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Intertidal Biota Monitoring at Boulevard Park, Bellingham, WA

Monitoring Report

Prepared for:

Whatcom County Marine Resources Committee

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This Monitoring Report describes the research and monitoring study of intertidal biota conducted in the summers of 2013-2015 and again in 2019 at Boulevard Park in Bellingham, WA. In 2019, this project has been funded wholly or in part under grant agreement SEANWS-2018-WhCoPW-00013 to the Whatcom Marine Resources Committee, by the United States Environmental Protection Agency under Assistance Agreement [CE-01J31901]. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use. Surveys in 2013, 2014, 2015 and this report were funded by the Whatcom County Marine Resources Committee.

Copies of this Monitoring Report will be available at http://www.mrc.whatcomcounty.org/.

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Acknowledgments

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Surveys, data entry, quality control assistance and report writing were made possible by a vast array of interns and volunteers. Significant help was provided by Lilya Jaeren and Crystal Schmalz to conduct the trainings, surveys, quality control measures, and data entry. On the beach assistance for identification was given by Bob Lemon and MRC member, Doug Stark years 2013-2015 and by Bob Lemon and Lynn Givler in 2019 with species list assistance from Linda Schroder and additional scientific technical help from Michael Kyte. These two individuals made all the difference to having a successful program.

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Abstract

The Whatcom County Marine Resource Committee performed intertidal surveys at four sites throughout Boulevard Park during the summers of 2013-2015 and again in 2019 to assess the 2013 shoreline enhancement action on the beach slope, substrate, and diversity of intertidal organisms, as well as to attain a baseline of these factors for the Boulevard Park Beach. At these four sites, the number of individual animals, areal coverage of plants, algae, and colonial animals within four 19.8 inches X 19.8 inches (50 cm X 50 cm) quadrats at the +6, +4, +1, and -1 foot (ft) tidal elevation were also recorded. Two of these sites underwent a restoration action in 2013, after the first survey had taken place, and two did not undergo any shoreline enhancement. The methodology was heavily influenced by Beach Watchers' strategies, with a few noted exceptions.

We found that the type and density of intertidal plants and animals are variable. Predominant species were green algae, barnacles, shelled snails, and limpets. The most striking difference in intertidal life occurred in 2014, after the restoration action, with some recovery of species seen in 2015 and 2019. Newly placed cobbles and gravel at the +6 and +4 foot tidal heights were not recolonized within one year of placement. Some colonization was evident in the 2015 and 2019 surveys. Throughout the survey sites, large cobbles and boulders were typically associated with more intertidal life than were beach areas with cobbles, gravel, and sand substrate.

Comprehensive listings of species were made for each of the four surveys over the last six years. These listings combined with the quadrat data form a solid baseline of the site, with which to compare future changes.

Introduction

Boulevard Park is a city-owned park in Bellingham, WA located on Bellingham Bay along South State Street and Bayview Drive in Bellingham's South Hill neighborhood. The park lies on artificial landfill along the shoreline. A map of the park is included in Figure 1. The beach at Boulevard Park underwent significant modification in 2013 to reduce shoreline erosion that resulted from ineffective beach armoring (Figures 2 and 3). The concrete rubble that had been used for armoring was removed. The modifications have created a sand and gravel beach with rock revetments. This document reports on surveys to measure the diversity, distribution, and abundance of intertidal species within the park beaches conducted in 2013, prior to the above-mentioned modifications, and in 2014, 2015, and 2019 after the modifications. Assessment and monitoring methods were based on those established by the Washington State University Beach Watcher Intertidal Monitoring Program. Modifications were made to enhance the representativeness of the data, while retaining key elements such that the studies will be largely comparable to other studies. The monitoring is intended to provide baselines for detection of changes following the beach modifications and include data from a portion of the beach similar in characteristic before the site project and that was not modified. Acquired baseline information can be used to assess the impacts of shoreline modification and for natural resource damage assessment, protection of critical habitats, and management of protected species.

Figure 1: Map showing Boulevard Park.

Figure 2: Boulevard Park before shoreline enhancement. (Photo by City of Bellingham.)

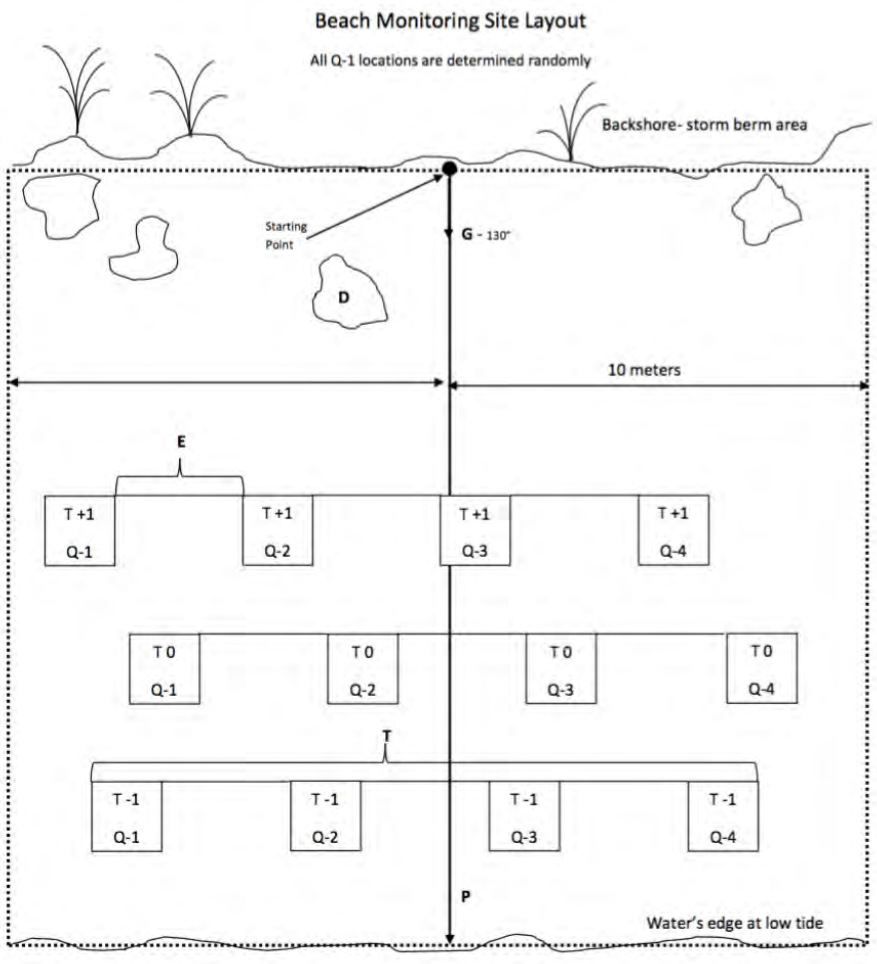
Figure 3: Boulevard Park after shoreline enhancement. (Photo by City of Bellingham.)

Goals and Objectives

The goals and objectives of this intertidal monitoring are to collect baseline data over time at specific monitoring sites within the park to document changes over time in beach slope, substrate, and biodiversity, using scientifically and statistically sound methods that will provide data comparable across various sites and monitoring years. This data will also indicate the effect of the restoration action on the intertidal life at tidal elevations of +6, +4, +1 and -1 ft. This data may be used to correlate changes in intertidal life with changing conditions in beach slope and substrate at these park beaches.

Data-collection Methodology

The study used a transect/quadrat model with a profile line from approximately ordinary high water to one foot below mean lower low water (-1 ft MLLW) or lower, if the tide allowed (Figure 4). The Beach Waters (2003) protocols were modified to include four randomly placed quadrats on each transect.



D Erratic near profile line which could be used as a vertical height reference point.
E Distance between quadrats. The four quadrats should be equally spaced along the transect line (16.5 feet apart).
G Compass heading of profile line towards horizon.
P Profile line, defined as line perpendicular to beach face from ordinary high water mark to one foot below mean lower low water or lower.
T Transect lines, defined as lines parallel to beach face at the tidal elevations of +1', 0', and -1'.

Figure 4. Layout of survey sites adapted from Island County/Washington State University Beach Watchers (2003). For the studies in this report, a fourth quadrat was added to each surveyed tidal height.

Four types of data were collected:

1. **Profile Data**- Elevation profile data was taken along a transect across the beach face perpendicular to the shoreline. Data recorded include beach slope and presence/absence of substrate type.
2. **Quadrat Data: Percent Cover**- Four randomly placed 50 cm X 50 cm (1.6 ft x 1.6 ft) quadrats were located at each of four tidal elevations: +6, +4, +1, and -1 ft mean lower low water (MLLW). The first quadrat was placed randomly between 0-16.5 ft to the nearest half a foot. Each quadrat was then placed 16.5 ft away from the previous quadrat on the transect (Figure 4). Colonial and aggregating animal species, sea grass, and macroalgae cover were estimated in each quadrat. Species were identified in groups as shown on the data sheets in Appendix A.
3. **Quadrat Data: Individual Species**- Individual epifauna species were counted within the same quadrats as those for percent cover. Organisms smaller than 3 mm (0.04 inches) in their longest dimension were not counted. Species were identified in groups as shown on the data sheets in Appendix A.
4. **Species Lists**- Knowledgeable citizen scientists (i.e., "Lead Naturalists") compiled species lists along each profile by sections. Each section was 10-feet (3 m) or longer and 66 feet (20 m) wide along the profile line. Complete lists of species found are presented in Appendix A in the species swath sheet. The lists reflect only species observed present.

In 2015, a new protocol was added after discussion about usefulness of collected data. This new protocol included counting species individually and by percent cover in each quadrat with minor removal of debris; the same as was done in 2013 and 2014. Next, citizen scientists removed all *Ulva* sp., a green alga that often covers large portions of the beach substrate when present. *Ulva* removal was added to assess if species were being missed because they were covered by this ephemeral alga.

In 2016, an additional modification was made to the protocol where species identified in quadrats by volunteer citizen scientists were lumped into general groups (see field sheets in Appendix A for groups of species identified). For example, instead of volunteers being expected to correctly identify between the barnacles *Balanus crenatus, B. glandula, Semibalanus cariosus, Chthamalus dalli,* the percent cover of all barnacles was estimated as the group "Barnacles". This increased the confidence in our quadrat results as well as increased citizen science volunteer recruitment and retention due to a more reasonable expectation.

Narrative of the Field Research

Basic training was given in Whatcom County, primarily targeting citizen scientist volunteers from the North Sound Stewards, the Cherry Point Aquatic Reserve Citizen Stewardship Committee, the Whatcom County Marine Resources Committee, as well as other volunteers. In each of the first three years, RE Sources trained volunteer citizen scientists in three 2-hour classroom sessions and one field training exercise. In 2019, the training was refined to a single 4-hour training with both classroom and field sessions. Trainings included basic protocol for measuring slope, identifying and counting organisms, both plants and animals, estimating percent coverage of plants and colonial animals, and correctly filling out the data sheets. Training was also dedicated to learning the organisms by sight, with help from identification guides. Over the four years of surveys, more than 100 citizen scientists were trained.

The Boulevard Park beach was surveyed at 4 locations. Locations were chosen to include 2 areas that had not been scheduled for modification (Pete's Beach Central and North), and 2 areas where beach modification would occur (Transects 3 and 7, so named for the restoration manager's study areas). Each location indicated

in Figure 4 marks where a transect line starts. Transect lines extend out into the water perpendicular from the shore and are constant from year to year.

Figure 5: Map of Boulevard beaches and approximate locations of profiles at Boulevard Park.

Table 2: Profile site information. The site location in terms of longitude and latitude marks the origin of the profile on the beach side.

Transect Name	GPS Location	Compass Reading	Location Description
Pete's Beach central	48° 43.860' N -122° 30.190'W	288°T	Southwest corner of blue table, 50 ft. south of Wood's Coffee
Pete's Beach north	48° 43.867'N -122° 30.190'W	274°T	Southwest corner of slab for Ernest Walstrom memorial 15' south of Wood's Coffee
Profile Site 3	48° 43.899'N -122° 30.168'W	312°T	Northwest corner of concrete walkway that surrounds play sets in playground
Profile Site 7	48° 43.922'N -122° 30.143'W	263°T	Nine parking places southwest of cul de sac in northeast corner of parking lot, just southwest of concrete curb with tree and lamppost inside

Declination: 16° 35.1'E, GPS unit: Garmin GPSmap 60CSx

Results

Results consist of comparisons for each site of percent cover species, individual count species, and beach elevation profile slope measurements for the years 2013, 2014, 2015, and 2019.

Quadrat Results for Percent Cover Species, Non-enhancement Sites:

Graphs of percent species cover in quadrats at Pete's Beach North and Central (Figures 6 and 7), the non-enhancement sites, show that there is quite a bit of variability in species coverage from quadrat to quadrat and year to year. At Pete's Beach North, barnacles were the most abundant at tide height -1 ft. There was also an increase in eelgrass observed at tide height -1 ft in 2019 at Pete's Beach North. Barnacles were a predominant organism at all tidal levels surveyed (+6, +4, +1, and -1 ft) at Pete's Beach Central with green algae being the one exception in 2013 at tide height -1 ft. The year 2013 appears to have had the most barnacles, declining in 2014, but steadily gaining numbers each year surveyed after. Both non-enhancement sites have green, brown, and red algae present.

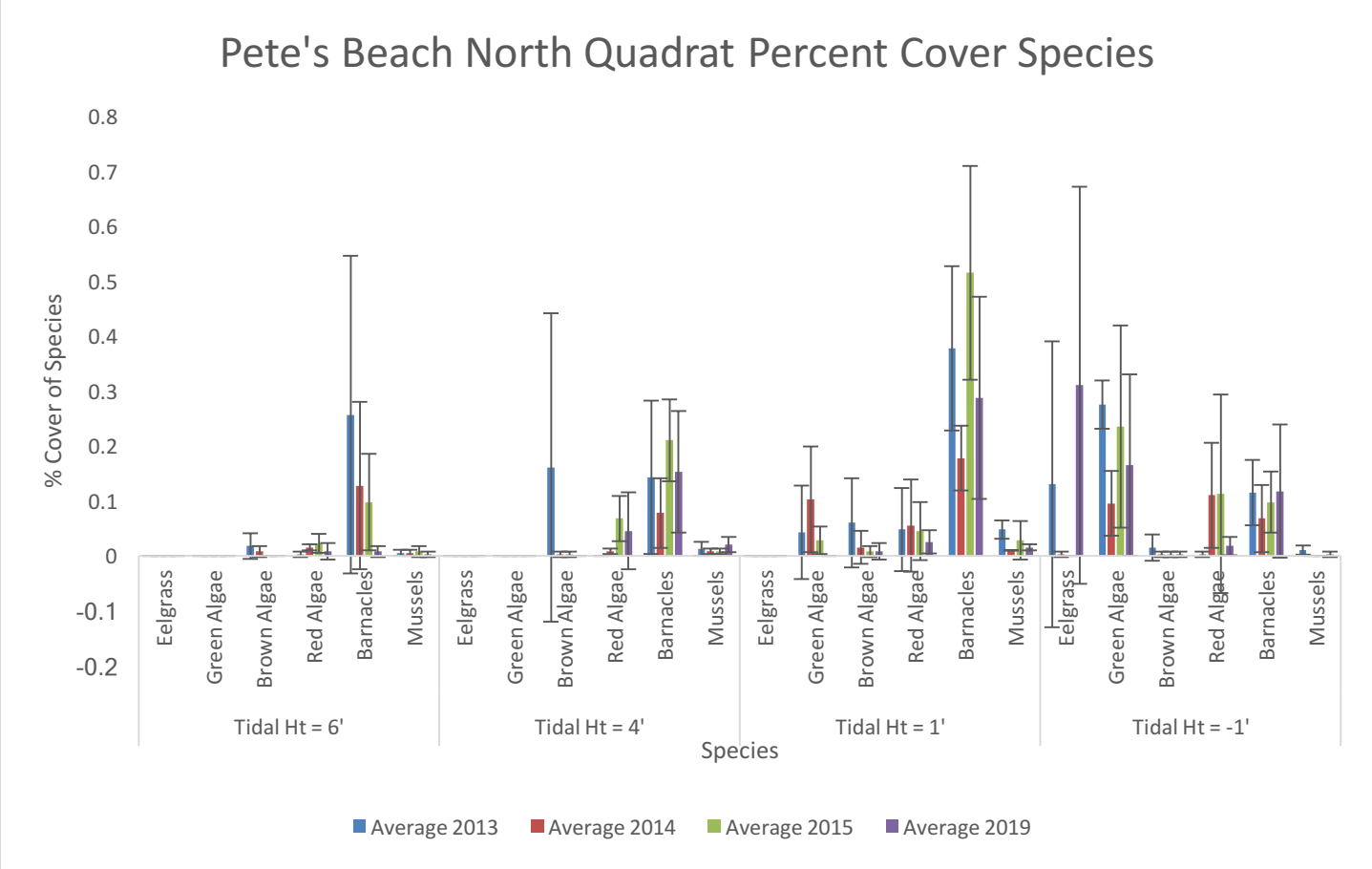


Figure 6: Percent Cover Species at Boulevard Park; Pete's Beach North from 2013, 2014, 2015, and 2019.

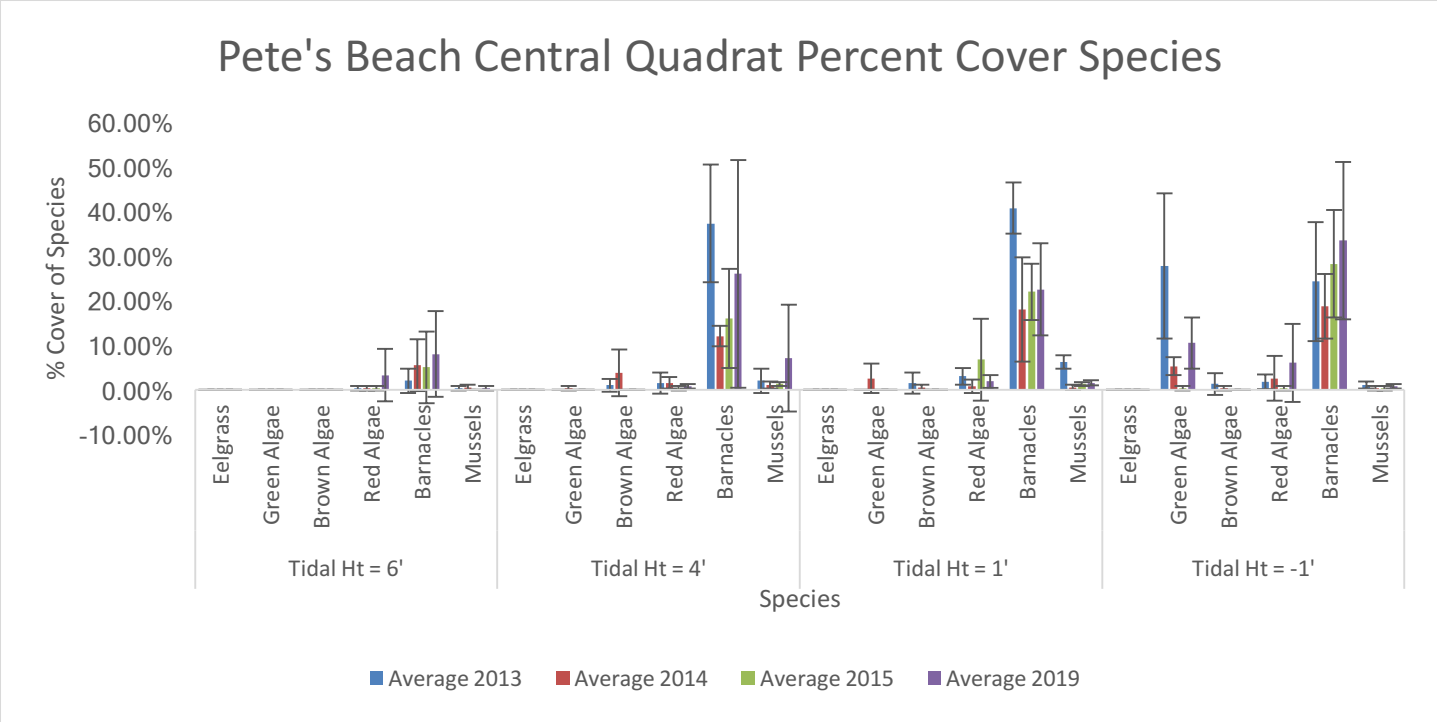


Figure 7: Percent Cover Species at Boulevard Park; Pete's Beach Central from 2013, 2014, 2015, and 2019.

The substrate found at the different tidal elevations sometimes varied across transects, and this variation can sometimes account for the different types of life found. Loose gravel and sand are generally poor substrate for intertidal life. The large rock versus gravel found at +6 ft, quadrats 1 (Figure 8) and 3 (Figure 9) at Pete's Beach Central provide a good example for this.

Figure 8: Quadrat 1 at +6 ft, Pete's Beach Central, 06/14/14.

Figure 9: Quadrat 3 at +6 ft, Pete's Beach Central, 06/14/14.

Quadrat Results for Percent Cover Species, Enhancement Sites:

Graphs of percent cover species at the enhancement sites, Transects 3 and 7, also showed variability in species coverage from quadrat to quadrat and year to year (Figures 10 and 11). The 2013 enhancement action occurred primarily in the upper intertidal, replacing rip rap with sand and cobble. A rock revetment lays across a portion of Transect 3, giving added substrate diversity to this site.

In 2014, at the +6 and +4 tidal elevations, newly placed cobbles present on the beach for approximately 10-11 months, were nearly entirely devoid of life. In 2015 and 2019, some colonization of these cobbles was evident, especially at Transect 3, which contained the rock revetment (Figures 12 and 13).

As with the non-enhancement sites, barnacles were a predominant organism at all tidal levels surveyed (+6, +4, +1, and -1 ft) and green algae were predominant at tidal levels +1 and -1 ft. Green, brown, and red algae were found throughout the quadrats and the most species were found at tidal heights +1 and -1 ft. Transect 7 had more overall species with higher counts in 2013 than any other year, though Transect 3 has a similar trend apparent.

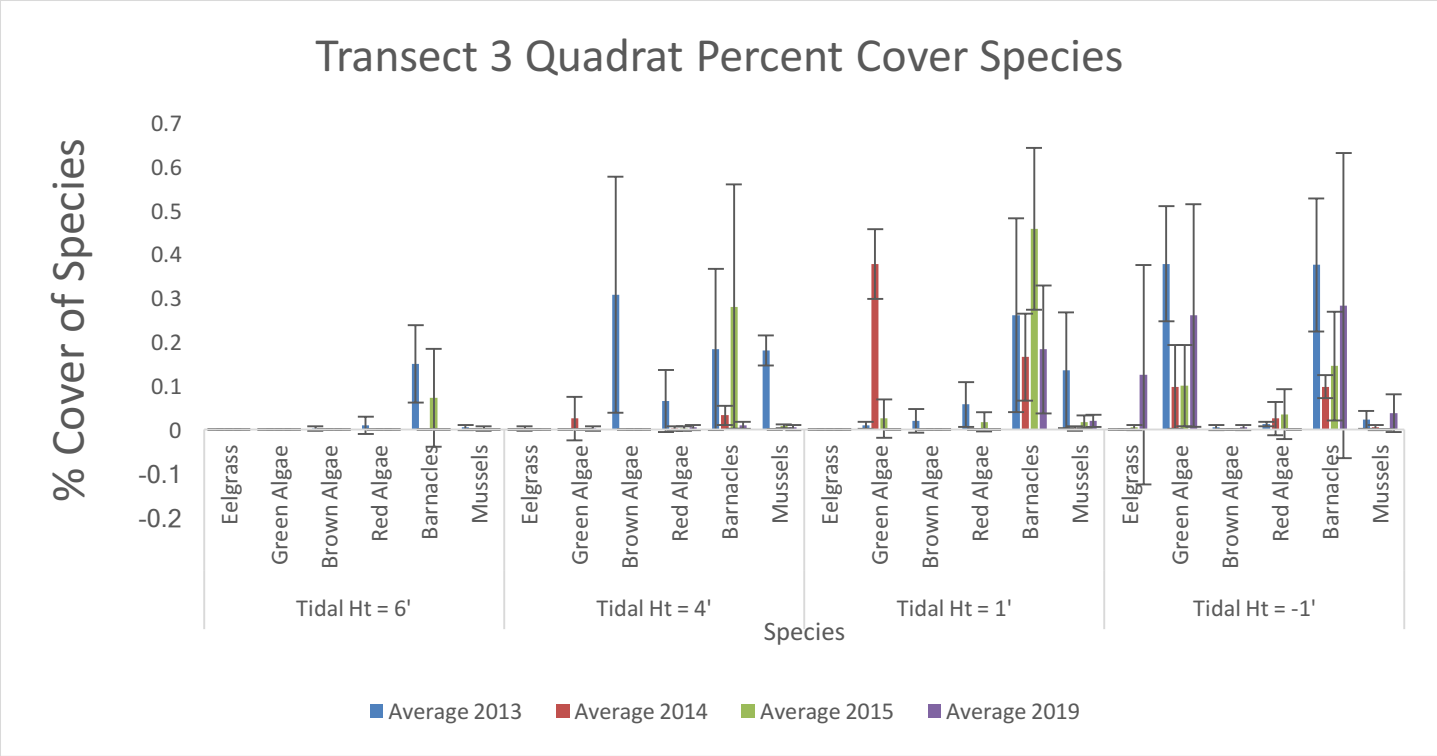


Figure 10: Percent Cover Species at Boulevard Park; Transect 3 from 2013, 2014, 2015, and 2019.

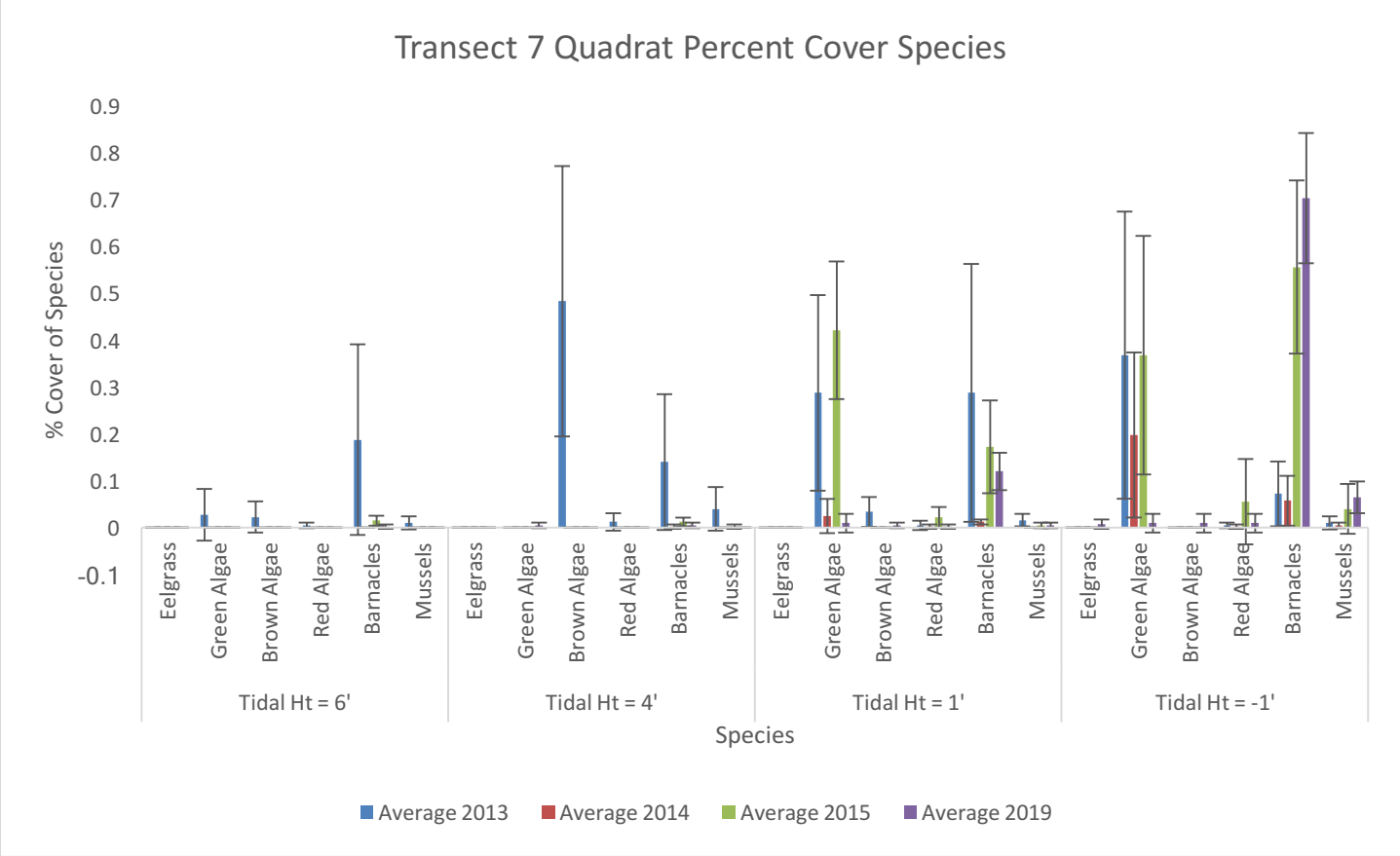


Figure 11: Percent Cover Species at Boulevard Park; Transect 7 from 2013, 2014, 2015, and 2019.

Figure 12: Quadrat 4 at +4 ft, Profile Site 3, 06/05/15.

Figure 13: Quadrat 4 at +4 ft, Profile Site 7, 06/05/15.

Quadrat Results for Individual Animals, Non-Enhancement Sites:

Shelled snails and limpets, both of which attach to rocks and graze upon algae and diatoms, were the predominant countable species found (Figures 14 and 15). Their populations were variable from year to year and quadrat to quadrat.

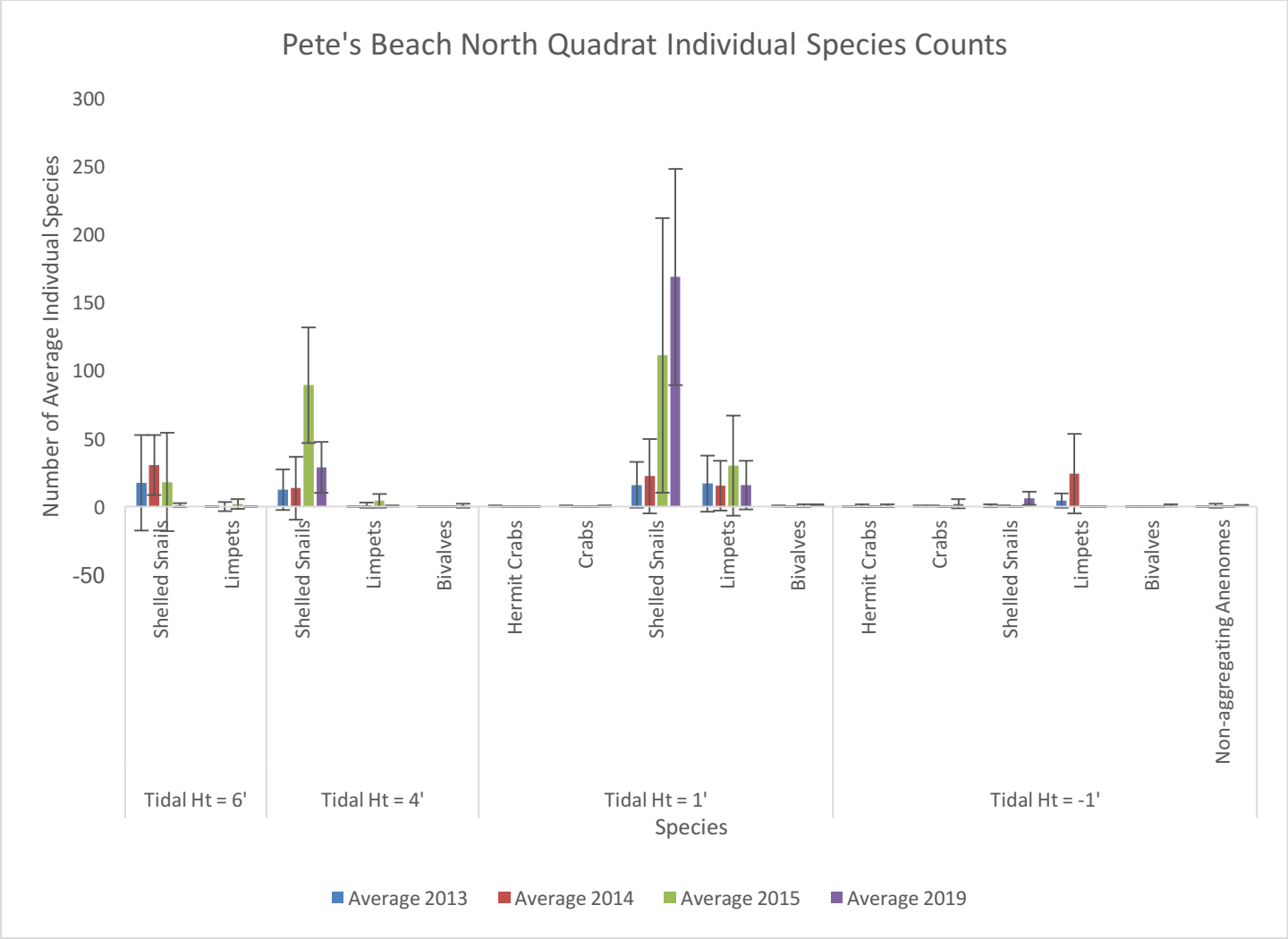


Figure 14: Individual Animals Species at Boulevard Park; Pete's Beach North from 2013, 2014, 2015, and 2019.

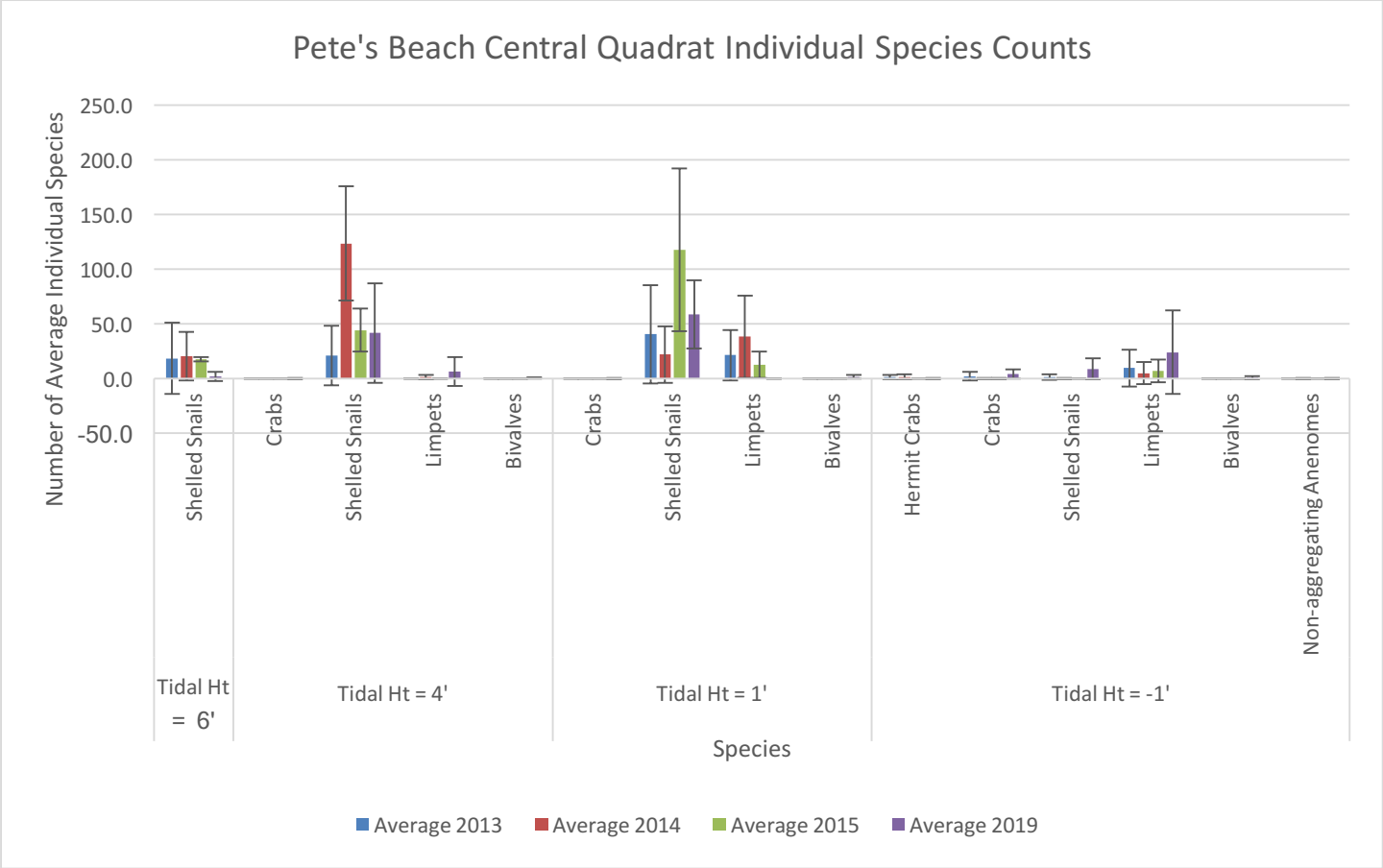


Figure 15: Individual Animals Species at Boulevard Park; Pete's Beach Central from 2013, 2014, 2015, and 2019.

Quadrat Results for Individual Animals, Enhancement Sites:

At Transect 3 (Figure 16), the numbers of individuals are low both pre- and post-enhancement. Interestingly, this is the transect that contains a rock revetment. For these animals, however, the presence of the rock substrate was not associated with a noticeable increase in individual animals. At Transect 7 (Figure 17), the number of animals was low in 2013, dipped in 2014, and showed an increase in limpets at the -1 ft elevation. The variability in the numbers of animals in the quadrats is high.

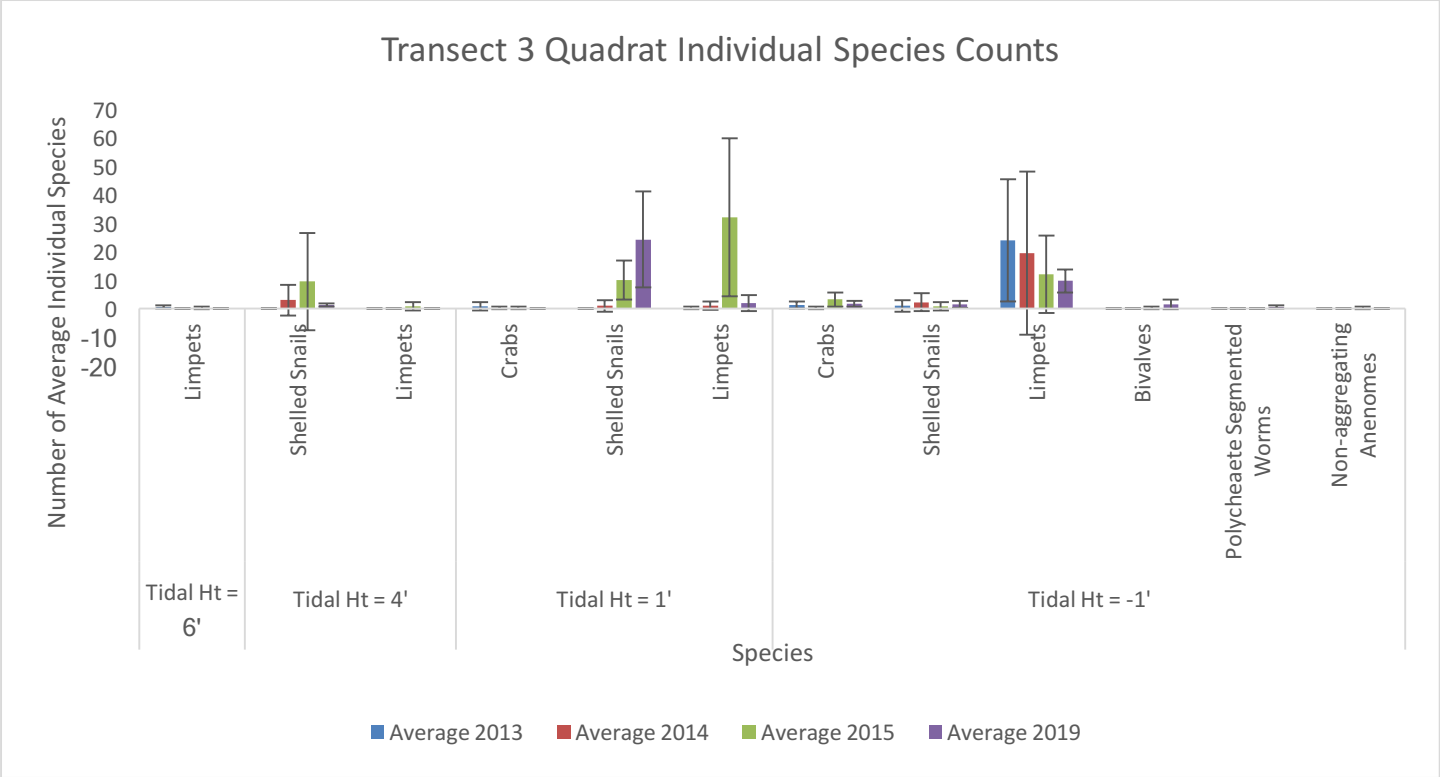


Figure 16: Individual Animals Species at Boulevard Park; Transect 3 from 2013, 2014, 2015, and 2019.

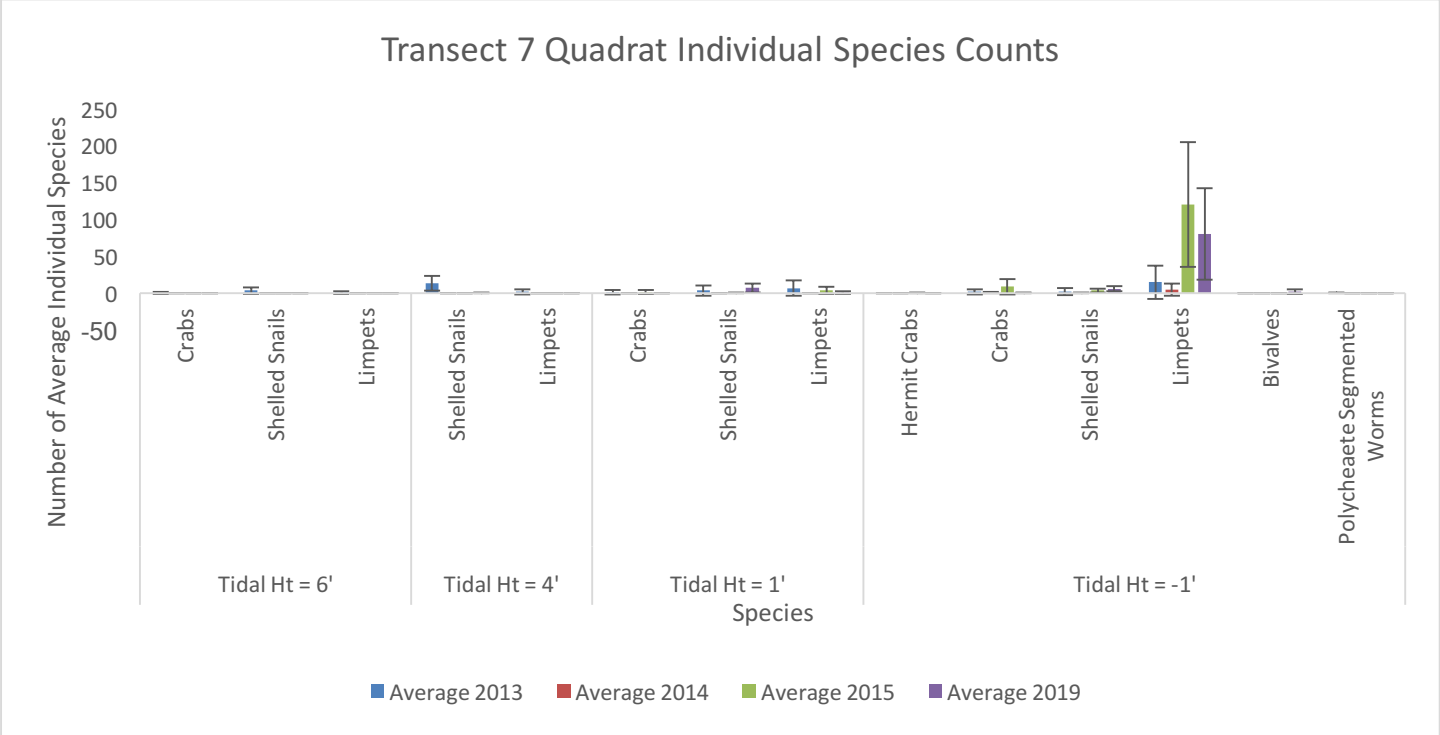


Figure 17: Individual Animals Species at Boulevard Park; Transect 7 from 2013, 2014, 2015, and 2019.

Beach Elevation Profiles, Non-enhanced Beach Sites:

The slope of the non-enhanced sites varies somewhat from year to year, but in general decreases in slope about 1 foot for every 10 feet in linear distance from the backshore.

Pete's Beach North's substrate can be generally characterized as gravel, cobble, and boulders with a few sandy areas close to the end of this profile. There is also shell debris typically found on this beach throughout the profile. There appear to be slight changes in elevation profile over the years (Figure 18). The 2019 elevation profile appears that accretion has occurred, where the slope is less shallow than other years. In 2019, there was a log just after the start of the profile with a rock close to 30 ft down the profile line.

Pete's Beach Central's substrate cab be generally characterized as gravel, cobble, and boulders with occasional sand. There is also shell debris typically found on this beach throughout the profile. There appear to be slight changes in elevation profile over the years (Figure 19). The beach slopes vary year to year, similar to Pete's Beach North, with the 2019 slope being most similar to 2014, which are the two least steep slopes of all the years measured.

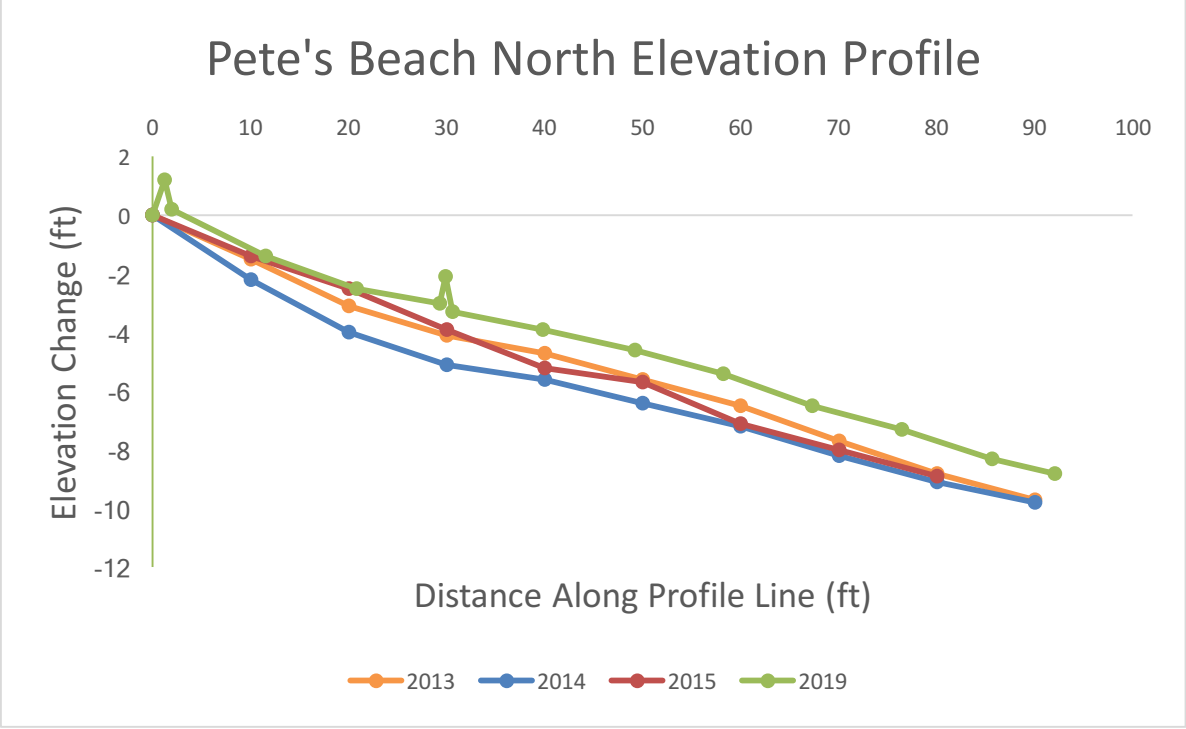


Figure 18: Slope of Pete's Beach North from Ordinary High Water to the water's edge, in years 2013, 2014, 2015, and 2019.

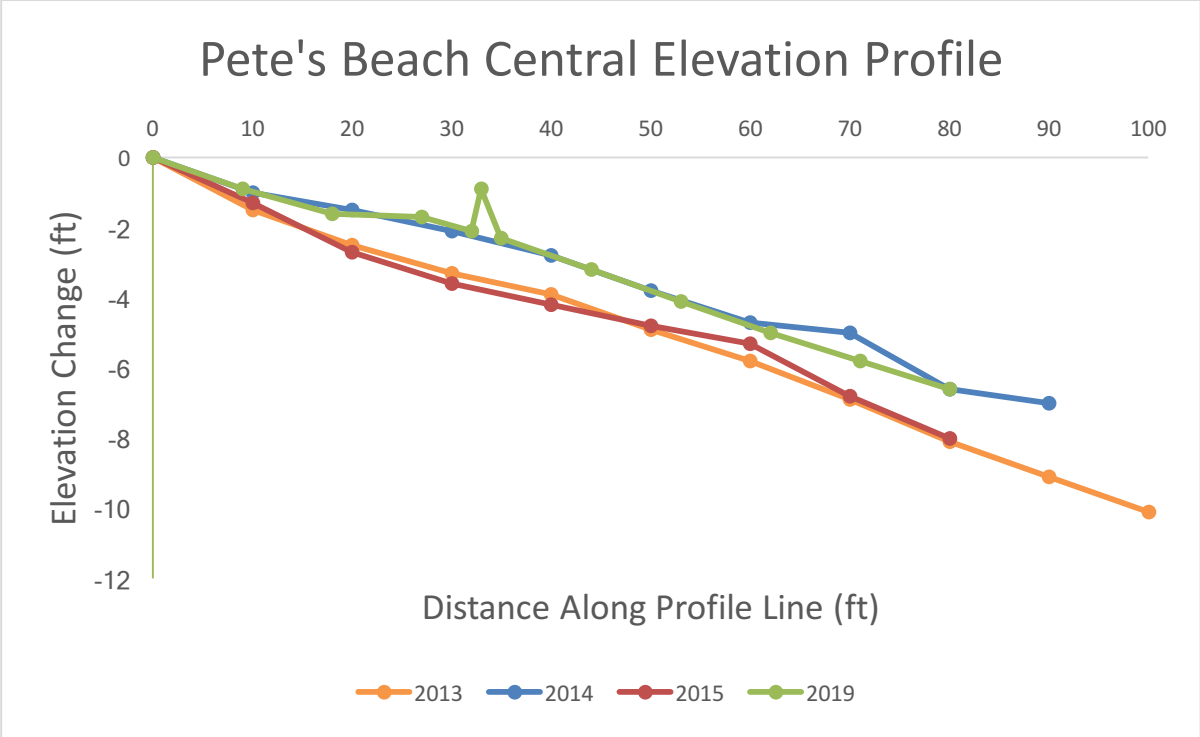


Figure 19: Slope of Pete's Beach Central from Ordinary High Water to the water's edge, in years 2013, 2014, 2015, and 2019.

Beach Elevation Profiles, Enhanced Beach Sites:

The substrate in Transect 3 can generally be characterized as mainly gravel, cobble, and boulders. The profile line (Figure 20) in 2019 appears to be much less steep than the years 2013-2015. The bump between 30 and 40 ft on the profile line in 2019 marks where there was a boulder on the beach.

The substrate in Transect 7 can generally be characterized as mainly gravel and cobble, with boulders past 90 ft on the profile line, as seen as the bump in 2019 (Figures 21 and 22), in contrast to the 2013 slope which was pre-enhancement. The bump between 10 and 20 ft on the profile line in 2019 marks where there was a log on the beach. Transect 7 appears to be have a steeper slope in 2019, indicating that the beach may have experienced scouring, which is consistent with the 2014 to 2015 slope steepening seen after the enhancement project happened. Figure 21 shows the measured elevation profile for 2019, which started at the bottom of a riprap drop off while Figure 22 shows a correction for possibly not starting at the same starting point in 2019 previously used in 2013 through 2015.

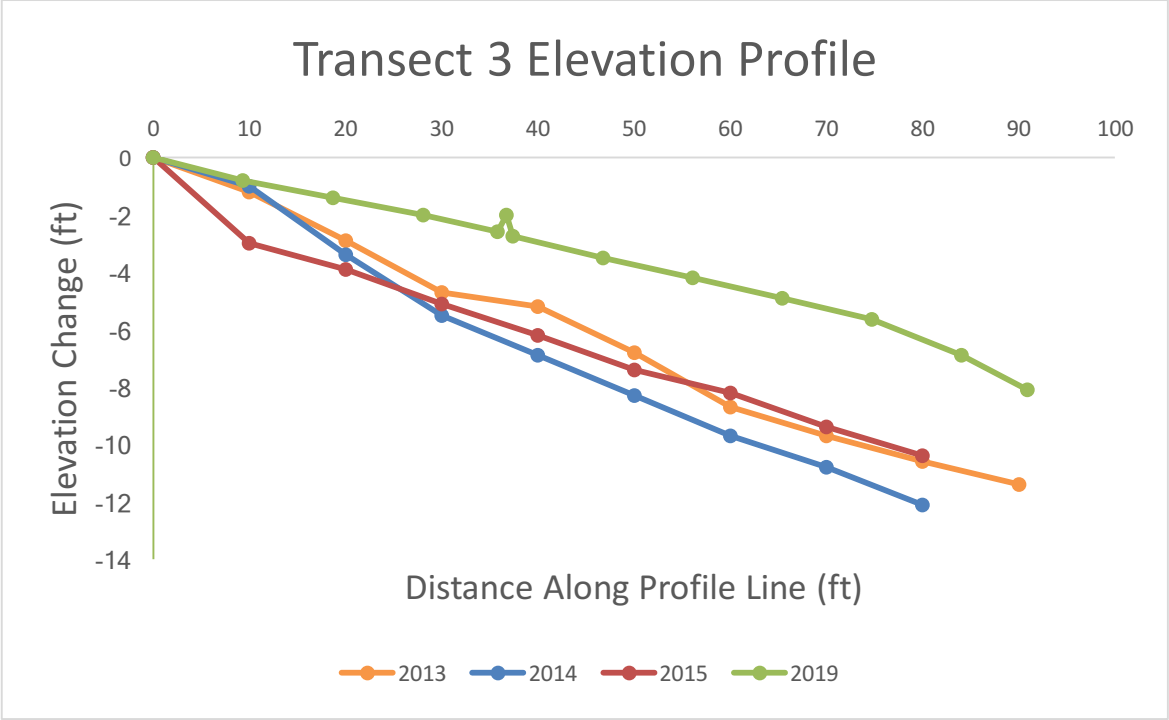


Figure 20: Slope of Transect 3 from Ordinary High Water to the water's edge, in years 2013, 2014, 2015, and 2019.

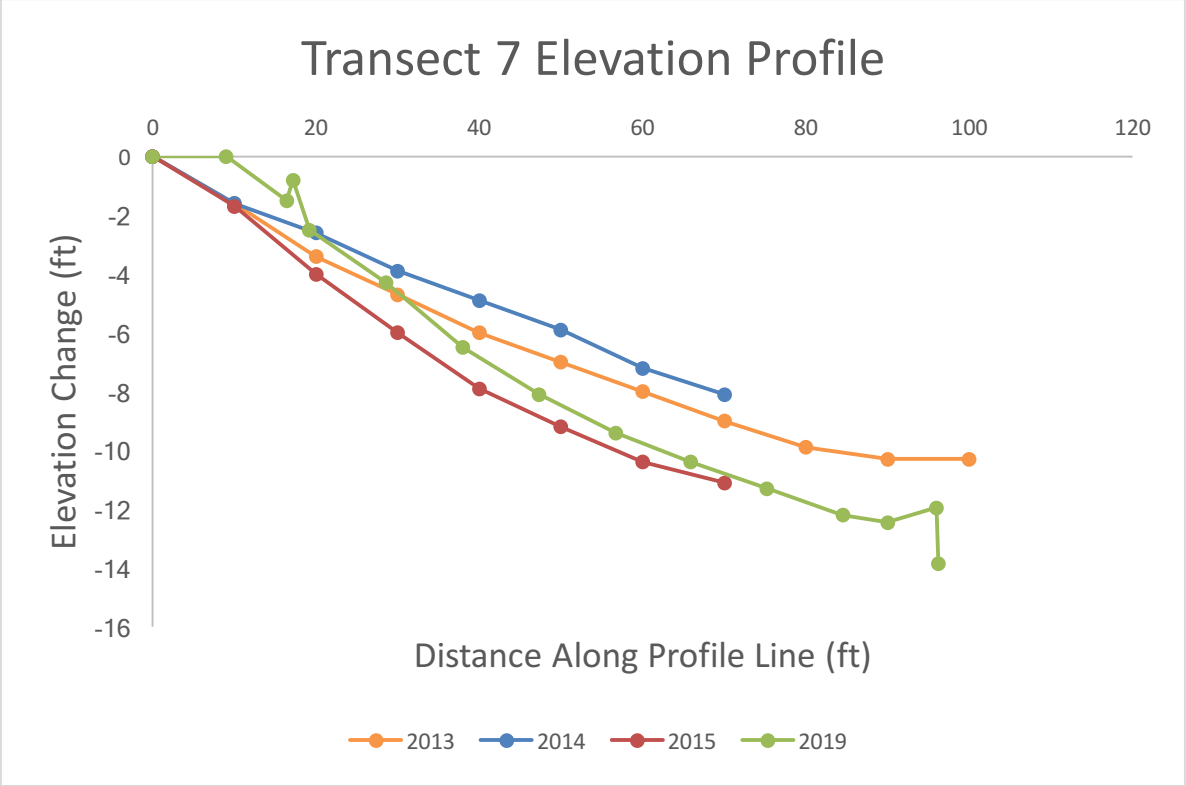


Figure 21: Slope of Transect 7 from Ordinary High Water to the water's edge, in years 2013, 2014, 2015 and 2019.

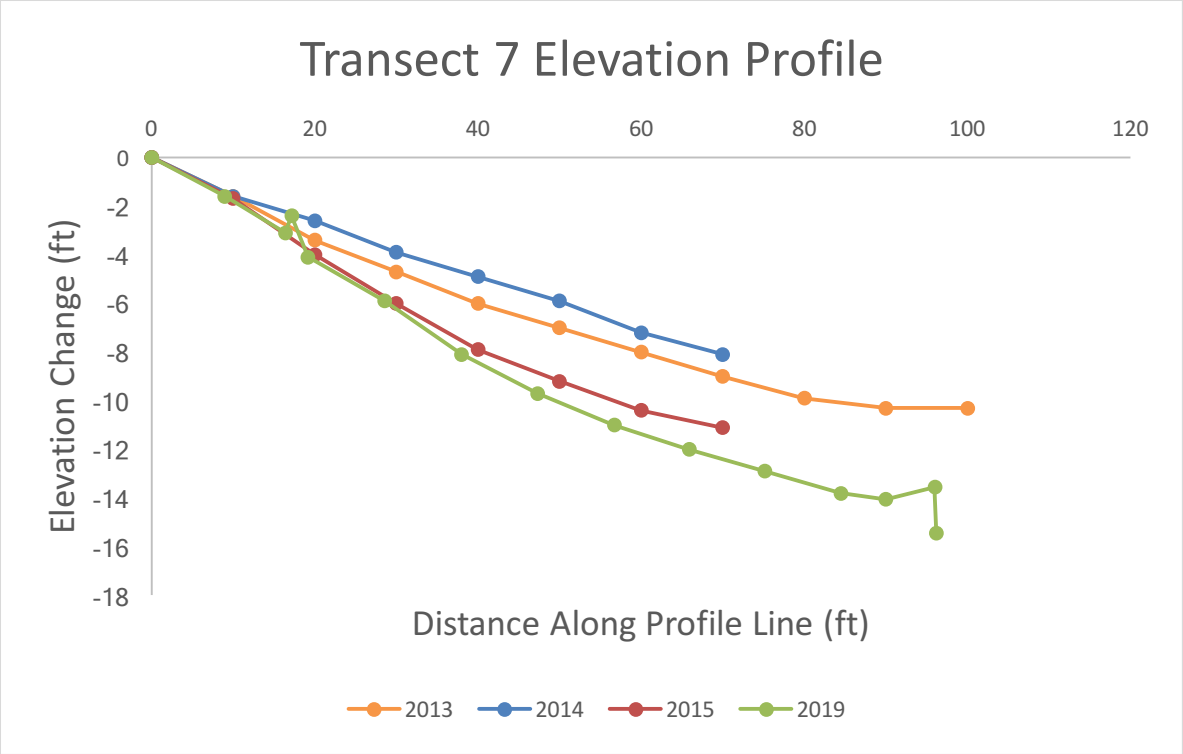


Figure 22: Transect 7 2019 slope corrected if start point was corrected to start at the top of the riprap, rather than below. Slope of Transect 7 from Ordinary High Water to the water's edge, in years 2013, 2014, 2015 and 2019.

Discussion

The goal of this project is to explore whether any discernable differences were observable at the Boulevard enhancement site and further to gather a baseline for detection of any future changes on beach slope, substrate, and intertidal biodiversity at four monitoring sites. The project was completed as intended.

At all of the transects, in 2013, the substrate was composed of a mixture of pebbles, cobbles and boulders. However; there were other materials present in several areas. Along Pete's Beach Central, increased amounts of gravel were observed at the higher tidal levels, but even at the -1 ft level some gravel was seen, where more eelgrass was seen in 2019. At Pete's Beach North there was less gravel, but some riprap was present at the +6 ft level and sand was found at the -1 ft level where also more eelgrass was seen in 2019. At Transect 3, as a result of previous armoring, concrete slabs and rubble were found and at the lower tidal levels, shell was found in some quadrats. The substrate found along Transect 7 was similar to that at Transect 3, however no shell was observed, and some gravel was found. The slope of all the beaches vary, with Transect 7 the only beach to become steeper in 2019 while the others became less steep in 2019.

In 2014, 2015, and 2019 substrate at the non-restoration sites of Pete's Beach remained as before. At Profile Sites 3 and 7, the substrate was altered from previously observed. Sand and cobble were brought in to replace the riprap and rock groins were anchored on either side of the restoration action to help it stay in place. Transect 3 rests partially on the southern groin. In 2014, substrate was comprised of cobble, gravel, boulder and shell with cobble predominant at the higher elevations and boulder apparent at +4 ft and lower. In 2015, the demarcation of these zones was not as clear, and broken shell became a component of the substrate, also. At Transect 7, substrate was composed of cobble, gravel and boulder with gravel and cobble predominating at

the upper elevations and boulder becoming more present at -1 ft. The -1 ft transect at Transect 7 lies upon a ridge of rock extending from the northern groin, after which there is a somewhat steep drop-off to the bay. Green algae were the predominant alga and was found in greatest abundance at the +1 and -1 ft tidal levels. Barnacles were well represented in most locations examined. Variability of percent cover species was high and may be more associated with substrate present, versus other factors.

Among countable species, shelled snails and limpet species were generally most abundant. Individual species were generally not detected at especially +6 ft, but also +4 ft and +1 ft one year after restoration at Transects 3 and 7. At two years after restoration, some colonization of these individual species occurred, but only at Site 3 which contained larger rock substrate as part of the southern groin. Pete's Beach has a large abundance of shelled snails particularly in certain quadrats while not found to the same degree at Transects 3 and 7.

As discussed, substrate type is correlated with type and diversity of animals found at the sites. There is a well-established positive correlation between substrate composition and intertidal habitat, flora, fauna, and ecology. According to Dethier and Schoch (2005), "In areas where cobbles (>~ 4" or 10 cm diameter) are abundant on the low shore, the substrate is stabilized into a complex mix of cobbles, pebbles, and sand; these habitats harbor a rich flora (on the cobbles) and fauna (both on the cobbles and infauna)."

An additional finding of these surveys is that there appears to be a settling or loss of substrate at Transect 7. A need for re-nourishment at gravel beaches has been observed at other sites (Shipman, 2001). Exploring the wave energy and wave patterns of the beach could loan some insight into whether or not erosion is suspected.

Extensive species data has also been collected to characterize each site around the profile line, extending 10 meter on either side. When collecting data for the species list, expert lead naturalists identify the organisms both on the surface and under the rocks (unlike data collected in the quadrats, where only surficial data is recorded). Species list data has been analyzed in minor detail, but the paired down list of species found is available in Appendix A in the species swath field sheet for further review. Collecting comprehensive species data such as this presents a good way to assess whether new species are coming in to the area and establishing themselves and for monitoring the presence of invasive or non-native species.

At Pete's Beach, the non-native *Nuttalia obscurata* varnish clam was observed in 2013, although not to a large extent as seen in other places. The non-native *Sargassum muticum* or Japanese wireweed was also observed on Pete's Beach in 2013 and 2015. Although Washington Department of Fish and Wildlife does not list either of these species as "invasive", they are both non-native species that have become problematic in some areas (Britton-Simmons, Washington Department Fish and Wildlife).

Because there is large natural variability in this type of intertidal monitoring, annual surveys are not necessary. Data in year 6 post enhancement was interesting and appears that some biota may be growing in numbers and diversity, but coming back to observe any changes in another 5 and 10 years may be even more interesting to see if these trends continue or not.

Recommendations for Any Modification of the Procedures and the Overall Program

Overall, we believe we have gathered valuable data and that this data paints an accurate picture of the intertidal life at Boulevard Park. From our experience over the past years, we highlight some things that served us particularly well, along with several recommendations to increase the accuracy of our data.

HIGHLIGHTS:

- Partnership with other like-minded and similarly trained groups helped fill recruitment for our beach days.
- Lumping species for the quadrats helped surveys go fast enough so that the tide coming back in was not an issue and increased our confidence in organisms identified.
- Having experts ("lead naturalists") on the beach was essential for those hard-to-identify organisms in the species swaths.
- Outreach at Boulevard Park helped educate passers-by about the beach and gained some recruits in the past, but was unfortunately not possible in 2019.

Figure 2: Information Station at Boulevard Park. This station was borrowed from the Fidalgo Bay Aquatic Reserve Citizen Stewardship Group. It was very popular with passers-by.

RECOMMENDATIONS:

- Volunteers identified organisms to the extent possible given conditions and their expertise. As part of our in-field quality control, we will be concentrating on consistency between identifiers.
- Explore the possibility of new sites that are separate from the rip rap at +6' (Pete's Beach North) and the rock groin (Profile Site 3). Excluding those features may lessen the variability and be better able to give a clearer signal of the effect of the restoration.
- Explore ways to mentor individuals to become experts.

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Appendix A: Field Data Sheets

Elevation Profile Sheet:

Site: _____ Date: _____ Time: _____

Team names: _____

Recorder: _____

Notes for starting point conditions (e.g. presence of landslide, large woody debris, or other shoreline modificaitons covering the starting point):

Directions: In column A record the number of feet traveled for each reading. Column B is the running total of column A. Column C is the actual profile reading (be sure to include + or -). Check the substrates found within each profile section.

	A	B	C		Substrate (check all that apply)						Notes:
Entry Number	Length of Survey Section (ft)	Cumulative Distance (ft)	+ or -	Survey Reading	Shell Debris	Clay/Silt	Sand (.002" - .08"; sugar grain to rice)	Gravel (.08" - 2"; pea to chicken egg)	Cobbles (2"-10"; chicken egg to basketball)	Boulders (>10"; larger than a basketball)	Large Woody Debris
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											

Quadrat Data Sheet:

Aquatic Reserve Intertidal Biota Monitoring **Quadrat Data Sheet**

Site: _____ **Date:** _____ **Time:**_____

Team Members: _____

Tide Level: _____ **Quadrat #:** _____

Distances: Quadrat distance on transect line: _____ft **Transect on profile line:** _____ft

Photo after debris removal (initial): _____**QC check (initial):** _____

Photo after Ulva sp. removal (initial): _____**QC check (initial):** _____

PERCENT COVERAGE METHOD: algae, plants and aggregating organisms:
If using the QUADRAT ESTIMATION worksheet, transfer that information here. If you encounter any aggregating species you believe are not on this list, please consult with a lead naturalist.

Organism Name	Guide Page #	Before *Ulva* removal	After *Ulva* removal
Eelgrass (Genus: Zostera)	Page 1		
Green Seaweed (Phylum: Chlorophyta)	Page 1		
Brown Seaweed (Phylum: Ochrophyta)	Page 1		
Red Seaweed: (Phylum: Rhodophyta)	Page 1		
Barnacles (Subphylum: Crustacea)	Page 1		
Mussels (Genus: Mytilus)	Page 2		
Aggregating anemone (Anthopleura elegantissima)	Page 3		
Sponges (Phylum: Porifera)	Page 4		
Bryozoans (Phylum: Bryozoa)	Page 4		
Colonial Ascidians (Class: Ascidiacea)	Page 4		

(Countable animals on the other side)

Aquatic Reserve Intertidal Biota Monitoring **Quadrat Data Sheet**

Countable Animals: Animals that can be counted and are >3mm in size. If you encounter any countable species you believe are not on this list, please consult with a lead naturalist.

Organism Name	Page #	Total before *Ulva*	Total after *Ulva*
Amphipods	1		
Isopods (Order: Isopoda)	1		
Shrimp (Infraorder: Caridea)	1		
Hermit Crabs (Superfamily: Paguroidea)	1		
Crabs (Infraorder: Brachyura)	1		
Shelled Snails (Class: Gastropoda)	2		
Limpets (Class: Gastropoda)	2		
Sea Slugs (Class: Gastropoda)	2		
Bivalves (Class: Bivalvia)	2		
Chitons (Polyplacophora)	2		
Ribbon Worms (Phylum: Nemertea)	3		
Flatworms (Phylum: Platyhelminthes)	3		
Polycheaete Segmented Worms (Class: Polycheata)	3		
Non-Aggregating Anemones (Class: Anthozoa)	3		
Sea Stars (Class: Asteroidea)	3		
Brittle Stars (Class:Ophiuroidea)	4		
Sea Urchins (Class: Echinoidea)	4		
Sea Cucumbers (Class: Holothuroidea)	4		
Solitary Tunicates (Subphylum: Tunicata)	4		
Fish (Phylum: Chordata)			

Substrate in Quadrat (% cover): Examples on side 4 of Quadrat Guide

Clay/Silt: _____ **Sand (.002”-.08”):** _____ **Gravel (.08”-2”):** _____

Cobble (2”-10”): _____ **Boulders (>10”):** _____ **Shell debris:** _____

Clay/Silt/Sand: _____ **Other (specify):** _____

Notes:

_____
_____
_____
_____
_____
_____

Species Swath Sheet:

Site: Boulevard Park	Date & Start Time:	Lead Naturalist & Scribe:					
	Please mark boxes with an X	Section along profile line, in feet					
Scientific Name or Group	Common Name	0 - 30	30 - 50	50 - 70	70 -		
CHROMISTA: Ochrophyta	**BROWN ALGAE**						
Fucus sp.	Rockweed						
Sargassum muticum	Japanese Wireweed (introduced)						
PLANTAE: Chlorophyta	**GREEN ALGAE**						
Ulvales (*Ulva, Ulvaria,* etc.)	Sea lettuce - foliose & tubular						
PLANTAE: Rhodophyta	**RED ALGAE**						
Rhodophyta - filamentous	unknown filamentous red						
PLANTAE: Tracheophyta	**PLANTS**						
Zostera japonica	Japanese eelgrass (introduced)						
Zostera marina	Native eelgrass						
ARTHROPODA: Crustacea	**CRUSTACEANS**						
Balanus crenatus	Crenate Barnacle						
Balanus glandula	Acorn Barnacle						
Chthalamus dalli	Little brown barnacle						
Gammaridea amphipods	Gammarid amphipod						
Gnorimosphaeroma oregonensis	Pill bug isopod						
Pentidotea wosnesenskii	Rockweed isopod						
Heptacarpus sp.	Shrimp						
Cancer gracilis	Graceful crab						
Hemigrapsus nudus	Purple shore crab						
Hemigrapsus oregonensis	Yellow shore crab						
Pagurus granosimanus	Grainyhand hermit						
Pagurus hirsutiusculus	Hairy hermit						
ANNELIDA: Polychaeta	**POLYCHAETE**						
NEMERTEA	**RIBBON WORMS**						
Paranemertes peregrina	Purple ribbon worm						
CNIDARIA: Anthozoa	**ANEMONES**						
Anthopleura artemisia	Moonglow anemone						
Anthopleura elegantissima	Aggregating anemone						
MOLLUSCA: Bivalvia	**BIVALVES**						
Crassostrea gigas	Pacific oyster (introduced)						
Mytilus trossulus	Pacific blue mussel						
Nuttallia obscurata	Purple mahogany-clam						
Saxidomus gigantea	Washington butterclam						
Venerupis (Ruditapes) philipinarum	Japanese littleneck (introduced)						
MOLLUSCA: Gastropoda	**GASTROPODS**						
Littorina scutulata	Checkered periwinkle						
Littorina sitkana	Sitka periwinkle						
Lottia pelta	Shield limpet						
Lottia persona	Mask limpet						
Lottia scutum	Plate limpet						
ECHINODERMATA: Asteroidea	**SEASTARS**						
Evasterias troschelii	Mottled seastar						
Pisaster brevispinus	Giant pink seastar						
Pisaster ochraceus	Ochre star						

NORTH SOUND STEWARDS

Event: Whatcom Intertidal Training
Date: 6/1/19

Name:	Email:	NSS?
Olivia Latimer	omllatim@gmail.com	
Steven Corson	srcolson@gmail.com	
Jordan Grant	jordan.grant@utexas.edu	
Sarah Brown	sarah.n.brown@utexas.edu	
Stu Currier	stu currier 729@gmail.com	
Dr. Adam Moles	spindrift research@gmail.com	
Chris Brown		
Dexter Davis	davisd35@wwu.edu	
Lindsey Parker	lindsey.parker2816@gmail.com	yes

NORTH SOUND STEWARDS

Event: Whatcom Intertidal
Date: 6/11/16

Name:	Email:	NSS?
Alison Lubeck	lubeck.alison@gmail.com	X
Bob Lemon	lemprev@olphobout.com	
Vicki Roy	royvicki54@yahoo.com	✓
Judith Akins	sunsetjam@gmail.com	✓
Lynn Colson	88LynnC@gmail.com	
MARGARET SANTAMARIA	mugit2001@gmail.com	✓
~~Mel Steffens~~	~~nellida44@msn.com~~	got sick had to leave early
~~Tori Steffens~~	~~vsteffens4@gmail.com~~	
Alice Sigurdson	asigurdson@yahoo.com	✓

NORTH SOUND STEWARDS

Event: Whatcom Intertidal Training
Date: 6/1/19

Name:	Email:	NSS?
Cesmatm@wwu.edu ↔ Michelle Cesmat		
Karen DeNicus	heron5557@gmail.com	

NORTH SOUND STEWARDS

Event:
Date:

Name:	Email:	NSS?

NORTH SOUND STEWARDS

Transects #7 & 3

Event: Boulevard Park Intertidal

Date: 6/3/19

Name	Email	Are you a NSS?	Hours
Morgan Mcboldrick	morganb.mcgoldrick@gmail.com	yes	4
Stu Currier	stucurrier729@gmail.com	yes	3
Judith Akins	sunsetjam@gmail.com	yes	3
Nicci Roy	roynicki54@yahoo.com	yes	4
Sarah Brown	sbrown@n-sea.org	No	3
Margaret Santamaria	MUGIT2001@GMAIL.COM	yes	3
Chris Brown			4
Bob Lemon			4
Lynne Girler			4
Alison		yes	2
Serena			3

NORTH SOUND STEWARDS

Pete's Beach North & Central

Event: Blvd Park Intertidal Monitoring

Date: 6/4/19

Name	Email	Are you a NSS?	Hours
MARGARET SANTAMARIA	MUGIT2001@GMAIL.COM	Y	4
Alice Sigurdson	asigurdson@yahoo.com	YES	4
Bob Lemon	lemonrev@alphanet.com	LMK	4
Bob Seamon	rlseamon@peoplepc.com	MK	4
Alison Lubeck	lubeck.alison@gmail.com	Yes	4
Kent Turner	~~Kturner@[illegible]~~ Kturner/a/a@gmail.com	yes	5


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