Intertidal Biota Monitoring in the Cherry Point Aquatic Reserve

2014 Monitoring Report

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Ensuring Regulatory Effectiveness in Puget Sound's Most Special Places

Prepared by:

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Copies of this Monitoring Report will be available from the Washington State Department of Natural Resources at http://www.dnr.wa.gov/ResearchScience/Topics/AquaticHabitats/Pages/aqr_rsve_aquatic_reserves_program.aspx at the Aquatic Reserves website http://www.aquaticreserves.org/resources/ and at RE Sources website at https://sites.google.com/a/re-sources.org/main-2/programs/baykeeper.

Cover Photo: Citizen Scientists Marie Hitchman and Nicole Miller identifying organisms in the profile swath at Birch Bay, 2014, RE Sources.

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Abstract

The Cherry Point Aquatic Reserve Citizen Stewardship Committee conducted intertidal surveys in 2013 and 2014 in the Cherry Point Aquatic Reserve to document beach slope, substrate, and diversity of intertidal animals and plants along four profiles. On these four profiles, the number of individual animals, and areal coverage of plants, algae, and colonial and aggregating animals within four 19.8" X 19.8" (50 cm X 50 cm) quadrats at the+1' ,0', and -1' (+0.3, 0m, -0.3m) MLLW tidal elevation were recorded. Methodology closely followed that of Washington State University Island County Extension Beach Watchers, with a few noted exceptions. In both 2013 and 2014, Neptune Beach had the highest fauna counts, areal coverage, and diversity, as well as the most varied substrate. This report details the results of the 2014 study, with comparisons to the 2013 monitoring.

It is hoped that baseline data will continue to be collected such that a robust baseline is generated and that trends will be detectable in the future.

Introduction

The Cherry Point Aquatic Reserve (CPAR) is one of seven aquatic reserves in Puget Sound managed by the Washington Department of Natural Resources (WDNR). In 2013, citizen-science programs were developed as part of a grant awarded to People for Puget Sound and transferred to Washington Environmental Council in 2012. This grant, "Ensuring Regulatory Effectiveness in Puget Sound's Most Special Places" focused on pairing local environmental groups with committee stakeholder groups to steward designated aquatic reserves through education and outreach, technical review of development proposals, and citizen science.

This document reports on the second year of the monitoring program conducted by the CPAR Citizen Stewardship Committee (CPAR CSC). The project included training citizen scientists to identify intertidal species and to measure their distribution and abundance within the aquatic reserve. Monitoring methods were based on those established by the Washington State University Beach Watcher (WSU BW) Intertidal Monitoring Program. Modifications were made to enhance the representativeness of the data, while retaining key elements to ensure that this study was largely comparable to other Beach Watcher studies. The monitoring provides a baseline for detecting future changes including the appearance of invasive species. It should also be useful for natural resource damage assessment in the event of an oil spill or other event, and in reserve management.

Background

WDNR designated the CPAR as an Environmental Reserve, an area of biological importance requiring special protective management where continued monitoring is a priority. The main purpose for establishing Cherry Point as a reserve was the preservation of critical spawning habitat for a late-spawning stock of Pacific herring. A broader purpose is to conserve and enhance native habitats and associated plant and wildlife species, with special emphases on herring, salmon, resident and migratory birds, Dungeness crab, groundfish rearing areas, and marine mammals (WDNR, 2010).

Most of the uplands adjacent to the Reserve are privately owned, primarily by five entities: BP, Pacific International Terminals, Alcoa-Intalco, Phillips 66, and Cherry Point Industrial Park. North of the industrial area are private residential lots and a small Whatcom County park with a public access area south and east of Point Whitehorn. Birch Bay State Park is located to the north and east of the residential lots and the eastern boundary of the aquatic reserve. The Lummi Indian Reservation is located adjacent to the south boundary of the Aquatic Reserve.

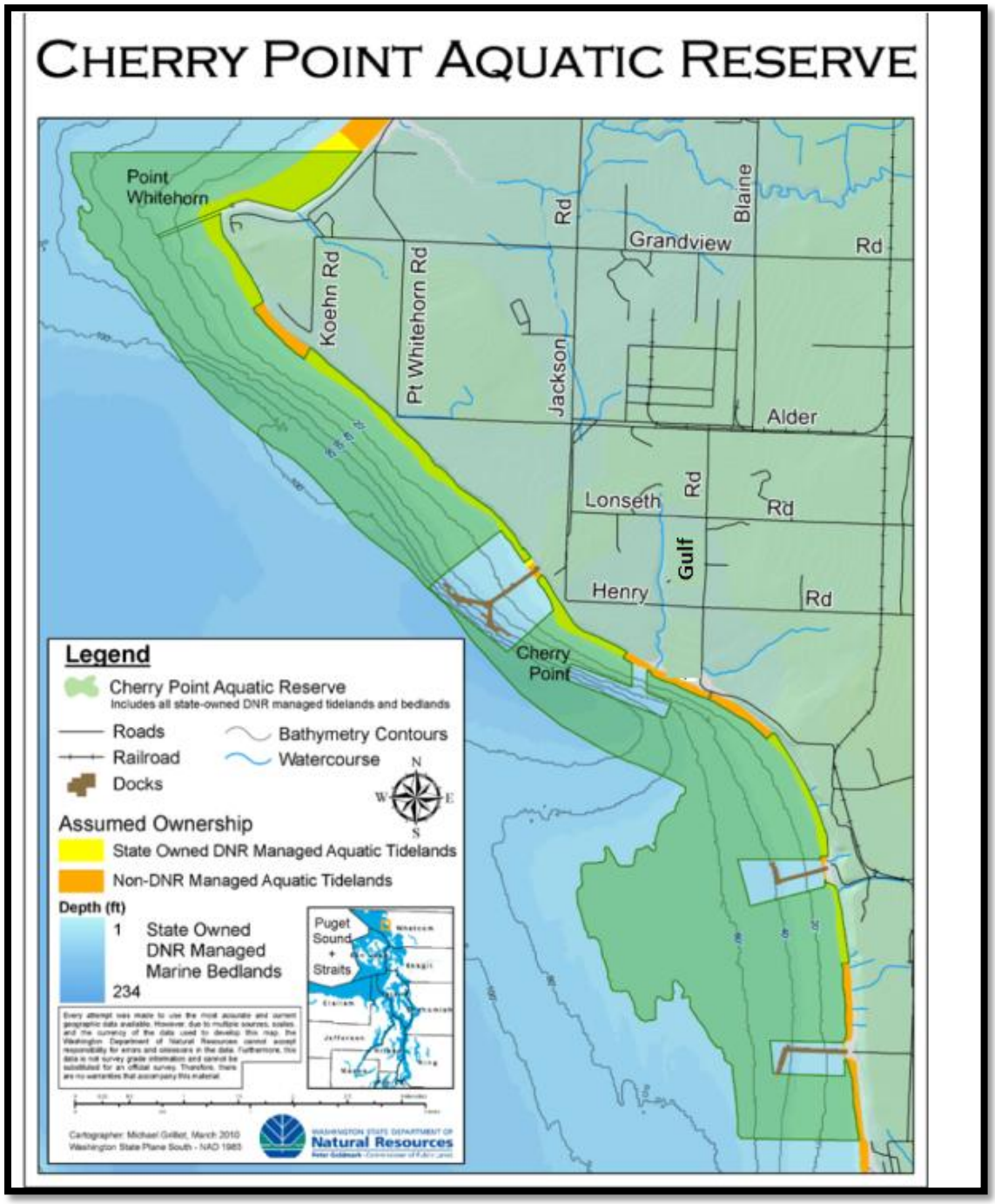


Figure 1: The Cherry Point Aquatic Reserve and surrounding area.

The following companies have existing use authorizations directly adjacent to or abutting the reserve (see Figure 1 showing easements, leased areas and cutouts, where a cutout is a small, designated area of tidal and subtidal lands removed from the CPAR to accommodate industrial marine docks):

- BP Cherry Point Refinery (lease and outfall easement),
- Intalco-Alcoa Works (lease and outfall easement),
- Phillips 66 Ferndale Refinery (lease and outfall easement),
- Birch Bay Water and Sewer District, near Point Whitehorn (outfall easement)

The fourth cutout near the end of Gulf Rd is a proposed Pacific International Terminals industrial pier for which no use authorization has yet been approved and no federal permits obtained.

Goals and Objectives

The goal of this project is to provide a baseline for detection of future changes due to natural or human-caused events in intertidal habitats, species composition, and species abundance. The specific objective is to collect baseline data on beach slope, substrate, and intertidal biodiversity at four monitoring sites. Scientifically and statistically sound methods are used to ensure that data are comparable across monitoring sites, monitoring studies in other reserves, and monitoring years.

This project documents animals and plants living on the beach surface sediments. Core samples to observe organisms in sediments below the surface were not taken. In future years, we hope to include core sampling. Core sampling is presently being done in the Fidalgo Bay Aquatic Reserve as a Citizen Stewardship Committee project.

Data-collection Methodology

The study used a transect/quadrat model using a transect or "profile" line from ordinary high water mark to one foot below mean lower low water (-1' MLLW) or lower if the tide allowed. The methodology is based on protocols developed by the WSU BW Intertidal Monitoring Program (Beach Watchers, 2003). This protocol for monitoring has been modified from this methodology to improve the statistical robustness of the study. Details of the sampling regime are given in Steffensen and Joyce (2013). Four types of data were collected:

1. **Quadrat Data: Percent Cover**. Four randomly placed 19.8" X 19.8" (50cm X 50 cm) quadrats were located at each of three tidal elevations: +1', 0', and -1'MLLW. Colonial and aggregating animal species, sea grass, and macroalgae cover were estimated in each quadrat.
2. **Quadrat Data: Individual Species**. Using the same quadrats as those for percent cover, individual animals were counted. Only epifauna were counted, organisms smaller than 3 mm were not counted.
3. **Profile Data**. Profile data are taken along a transect perpendicular to the beach face. Data recorded include beach slope and elevation, substrate type, and organism types.
4. **Species Lists**. Species lists were compiled for each 10' portion of beach profile covering a 65.6' (20 meter) wide swath [32.8' (10 meters) on either side of the profile line]. This list is more

detailed and intensive than the profile data, requiring considerably more observation time. These data are presented as an Addendum to the report.

Figure 2 from the Island County Beach Watchers training manual (Island County/Washington State University Beach Watchers, 2003), served as the basis for survey site layout. Instead of three quadrats as prescribed by the BW protocol, four quadrats were randomly located along each tidal height transect. The purpose of the change was to increase the representativeness of the data and improve our ability to compare results between beaches.

Additional details regarding the development and design of the monitoring project are given in the Quality Assurance Project Plan (QAPP) (Steffensen & Joyce, 2013).

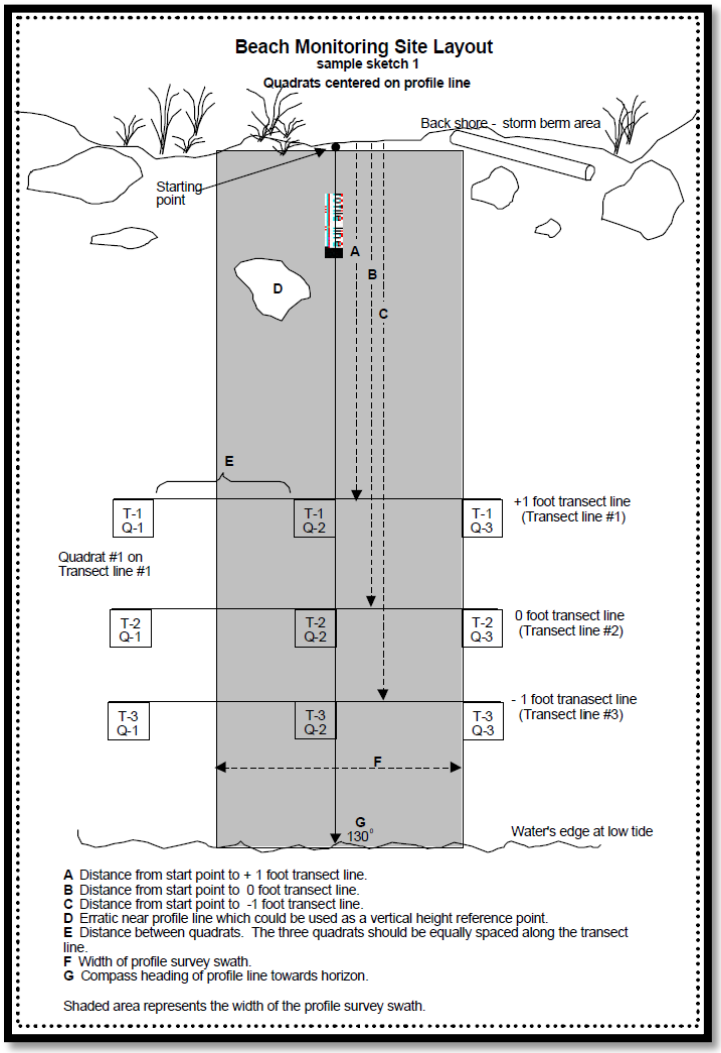


Figure 2: Layout of survey sites

Volunteer Training

Training sessions were provided in Whatcom County for citizen scientist volunteers from the CPARCSC, the Whatcom County Marine Resources Committee, Whatcom County Beach Watchers, and other Whatcom volunteers. A similar training session was held in Skagit County. Volunteers who could not

attend Whatcom County trainings could attend Skagit County trainings and be similarly qualified to conduct surveys.

In Whatcom County, twenty-eight citizen scientists were trained in three 2-hour sessions on April 1, 8, and 15, and one field training on April 19. Trainings included basic protocol for measuring slope, identifying and counting plants and animals, estimating percent coverage of plants and colonial animals, and completing data sheets. During the trainings, volunteers learned telltale key characteristics and habitats for common organisms, as well as both common and scientific names.

Field Surveys and Results

The CSC, with additional volunteers, surveyed the CPAR beach at four locations on dates with a low tide below -1' MLLW. Locations were chosen from historical monitoring sites (Geiger, 1982, and Schneider and Dube, 1969) and were limited to where we could obtain access (Tables 1 & 2; Figure 3).

Survey forms and instructions are included in Appendix A and B.

Table 1: Survey Information

	Date	Low tide time	Low tide elevation MLLW	Number of surveyors
Birch Bay (Seagrass Net)	5/18/14	2:20 PM	- 2.9'	10
Point Whitehorn County Park	5/17/14	1:40 PM	- 2.2'	15
Intalco Beach	7/11/14	11:02 PM	- 2.4'	10
Neptune Beach	7/13/14	12:33 PM	-2.6'	10

Table 2: Site Information

Site	Compass Bearing 1	Compass Bearing 2	Compass Bearing 3	Current Lat. (N)	Current Long. (W)	Historic Lat. (N)	Historic Long. (W)
Birch Bay	Point Whitehorn-230º	Point Lily at Point Roberts-275º	Birch Point-230º	48.89830	122.77841	48.89772	122.77863
Point Whitehorn	Outer end of the Cherry Point pier - 135º	North edge of Sucia Island - 205º	West edge of Point Roberts - 260º	48.87778	122.77838	48.88158	122.77838
Intalco Beach	Left hand corner of first white shack on Intalco pier perpendicular to shore - 181º	First black stack from shore on BP pier - 283º	Pointy, triangular, flat surfaced rock that faces shore - 325º	48.85062	122.72043	48.85075	122.72043
Neptune Beach	Northeast corner of tan shed on pier - 311º	State Park Red entrance marker - 182º	Mount Constitution on Orcas Island - 208º	48.82030	122.70952	48.82067	122.70968

Four sets of results were taken for each site.

1. Quadrat Data: Percent Cover
2. Quadrat Data: Individual Species counts
3. Profile Data: Beach slope and elevation, substrate type, and organism types
4. Species lists: By distance along profile line

Results for the quadrat data are shown in tables (3-14) and associated figures. The tables show coverage estimates and individual counts as well as averages of estimates or counts for each species or species group Averages were calculated from whole numbers. Because the numbers of organisms were so low in many instances, calculated averages are used; numbers in tables are shown with a higher degree of precision than known to document the presence of organisms and provide the data used in the corresponding graph. Graphs depict averages of quadrat data for each tidal-height transect as colored columns and standard deviations are shown as error bars.

Conventions used in these tables and figures include the following:

1) Abbreviation “spp.” is used to indicate multiple species of the same genera.
2) Profile data are shown in a table and figure for each sampling location within the results section
3) . Cover values in bold italics indicate that the estimate was less than the number recorded.
4) The species lists are given in a separate Addendum, Cherry Point Aquatic Reserve 2014 Intertidal Species Lists at Four Locations.

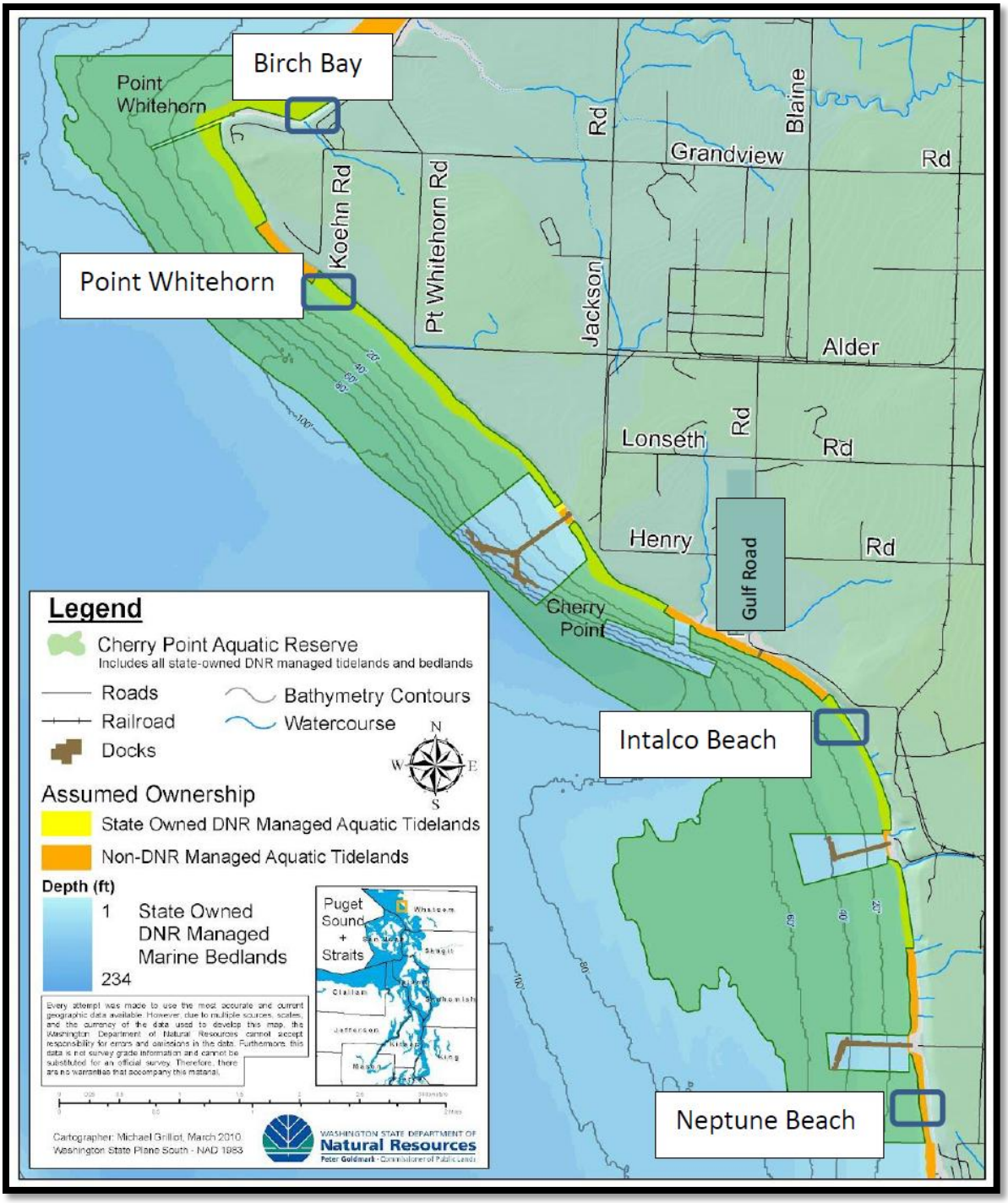


Figure 3: Locations of the survey sites

Birch Bay results

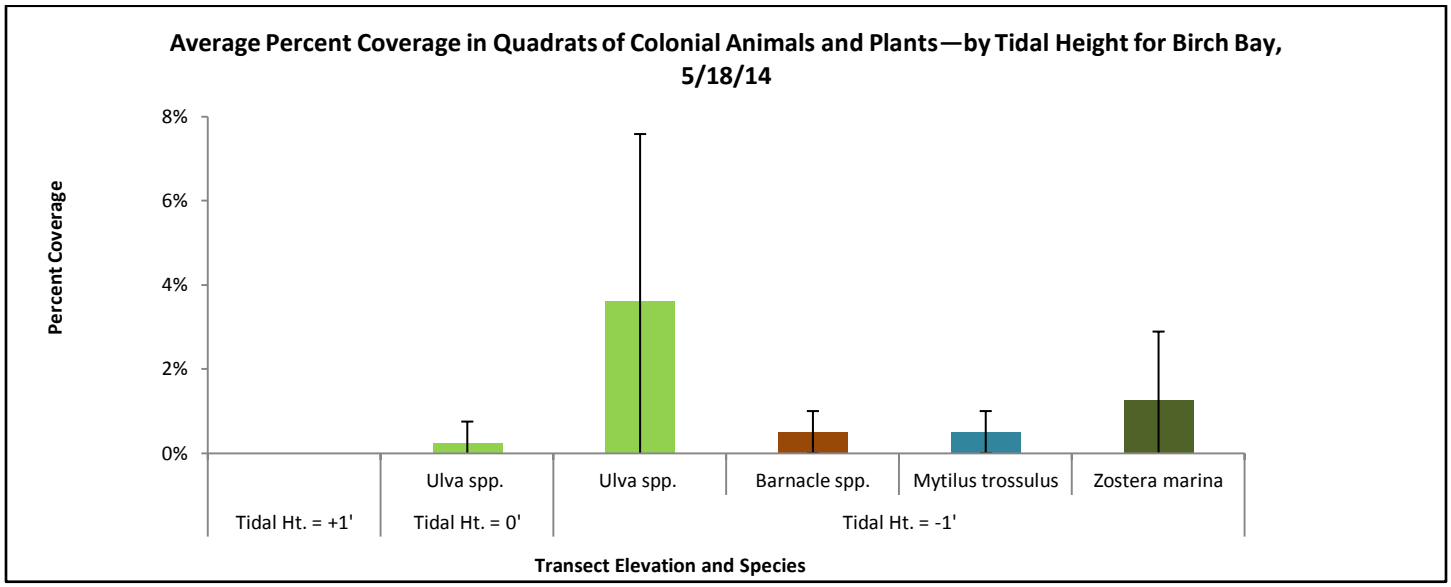


Figure 4: Average Percent Cover in Quadrats of Colonial Animals and Plants in quadrats at Birch Bay

Table 3: Birch Bay Percent Cover Data

Birch Bay		Date: 5/18/2014				
Transect Elevation	Species	Quadrat, ft.				Average percent
		1	**2**	**3**	**4**	
1'						
	Substrate	S	S	S	S	
		1	**2**	**3**	**4**	
0'	*Ulva* spp.	0%	0%	0%	1%	0.3%
	Substrate	S	C/S, S	S	S	
		1	**2**	**3**	**4**	
-1'	*Ulva* sp. (tubular)	0%	0%	10%	0%	2.4%
	Ulva spp.	5%	0%	0%	0%	1.3%
	Ulva spp. (SUM)	5%	0%	10%	0%	3.6%
	Barnacle spp.	***1%***	0%	***1%***	0%	0.5%
	Mytilus trossulus	***1%***	0%	***1%***	0%	0.5%
	Zostera marina	4%	***1%***	0%	0%	1.3%
	Substrate	S	S	C/S, S	S	

nr = not recorded, C/S: Clay/Silt, S: Sand, G: Gravel, C: Cobbles, B: Boulders, E: Erratic

Bold italic denotes instances where the species was present at less than 1%

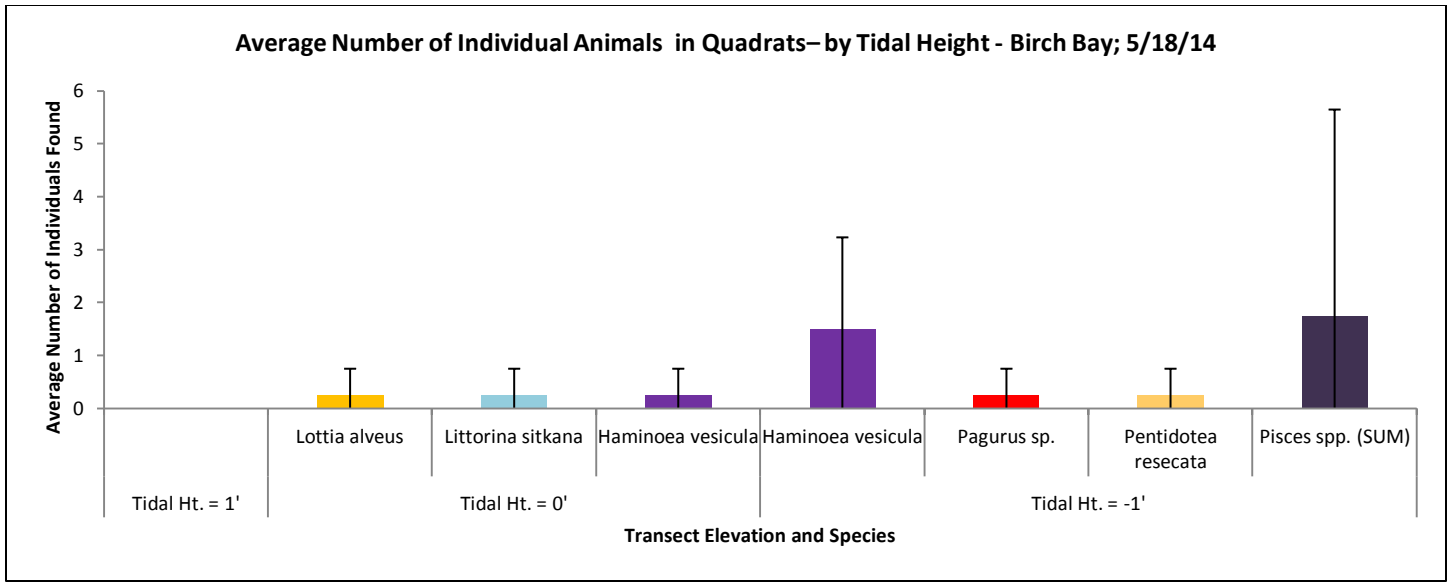


Figure 5: Average Number of Individual Animals in Quadrats at Birch Bay

Table 4: Birch Bay Individual Species

Birch Bay	Date: 5/18/2014	Countable Animals				
Transect	Species	Quadrat				Average
Elevation	[redacted]	1	2	3	4	Count
1'						
Substrate	[redacted]	S	S	S	S/C	[redacted]
0'	*Lottia alveus*	1	0	0	0	0.3
	Littorina sitkana	1	0	0	0	0.3
	Haminoea vesicula	1	0	0	0	0.3
Substrate	[redacted]	S	C/S, S	S	S	[redacted]
-1'	*Haminoea vesicula*	0	3	3	0	1.5
	Pagurus sp.	0	0	1	0	0.3
	Pentidotea resecata	0	0	1	0	0.3
	Cottidae	0	0	2	0	0.5
	Pholidae.	0	0	1	0	0.3
	Pleuronectidae	0	0	6	0	1.5
	Pisces (all fish) (SUM)	0	0	9	0	2.3
Substrate	[redacted]	S	S	C/S, S	S	[redacted]

Table 5: Birch Bay Beach Profile Data: Elevation, Substrate, and Species Groups

Birch Bay 05/18/1				Substrate (check all)								Seaweeds and Invertebrates (check all that apply)																										
Entry	Length of survey section	cumulative distance	Survey Reading + or -	Ground shell debris	Clay/Silt	Sand (.002"-.08")	Gravel (.08"-2")	Cobbles (2"-10")	Boulders (>10)	Erratics (BIG ROCKS)	Amphipods	Anemones	Barnacles	Chitons	Clams	Crabs	Fish	Insects	Isopods	Limpets	Mussels	Nudibranch	Sand Dollars	Sea Cucumbers	Seastars	Snails	Urchins	Flat Worms	Nemerteans	Polychaetes	Green Seaweeds	Red Seaweeds	Brown Seaweeds	Seagrass	Arachnid	Shrimp
1	30	30	-3.9			X	X	X		X	X																									
2	10'	40	-12				X	X	X				x			x		x																		
3	10'	50	-1				X	X	X				X			X		X																		
4	10'	60	-1.1				X	X	X				X			X		X		X	X									X	X		X			
5	10'	70	-0.4	X			X	X	X			X	X			X				X	X	X			X	X				X	X	X	X			
6	10'	80	-0.1	X		x		X	X			X	X			X				X	X				X	X					X		X	X		
7	70'	150	-0.6			X			X			x	x				X			x	x					x					x					
8	30'	180	-1.1	X		X			X		x	x	x		x					x	x					X					x		x			
9	20'	200	-0.8	X		X			X				x		x	x	x		x	x						x					x	x		x		
10	30'	230	-0.1	X		X			X		X		X		X	X	X		X	X	X	X				X				X	X	X		X		
11	20'	250	0	X		X			X		X	X	X		X	X	X			X	X	X				X				X	X	X	X	X		
12	20'	270	-0.1	X		X			X				X			X	X		X	X	X	x				X					X	X		X		
13	20'	290	0.6	X		X			X		X		X			X										X					X			X		
14	20'	310	0.8	X		X																														
15	20'	330	0.5	X		X																														
16	20'	350	-0.2	X		X																														

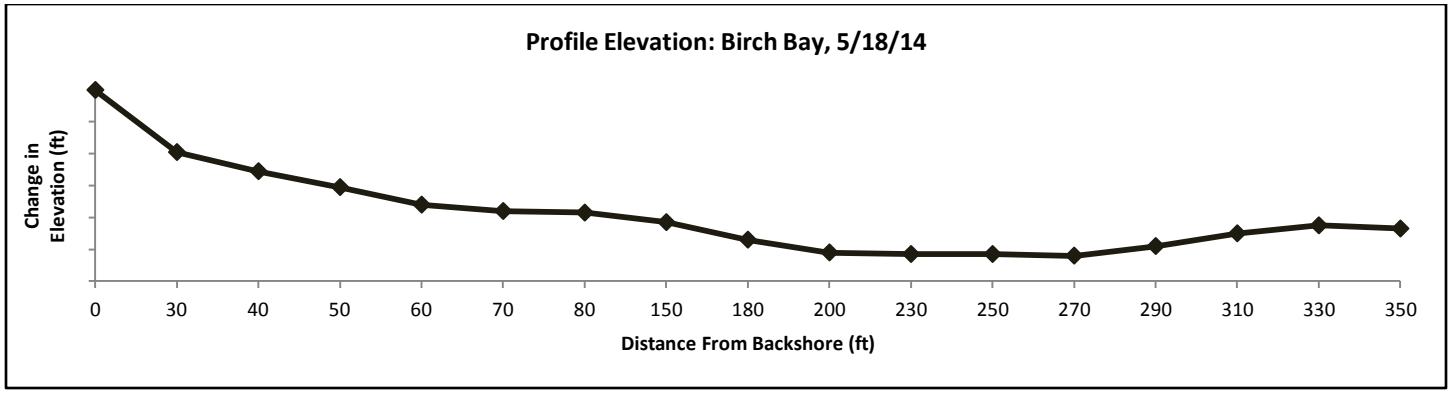


Figure 6: Beach elevation profile for Birch Bay

At the Birch Bay survey site, no colonial or aggregating species were present at +1' or 0'. Minimal coverage of *Ulva* sp., barnacles, mussels, and eelgrass was present at -1', with very few individual animal species throughout. The profile undulates over a long expanse of shallow beach, making it difficult to determine tidal elevation because it falls and rises over hundreds of feet of beach.

Colonial species and coverage amounts were very similar in 2014 and 2013. The composition of individual species in the quadrats was different, but both consisted of very low numbers.

Point Whitehorn results

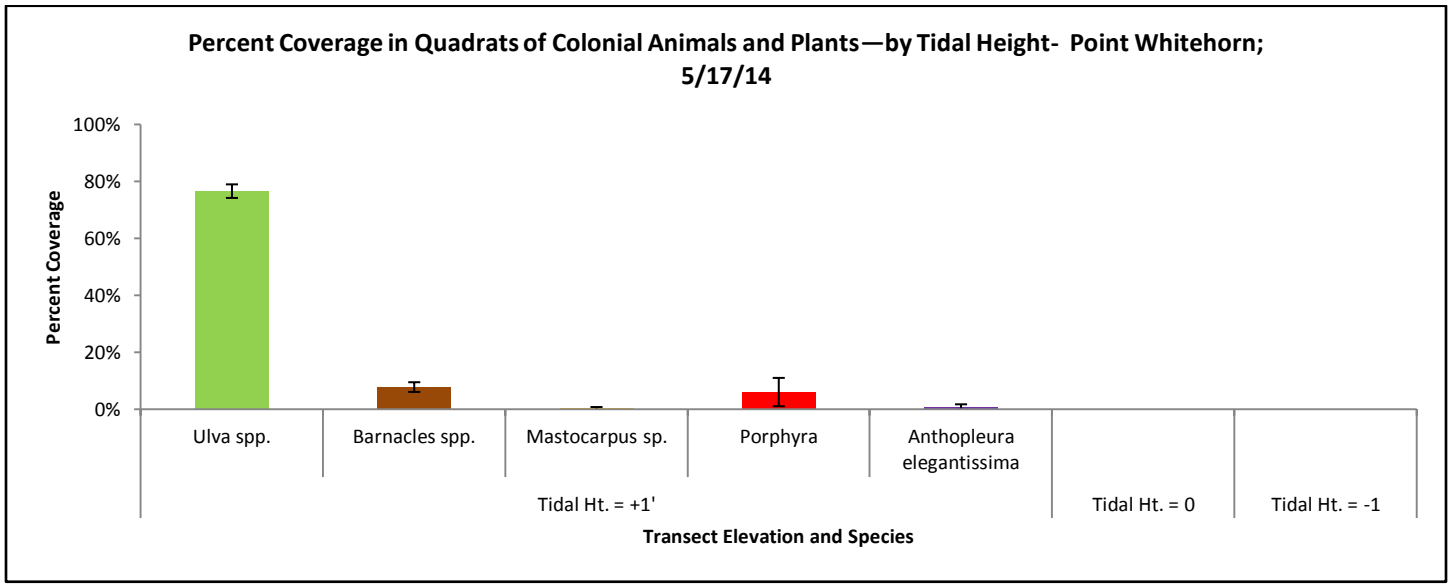


Figure 7: Percent Cover of Colonial Animals and Plants in Quadrats at Pt. Whitehorn

Table 6: Pt. Whitehorn Percent Cover Data

Pt. Whitehorn		Date: 5/17/2014				
Transect	Species	Quadrat, ft.				Average
Elevation		**1**	**2**	**3**	**4**	percent
1'	*Ulva* sp. (tubular)	19%	78%	6%	1%	26.0%
	Ulva sp. (bladed)	58%	0%	67%	77%	50.5%
	Ulva spp. (SUM)	77%	78%	73%	78%	76.5%
	Chthamalus dalli	0%	0%	0%	7%	1.8%
	Balanus crenatus	0%	6%	0%	0%	1.5%
	Balanus glandula	6%	0%	0%	***1%***	1.8%
	Semibalanus cariosus	***1%***	0%	0%	0%	0.3%
	Barnacle spp.	0%	0%	10%	0%	2.5%
	Barnacles spp. (SUM)	7%	6%	10%	8%	7.8%
	Mastocarpus sp.	0%	0%	0%	1%	0.3%
	Porphyra	4%	0%	9%	11%	6.0%
	Anthopleura elegantissima	2%	1%	0%	0%	0.8%
	Substrate	S,G,C	S,G,C	S,C	S,C	
		1	**2**	**3**	**4**	
0'						
	Substrate	S	S	S	S	
		1	**2**	**3**	**4**	
-1'						
	Substrate	S	S	S	S	
Bold italic denotes instances where the species was present at less than 1% nr = not recorded, C/S: Clay/Silt, S: Sand, G: Gravel, C: Cobbles, B: Boulders, E: Erratic						

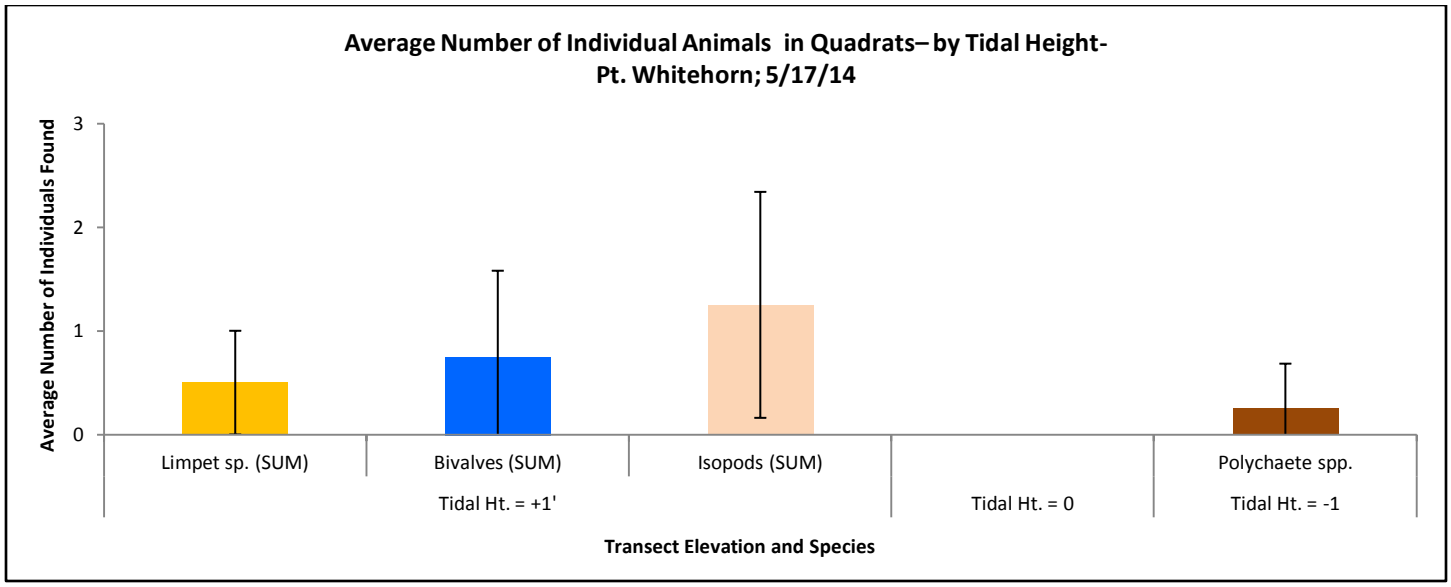


Figure 8: Average Number of Individual Animals in Quadrats at Pt. Whitehorn

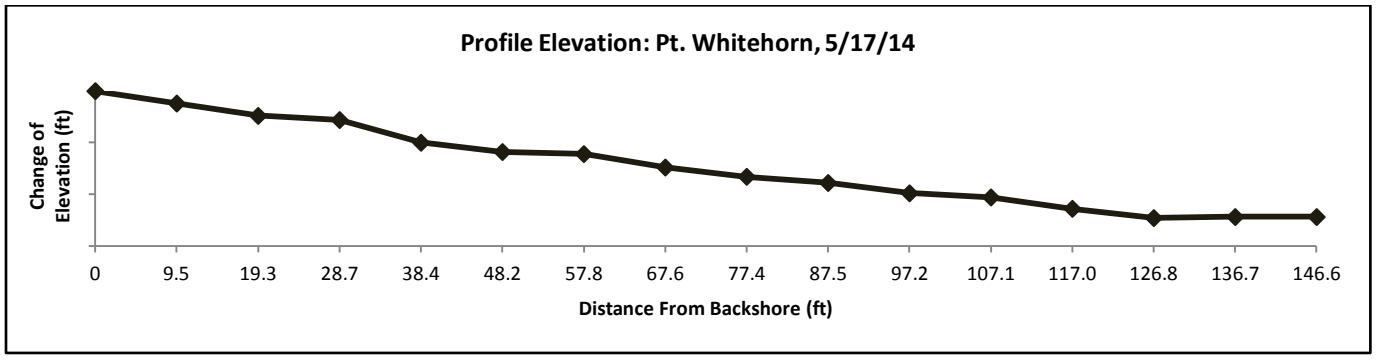
Table 7: Pt. Whitehorn Individual Organisms Data

Pt. Whithorn	Date: 5/17/2014	Countable Animals				
Transect	Species	Quadrat				Average
Elevation		1	2	3	4	Count
1'	*Tectura persona*	0	1	0	0	0.3
	Tectura scutum	0	0	1	0	0.3
	Limpet spp. (SUM)	0	1	1	0	0.5
	Littorina scutulata	0	1	0	1	0.5
	Nucella lamellosa	0	1	0	0	0.3
	Bivalves (SUM)	0	2	0	1	0.8
	Gnorimosphaeroma oregonensis	0	1	1	0	0.5
	Pentidotea wosnesenskii	0	0	0	3	0.8
	Isopods (SUM)	0	1	1	3	1.3
Substrate		S, G, C	S, G, C	S, C	S, C	
0'						
Substrate		S	S	S	S	
-1'	Tubeworm (a polychaete)	1	0	0	0	0.3
Substrate		S	S	S	S	

Figure 9: Point Whitehorn profile area; Photo credit: RE Sources

Table 8: Point Whitehorn Beach Profile Data: Elevation, Substrate and Species Groups

Entry	Length of survey section	cumulative distance	Survey Reading + or -	Ground shell debris	Clay/Silt	Sand (.002"-.08")	Gravel (.08"-2")	Cobbles (2"-10")	Boulders (>10)	Erratics (BIG ROCKS)	Amphipods	Anemones	Barnacles	Chitons	Clams	Crabs	Fish	Insects	Isopods	Limpets	Mussels	Nudibranch	Sand Dollars	Sea Cucumbers	Seastars	Snails	Urchins	Flat Worms	Nemerteans	Polychaetes	Green Seaweeds	Red Seaweeds	Brown Seaweeds	Seagrass	Arachnid	Shrimp
1	9.5	9.5	-1.2		X		X	X	X	X	X							X																		
2	9.8	19.3	-1.2	X		X	X	X	X																											
3	9.4	28.7	-0.4	X		X	X	X	X	X																										
4	9.7	38.4	-2.2					X	X		X		X					X																		
5	9.8	48.2	-0.9					X	X																											
6	9.6	57.8	-0.2					X	X																											
7	9.8	67.6	-1.3	X			X	X	X				X													X							X			
8	9.8	77.4	-0.9	X			X	X	X		X	X	X			X				X						X				X	X		X			
9	10.1	87.5	-0.6	X				X	X		X	X	X			X				X						X					X	X				
10	9.7	97.2	-1					X	X			X	X			X			X	X						X				X	X	X			
11	9.9	107.1	-0.4					X	X			X	X			X			X	X						X				X	X	X			
12	9.9	117.0	-1.1			X	X	X	X			X	X			X		X	X	X						X					X	X			
13	9.8	126.8	-0.9			X	X	X	X			X	X			X	X		X	X					X	X					X	X			
14	9.9	136.7	0.1	X		X		X	X			X	X												X					X	X				
15	9.9	146.6	0			X			X			X	X																							
16	10.0	156.6	-0.4	No data collected.																																
17	9.9	166.5	-0.4																																	
18	9.9	176.4	-0.5																																	
19	10.1	186.5	-0.4																																	
20	10.0	196.5	-0.5																																	



At Point Whitehorn, *Ulva* sp. was prominent in the +1' quadrats; however no plants or colonial animals were seen in the 0' and -1' quadrats. We documented a total of 4 species groups and 18 individuals, most of which were in the +1' quadrat.

Compared to 2013 data, Point Whitehorn showed substantially more *Ulva* spp. in 2014. In 2013, the *Ulva* spp. Cover totaled 1.8% for all quadrats and elevations. In 2014, 76.5% cover by *Ulva* spp. was present, all of which was at the +1' elevation. This difference appears to be related to a change in substrate. In 2013, the +1', 0', and -1' quadrats all fell on a

sand bar between two more diverse areas with cobbles and gravel. In 2014, the sand bar shifted and the +1' quadrats were on more diverse substrate. The average number of individuals recorded in 2014 is comparable to the number recorded in 2013.

Intalco Beach results

Table 9: Intalco Beach Percent Cover Data

Intalco		Date: 7/11/2014				
Transect	Species	Quadrat, ft.				Average
Elevation		1	2	3	4	percent
1'						
	Substrate	S, G, C	S, G, C	G, C	S,G	
		1	2	3	4	
0'						
	Substrate	S, G, C	S, G, C	S, G	G	
		1	2	3	4	
-1'						
	Substrate	S, G	G	S, G	G	

nr = not recorded, C/S: Clay/Silt, S: Sand, G: Gravel, C: Cobbles, B: Boulders, E: Erratic

Bold italic denotes instances where the species was present at less than 1%

Figure 10: John Bremer and Jennie Tuckerman removing debris from a quadrat on Intalco Beach; Photo credit: RE Sources

Figure 11: Marissa McBride and Bob Lemon identifying organisms on Intalco Beach; Photo credit: RE Sources

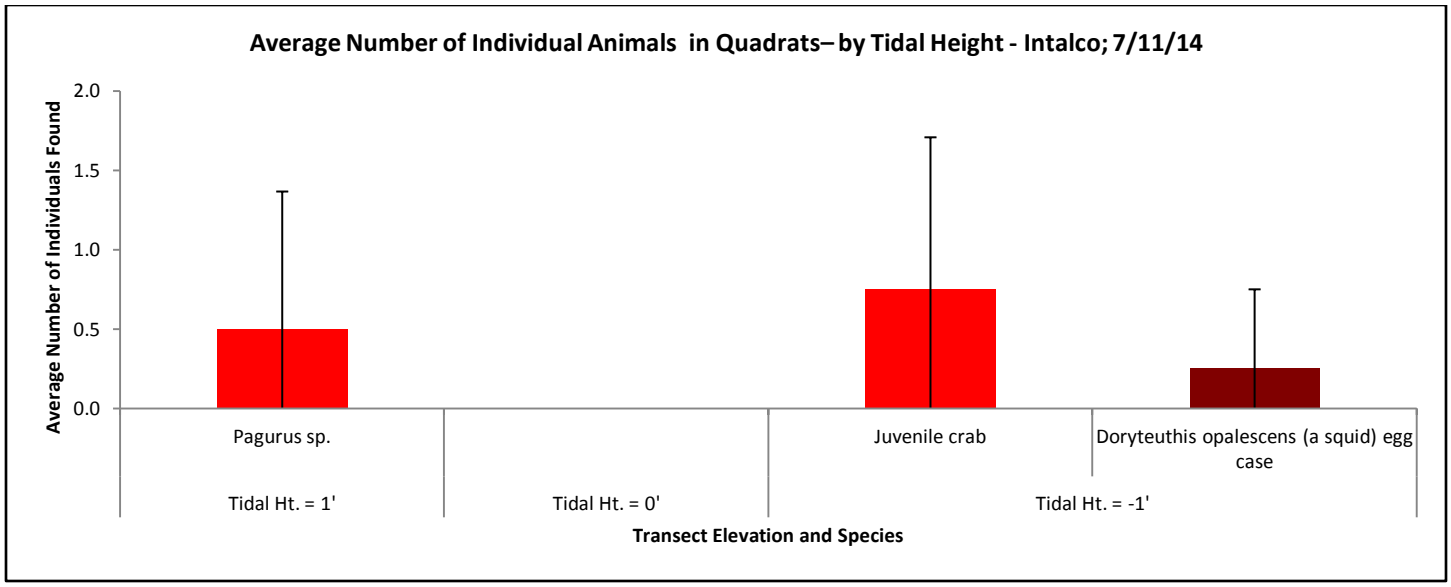


Figure 12: Average Number of Individual Animals in Quadrats at Intalco Beach

Table 10: Intalco Beach Individual Organisms Data

Intalco	Date: 7/11/2014	Countable Animals				
Transect	Species	Quadrat				Average
Elevation	[redacted]	1	2	3	4	Count
1'	*Lophopanopeus bellus*	0	0	0	1	0.3
	Juvenile crab	0	0	0	1	0.3
	Pagurus sp.	0	0	0	2	0.5
Substrate	[redacted]	S, G, C	S, G, C	G, C		[redacted]
0'						
Substrate	[redacted]	S, G, C	S, G, C	S, G	G	[redacted]
-1'	Juvenile crab	1	0	2	0	0.8
	Doryteuthis (Loligo) opalescens (squid egg case)	0	0	1	0	0.3
Substrate	[redacted]	S, G	G	S, G	G	[redacted]

Figure 13: Squid egg casing at Intalco; Photo credit: RE Sources

Table 11: Intalco Beach Profile Data: Elevation, Substrate, and Species Groups

Intalco: 7/11/2014				Substrate (check all)											Seaweeds and Invertebrates (check all that apply)																														
Entry	Length of survey section	cumulative distance	Survey Reading + or -	Ground shell debris	Clay/Silt	Sand (.002"-.08")	Gravel (.08"-2")	Cobbles (2"-10")	Boulders (>10)	Erratics (BIG ROCKS)		Entry	Length of survey section	cumulative distance	Amphipods	Anemones	Barnacles	Chitons	Clams	Crabs	Fish	Insects	Isopods	Limpets	Mussels	Nudibranch	Sand Dollars	Sea Cucumbers	Seastars	Snails	Urchins	Flat Worms	Nemerteans	Polychaetes	Green Seaweeds	Red Seaweeds	Brown Seaweeds	Seagrass	Arachnid	bryozoans
1	10'	10	-1.3			X	X																																	x	
2	10'	20	-0.8			X	X					1	20'	20	x																									x	
3	10'	30	1.2			X	X	X							x																									x	
4	10'	40	-1.9				X	X				2	20'	40	X																									x	
5	10'	50	-1.5			X	X	X							x																										
6	10'	60	-1.4			x	X	X				3	20'	60			x							x						x					x	x				
7	10'	70	-1.3				X	X	X								x							x						x					x	x				
8	10'	80	-1.3			X	X	X				4	20'	80	x		X							X						X					x	x				
9	10'	90	-1.1			X	X	X							x		x							x											x	x				
10	10'	100	-1			X	X	X	X			5	20'	100	X		X	x						X											x	X				
11	10'	110	-1			X	X	X							X	x	x	x		x			x	x					x	x				x	x	x	x			x
12	10'	120	-0.9		X	X	X	X	X			6	20'	120	X	X	X	X		X			x	X					X	X				X	x	X	X			x

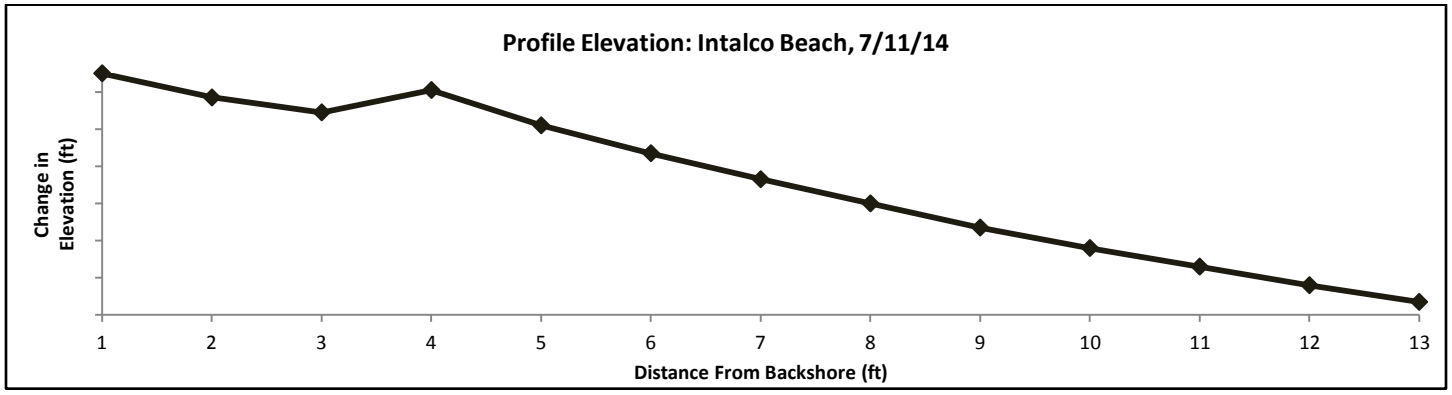


Figure 14: Beach elevation profile for Intalco Beach

At the Intalco Beach survey site, attached plants or colonial animals were absent. Very few individual organisms were present on the beach; however, a squid egg cluster was observed.

The amount of plants and colonial animals in the beach decreased from 2013 to 2014. *Ulva* spp. and barnacles were seen in 2013 but in 2014, no colonial organisms were seen. The number of individuals animals varied from 2013 to 2014, but numbers were low in both cases.

Neptune Beach results

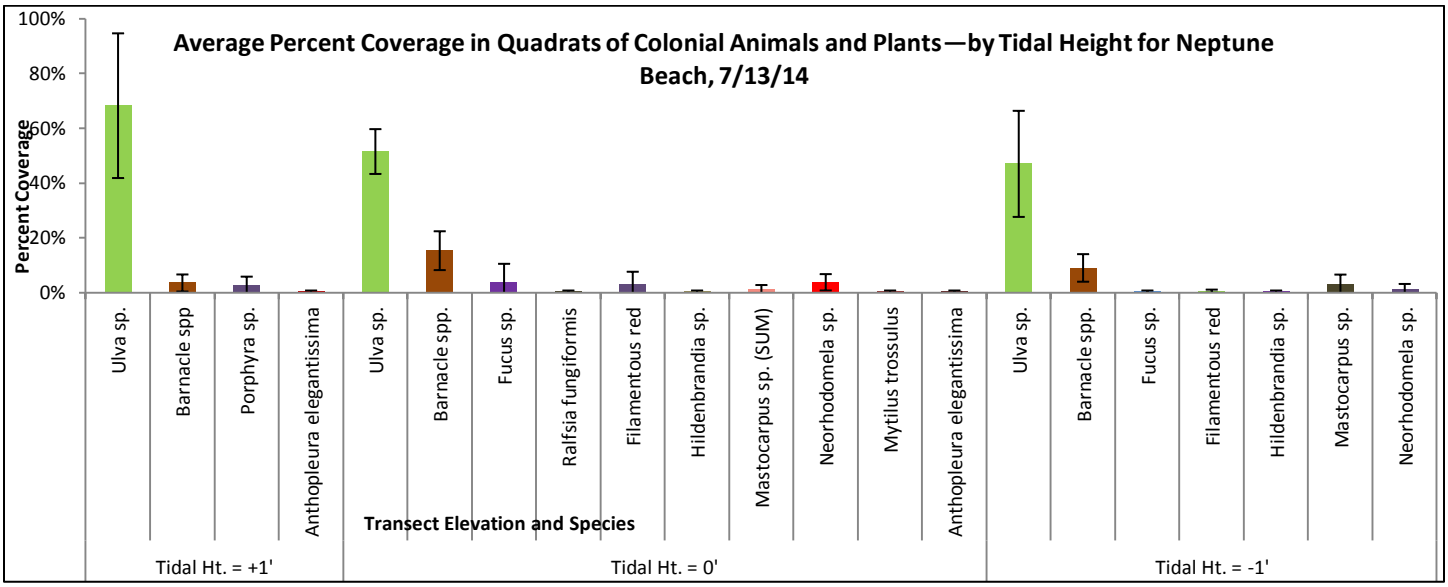


Figure 15: Percent Coverage of Colonial Animals and Plants in Quadrats at Neptune Beach

Figure 16: Kim Clarkin and Bob Cecile estimating percent cover; Photo credit: RE Sources

Figure 17: Michael Kyte identifying organisms; Photo credit: RE Sources

Table 12: Neptune Beach Percent Cover Data

Neptune Beach		**Date: 7/13/2014**				
Transect	Species	Quadrat, ft.				Average
Elevation		**1**	**2**	**3**	**4**	percent
1'	*Ulva* spp.	98%	47%	83%	45%	68.3%
	Balanus glandula	0%	7%	2%	0%	2.3%
	Barnacle spp.	0%	0%	0%	5%	1.3%
	Barnacle spp. (SUM)	0%	7%	2%	5%	3.5%
	Porphyra sp.	0%	3%	0%	7%	2.5%
	Anthopleura elegantissima	0%	***1%***	0%	0%	0.3%
	Substrate	S, C	S, C, B	S, G	S, G, C	
		1	**2**	**3**	**4**	
0'	*Ulva* spp.	45%	62%	45%	54%	51.5%
	Chthamalus dalli	5%	0%	0%	0%	1.3%
	Balanus crenatus	0%	1%	0%	0%	0.3%
	Balanus glandula	4%	17%	24%	0%	11.3%
	Barnacle spp.	0%	0%	0%	10%	2.5%
	Barnacle spp. (SUM)	9%	18%	24%	10%	15.3%
	Fucus sp.	0%	0%	0%	14%	3.5%
	Ralfsia fungiformis	0%	0%	***1%***	0%	0.3%
	Filamentous red	10%	0%	0%	***1%***	2.8%
	Hildenbrandia sp.	0%	0%	1%	0%	0.3%
	Mastocarpus sp. (tar spot)	0%	0%	***1%***	0%	0.3%
	Mastocarpus sp.	0%	0%	***1%***	3%	1.0%
	Mastocarpus sp. (SUM)	0%	0%	***2%***	3%	1.3%
	Neorhodomela larix	5%	7%	3%	0%	3.8%
	Mytilus trossulus sp.	0%	***1%***	0%	0%	0.3%
	Anthopleura elegantissima	0%	***1%***	0%	0%	0.3%
	Substrate	S, G, C, B	S, C	S, G, C	S, C, B	
		1	**2**	**3**	**4**	
-1'	*Ulva spp.*	24%	69%	55%	40%	47%
	Chthamalus dalli	0%	0%	0%	1%	0%
	Balanus crenatus	0%	4%	0%	0%	1%
	Balanus glandula	7%	0%	0%	7%	4%
	Semibalanus cariosus	***1%***	0%	0%	0%	0%
	Barnacle spp.	0%	0%	16%	0%	4%
	Barnacle spp. (SUM)	8%	4%	16%	8%	9%
	Fucus sp.	1%	0%	0%	0%	0%
	Filamentous red	***1%***	0%	0%	1%	1%
	Hildenbrandia sp.	***1%***	0%	0%	0%	0%
	Mastocarpus sp.	8%	0%	1%	3%	3%
	Neorhodomela sp.	1%	0%	4%	0%	1%
	Substrate	C/S, S, G, C, B, E	S, C	S, C, B	S, C	

nr = not recorded, C/S: Clay/Silt, S: Sand, G: Gravel, C: Cobbles, B: Boulders, E: Erratic

Bold italic denotes instances where the species was present at less than 1 or 2%

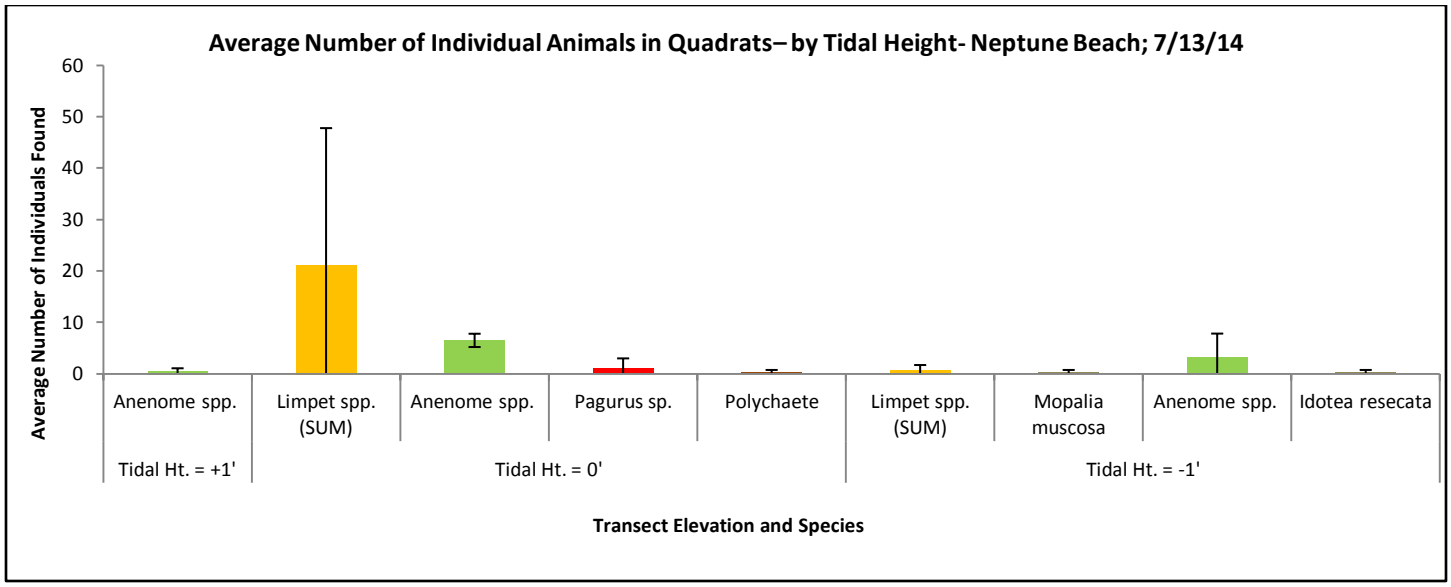


Figure 18: Average Number of Individual Animals in Quadrats at Neptune Beach

Table 13: Neptune Beach Individual Organisms Data

Neptune	Date: 7/13/2014	Countable Animals				
Transect	Species	Quadrat				Average
Elevation		1	2	3	4	Count
1'	*Anthopleura artemisia*	0	0	0	1	0.3
	Anemone sp.	0	0	1	0	0.3
	Anenome spp. (SUM)	0	0	1	1	0.5
Substrate		S, C	S, C, B	S, G	S, G, C	
0'	*Lottia pelta*	60	0	14	0	18.5
	Tectura persona	0	11	0	0	2.8
	Limpet spp. (SUM)	60	11	14	0	21.3
	Anthopleura artemisia	6	1	3	5	3.8
	Anemone sp.	0	7	4	0	2.8
	Anenome spp. (SUM)	6	8	7	5	6.5
	Pagurus sp.	4	0	0	0	1.0
	Polychaete	0	1	0	0	0.3
Substrate		S, G, C, B	S, C	S, G, C	S, C, B	
-1'	*Lottia pelta*	1	0	0	0	0.3
	Tectura persona	0	0	2	0	0.5
	Limpet spp. (SUM)	1	0	2	0	0.8
	Mopalia muscosa	0	0	1	0	0.3
	Anthopleura artemisia	0	2	10	0	3.0
	Anemone sp.	1	0	0	0	0.3
	Anemone spp. (SUM)	1	2	10	0	3.3
	Pentidotea resecata	0	0	1	0	0.3
Substrate		C/S, S, G, C, B, E	S, C	S, C, B	S, C	

Table 14: Neptune Beach Profile Data: Elevation, Substrate, and Species Groups

Neptune Beach: 7/13/2014				Substrate (check all)										Seaweeds and Invertebrates (check all that apply)																													
Entry	Length of survey section	cumulative distance	Survey Reading + or -	Ground shell debris	Clay/Silt	Sand (.002"-.08")	Gravel (.08"-2")	Cobbles (2"-10")	Boulders (>10)		Entry	Length of survey section	cumulative distance	Amphipods	Anemones	Barnacles	Chitons	Clams	Crabs	Fish	Insects	Isopods	Limpets	Mussels	Nudibranch	Sand Dollars	Sea Cucumbers	Seastars	Snails	Urchins	Flat Worms	Nemerteans	Polychaetes	Green Seaweeds	Red Seaweeds	Brown Seaweeds	Seagrass	Arachnid	Porifera
1	10'	10	-0.5			X					1	10	10																				X							
2	10'	20	0.2			X	X																										X						
3	10'	30	-1.1			X	X				2	20	30	x																									
4	10'	40	-1.1			X	X							x																									
5	10'	50	-1.2			X	X							x																									
6	10'	60	-1.2			X	X	X			3	30	60	No Organisms found in this swath																										
7	10'	70	-1			X	X	X	X		4	10	70			X							X						X			x		X	X					
8	10'	80	-0.8			X	X	X	X		5	10'	80	X		X						X							X					X	X					
9	10'	90	-0.9			X	X	X	X		6	10'	90	X	X	X		X	x			X	X	X					X				x	X	X					
10	10'	100	-1			X	X	X			7	10'	100		X				X			X		X					X											
11	10'	110	-0.4			X	X	X			8	10'	110	x	X	X			X				x	X				x					x	X	X					x
12	10'	120	-0.1			X	X	X	X		9	10'	120	No Data Collected in this Swath																										
13	10'	130	-0.6			X	X	X	X		10	10'	130		x	x							x	x				x							x	x	x			
14	10'	140	-0.6		X	X	X	X	X		11	10'	140	x	x	x	x		x									x					x	x	x	x	x			x

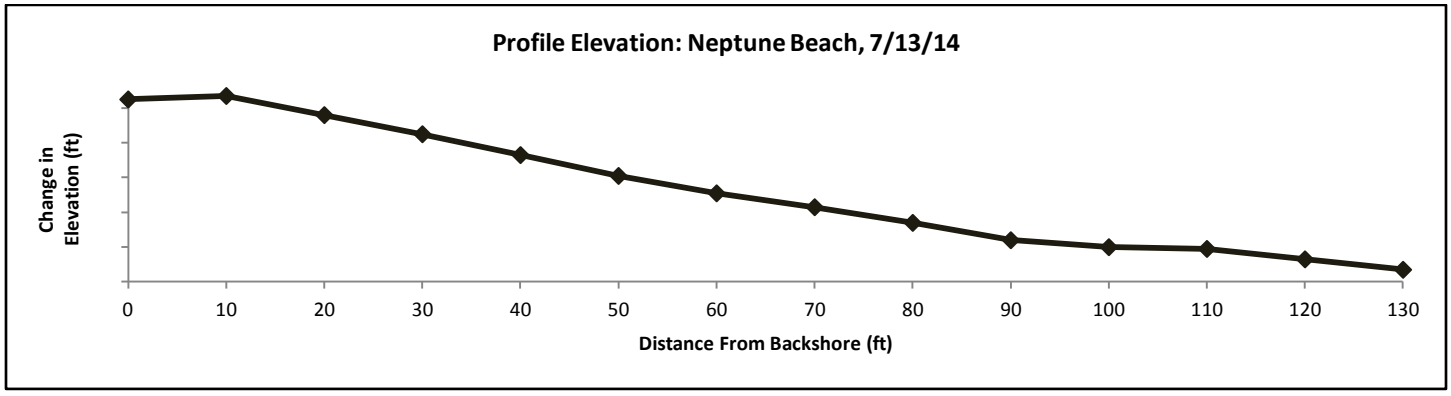


Figure 19: Beach elevation profile at Neptune Beach

At the Neptune Beach survey site, species represented as percent coverage were diverse, with *Ulva* spp. and barnacles having the highest percent coverage values throughout all tidal-height transects. The number of countable animals at Neptune Beach was the largest and most diverse collection of all those seen at the four study sites. Limpets and anemones were the dominant species at this site.

The data changed very little from 2013 to 2014.

Discussion

The goal of this project is to provide a baseline for detection of any future changes and the objective is to collect baseline data on beach slope, substrate, and intertidal biodiversity at four monitoring sites. The 2014 project was completed as intended. Twenty-eight volunteers were trained and participated in this year's survey. Quality control (QC) protocols described in the QAPP were satisfactory given the parameters and limitations of the study, and these were improved in this Year 2 of study (see planned program and procedure improvements below).

Across all four sites, the percent cover and number of animals was highest at Neptune Beach. This is consistent with the 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 diam.) 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)."

Three of the four survey sites are predominantly sandy and have little observable biota. Because of this, there is interest from the committee in changing the survey sites in upcoming years.

Recommendations

In Year 1, we made a number of recommendations to improve the training, data capture, and quality control for the surveys. The implementation of some of these recommendations ensured a better-trained cadre of volunteers and a more efficient and accurate quality control process. There remain some recommendations to be implemented or considered, and some clarifications to be made.

Recommendations from Year 1

The following recommendations and changes were implemented for Year 2:

- Training: Accurate of common organisms was emphasized.
- Training: Identification of invasive species was emphasized
- Photographing quadrats: Photos were taken after removing debris and unattached algae
- Data management: Each quadrat had at least 1 data sheet; quadrats were not pooled on 1 sheet
- Data collection: The distance along the profile line was noted for each transect level.
- Quality Control: The on-the beach portion included,
    - Ensuring that all blanks were filled out
    - Ensuring that animals and plants were placed in correct category (percent coverage vs. countable species)
    - Asking that participants total the entire percent coverage—and having them assess whether that was reasonable (some previous estimates were greater than 100%)
    - QC specialist reviewed estimates and verified that these seemed reasonable, on-site.

The following recommendations from Year 1 were not implemented but will be implemented or considered in Year 3.

- Additional Transect at -2': Volunteers are interested in adding a survey transect at -2' to document organisms present below -1', especially where much richer species diversity exists. For example, at Point Whitehorn, a band of sand with very few plants and animals was present between -1' and +1', whereas higher and lower elevations were obviously rockier and more diverse. For these surveys to be valuable, the -2'survey must occur in all years. Ideally, it should be done at all sites.
- Surveys of fauna in sediments: Future surveys may allow for the possibility of surveying fauna located within intertidal sediments (i.e., below the surface) to provide a greater representation of the ecological communities present at the CPAR. This undertaking will depend on overall interest from the community, as it does entail significantly more work. The tools would likely be available from the Fidalgo Bay Aquatic Reserve CSC.
- Station identification: We will ensure that GPS information includes units and consistent coordinate format (decimal degrees or degrees, minutes, seconds) and that compass readings include declination.

Clarifications and considerations for Year 3

The following clarifications are needed to ensure greater reproducibility of fieldwork. Answers to these questions should be discussed with experts and satisfactory solutions should be amended in the QA plan.

- What constitutes debris that should be removed: All dead/ unattached algae, shells and rocks (, especially if these constitute much of the substrate), and what about when they have associated life on them?
- When a quadrat lands on uneven surfaces/rocks, estimates should be made taking a strictly vertical view. Is there any angle that is considered too steep for this procedure? Does this limit apply equally to percent cover and individual species?
- When a quadrat lands on a boulder such that the elevation is not representative of the transect line, should the quadrat be moved to a more representative spot on the timeline? How will this be determined?
- How should shell debris be noted? Is there a size classification for shell debris?

Other changes to be made or considered:

- Should additional or different sites be added, to ensure that data could be collected where there is sufficient biota?
- When making species lists or examining quadrats, should there be a time limit to search for organisms or size limit on species? (This has been recommended by one volunteer expert but should be discussed broadly.)
- The general species list (Beach Watcher D- 4, Field data sheet) does not need to be filled out when expert identifiers are compiling species on the detailed species list (Species Checklist, Appendix 1). Data can be transferred where appropriate from the detailed list to the general list.

- The use of scientific names and the practice of identifying organisms down to species, where possible, needs to be emphasized in training of citizen volunteers to decrease confusion about species ID.
- Amend the Beach Watcher D- 4, Field data sheet, to include shell debris as a substrate.

Possible future uses of this data

Ongoing annual surveys will allow comparisons from year to year. In this way, changes in overall species diversity may be detected. After detection, causes may be able to be elucidated and potentially remedied. These surveys may also be used in any Natural Resources Damage Assessment in the event of an oil spill or other event, and to identify and attend to invasive species presence.

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Acknowledgments

Most of the sampling protocol and procedures is based on the work of the Island County/WSU Beach Watchers. We thank them for the use of their materials and assistance. In particular, we thank Barbara Bennett, project coordinator for her assistance.

We also thank our partners at WDNR and especially Betty Bookheim for her assistance in refining the procedures. Finally, we thank Dr. Megan Dethier of University of Washington for her assistance in helping us resolve some of the theoretical issues in the sampling protocol.

We would also like to thank Betty Bookheim, Michael Kyte, and Bob Lemon for their review and comments on this report.

Gratitude goes to RE Sources interns Marissa McBride and Taylor Garrod for assisting in data entry and graph- making, and to Maddie Foutch for formatting assistance and support throughout the project.

A special thank you goes to the volunteers who attended classes and who came out in both sun and rain to survey Cherry Point Beaches. Without your assistance, this work would not have happened.

Appendix A: Data Forms

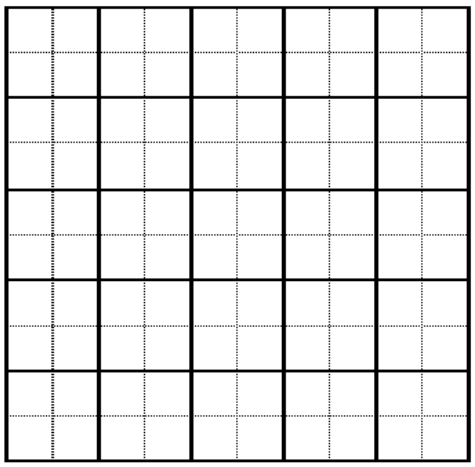
The following data forms were used in this project:

Form	Purpose
Quadrat Estimation Worksheet, rev1	Assess percentage coverage
Whatcom Quadrat Sheet, rev 1	Quadrat analysis, Cherry Point AR
Beach Watcher Profile data sheet	Profile elevation, substrate type and species type
Cherry Point Species List With Common Organisms	Identify and tally species
Species Checklist_scientific nomenclature, rev1	Species identification
Profile Start Point Form, rev1	Record start point with multiple readings
Beach Watcher, Vertical Height Form	Record presence and dimensions of structure on or near the profile line
Beach Watcher, Directions to Beach Form	Identifies general location of beach and then provides specific information to locate start point

Quadrat Estimation Worksheet

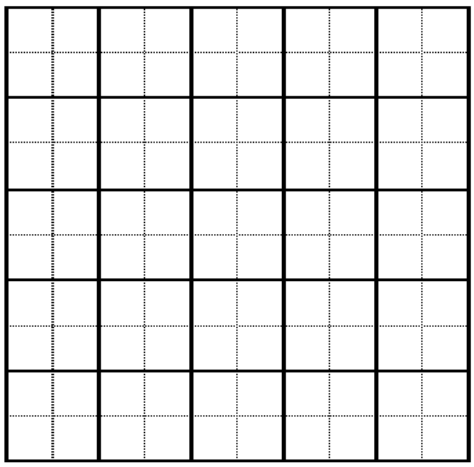
Site_____ Date and Time_____
Identifier:_____ Recorder_____
Other Team members:_____ and _____
Transect Elevation (circle one): +1’ 0’ -1
Quadrat Number _____, Quadrat Distance along transect line _____

Organism: _____ Row Totals



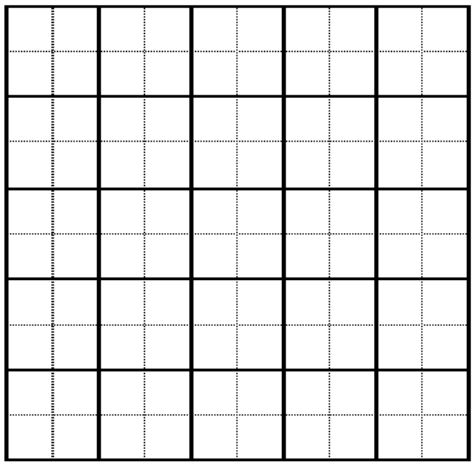
Grand Total:

Organism: _ Row Totals

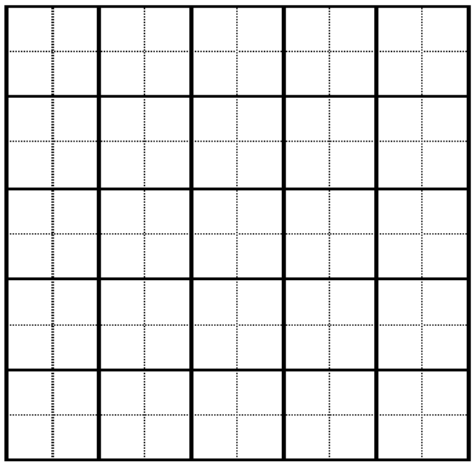


Grand Total:

Organism: _____ Row Totals



Organism: __ Row Totals



Whatcom Quadrat Sheet

Aquatic Reserve Intertidal Biotic monitoring QUADRAT DATA SHEET

LEAD:_____
Team names: _____ and _____
Identifier: _____ Recorder: _____
Site: _____
Date and Time of sampling: _____

OUR QUADRAT DATA:

Transect elevation (circle one): +1' 0' -1'
Quadrat #: _____
Quadrat distance: _____
Substrate in Quadrat: _____

PERCENT COVERAGE ORGANISMS: algae, plants and colonial organisms*:

transferred information from QUADRAT ESTIMATION worksheet

	Organism Name	% Cover		Organism Name	% Cover
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

* Barnacles, mussels, sponge, bryozoans, colonial ascidians, & Anthopleura elegantissima

COUNTABLE ANIMALS:

	Organism Name	Number		Organism Name	Number
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

NOTES AND OBSERVATIONS (i.e weather, dominant vegetation, tide, invasives, etc)

Pg. 1/1

Beach Watcher Profile Data Sheet

SIDE A Profile data sheet Page ___of ___ *** Please complete additional information on the back of this form

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, seaweeds, and animals found within each profile section.

	A	B	C	Substrate (check all that apply)							Seaweeds and Invertebrates (check all that apply)																														
Entry (1,2,3, etc.)	Length of survey section	Cumulative Distance (optional) + or -	Survey Reading	Ground shell debris	Clay/Silt	Sand (.002" - .08")	Gravel (.08" - 2")	Cobbles (2" - 10")	Boulders (>10")	Erratics (BIG ROCKS!)	Amphipods	Anemones	Barnacles	Chitons	Clams	Crabs	Fish	Insects	Isopods	Limpets	Mussels	Nudibranchs	Sand Dollars	Sea Cucumbers	Seastars	Snails	Urchins	W Flat Worms	W Nemerteans	W Polychaetes	Green Seaweeds	Red Seaweeds	Brown Seaweeds	Seagrass	Arachnid	Shrimp	Other
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Cherry Point Species List With Common Organisms

Site: _____

Date & Time of sampling: _____

Identifier:_____Recorder:_____

			Elevation Distances							
Kingdom/Phylum	Genus/Species name	Common Name								
Animalia/Chordata	*Gobiesox maeandricus*	Northern cling fish								
	Pholis ornata	Saddleback gunnel								
	Oligocottus maculosus	Tide pool sculpin								
Cnidaria	*Anthopleura elegantissima*	Aggregating anenome								
	Anthopleura artemisia	Moonglow anenome								
	Urticina coriacea	Stubby rose anenome								
	Metridium farcimen	Plumose anenome								
Nemertea	*Tubulanus polymorphus*	Orange ribbon worm								
	Paranemertes peregrina	Purple ribbon worm								
Mollusca	*Littorina scutulata*	Checkered periwinkle								
	Littorina sitkana	Sitka periwinkle								
	Lacuna variegata	Chink shells								
	Lirabuccinum dira	Dire whelk								
	Nucella lamellosa	Frilled dogwinkle								
	Onchidoris bilamellata	Barnacle eating nudibranch								
	Tresus capax	Horse clam								
	Protothaca staminea	Pacific littleneck								
	Venerupis philippinarum	Japanese littleneck								
	Clinorcardium nuttallii	Heart cockle								
	Pododesmus macrochisma	Green false-jingle								

Cherry Point Species List With Common Organisms

Site: _____

Date & Time of sampling: _____

Identifier:_____Recorder:_____

			Elevation Distances							
Kingdom/Phylum	Genus/Species name	Common Name								
Mollusca	*Mytilus trossulus*	Pacific blue mussel								
	Crassostrea gigas	Pacific (Japanese) oyster								
	Mopalia muscosa	Mossy chiton								
	Mopalia ciliata	Hairy chiton								
	Lottia digitalis	Finger limpet								
	Lottia alveus paralella	Eelgrass limpet								
	Tectura pernosa	Mask limpet								
	Calliostoma ligatum	Blue top shell								
Arthropoda	*Gnorimosphaeroma oregonense*	Pill bug isopod								
	Pentidotea wosnesenskii	Rockweed isopod								
	Cirolana harfordi	Harford's isopod								
	Megalorchestia californiana	California beach hopper								
	Hemigrapsus nudus	Purple shore crab								
	Hemigrapsus oregonensis	Hairy shore crab								
	Lophopanopeus bellus	Black-clawed crab								
	Cancer gracilis	Graceful crab								
	Cyclocoeloma tuberculata	Decorator crab								
	Petrolisthes eriomerus	Flat-top porcelain crab								
	Pagurus granosimanus	Grainy hermit								
	Pagurus beringanus	Bering Hermit								
	Heptacarpus spp.	Broken back shrimp								

Cherry Point Species List With Common Organisms

Site: _____

Date & Time of sampling: _____

Identifier:_____Recorder:_____

			Elevation Distances							
Kingdom/Phylum	Genus/Species name	Common Name								
Anthropoda Cont.	*Balanus glandula*	Acorn barnacle								
	Semibalanus cariosus	Haystack barnacle								
Bryozoa	*Membranipora membranacea*	Kelp lace								
Echinodermata	*Leptasterias spp.*	Brooding star								
	Pycnopodia helianthoides	Sunflower star								
	Amphiodia occidentalis	Long-armed brittle star								
	Strongylocentrotus droebachiensis	Green sea urchin								
Plantae/Chlorophyta	*Codium fragile*	Dead man's fingers								
	Ulva lactuca	Sea lettuce								
	Ulva intestinalis	Sea lettuce								
Ochrophyta	*Alaria marginata*	Winged kelp								
	Saccharina latissima	Sugar kelp								
	Nereocystis leutkeana	Bull kelp								
Rhodophyta	*Lithothamnion spp.*	Encrusting corraline red								
	Priontis lanceolata	Bleachweed								
	Hildenbrandia fluccosa	Sea brush								
Other:										

Cherry Point Species List With Common Organisms

Site: _____

Date & Time of sampling: _____

Identifier:_____Recorder:_____

			Elevation Distances							
Kingdom/Phylum	Genus/Species name	Common Name								

Profile Start Point Form

Start Point of Permanent Profile Line

BEACH SITE_____

Beach Watcher(s) _____

Date of Measurements _____

STARTING POINT -- 3 COMPASS READINGS

Compass Reading	Description of Point Sighted for Reading
1.	
2.	
3.	

LONGITUDE _____

LATITUDE _____

Beach Watcher Vertical Height Form

Vertical Height of Permanent Structure Close To or On Profile Line

BEACH SITE_____

Beach Watcher(s) _____

Date of Measurements _____

Description of the structure you are measuring: _____

_____

_____

_____

Where is the structure in relation to your profile line? _____

_____

_____

_____

Compass reading: _____(to clarify the direction measurement was made)

HEIGHT: _____(specify feet, inches, tenths, centimeters)

Attach a photo or sketch below to show how the above measurement was made.

Beach Watcher Directions to Beach Form

Directions for Access to a Monitored Beach

Name of beach_____County_____

Monitoring Team Leader _____Phone_____

Nearest Town _____Nearest Body of Water _____

GPS Coordinates of Starting Point (if available)

GPS Brand_____GPS Model_____

Latitude_____Longitude_____PDOP_____

Directions to Beach Access (from major intersection or town):

Directions to Starting Point from Beach Access:

Compass Reading (magnetic) for Profile:_____
(from starting point to horizon over the water)

Appendix B: Field Instructions

Intertidal Monitoring STEP BY STEP

Do NOT walk below +1 before quadrats are set AND do Not walk in quadrats!

Placement of Profile Line: A member of the CPARCS committee will do this

Placement of Profile Swath:

After the profile line is set, one can start setting the outer limits of the profile swath using small marker flags. The swath is 20 meters wide, thus mark 10 meters on each side the profile line, every 10 linear feet of the profile. In the +1, 0, and -1 area of the profile, do not mark the area of the swath until a'er the quadrats have been placed.

Placement of Transect Lines:

As the tide is going out- place markers at +1, 0, and -1. To determine placement, use the nearest tide chart location and place the marker at the midway point as tide is lapping in and out at the time designated by the tide chart. Place a line or tape measure at the +1, 0, and -1 levels as soon as possible. The transect length should be 20 meters (66 feet). Place the tape with 0 feet at the left (if back is to water) and 10 meters (33 feet) at the profile line.

Placement of Quadrats:

Place 4 quadrats as soon as possible after the transects are placed. In this way, quadrat placement demarcates the area where participants are not to walk. The location of the first quadrat is randomly selected and placement of subsequent quadrats are placed at equal intervals. To place the first quadrat use a prepared computer-generated randomization chart for the numbers 0-4. Add 5, 10, and 15 to the numbers to get your measure. (When materials are only in English units, transect length will be 66', and random numbers will be from 0-16, and the numbers 16.5, 33, and 49.5 will be added to get the correct measure). Quadrats will be placed below the transect line with the top le' corner of the quadrat placed on the random number. For example:

Measuring Elevation Using Profile Poles:

Begin at the starting point of the profile line. Person A has profile pole #1 with the peephole- This will always by the shoreward pole. Person B has profile pole #2. Person B walks profile pole #2 ten feet down the profile line towards shore. Level both poles. Person A peeks through profile pole #1 peephole and directs her line of sight across the water to the horizon. Person A then matches the horizon line with the height at which it intersects profile pole #2. Observe the height of this intersection as it is measured on pole #2 and record in the Profile Data Sheet. This tells us the elevation change of each profile section.

Person A then walks her pole down and levels it on exactly the same spot that Person B had pole #2. Person B then walks his pole #2 down 10 more feet. Repeat the process until the end of the profile line is reached (water's edge). Extra surveyors can be used to assist in leveling the poles and scribing.

Recording Types of Organisms on Profile Swath:

Record with a checkmark all of the types of substrates, plants and animals found within each profile section (10 feet long by 20 meters wide) in the *Profile Data Sheet*. Start at the highest profile section and

work your way down the beach, one profile section at a time. The form indicates 1-10, 10-20, etc.. This refers to the distance in feet along the profile line, towards shore. Use a key to identify findings but at this point we only need to specify 'type' of organism. Gently lift rocks to investigate and gently roll rocks back over in the same position you found them. Depending on the number of surveyors, this can occur concurrently with 'Measuring Elevation'.

Recording Species on Profile Swath:

Record with a checkmark all of the species of plants and animals found within each profile section in the *Species Checklist Sheet*. Gently lift rocks to investigate and ensure to gently roll rocks back over in the same position you found them. Use a key to identify findings down to species. Add any plants or animals found that are not included on the form in the blank columns below. Have experts present for this part of the survey. Depending on the number of surveyors, this can occur concurrently with'Measuring Elevation' and 'Recording Types'.

Recording Organisms in Quadrat:

We need to be consistent in which organisms get % coverage and which get counted. Having organisms presented in two different formats, makes data presentation difficult.

All blanks should be filled out on the data sheet.

- Remove any debris, shells, unattached seaweeds or miscellaneous drift that might hinder analysis. ONLY IDENTIFY THE TOP VISIBLE LAYER. Photograph the quadrat with the appropriate quadrat identification label lying just beside the quadrat.
- Record all organisms within quadrat as species specific as possible in *Quadrat Data Sheet*. Have experts' present for this part of the survey.
- Estimate percent cover of seaweeds, sea grasses or colonial organisms, such as barnacles or aggregating anemone. Use 2-4 people and average the estimates. Percent cover estimate methods are dynamic and can be combined. Binary method (estimators assign a value of 1 to each 1% grid section where coverage is greater than ½ for a specified organism, and 0 where coverage is less than ½ for that organism. The values are totaled to arrive at % coverage) works well for any organism that covers a large percentage of the area. Binary method is not preferred for organisms that cover small percentages of the area. Using a 1% card works well in both cases.
- Identify invertebrates as species specific as possible. Count the number of animals found and record.