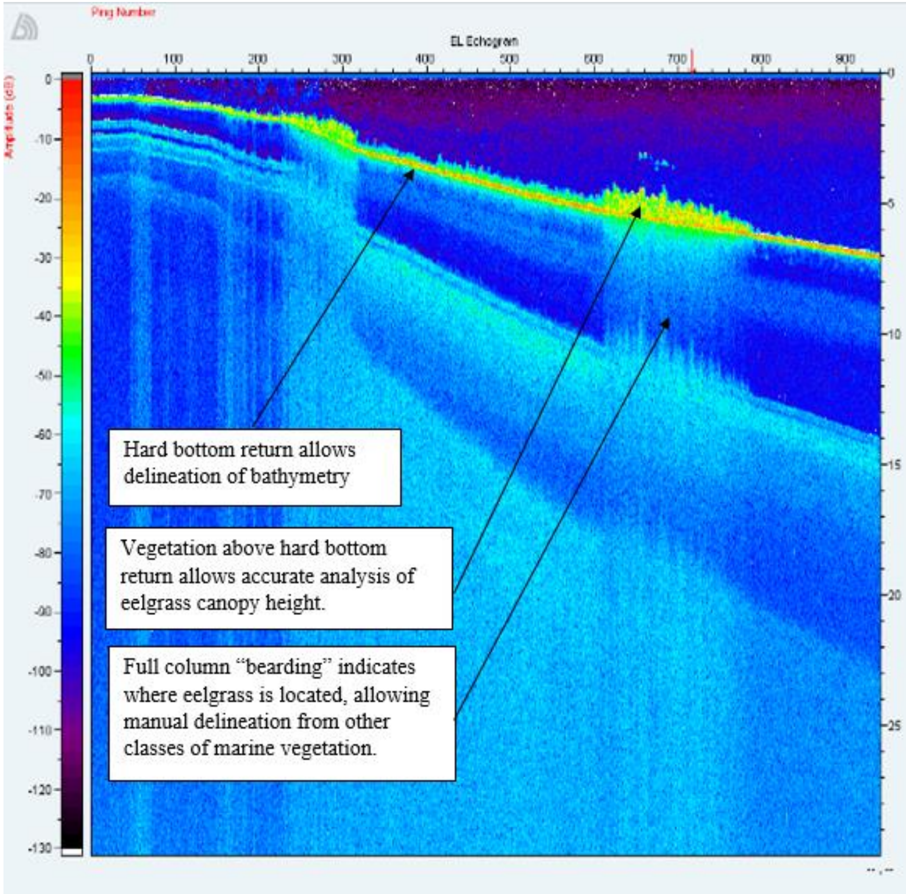

Figure 8. Image showing the distinction in the backscatter pattern unique to eelgrass.

Processed transect files are exported to a CSV format and combined into one complete dataset for further post-processing and analysis. These exported CSV files include attributes for the date, time, location (latitude, longitude), percent eelgrass cover, eelgrass canopy height, and substrate depth. Eelgrass cover for each ping is represented with a one (present) or a zero (absent), and percent cover is calculated by averaging eelgrass presence and absence over 10 pings.

GPS data collected with a Trimble Pro 6H antennae is differentially corrected with Trimble GPS Pathfinder Office (TPO). This software utilizes a network of base stations to increase accuracy of locational data by removing errors caused by various factors (e.g., cloud cover). Accuracy for data collected with the Trimble Pro 6H can be as resolute as 10 cm after post-processing.

Raw bathymetry is imported from the processed Visual Aquatic CSV and corrected for an offset to adjust for the distance between the top of the water line and the bottom of the transducer (measured before each survey). It is then transformed to Mean Lower Low Water (MLLW) vertical datum using tidal data from T-bone tides and a custom R version 4.2.2 script (University of South Carolina 2020, R Core Team 2023).

Video data is reviewed by a trained analyst into one-second segments. Presence and absence of all marine vegetation classes (kelps, red algae, green algae, seagrass, and sargassum) as well as bottom type are determined. BioSonics data for the same transects are compared to results from processed video for quality control and to tune BioSonics edits.

2.2.5 Field Collection – Multi Beam Sonar

An R2sonic 2020 multibeam sonar and an integrated Applanix navigation system was utilized for bathymetry. The R2Sonic 2020 model is a small and light flat-array multibeam unit that combines the transmitter and receiver into a single instrument. Position, heading, pitch, yaw, and roll are recorded with an Applanix Inertial Motion Unit (IMU) and Trimble GNSS positioning system. Using Applanix's POS PAC software (Applanix Corporation 2021) DNR scientists are able to collect raw motion and heading data in the field, process these observations in the office, and recalculate the entire survey's data for high-accuracy three dimensional spatial locations.

Data was collected at a 400 kHz frequency, with a beam width of 130 degrees. At least fifty percent data overlap was collected between tracks. The survey was planned and carried out with QINSY software by QPS Maritime Software Solutions. Sound speed calibration casts were taken every 2 hours with a Sontek Castaway CTD.

Figure 9. RV Neap

Figure 10. R2Sonic 2020 multibeam (bottom, grey), Applanix IMU (top, black), and mount (blue)

2.2.6 Data Processing

Bathymetric surfaces were cleaned and processed with QPS QIMERA software. A corrected position and motion file was created with Applanix PosPac software and applied to raw bathymetric files. From these raw files, a dynamic surface was created by which point surface data anomalies were edited by hand.

Once manual edits were applied, a final dynamic surface was exported as a two band 0.25 m^2 resolution raster (hereafter referred to as Bathymetric Attributed Grid (BAG)). Band 1 in the BAG contains elevation data in the NAVD88 (m) vertical datum averaged from a cloud point surface. Band 2 contains CUBE uncertainty data for every band 1 cell calculated as the standard deviation of the accepted soundings that contributed to the selected surface hypothesis.

Bathymetric estimates in survey datum NAVD88 (m) were converted to MLLW (ft.) using NOAA’s Vdatum tool (NOAA 2023).

Using the Benthic Terrain Modeler (BTM) package in ArcPro, the “roughness” of the Wildcat BAG surface was defined using rugosity and slope. Rougher zones were extracted using a supervised classification in ArcPro and exported to a single feature class to provide a multibeam generated representation of eelgrass in the cove.

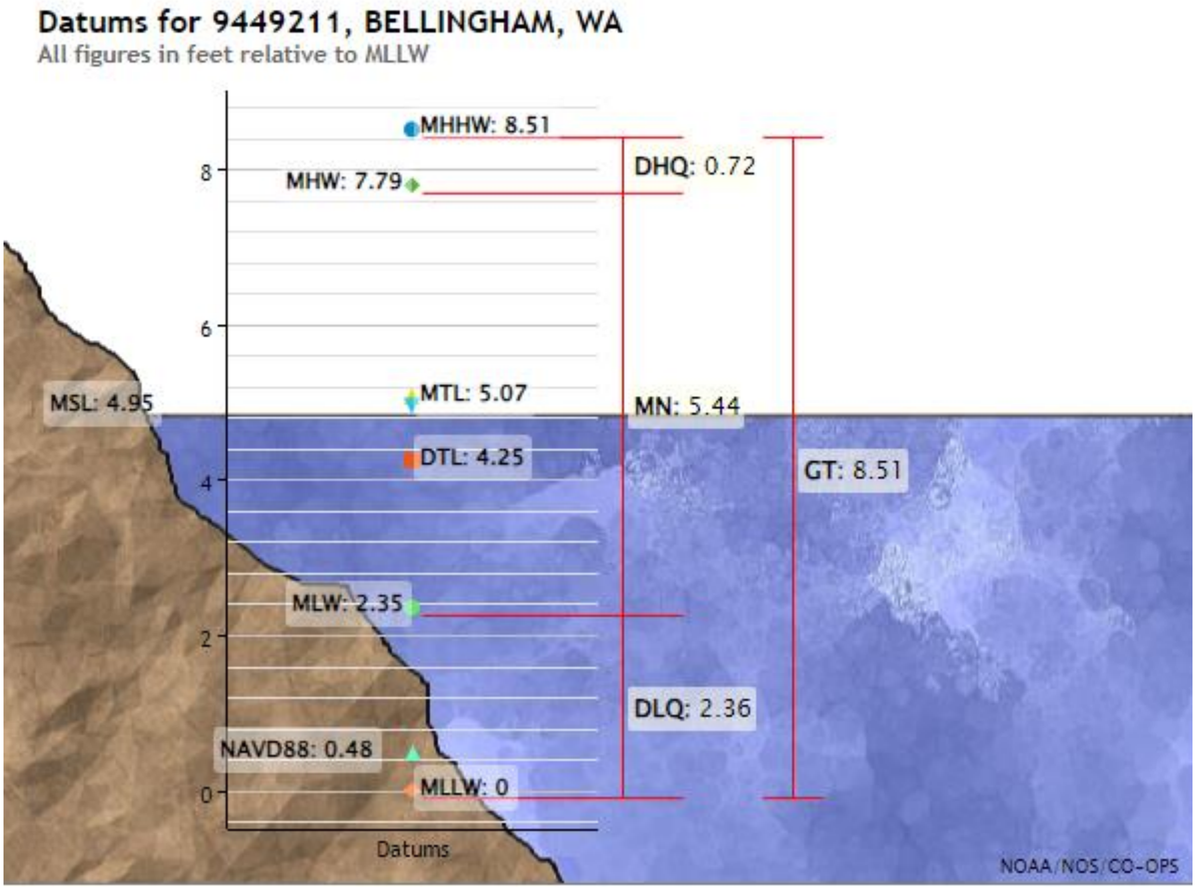

Figure 11. Datum Benchmarks for Bellingham Bay showing the difference between NAVD88 (m) and MLLW (ft.).

3 Results

3.1 Bathymetry – Multi Beam Sonar

Bathymetry mapped in the vicinity of Wildcat Cove revealed a steep incline at its mouth. The seafloor slopes up from -12 ft. (MLLW) to – 2 ft. (MLLW) in a distance of only 230 ft. Shoreward of this steep slope, the cove has a gentle slope that increases to only 1 ft. MLLW at the very shallowest zones (Figure 12).

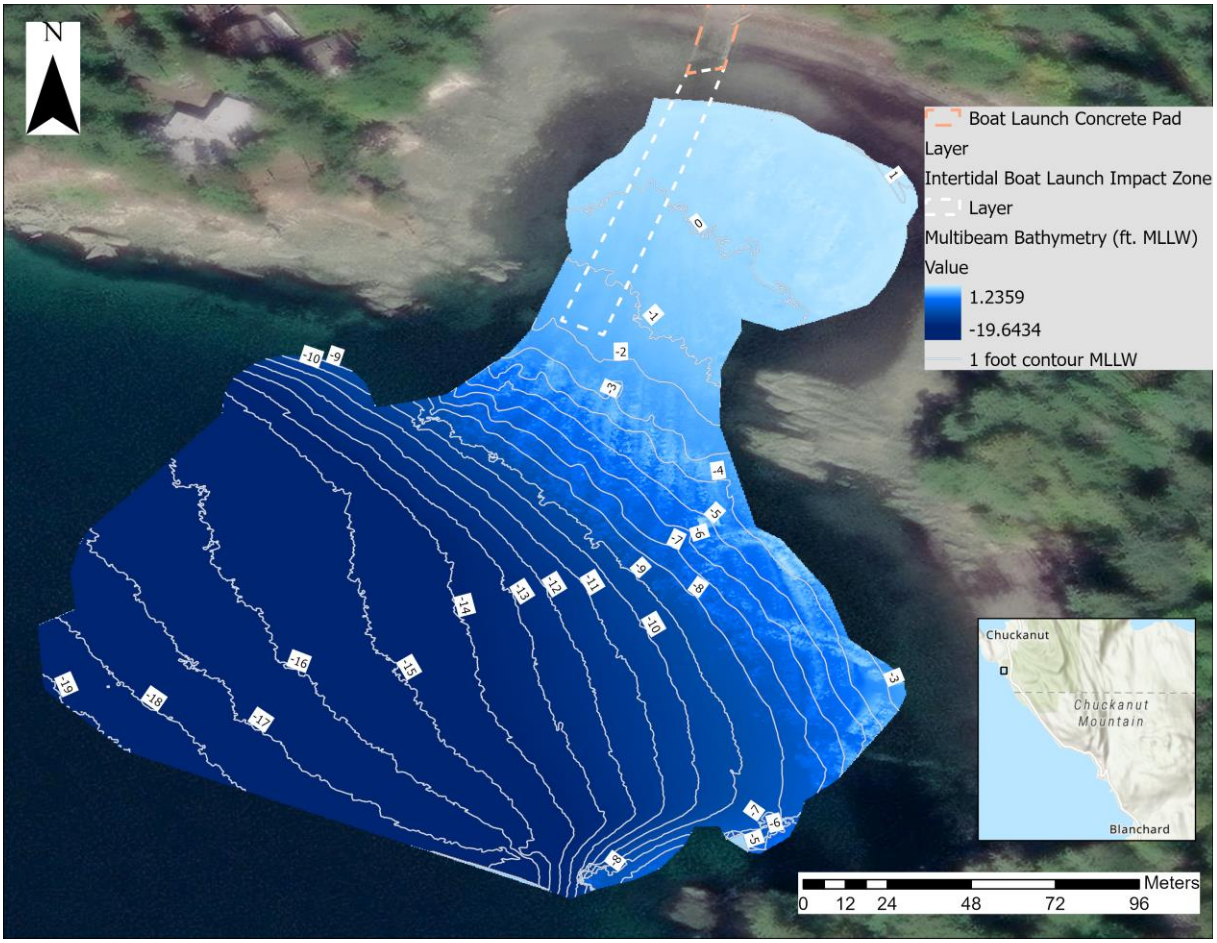

Figure 12. Wildcat Cove Bathymetry

3.2 Eelgrass – Multibeam Sonar

By exporting a classified surface of the rugosity tool in the Benthic Terrain Modeler, eelgrass distribution was estimated in and around Wildcat Cove. The product of this workflow is represented in Figure 13. Because this classification is based on surface "roughness", it represents areas where eelgrass canopy height is equal to or exceeds approximately 5 - 10 cm. It is important to note that in locations where very small or sparse plants exits, they may not be represented by this surface.

Eelgrass is densest in a narrow subtidal band between -2 and -10 ft. MLLW (Figure 13). Farther into Wildcat Cove (shallower than -2 ft. MLLW), the bed becomes much more fragmented (Figure 13). It is apparent that the zone surrounding the boat launch (and its trajectory) is much less dense, with bare sand and very few instances of plants.

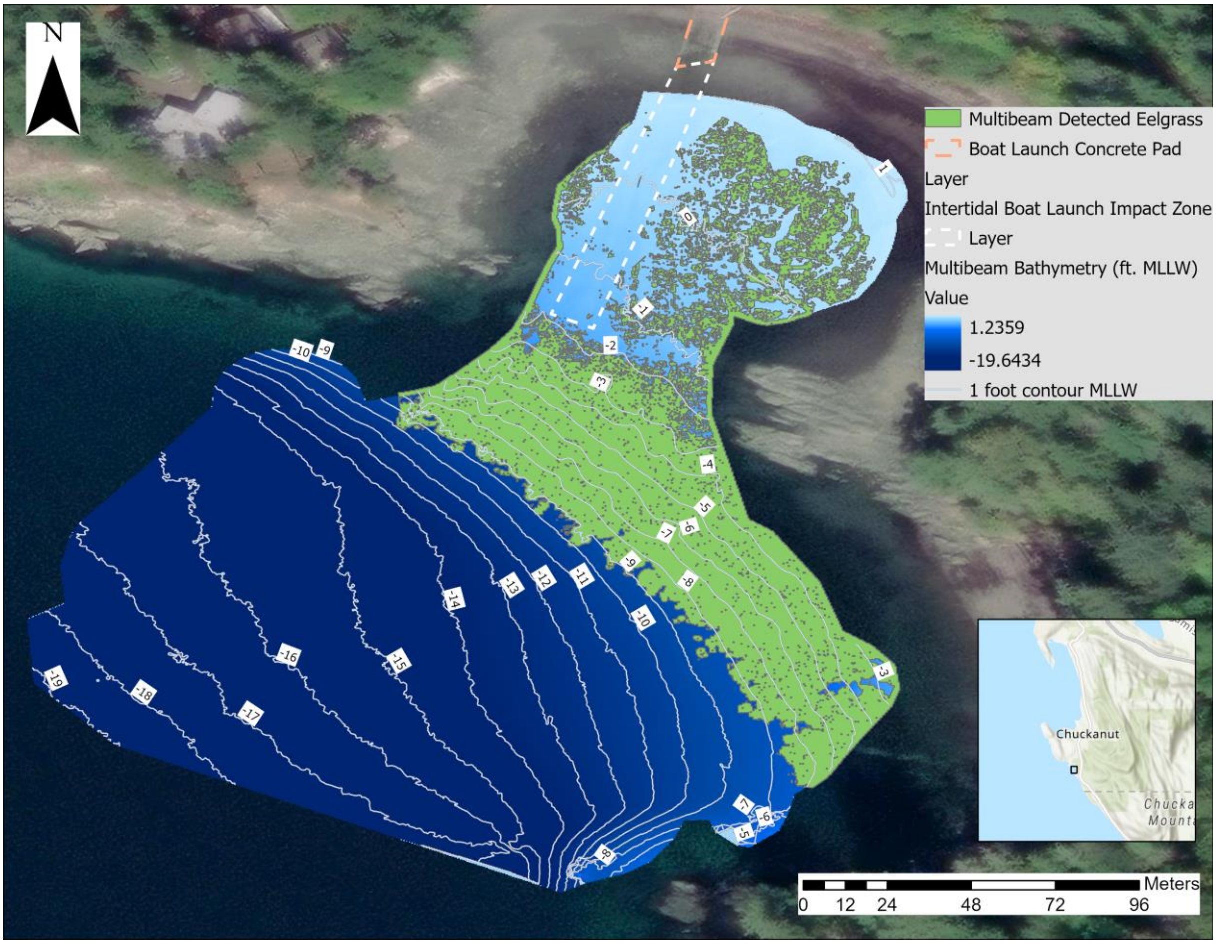

Figure 13. Eelgrass detected with mutibeam sonar.

3.3 Eelgrass - Single Beam Sonar and Video (Percent Cover and Canopy Height)

The following maps are for percent cover and canopy height of eelgrass directly under the RV Neap. While every attempt was made to stay on transect, operation within the narrow rocky confines of the cove proved difficult, and as seen in Figure 16 and Figure 17, the vessel strayed from straight line transects.

3.3.1 Bathymetry

Single beam sonar data corroborates data from the multibeam sonar, and shows the same pattern of dense, deep, eelgrass from -10 to -2 ft. MLLW within a narrow band and fragmented, short eelgrass (*Z. marina spp.*) within the flats of the cove (Figure 16 and Figure 17). Figure 14 and Figure 15 are snapshots from video, and represent eelgrass that was found in a deep band (Figure 14), and that which was found in shallow portions of the cove (Figure 15).

Figure 14. Eelgrass from video survey - this sample is from within the -10 to -2 ft. MLLW zone.

Figure 15. Eelgrass found in the upper regions of Wildcat Cove was patchily distributed and short such as the sample in this screenshot.

3.3.2 Percent Cover

Percent cover is highest within the deep band from -10 to -2 ft. MLLW (75 – 100%), and becomes more fragmented shoreward of -2 ft. MLLW, where 20 – 75% cover is common, but higher and lower cover instances in patchwork exist (Figure 16). The region inside and bordering the intertidal boat launch impact zone appear to be the only locations (other than the shallow edge of the bed) where continuous portions of eelgrass were absent (Figure 16). While isolated instances of low percent cover exist within shallow regions of Wildcat Cove, locations that are fringe to the boat launch impact zone have the lowest percent cover of the entire cove on the order of 0 – 20 %, compared to an inner cove average of 31.8% cover (Figure 16).

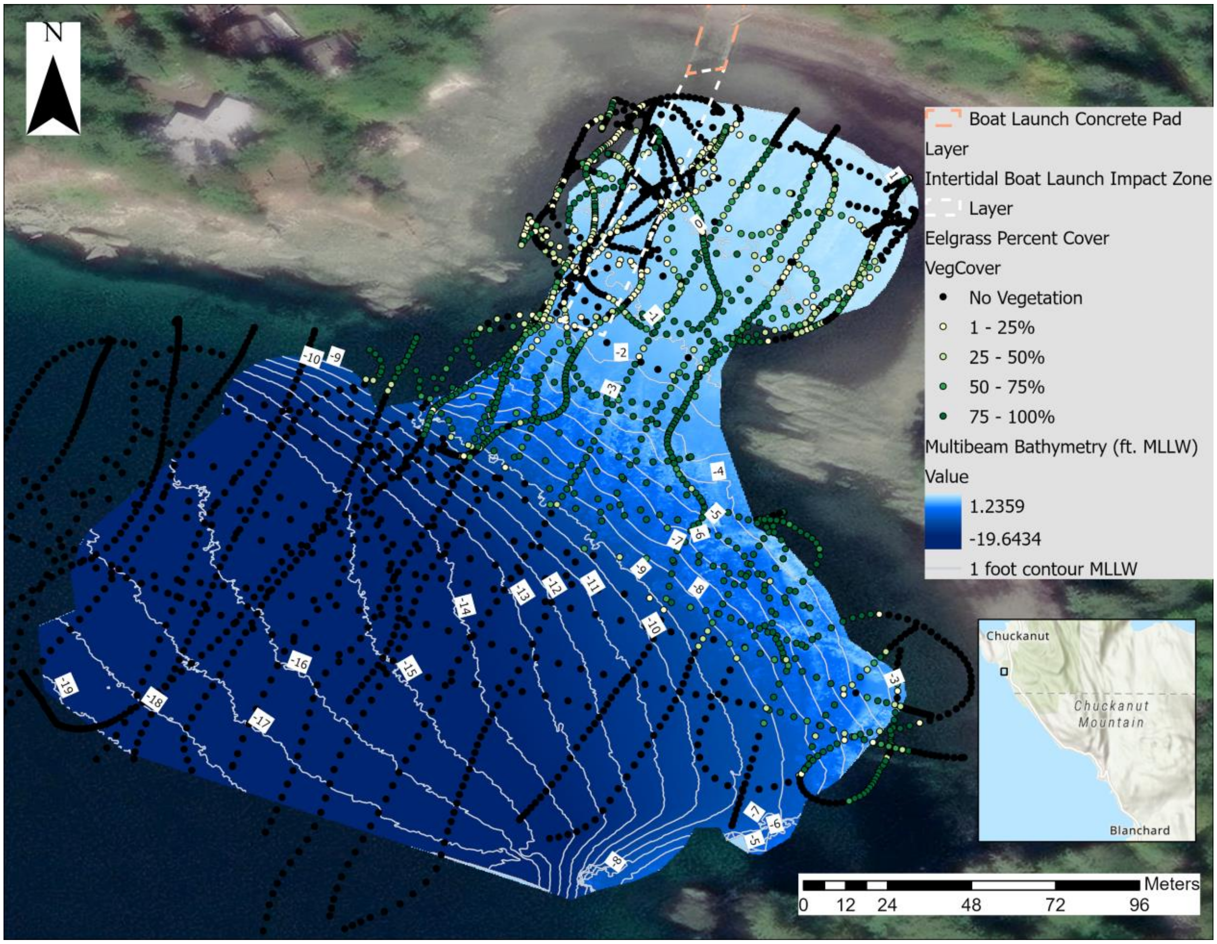

Figure 16. Eelgrass percent cover from single beam sonar survey transects. The points indicate where RV Neap was driven.

3.3.3 Canopy Height

Eelgrass canopy height is greatest in the deep narrow band from -10 to -2 ft. MLLW, and averages 72 cm with maximum length at 179 cm. Shallower than -2 ft. MLLW, canopy height is much shorter, and averages 10 cm, with a maximum length of 40 cm (Figure 17). Areas that fringe the boat launch impact zone have shorter eelgrass than the average of 10 cm (Figure 18).

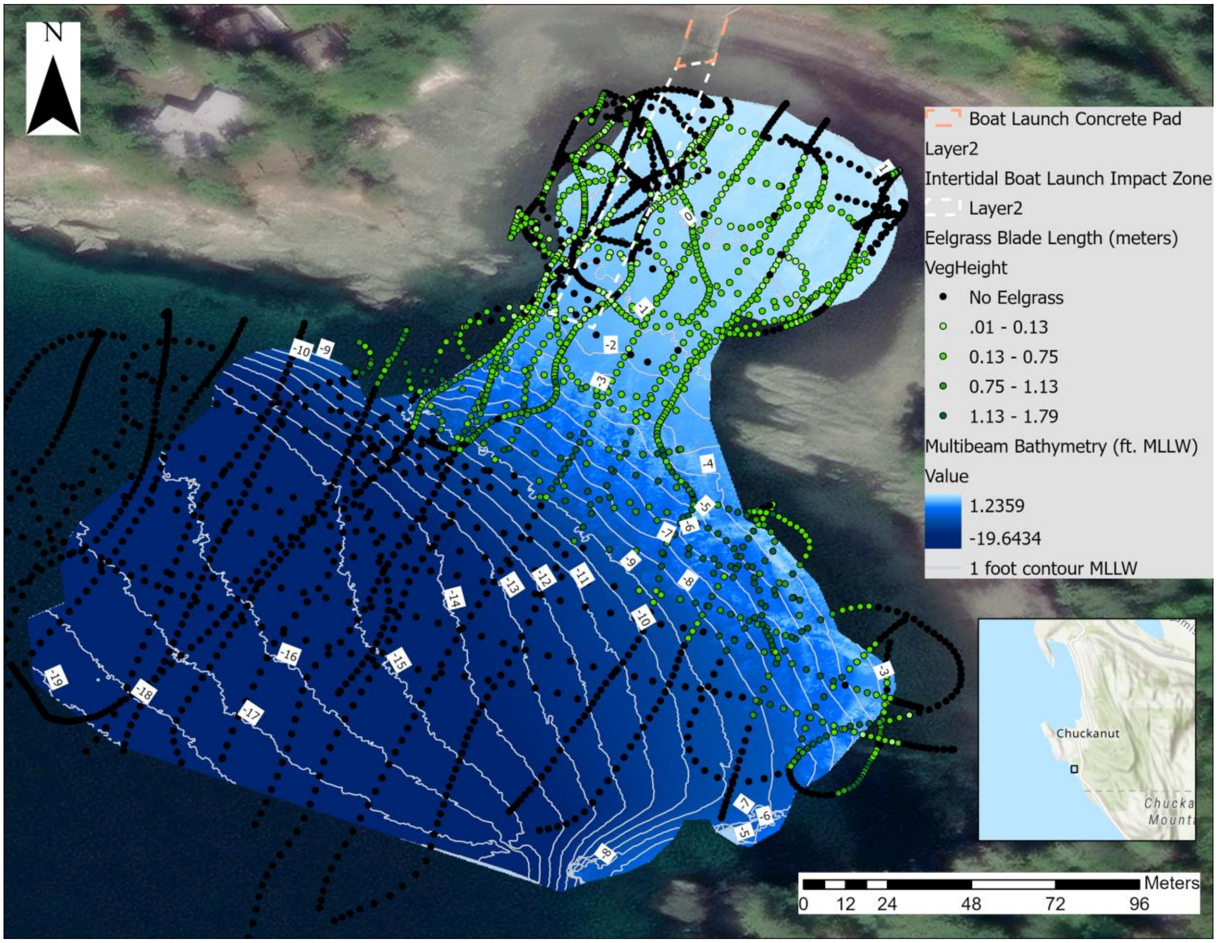

Figure 17. Eelgrass canopy height from single beam sonar survey

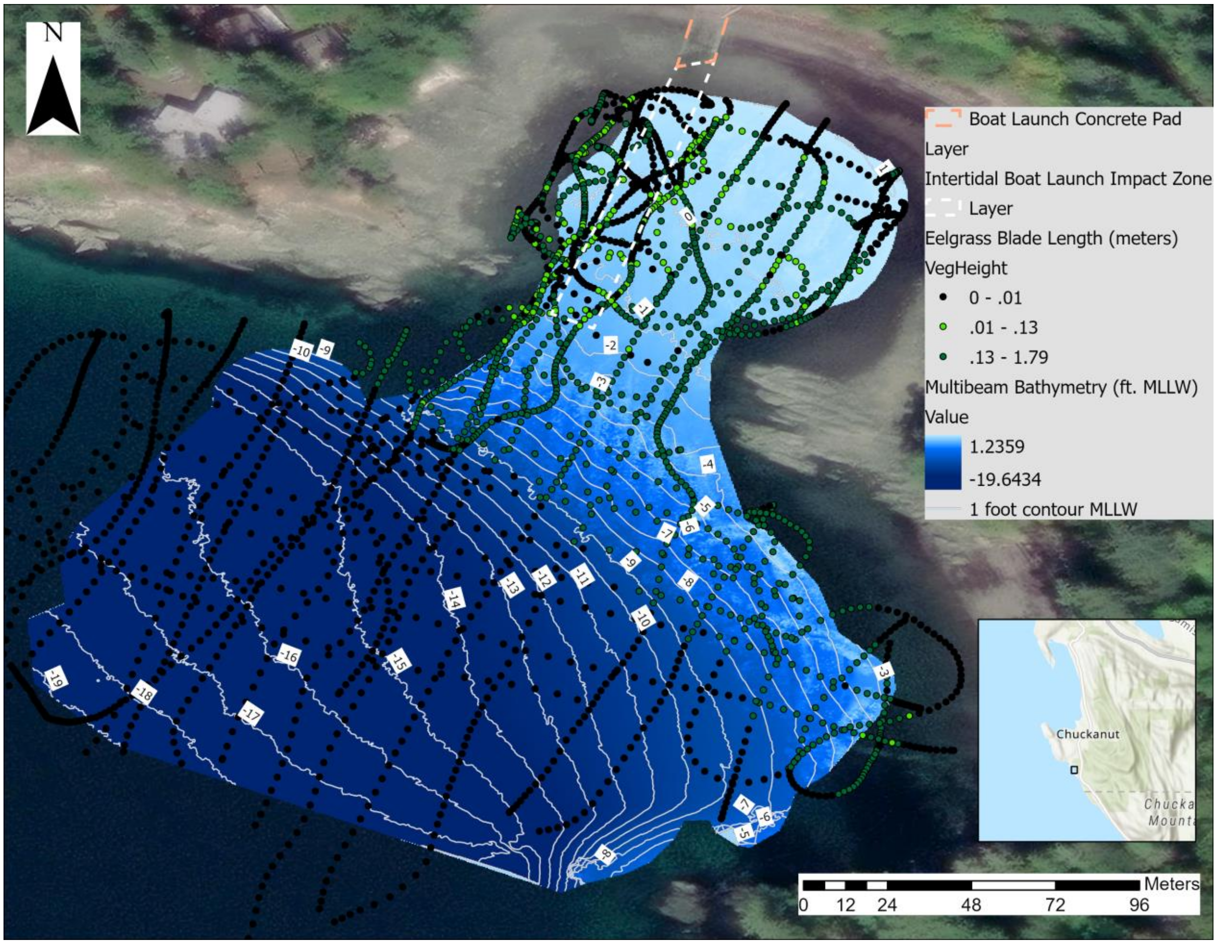

Figure 18. Canopy height represented with a simplified scale.

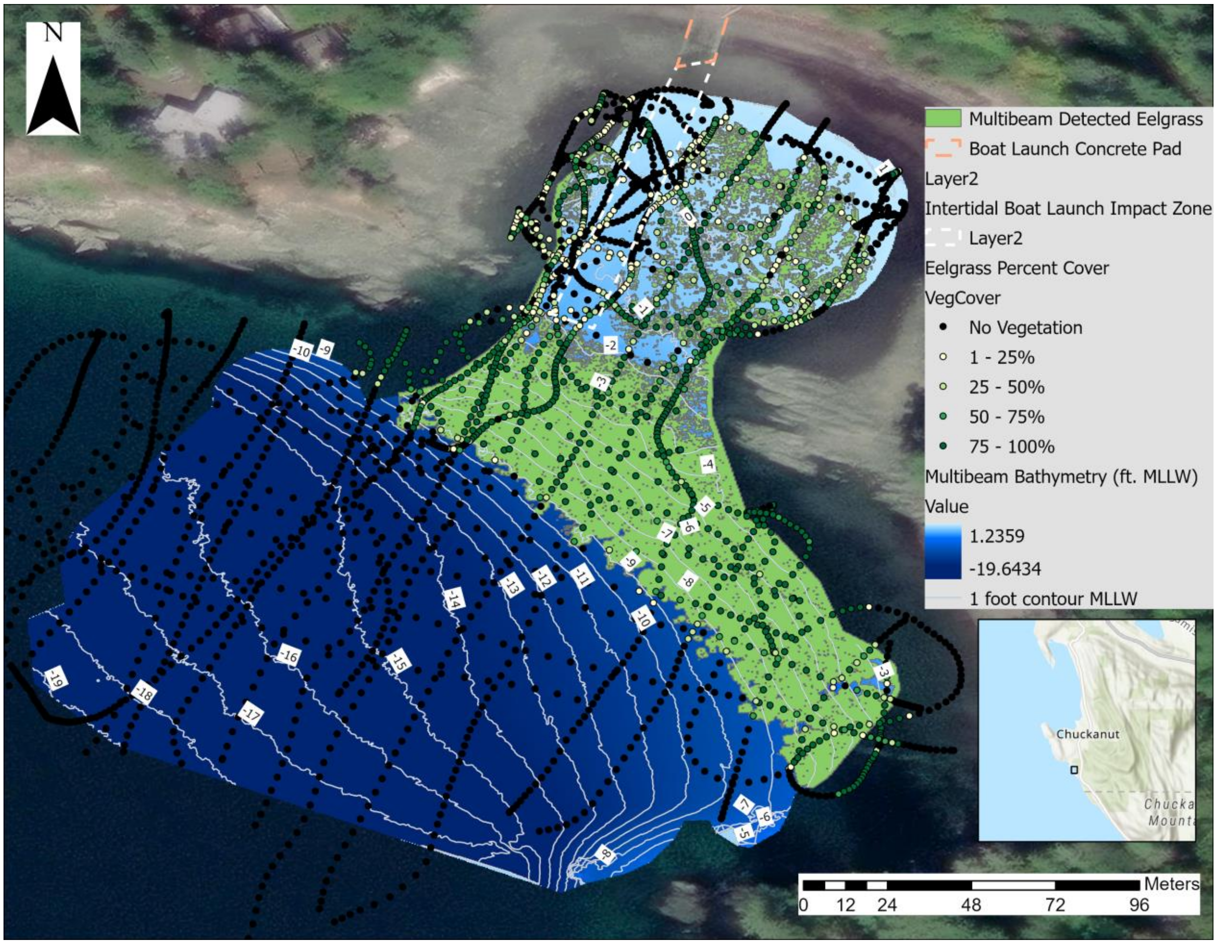

Figure 19. Multibeam bed morphology and single beam percent cover.

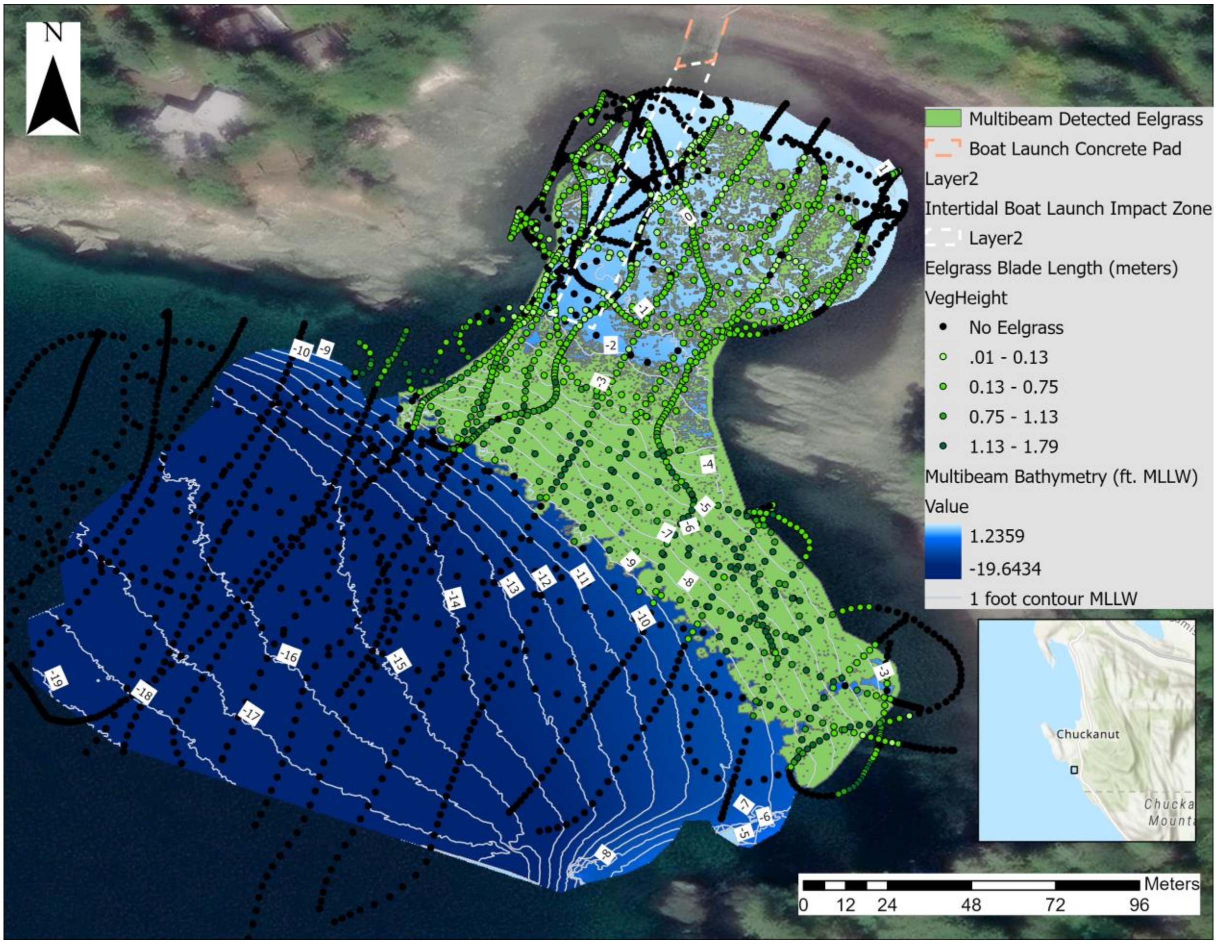

Figure 20. Multibeam bed morphology and single beam canopy height

3.3.4 Video

Video revealed that filamentous green algae (*Ulva spp.*) was mixed in with eelgrass primarily above 0 ft. MLLW within Wildcat Cove. Eelgrass species were not possible to differentiate from video. We confirm *Zostera marina* present, and while it is possible that Zostera japonica (Japanese dwarf eelgrass) exists shallower in the cove, other nearby DNR eelgrass surveys do not indicate the presence of non- native eelgrass (DNR Submerged Vegetation Monitoring Program 2008).

4 Discussion

The results from both the single beam and multibeam sonar surveys in Wildcat Cove suggest that boat launch activity in the summer negatively impacts the eelgrass bed there. Although eelgrass above -3 / -2 ft. MLLW is sparse and small to be begin with, we found significantly further reduced bed coverage, canopy height, and percent cover within and adjacent to where boats are driven across the tide flat at low tide. While this absence of eelgrass is evident even from aerial imagery, we suggest that a finer scale understanding may require repeatable surveys at low tide. This type of survey would allow surveyors to return to the same transects season after season to understand change vs use.

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