NORTH SOUND **STEWARDS**

2019 Intertidal Workbook

MRC Whatcom County

RE SOURCES FOR SUSTAINABLE COMMUNITIES
PROTECT. ACTIVATE. INNOVATE. THRIVE.

Intro to Intertidal Monitoring

Intertidal monitoring is a tool used to manage and protect our marine nearshore resources by measuring and monitoring the diversity, distribution, and abundance of intertidal species. The survey methods are based on those established by the Washington State University Beach Watcher Intertidal Monitoring Program.

The monitoring is meant to provide baseline data for detection of abnormal conditions and determination of whether these changes are due to natural variation or anthropogenic causes such as an oil spill. **Long term data collection can be useful for natural resource damage assessment, detection of invasive species, reserve management, and protection of critical habitats and species.** Intertidal monitoring can also be useful for assessing success of shoreline restoration projects.

Cherry Point and Fidalgo Bay Aquatic Reserves are two of eight reserves created by the Department of Natural Resources to protect native ecosystems that are crucial to the overall health of Puget Sound. The goal of the Aquatic Reserve program is to promote the preservation, restoration, and enhancement of state-owned aquatic lands that are of special education, scientific, or environmental interest. Intertidal monitoring at these reserves aims to collect baseline data to be incorporated into management plans.

Additionally, the Northwest Straits Foundation and the Whatcom Marine Resources Committee conduct intertidal surveys at sites where shoreline enhancement or restoration projects have taken place, aimed to capture and characterize before and after the enhancement or restoration project to see what changes may have occurred. Often these are shoreline softening projects that should enhance ecosystem functions and services along the shoreline, but monitoring these changes is important to inform future projects.

Citizen science plays a key role in the success of this long term scientific monitoring program. Each year since this monitoring program began in Whatcom and Skagit counties in 2013, interested citizens are recruited and trained to assist with intertidal monitoring. Entered data goes into reports that are shared with resource agencies to better manage our aquatic lands and shorelines. **Volunteers are the foundation to our success every summer, we cannot thank you enough!**

For more information, please contact:

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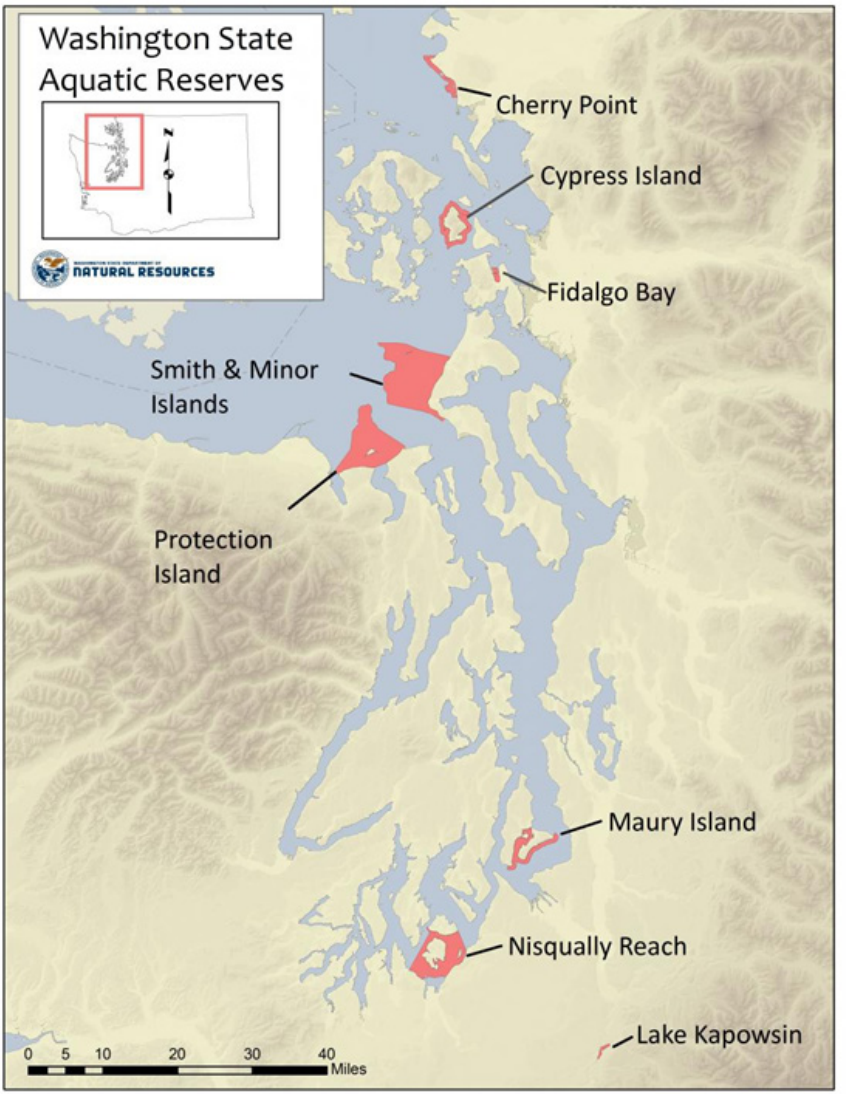
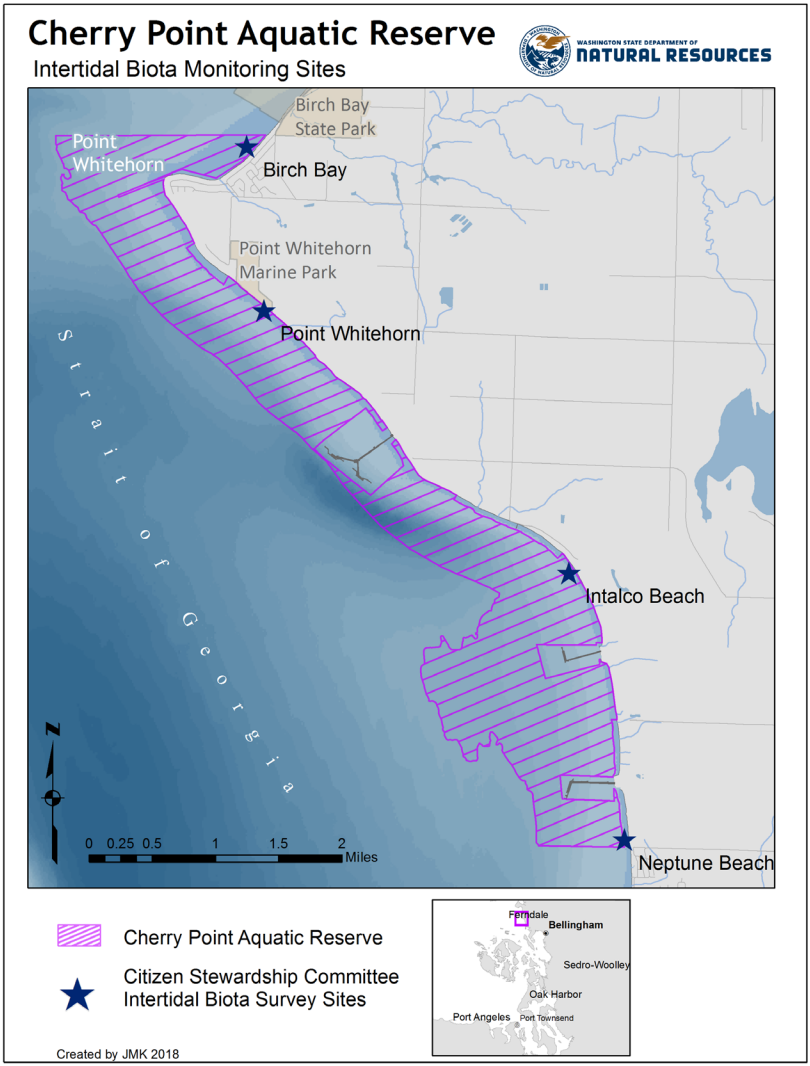
Aquatic Reserves in Washington



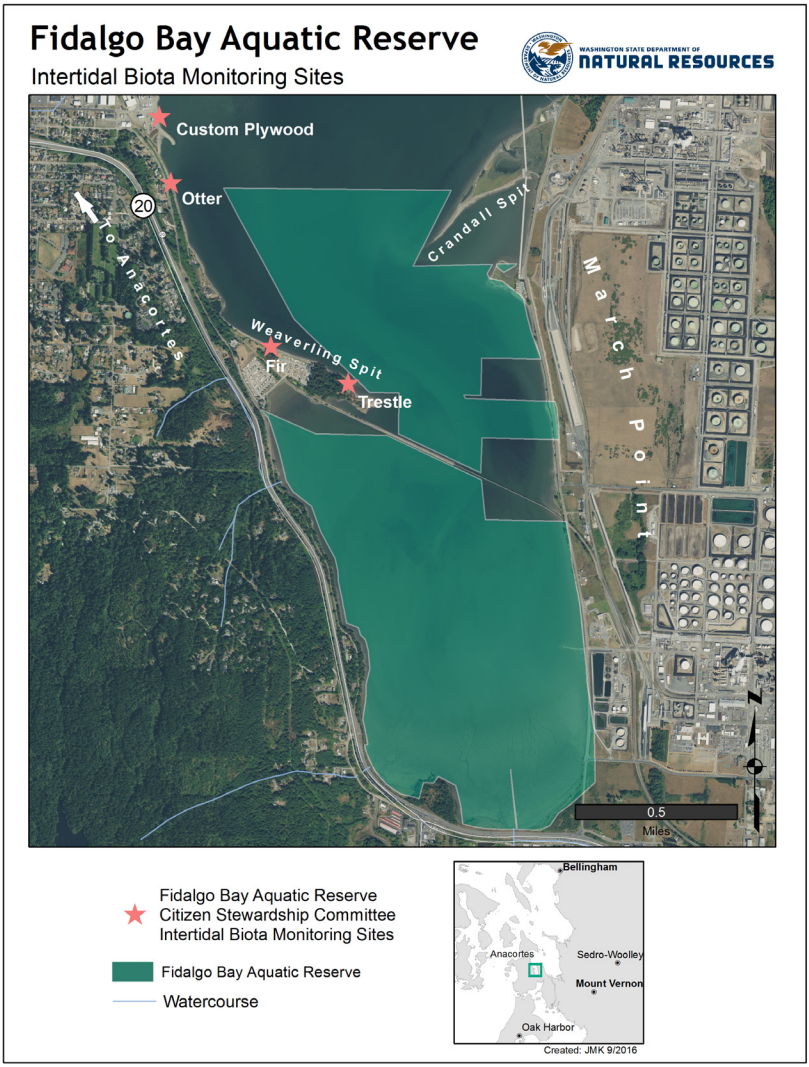
Map showing all eight of the Department of Natural Resources' Aquatic Reserves in Washington.

Cherry Point Aquatic Reserve



Map of Cherry Point Aquatic Reserve showing all four intertidal biota monitoring sites (Barnacle Rock, Point Whitehorn, Intalco, and Neptune).

Fidalgo Bay Aquatic Reserve



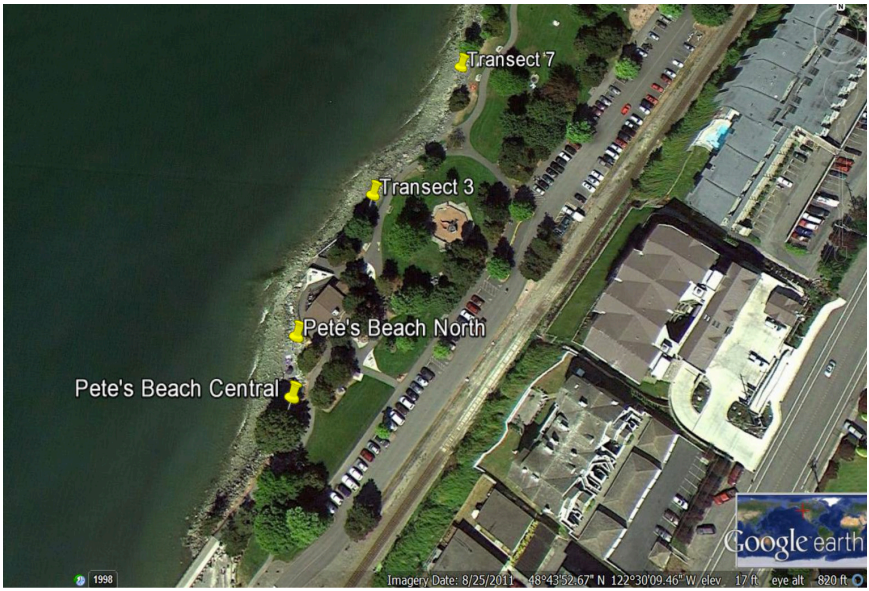
Map of Fidalgo Bay Aquatic Reserve showing all four intertidal biota monitoring sites (Custom Plywood, Otter, Fir, and Trestle).

Northwest Straits sites

March's Point
Aerial map of NW March's Point showing intertidal biota monitoring location.

Bowman Bay
Aerial map of Bowman Bay showing intertidal biota monitoring location

Whatcom MRC - Boulevard Park sites



Whatcom MRC Boulevard Park intertidal survey locations. Pete's Beach Central and Pete's Beach North are the two reference sites that still have riprap. Transects 3 and 7 are the two locations where the shoreline softening project occurred in 2013.

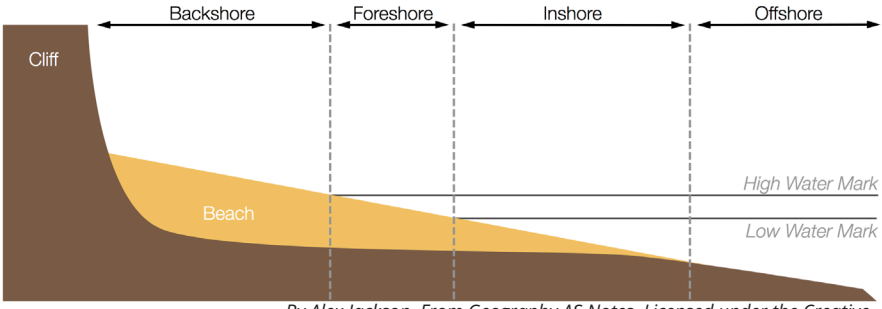
Glossary

Acronyms -

- QA/QC = quality assurance and quality control
- MRC = Marine Resources Committee
- NWSF = Northwest Straits Foundation
- NSS = North Sound Stewards
- SSS = South Sound Stewards
- CSC = Citizen Stewardship Committee
- FBAR = Fidalgo Bay Aquatic Reserve
- CPAR = Cherry Point Aquatic Reserve

Aquatic Reserve - established by the WA State Department of Natural Resources on state-owned aquatic lands in Puget Sound, these reserves include important biodiversity and habitat that are critical to the overall health of the Puget Sound.

Backshore: the part of the beach that lies between the foreshore and the coastline. This area is dry under normal conditions and is generally without vegetation and is often characterized by berms. The backshore is only exposed to waves under extreme events with high tide and storm surges.



Beach berm: a nearly horizontal plateau on the beach face or backshore, formed by the deposition of beach material by wave action. When present at our sites, these are often shown as a bump in the upper portion of the beach elevation profile.

Benthic zone: the zone at the bottom of a waterbody. Organisms that live near, on or in the benthic zone are referred to as benthos.

Biota: the animal and plant life of a particular region or habitat.

Calcareous: created using calcium carbonate (mostly referring to shells for intertidal monitoring).

Carapace: the hard upper shell or covering of some aquatic organisms.

Countable animals: species that can be counted individually within the quadrat and are >3mm in size. Species include: non-aggregating anemone, ribbon worms, flatworms, polychaete segmented worms, shelled snails, sea slugs, bivalves, chitons, limpets, isopods, shrimp, crabs, hermit crabs, solitary tunicates, sea stars, brittle stars, sea urchins, sea cucumbers, and fish.

Elevation profile: these surveys are completed along the profile line to determine change in elevation of the beach over time. Substrate identification also occurs during this survey.

Encrusting: cover with a hard surface layer, like a crust (e.g. an encrusting algae or sponge on a rock).

Epifuana: biota living on the surface of the seabed or submerged objects.

Exoskeleton: a hard outer protective and supporting covering (arthropods, including crabs) that is often shed to allow the organism to grow.

Horizon line: where the water and the sky or water and land meet.

Intertidal zone: the area between the high tide and low tide mark. Organisms that live in this zone deal with extreme environmental conditions, being both submerged in sea water and exposed to the air. Organisms deal with the impact of waves, desiccation, sunlight, and of course the risk of predation.

Invasive species (vs. non-native): Both are biota found living outside their native range, but invasive species are considered harmful to the non-native ecosystem, often spreading and reproducing quickly and outcompeting or excessively preying on native species. Non-native species can be invasive, but aren't necessarily if they don't pose a threat to the native ecosystem.

Invertebrates: have no internal spine or backbone.

Ordinary high water mark (or level): is a biological vegetation mark, as defined by the WA State Department of Ecology and under the Shoreline Management Act. Along marine shorelines, this often is the mean higher high tide mark where vegetation may meet the sand or gravel shoreline.

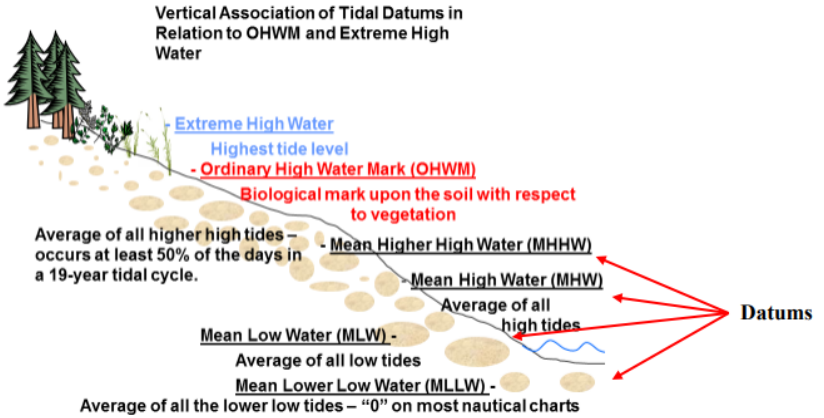


Figure 4-5: Vertical association of tidal data and OHWM along a typical undisturbed marine shoreline.

+6, +4, +1, 0 and -1 ft tide heights: these are the tidal heights we measure intertidal species at for some of our surveys with transect lines and quadrats. When the tide reaches each level, we flag the water line and then place the transect tape along the flagging.

Oscula: a little opening structure in the living sponge through which water passes.

Profile line: a line in which the elevation profile of the beach is measured. This line is vertical on the beach from the start point at the ordinary high water mark to the low tide line.

Percent cover: a method of determining the relative abundance of species or substrate within a quadrat. The total species of each quadrat will add up to no more than 100%. Species that are counted via percentage include: eelgrass, green, brown and red algae, sponges, aggregating anemones, mussels, barnacles, bryozoans, and colonial ascidians. Total percent cover for substrate will add up to 100% and substrate types include: clay/silt, sand, gravel, cobble, boulders, and shell debris.

Quadrat: a tool used to mark a random sample point and determine the counts and percentages of biota within the marked area.

Sessile organism: an organism that is fixed in one spot, not mobile.

Species swath: these are done by our Lead Naturalists with the help of a volunteer scribe who cover a specific section of the beach to record the presence of each species they find.

Substrate: is the surface on which an organism lives, this can include organic materials, rocks, sand, woody debris, and more. Here are the substrates wwe classify and record data on:

- **Shell debris**
- **Clay/silt:** smaller than sugar grain (<0.002")
- **Sand:** sugar grain to rice size (0.002-0.08")
- **Gravel:** pea to chicken egg size (0.08-2")
- **Cobbles:** chicken egg to basketball size (2-10")
- **Boulders:** larger than a basketball (>10")

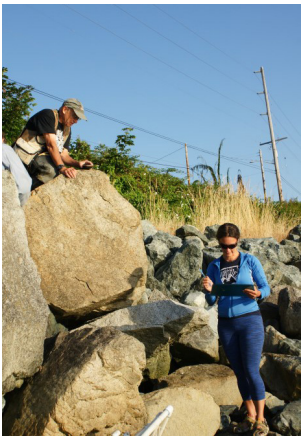
Transect line: a line marked at regular intervals along which monitoring occurs. During intertidal monitoring these lines are horizontal on the beach, placed at specific tide heights.

Ulva: common name of sea lettuce; Ulva is prolific at many intertidal sites. In fact, we remove Ulva before completing the quadrat samples because sometimes it covers so much other biota!

Standard Operating Procedure

I. Set-up

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



Placement of Profile Line
A setup crew member will do this, based on historical placements.

Placement of Profile Swath
After the profile line is set, mark the outer limits of the profile swath using small marker flags so lead naturalists can get started. A swath is 20 meters wide with variable lengths. Mark 10 meters on each side the profile line. Have one person with the tape measure on either end of the swath and one in the middle on the profile line to ensure that swaths are properly marked to be consistent with previous years. Swath intervals are on the logistics and species swath sheets.

Placement of Transect Lines
As the tide goes out, place markers at the appropriate transect tidal heights. For Cherry Point and FidaIgo Bay this will be +1, 0, and -1 ft. For others, this will be +6, +4, +1, and -1 ft. The logistics sheet will have the time of each tide. Place markers at the midway point as tide is lapping in and out, or where the waves are breaking, at the time designated by the tide chart. Be sure to go out at least 10 meters in either direction of the profile line with flag markers.

Next, lay down a tape measure to make the transect line, using flag markers to guide the tape line. Use one person on either end of the tape and one in the middle. Place the tape with 0 ft at the left and 10 m (33 ft) at the profile line and 66 ft (20 m) at the right end. Remove flag markers when done.

Placement of Quadrats

Place 4 quadrats after the transects lines are in place. In this way, quadrat placement demarcates the area where participants are not to walk. The location of each quadrat will be found on the logistics sheet. Place a flag to mark where each quadrat will go. Then place quadrat so that looking at the backshore, the upper left corner is placed with the flag just inside. Remove any debris from quadrat (anything that could float out at next high tide) so that the quadrat is ready for its before ulva removal quality control photo.

II. 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 the water.

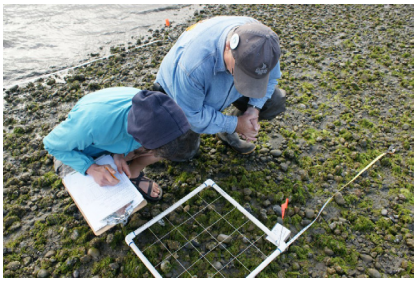
Level both poles using the levelers as indicators. Person A looks through the profile pole #1 peephole and directs their line of sight across the water to the horizon (water meets air or water meets land). Person B holds their finger up to pole #2 and slowly runs their finger along the pole measurement markings. Person A then tells Person B to stop when their finger matches the horizon line.

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. Note that if the beach is sloping down, pole #2 will have a negative reading, but will move in the upward direction. If the beach is sloped up, the reading will be positive and pole #2 will move down on the pole from zero.

Be sure to note which substrate types are present in your profile swath, meaning the rectangular area 10 ft down the profile line by 33 ft out on either side of the profile.

Person A then walks their pole down and levels it on exactly the same spot that Person B had pole #2. Person B then walks their pole #2 down 10 more feet. Repeat the process until the end of the profile line is reached (water's edge, or the -1 transect). Extra surveyors can be used to assist in leveling the poles and scribing.

III. Recording organisms in quadrat



Individual counts and percent cover estimates of intertidal biota will be recorded. All debris should already be removed from when the quadrats were laid out. Make sure that a quality control before ulva removal photo has been taken and has been marked on your data sheet. Fill out the top of your data sheet, then start counting and estimating percent cover. Each group should have 2-4 people.

BEFORE ULVA REMOVAL

- Record all organisms within quadrat the quadrat data sheet. Countable organisms are found on one side of the data sheet and percent cover on the other. Experts will assist if you are having difficulty with identification.
- Be sure to first identify any organisms that may be scurrying away or otherwise hide that you may not get a chance to count later.

- Percent cover estimate methods are dynamic and can be combined. Binary method is preferred for organisms that cover small percentages of the area and are scattered throughout the quadrat, making a visual estimation difficult. Visual estimation works well for any organism that covers a large percentage of the area. Using a 1% card can work well as a reference.
- Please fill in all of the blanks on the quadrat data sheet for before ulva removal.
- Once completed, **have your data sheet checked by a QC specialist.** If everything checks out, you will then be asked to remove all the ulva from your quadrat and fill out the second half of your data sheet.

IF THERE IS ONLY A LITTLE ULVA, your QC specialist may say you are either done (if the ulva isn't hiding any more organisms) or may allow you to simply add on what additional organisms were previously hidden under the ulva for the after ulva removal section.

AFTER ULVA REMOVAL

- Remove the ulva to reveal what is in or underneath this green algae. This is the only species you remove. You can place it in a tray to help uncover & identify small organisms that may be hiding in it.
- Be sure to fill out the percent substrate type covers within the quadrat. This will total 100%.
- Repeat the same steps as before, including getting a second quality control photo and **having your estimate checked by a QC specialist.**

Fidalgo Bay Only:

- Core will be taken to the upper right of the quadrat.
- If live eelgrass, rocks, or other impediments are present, adjust the placement of the core.
- Remove any surface biota before taking core so that surface biota is not counted as infauna biota.
- Place core in sediment with plug out. Try to get the core sample to the blue line on the PVC pipe, which is 30 cm deep. Mark depth on data sheet.
- Place plug into core before removing from sediment to avoid losing sample.

- Organisms left in sieve will be counted, identified and recorded. Commonly found core organisms are already listed on the core data sheet.
- Sediment will be returned to the core from which it was taken or otherwise filled in. Leave flag near hole so volunteers don't fall in it.

IV. Recording types of organisms on profile swath

Species swath scribes will work with lead naturalists to inventory all the species in our survey area, broken up by swaths. Scribes will record an "X" for the appropriate swath and species when present. The lead naturalists will do all of the identification while scribes are needed to accurately record species presence.

Lead naturalists will inventory all species divided by swath. They may gently roll over rocks, but pay attention to survey effort time so that all swaths may be completed during the survey tide window. Swaths will be consistent with past intervals used. Swaths extend out 10 m (33 ft) on either side of the profile line. Swaths intervals may stop once the -1 ft tidal elevation has been reached.

Diagram: Elevation Profile

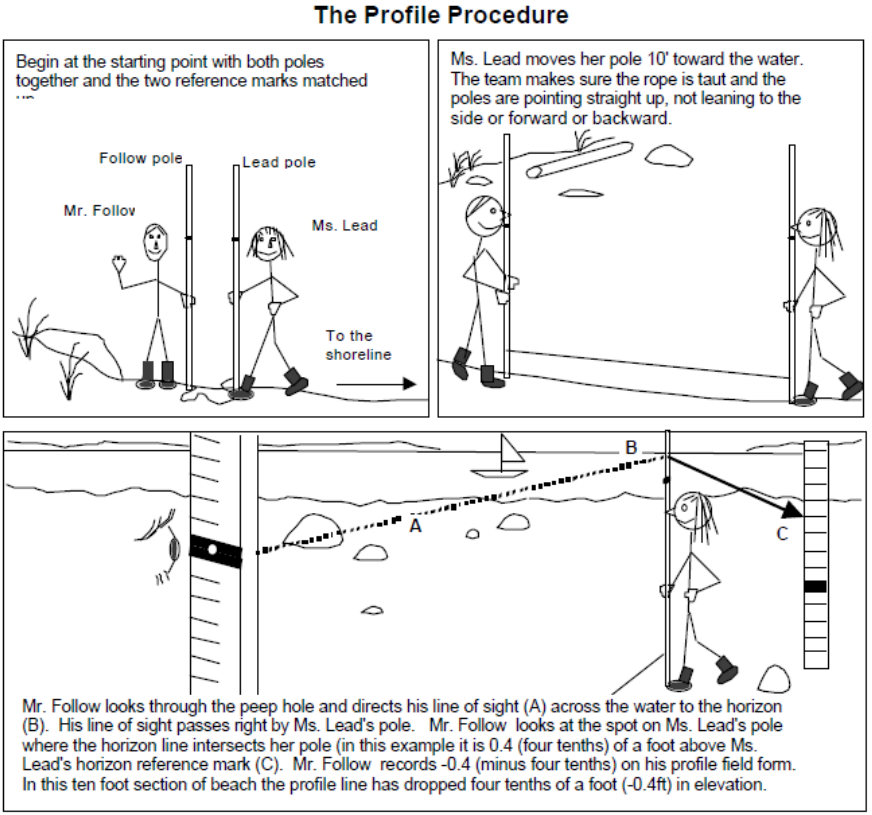
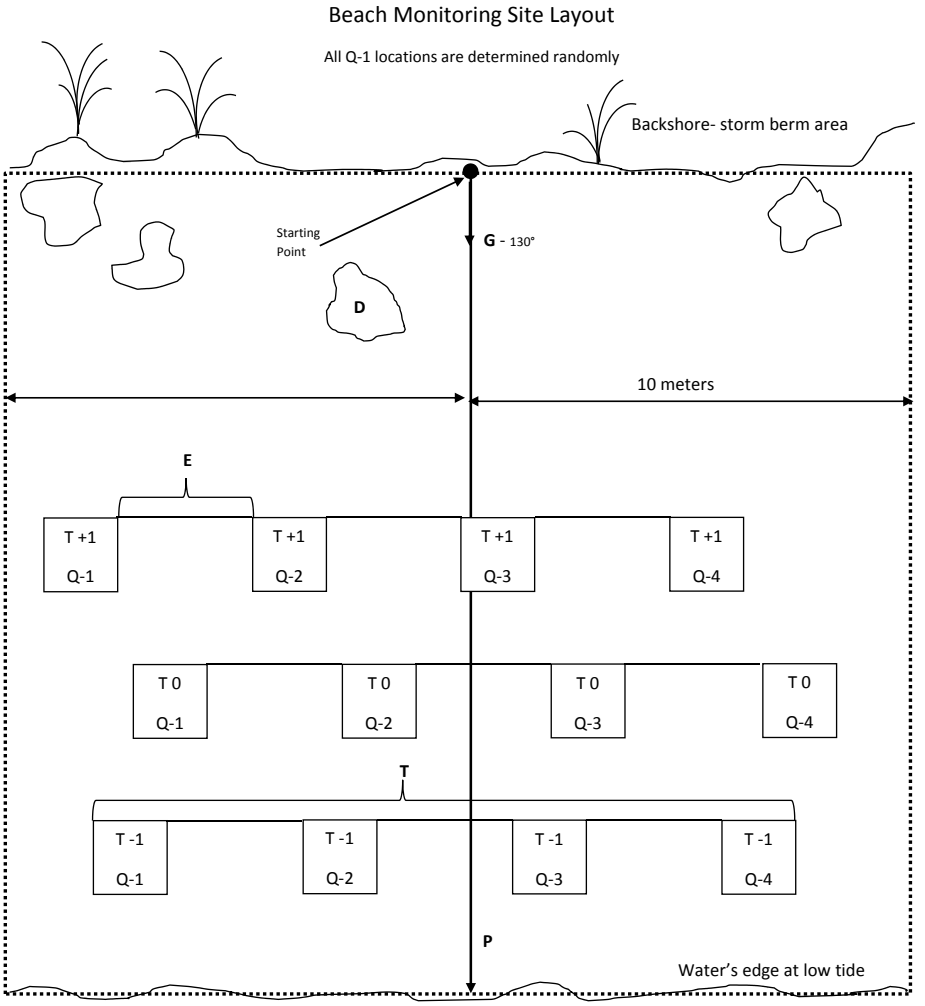


Diagram: Transect setup



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'.

Volunteer Roles

Set up crew - Set up crew will generally arrive an hour early to find the start point, get the profile line set, mark the tide heights as we hit the +1, 0, and -1ft tides, lay out transect lines, set quadrats out, and help with other general set up needs. You may choose to sign up for other tasks in addition to this one.

Photographer for Quality Control - The photographer can bring their own camera or will be provided with one to take photos of each quadrat for quality control purposes and may take photos of volunteers in action.

Beach Elevation Profiles - The beach elevation profiles measure the change in beach slope and characterize the beach sediment. There are 2 people on poles taking measurements, 1 scribe writing down the data, and 1 additional surveyor to assist with leveling the poles and accurately IDing substrate types. These jobs can be rotated. Profile volunteers may show up at the normal start time, but the tide won't be out far enough to complete this survey to the -1 ft tide height until later.

Quadrats - Quadrats will be done in groups of 2-4. This job entails identifying percent substrate types in quadrats, percent cover of species, and individual counts within quadrats. Quality control measures will be taken and lead naturalists are there to help along the way for accurate data collection. The two main jobs include 1) scribe and 2) species counts and identification.

Species Swath with Lead Naturalist - This job is to assist our lead naturalists with the species swaths. It is a great way to learn intertidal organisms. You'll be holding the clipboard and navigating through a species list to check off species as the lead naturalist finds them.

Core sampling assistant (Fidalgo Bay only)
The core sampling assistant will help a lead naturalist take core samples beside each quadrat, sieve the core samples, identify organisms, and collect the data. This job can be done while also helping with other tasks.

Sea Star Wasting Syndrome Surveys (Pt Whitehorn Park and Neptune ONLY) - These surveys are done alongside our intertidal surveys. They entail measuring, identifying and assessing sea star health within a survey plot. The amount of time they take varies depending on the number of stars found. This task can be done alongside others. Also a good task if you can't make it until later in the day.

Data Sheets

Profile sheet

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

Team names: _____

Recorder:_____

Notes for starting point conditions: (ex: presence of landslide, shoreline modifications covering start 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 substrate 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												
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Quadrat 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 and substrate on reverse side)

Quadrat sheet (continued)

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 and Sand: _____ **Other (specify):** _____

Notes:

_____

_____

_____

_____

2

FBAR sediment core data sheet

Fidalgo Bay Sediment Core Data Sheet

Site: _____ Date: _____

Names: _____

Tide Level: _____ Quadrat #: _____

Quadrat distance on transect line: _____ ft Transect on profile line: _____ ft

Animals Buried in the Sediment **Core Depth: _____ (cm)**

Name:	**Total Count:**
Bivalves-	
Clinocardium nuttallii (Heart Cockle)	
Leukoma staminea (Pacific littleneck clam)	
Macoma inquinata (Pointed macoma)	
Macoma nasuta (Bent-nose macoma)	
Mya arenaria (Softshell clam)	
Saxidomus gigantea (Butter clam)	
Tresus sp.	
Venerupis philippinarum (Japanese littleneck)	
Worms-	
Hesionidae - Oxydromus pugettensis (Bat star worm)	
Neretidae - *Alitta brandti* (Pile worms)	
Polynoidae (Scale worms)	
Nemertea sp.(Ribbon worms)	

Notes:

Intertidal Partners

Cherry Point Aquatic Reserve: Established in 2010, the Cherry Point Aquatic Reserve (CPAR) is a rich, diverse and dynamic stretch of shoreline nearby Ferndale in Whatcom County. Near natural beaches lie below active bluffs, eelgrass beds form meadows over soft sea-floors, and kelp beds float off cobble and boulder-covered beaches. These nutrient-rich habitats provide diverse food and dwellings in abundance for birds, fish, and marine invertebrates and marine mammals as they live in and migrate through the area. The CPAR Citizen Stewardship Committee is a stakeholder group tasked with ensuring the protection of this Aquatic Reserve.

DNR Aquatic Reserves: Aquatic Reserves, established by the Washington State Department of Natural Resources (DNR) on state-owned aquatic lands in Puget Sound, include important biodiversity and aquatic habitat critical to the health of the Puget Sound.

Fidalgo Bay Aquatic Reserve: Established in 2008, the Fidalgo Bay Aquatic Reserve, located in Fidalgo Bay just east of Anacortes in Skagit County, features expansive eelgrass beds and an array of saltwater marsh, beach, and tidal flat habitats. Adjacent to over four miles of shoreline, these nutrient-rich habitats are essential contributors to the reproductive, foraging, and rearing success for numerous fish and bird species. The FBAR Citizen Stewardship Committee is a stakeholder group tasked with ensuring the protection of this Aquatic Reserve.

Northwest Straits Foundation: Their mission is to protect and restore the health of Northwest Straits' marine resources by promoting and implementing science-based restoration and stewardship, enhancing collaboration, and attracting resources for the work of the Northwest Straits Initiative. Since being founded in 2002, they've invested millions of dollars of private and corporate contributions in education, protection, and conservation across the seven-county region of the Northwest Straits.

RE Sources for Sustainable Communities: RE Sources is a Bellingham based non-profit organization working primarily in Whatcom and Skagit counties. They promote sustainable communities and protect the health of northwestern Washington's people and ecosystems through application of science, education, advocacy and action. Their vision is to help people in northwestern Washington live satisfying lives in accord with the ecosystem we depend on- generation after generation. RE Sources provides support for the FBAR and CPAR CSCs.

Whatcom Marine Resources Committee: The Whatcom County Marine Resources Committee (MRC) is one of seven citizen-based committees in the Northwest Straits region to address marine issues. The MRCs' purpose is to guide local communities, using up-to-date information and scientific expertise, to achieve the important goals of resource conservation and habitat protection within the Northwest Straits. The mission of the Whatcom County Marine Resources Committee is revitalizing and preserving Whatcom County marine resources for future generations