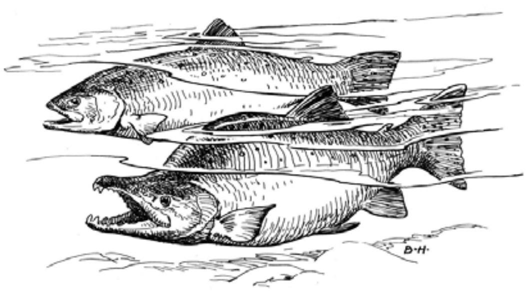
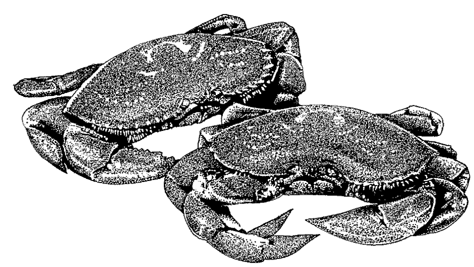
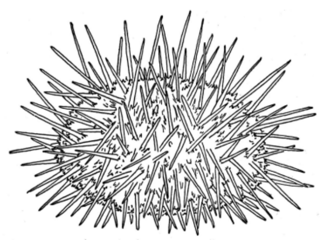
NatureMapping for Beaches
A Guide to Monitoring Marine Invertebrates and Fish Species

Stewardship for Fish and Wildlife
Tell us what you see!







The *NatureMapping* Program

A tool to keep common species common

A tool to build expert and volunteer partnerships

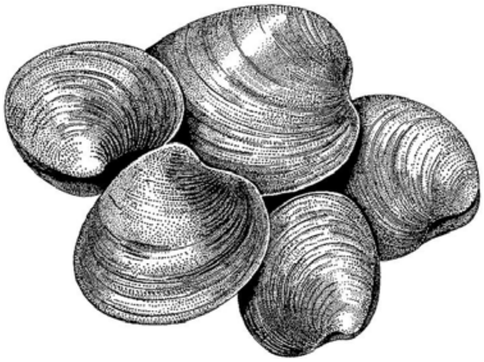
A tool to prepare a biodiversity report card

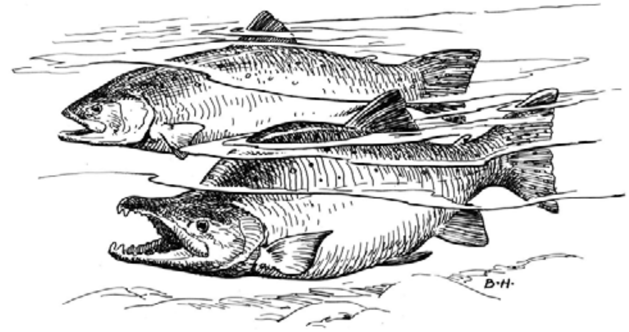
Revised November 2009

SEATTLE AQUARIUM

Washington Department of FISH and WILDLIFE

Washington NatureMapping Program





The *NatureMapping* Program
Guidelines for Beaches

November 2009

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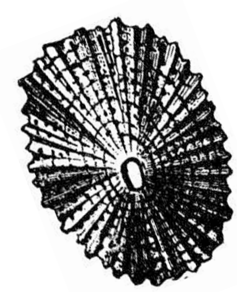

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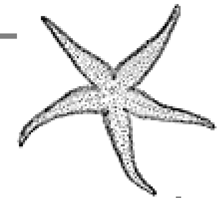


Introduction

The *NatureMapping* Program

The *NatureMapping* Program invites citizens of all ages to conduct meaningful science to benefit ***biodiversity*** in their local communities and contribute to studies of professional scientists. The *NatureMapping* Program's goal is to keep common species common and, in doing so, maintain our quality of life. The Program assists volunteers as they investigate the local biodiversity and learn how the animals, plants, insects, water, and soil communities are linked together. Its vision is to create a national network of individuals, schools, and professionals dedicated to stewardship. Through *NatureMapping*, we can better understand the interrelationship of components of the environment that sustain biodiversity in our world!

Please note: This manual has been designed to be used as a guide to monitor ***intertidal*** species. For more information on the *NatureMapping* Program and other available modules, please visit the website at: http://depts.washington.edu/natmap/.

Scientific Value- *Tell Us What You See and Where You See It!*

The *NatureMapping* Program asks a scientific question regarding the presence and absence of species statewide. The data contributed by citizens help answer questions about the status of biodiversity in Washington State. *NatureMapping* data on beaches can provide a scientific window on areas most likely to be affected by crucial pressures such as ***sea level*** rise, climate change, shoreline development and invasive species..

The protocols in the *NatureMapping* Program provide the methodology for the public to collect descriptive data on species in a location. These data can be shared with the University of Washington's College of the Environment *NatureMapping* Program. Data submitted are evaluated by overlaying them with range maps for Washington species to check the following:

- ✓Do the *NatureMapping* sightings align with predicted ranges in scientific maps?
- ✓Do the data indicate a possible range expansion or change in distribution?
- ✓Are there any non-native and/or invasive species changes?

Following a rigorous quality assurance, quality control check, the *NatureMapping* data are incorporated into a public database available to all. The *NatureMapping* data provided by volunteers are reflected in species range distribution maps updated monthly. These maps can be found on the *NatureMapping* website. Users of the database may include scientists, K-20 students, conservation groups, and local, state and federal organizations.

The Scientific Value *continued…*

There are no predicted range maps for the intertidal species. *NatureMapping* has developed predicted species lists for the Puget Sound and the coast with the help of scientists and local divers. The baseline descriptive (e.g., describing your observations using the *NatureMapping* data collection protocols) data gathered over time can be used to develop range maps and specific species lists for a local beach in your community.

With descriptive baseline data in hand, *NatureMapping* participants and scientists can develop comparative studies to monitor issues such as biodiversity trends over time. Follow-up projects based on descriptive *NatureMapping* data could include studies of individual species or of communities of organisms. Properly designed, these studies could help assess the effects of major issues such as climate change, sea level rise, new or burgeoning invasive species, or pollution effects.

What's a Beach ?

For purposes of this document a ***beach*** is defined broadly as the seashore. The ***beach*** is the boundary between the upland and the sea, two very different ***habitats*** or ecosystems. Species adapted to both land and water may use this edge, making this area very diverse. The intertidal zone generally has the most variety of species within a beach. The intertidal is the area between ***high tide*** and ***low tide*** that is underwater when the tide is in and uncovered when it is out.

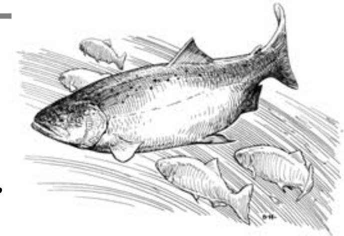
Why Do We Care?

Beaches and marine coastal areas interact with the earth's oceans that cover 70% of the planet's surface. Visited by both marine and terrestrial species, beaches are unique and fascinating habitats. Some species are dependent on these areas during their entire lifecycle. For example, juveniles of many fish and marine ***invertebrates*** use the ***nearshore*** to feed, grow and to escape from larger predators lurking in deeper water.

Beaches are high value area for a wide variety of human activities, including recreation, cultural and spiritual values, aesthetic, and economic endeavors. Sitting between the upland and the deeper waters, beaches and the species they sustain can show the influence of changes in both adjacent land areas and in the oceans beyond them.

Biological Importance of Nearshore Habitats

Beaches support a wide variety of fish and invertebrates. Some of these species visit beaches only periodically. Many others must use the intertidal for at least part of their lives. Species that are dependent upon the intertidal include a wide range of organisms, from mollusks (e.g. mussels), to crustaceans (e.g. barnacles), to fish (e.g. forage fish like smelt and candlefish that only lay eggs in the intertidal). An even larger variety of species depend on these intertidal users as food sources, including birds and mammals.



Why Do We Care?

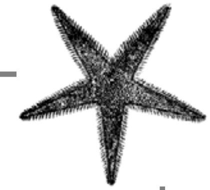
Biological Importance of Nearshore Habitats *Continued…*

Pacific salmon use nearshore habitats for only a portion of their lives but during a critical period in their life cycle. Perhaps the most recognized ***keystone species*** of the Pacific Northwest, salmon rely on these areas for weeks or months shortly after they leave their birth streams. In the late spring and early summer, juvenile Chinook, pink, and chum salmon follow the Puget Sound shoreline moving toward the ocean. Salmon make a critical transformation from a freshwater to a saltwater fish while they reside in estuaries and nearshore waters. This process, called smoltification, involves changes in body chemistry, appearance, and behavior. A complex ***detritus***-based food web in intertidal and nearshore areas provides rich and abundant prey. Salmon experience the highest growth rates of their lives while living in the food-rich environment of these protected waters. Nearshore areas and estuaries allow the small juveniles refuge from predators while they grow. When salmon return from sea as adults, they again have to adapt to freshwater in order to go upstream to spawn.

Beaches: Values and Uses

Indigenous peoples have relied on the flora and fauna of their shoreline ecosystems for thousands of years. Their lives and health depended upon natural harvests and the understanding of seasonal cycles and relationships. Native peoples know that the future of their children and their children's children depends on stewardship of the shoreline. "Seventh generation" thinking, which considers future impacts when making present decisions, has always been a fundamental value of the native peoples. The collection, consumption, and trade of the nearshore resources are the most traditional uses of the shoreline. The natural abundance of marine foodstuffs defined the lifestyle of indigenous peoples. The most common marine animals harvested from beaches for food include crabs, clams, mussels, barnacles, sea cucumbers, urchins, octopus, limpets, chitons, periwinkles, as well as many species of fish and fish eggs. Tribal peoples also harvested eelgrass and various kinds of seaweeds including kelps and large ***algae***.

Today, a variety of cultures recognize the intrinsic value of shoreline areas and of the plants and animals that live there. Much is still to be learned about this diverse and complex ecosystem of flora and fauna that is both unique and mysterious. In addition these areas are used for a wide variety of recreational, aesthetic and commercial uses. Every year, thousands of people visit and enjoy marine beaches in Washington State for prime recreational experiences. Tourism is a huge economic benefit to the state.



Why Do We Care?

Beaches: Uses and Values *Continue…*

Some come to our beaches for wildlife viewing, diving opportunities or simply opportunities to play on the sand while others come to harvest fish or shellfish. The more recent harvesters include Asian Pacific Islander communities who traditionally depended upon seafood resources in their countries of origin and place high value on beach resources today. Ports and cities are also dependent upon the nearshore and shoreline areas for commercial shipping sites. These types of uses generate revenue for state and local governments. Many of the intense shoreline uses by humans have impacts on the natural systems in these areas. These areas can also be affected by human activities distant from the shorelines.

Beach Impacts-Human Disturbances on Beaches

People who visit a beach repeatedly often recognize changes occurring over time. Changes in ***substrate*** and flora and fauna may be natural and seasonal. Changes that are clearly human-caused may be noteworthy or "data worthy" during observations or could become the topic of more intensive data collection.

Marine Debris

The world's oceans are receiving trash and debris from land sources as well as material discarded from ships. Much of this debris enters the ocean from land through storm drains and rivers. A few beaches even have embedded or grounded ships. This discarded material is called ***marine debris***. Much of this debris is plastic and causes major problems for various types of sea life. Just like the soap in a bathtub that creates a ring, debris spreads out across the water surface until some is stranded on the shoreline. A great deal of this material collects near high tide.

Construction Projects

Existing structures can be found on many beaches and new construction sometimes occurs between high and low tide. Common types of construction on beaches include pilings, bulkheads or sea walls, and docks or piers. Impacts can vary due to: the resources living in the vicinity, the type of beach substrate and the nature of the construction project. The substrate at a site may change if a nearby or distant bulkhead or groin stops ***sand*** or ***cobble*** from reaching a beach. A beach that is "starved" for material will become coarse and may erode more quickly into the uplands. Construction can also create new runoff onto a beach which can bring more fine material suffocating organisms that need rocky attachments. Port and cities have historically impacted shoreline and nearshore areas through shoreline hardening, inadvertent industrial spills, and direct development, changing the character and ecology of these nearshore areas.

Invasive Species

Non-native species have been introduced, accidentally or on purpose, and have spread throughout Washington State. In marine waters, this includes the Spartina, Pacific oyster, the Eastern softshell clam, the Manila littleneck clam, Japanese eelgrass, and most recently the purple varnish clam.

Some introduced species have proven harmful to native species, habitats, the economy and human health. These are called the invasive species or aquatic nuisance species and control is difficult or impossible once the invader is well established.

Beach Impacts Human Disturbances on Beaches *Continue…*

Invasive species can reduce biodiversity if they prey directly on native species, physically crowd them out, use up available resources, or simply alter the habitat.
Invasive species in Washington marine waters include *Spartina* (an emergent plant), several species of tunicates or sea squirts, and European green crab. Identification of these species can be difficult if they are similar to native ones. For more information on the occurrences of invasive species go to the Washington Dept of Fish and Wildlife: http://wdfw.wa.gov/fish/ans/index.htm. Possession of specimens may be regulated or illegal. Photographs to identify them and documentation of the location and time of observations are best and should be reported.

Global Climate Change

Climate change and sea level rise are problems that are likely to affect local beaches. Beaches will be the first areas to see the effects of sea level rise. Indeed, they are like the "canaries in the coal mine" for this issue; they may show the effects well before the rest of us feel them. In addition, beaches may provide us with a window on the profound changes in the oceans due to climate change. Warming temperatures are, of course, related to an increase in sea level worldwide. Washington waters have seen a rise in temperature over recent years, and this trend is predicted to continue. With climate change, scientists project an increase in the strength of storms, which would cause bigger storm surges. In addition, these storms would add more freshwater to the ocean and bays during the rainy season. The changes in storms may change the circulation pattern in the ocean off our coast. Circulation changes may have already contributed to "dead zones" where oxygen is depleted (seen off the coast of Washington and Oregon) known as "hypoxia". As the oceans worldwide absorb carbon dioxide from air pollution, they are becoming more and more acidic, also known as ocean acidification. Sufficient increase in the acid content of the water would make production of shells more difficult particularly for small planktonic shell-forming organisms, as well as larger animals like clams or oysters. Acidification may impact some life history stages of an array of species including crustaceans and echinoderms and may have profound effects on the ocean food web.

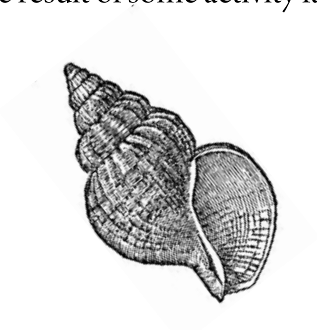
Why Nature Map?

NatureMapping is an excellent tool to begin documenting what things are like right now. "Baseline monitoring" is especially important to conduct for areas where data have not been previously collected. The start of all science is developing the powers of observation and methodical recording of your results. *NatureMapping* on beaches provides a meaningful way to expand your appreciation and understanding of your favorite beach. For those with an interest in the marine world, the intertidal offers a glimpse of the life beneath the waves twice a day as the water is pulled away at low tide. Any or all of human impacts may produce rapid changes in beach communities including the many species that are not regularly surveyed. Intertidal species are an important indicator of the impacts from actions on or near the beach as well as global ones. It is with increased importance that we begin a coordinated effort to monitor the presence and absence of intertidal species which will alert scientists to short and long-term changes in the nearshore ecosystem.

Beaches are Dynamic Habitats

The casual visitor to a beach may think of it as a stable area, the same from season to season or year to year. Repeat visits and careful measurements indicate this is not the case even under natural conditions. The actions of the waves continually erode some beach areas, providing beach sediment. Waves move this material along the beach in an action called "long shore drift." Many beaches commonly "inflate" and "deflate," gaining sand or ***gravel*** in summer and losing it to erosion during winter storms.

Other materials such as driftwood, man-made materials and even pollutants such as oil are deposited on beaches. Some of these may become incorporated into the substrate of the beach. Others may be picked up by the next high tide and carried farther along with the currents. The currents that reach a beach may vary from season to season, changing with general weather patterns, river flows or offshore circulation patterns. It is not uncommon to find material that has traveled across the ocean from Japan or China before being dropped on the eastern shores of the Pacific Ocean. Oceanographers have traced items that have been carried from the Pacific under the Arctic ice cap and emerged in the North Atlantic. Given the dynamic circulation in marine waters, a change observed at one location might be the result of some activity far removed from the site of the observation.



A Beach: "A City with Neighborhoods

Even the most uniform looking beach has huge variations from area to area and from high tide to low tide. Some areas on a beach may contain certain animals and plants while, 100 feet away, another group of organisms thrives. The changes are due to physical variations such as:

- Differences in the substrate.
- The amount of time an intertidal area is exposed to the air (the ***tide zone***).
- The amount of freshwater that mixes with the saltwater.

Rather than a single habitat, in some ways a beach could be compared to a complex city. The various areas of the beach are like neighborhoods. Groups of plants and animals that commonly occur together and all have the ability to thrive in the physical environment at that particular place. One of the clearest distinctions is between the intertidal and the adjacent area above the splash zone (e.g. dunes, salt grass areas, etc).

A Beach: "A City with Neighborhoods" *continued…*

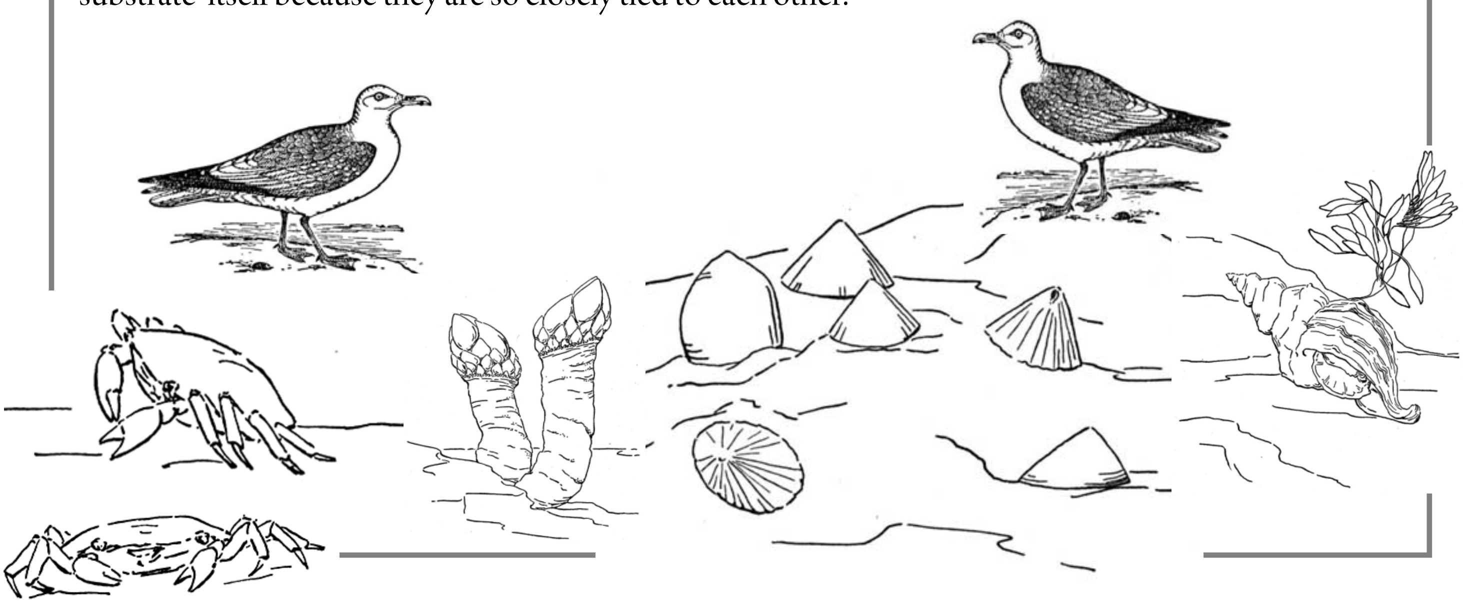
Within the intertidal area, there can be a variety of neighborhoods. The fish and invertebrates that live in the intertidal have several basic needs for survival.

These include:

- Shelter areas that provide places to dig, hide or for attachment.
- A way to stay moist at low tide and to survive temperature changes.
- The right water conditions (salinity, oxygen in the water, clean water, etc.).
- Food (phytoplankton, plants, other animals or detritus).
- The right conditions for reproduction and survival of young.

How they meet these needs varies from neighborhood to neighborhood. The ones that live close to high tide must be able to withstand the heat of the summer time and the cold of winter. The tide leaves these species uncovered twice a day. They must be able withstand these conditions longer than the organisms who live in areas closer to low tide. Those that live in sand must be able to disappear down into the sand or, perhaps, into a shell when the tide is out to avoid drying out. Animals in sand must be able to deal with an unstable substrate by moving around. Heavy wave action is common on many rocky shorelines and the organisms there must be able to hold their place in the surf. Those that live on a bedrock beach often have strong attachments to clean solid substrate or they may hide in crevices to stay in place

Changes in the physical habitat throughout a beach will result in changes in the organisms present. The Beach *NatureMapping* procedures ask the observer to look at both the organisms and the beach substrate itself because they are so closely tied to each other.



Preparing to *NatureMap*

Safety at the Beach

Beach surveying is not a dangerous activity, but beaches are natural, uncontrolled environments. A few simple precautions will help ensure your safety:

✓**Do not venture on to soft mud beaches**: Many beaches have extremely soft mud in the lower portion of the intertidal area that acts like quick sand. If you find that you have entered an area with soft mud, exit quickly and try tiptoeing.

✓**Do not touch colorful jellyfish**: Red or orange jellyfish can deliver a nasty sting even if they are dead.

✓**Never turn over rocks larger than your head**: Large rocks are difficult to control as you are returning them to their original position and a misplaced hand can be severely injured.

✓**Avoid logs in the water**: These are extremely dangerous! Although they are very heavy and may seem buried in sand, the incoming tide can move them suddenly, potentially crushing an unwary visitor.

✓**Avoid being separated from beach exits by incoming tide**: Become familiar with your beach and know whether the tide might leave you in a pocket beach or stranded up against a cliff or sheer wall. Do not wade out to islands at low tide.

✓**Beware of "Sneaker Waves":** This is used to describe coastal waves that are much larger than preceding waves and go up to 100 yards farther up the beach. Sneaker waves can catch unwary beach users on the Washington coast, washing them out to sea or throwing them against rock walls or jetties. Sometimes described as "every 7th wave," these extra big waves can actually occur anywhere in the wave train.

✓**No running on the beach!** Avoid damaging sensitive areas by not running where there is an abundance of species present. Barnacles are found in almost all intertidal marine and estuarial areas. These tough little invertebrates have sharp shells that will cut hands, knees, and feet.

✓**Seaweeds are slippery**: Seaweeds on rocks are extremely slippery. Shoes with good soles help, but take care in crossing seaweed-encrusted rocks.

What to Wear!

✓Good footwear!

✓Rain gear!

✓Dress in layers for expected weather conditions.

✓Sunscreen!

What to Bring!

✓Buckets for seawater if holding critters is allowed.

✓Pencils, clipboard, and datasheets for recording data, and field guides.

✓Species ID guides, marine field guides.

✓Have a watch or a clock to record accurate time.

✓Tide table information.

Preparing To *NatureMap*

Beach Conservation and Etiquette

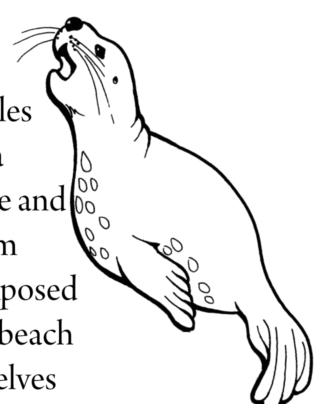
The beaches of Washington are alive with plants and animals. During surveys for *NatureMapping*, it is important to minimize disturbance of the organisms that live on the beach.

Always ask permission to enter and collect data on private property. Your ability to monitor and enhance habitat depends on the goodwill of the landowner.

Know the rules. Some parks do not allow even temporary handling of organisms. Many do not allow the collection of specimens. If you hold organisms, wet your hands and keep them moist in a bucket of cool water.

Please be careful; someone lives here. When you are examining a beach, you are walking in the "living room" of a lot of organisms. Breaking shells or displacing organisms can kill them. If you have to handle organisms at all, always wet your hands first and then return them to the exact place they were found. Rocks that are turned over should be gently turned back and "propped" to leave room for critters below.

If you dig a hole, fill it in.
There are several reasons to refill holes on the beach. Animals underneath a pile of beach material cannot breathe and will die. Those exposed at the bottom of the hole may be swept away or exposed to the elements or predators. Other beach visitors might trip and injure themselves in the hole. It is also a regulation from the state. Refill holes on the beach.



Every empty shell has a "for rent" sign on it. Shells are reused long after the original occupant is gone. Very tiny invertebrates and plants attached to empty shells may be difficult to see. Hermit crabs commonly use them as homes. Other organisms even scavenge the calcium of empty shells.

Leave the beach for others to enjoy! It is tempting to take "souvenirs" from the beach (e.g. sand dollars, small sea stars, etc.). But for most of us, these just find their way into the garbage can at home. Far better to leave those casually collected items for others to enjoy.

Leave marine mammals alone.
It is a violation of federal law to disturb marine mammals. In addition, seals and sea lions are wild animals and could be dangerous if they feel threatened. Baby seals seen alone are generally not abandoned or in trouble; they are just waiting for their mother who is feeding. Do not remove a seal pup from the beach. Harbor seal mothers are very shy and will not return to shore for their young if they feel it is not safe. Always observe from a distance and at a minimum of 100 meters away. If you are concerned about a particular animal, contact the WA Department of Fish and Wildlife at 360-902-2200 to be connected to your local Regional Office or visit:
http://wdfw.wa.gov/about/contact/
Or contact NOAA Stranding and Enforcement Hotline 1-800-853-1964.

Preparing To NatureMap

Understanding Tides

Understanding the tides is important when you are *NatureMapping* for nearshore life. Different parts of the beach and different beach communities will be exposed as the tide goes in and out. Recording the time of observations is crucial when data are collected so that the tide stage can be related to the information. Knowing how, why, and when the tides change will make your data more meaningful and may help you find particular organisms. In addition, there are safety reasons for understanding the tides (see the Safety at The Beach s section on page 11).

How Tides Work

Tides are the result of the gravity of the moon and sun pulling on the waters of the oceans. In this area, there are generally two sets of tides every day, with two highs and two lows. High tides occur about 12 hours 24 minutes apart on average.

Spring tides are very high tides and occur on the same days as the very lowest low tides. ***Neap tides*** are ones that have little change from high to low tide. During neap tides, the lowest portions of the beaches will not be exposed and only the mid-tide zone of the beach may be visible at low tide.

The periods of neap tides and the periods of extreme tides each last about a week . Therefore if you are looking for the very low tides, they will occur every other week. The very lowest low tides occur in the daytime in spring and summer months. In the winter, the lowest lows are all at night.

Times of tides

Tide charts and tables show the times at a particular location. When looking up the tides at your site, find the location closest to your beach. Some sources only list times for major ports and include corrections for other places. To estimate the tides for these other locations, you need to add the amount of time listed in the corrections to estimate the time at your location.

On the same day, the times of tides are very different around the state. The high and low tides are 9 hours later at the south end of Puget Sound (Shelton) than they are at Ilwaco on the coast. Even within the Sound, the tides vary from place to place. It is very important to record the tidal information for a location as close to your sampling site as possible.

Preparing To *NatureMap* - Understanding Tides *continued…*

Tide heights

Tide charts and tables show how high or low the tides will be in feet. Like the times for the tides, the tidal heights vary greatly with the location so use the information for the place closest to you. ***Tide heights*** also may need to be corrected for your location by adding or subtracting the correction listed. The long-term average place that the water reaches on the lower of the two low tides is called *"**Mean Lower Low Tide,**"* or "***zero feet***." All other tide levels are listed by how far above that (e.g. +1.2 ft) or below that (e.g. -2.3 ft) a given tide will be. **The best times to collect data are on tides that are below 0.0 ft that are also called "minus tides", since those expose the most beach.** These are vertical feet, not horizontal along a beach. That means that if a person were standing at the ***zero tide*** level and the tide was a +1.5 feet, the water would almost be up to the person's knees. On a flat beach this might be a long way from the uplands, while on a beach with a steep ***slope*** that might be a fairly short distance. Both the times and the heights of the tides listed in tide charts are estimates. Storms or high winds may make the actual tide very different.

Tips for Monitoring with the Tide

✓ For the best viewing opportunities, each selected monitoring day should be during a minus tide (for example –1.2 ft). The lowest tides are best for viewing the greatest variety of organisms. Arrive at least 1 hour before low tide.

✓ If you want to record organisms on the entire beach, start before low tide. Watch the clock and move down to the water line at the predicted low tide time. You will get to see the ***low tide zone*** ONLY if the tide that day is close to 0 feet or lower.

✓ Middle tide zone will be about half way between high and low tide. As the tide goes out or as it is coming in, fill in your data sheet for the middle tide zone.

✓ Data on the high tide and splash zone (above or at the barnacle or debris line) can be collected at the very end of your monitoring as the tide is returning or before the tide goes out.

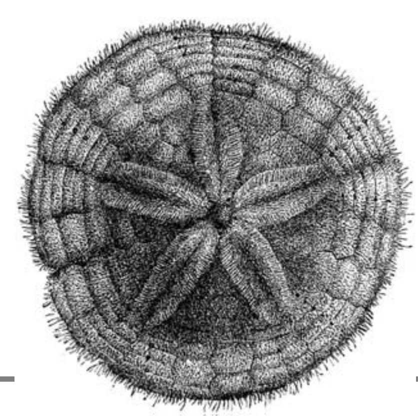
Tide Information Online

SaltwaterTides.Com
http://www.saltwatertides.com/dynamic.dir/washingtonsites.html

FTT-FreeTideTables.Com
http://www.freetidetables.com/

National Oceanic and Atmospheric Administration
http://tidesandcurrents.noaa.gov/tides09/
(*Please Note:* 09 in the url stands for the year, choose the appropriate year accordingly.)

OlyPen Inc
http://www.olypen.com/cgi-bin/tidetables



Preparing To *NatureMap*

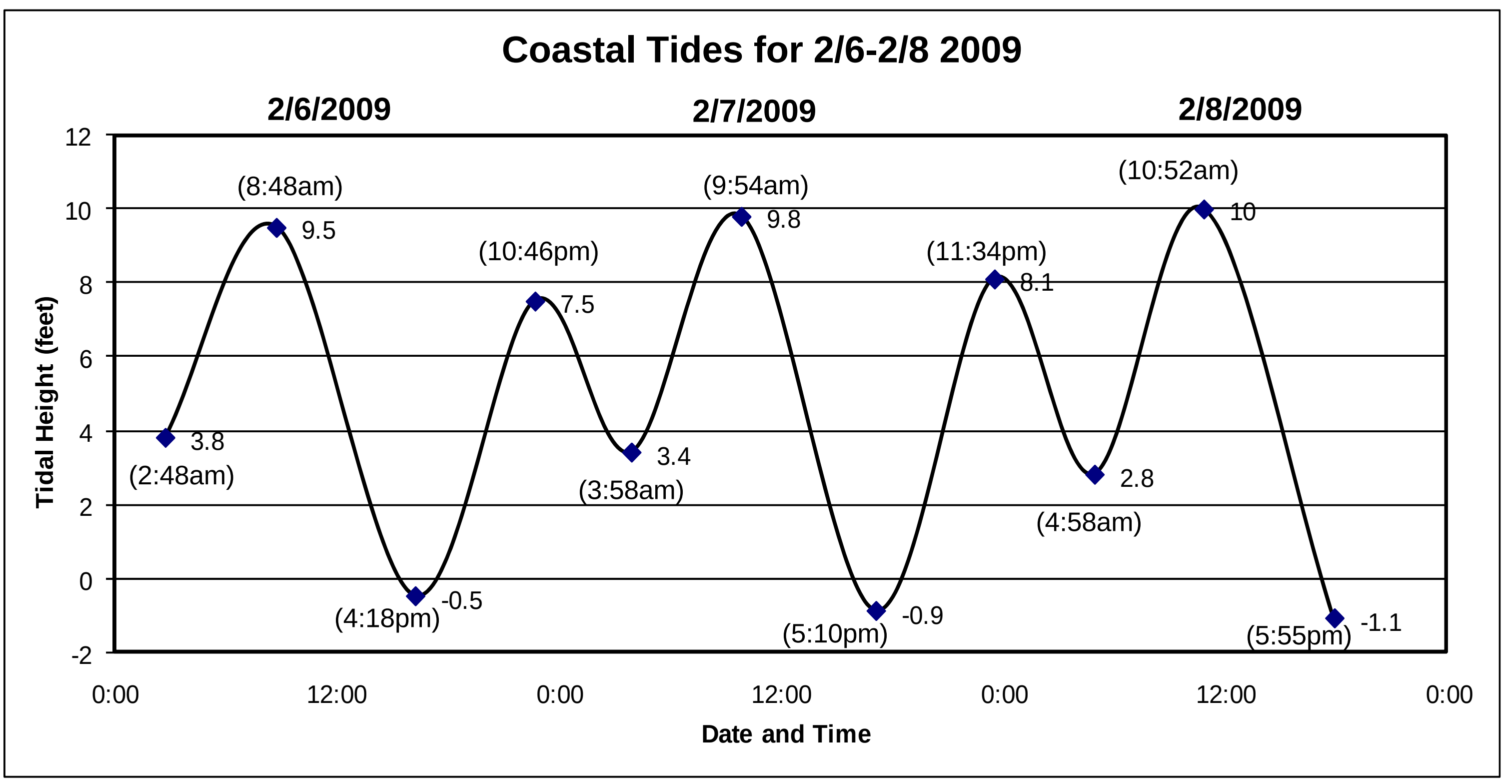
Reading Tide Tables and Charts

Tide charts or tide tables are available in booklets, in calendar form, and online. Tide tables usually have information about the time and heights of all four tides each day (two highs and two lows). The format may vary from one chart to another. Some only use tables for tidal information.

The following table shows the dates, times and tide heights for Washington coastal tides for three days in February 2009:

Date	Time	Tidal Height (Feet)
2/6/09	2:48am	3.8 (low)
2/6/09	8:48am	9.5 (high)
2/6/09	4:18pm	-0.5 (low)
2/6/09	10:46pm	7.5 (high)
2/7/09	3:58am	3.4 (low)
2/7/09	9:54am	9.8 (high)
2/7/09	5:10pm	-0.9 (low)
2/7/09	11:34pm	8.1 (high)
2/8/09	4:58am	2.8 (low)
2/8/09	10:52am	10 (high)
2/8/09	5:55pm	-1.1 (low)

The following shows these same tides as a graph. The dates and times of the tides are located at the bottom of the graph. The numbers at the left indicate the heights in feet of the various tides.



Preparing To NatureMap

Mapping – Figure Out Where You Are!

Using a GPS Unit

If you have access to a GPS receiver, you can use it to easily find your location. To use GPS to record your data, there are a couple settings that you need to adjust first. In the options or settings menu of your unit find the settings for **datum** and **position format** (refer to the user manual for your particular unit). http://www.gps.gov/

Datum

When using a GPS receiver in conjunction with a map it is extremely important to set the correct datum for the map being used. If the datum for the map does not match that set in the GPS unit, then indicated positions can be very inaccurate – up to a kilometer off in the worst cases. Most older maps in the United States use NAD27, though newer maps often use NAD83 or WGS84. Find the datum indicated on your map in the lower left corner and then set your GPS option accordingly. Also make a note of the datum used with your recorded data. When submitting your data for *NatureMapping*, you should always use WGS 84.

Position Format

The second option to set for your GPS receiver is the position format. All current topographic maps have the UTM grid (1 km squares). You can use either UTM or latitude and longitude (lat/long). For the purposes of *NatureMapping* you should record data in lat/long. For lat/long most GPS units allow you to choose Degrees.Minutes, Degrees.Minutes.Seconds, or Decimal Degrees. Decimal degrees is the simplest option to use, this converts the minutes and seconds to fractions of a degree and is the preferred format for recording location.

Using online satellite imagery

If you don't have access to a GPS, you can find your position by noting prominent landmarks nearby and using an online mapping program. One of the most useful mapping websites is www.flashearth.com. Start by taking notes about your location relative to major landmarks – this will be easier if you have a paper map in the field with you. Then go the Flash Earth website and zoom in (for accuracy) using the landmarks in the images to get as close as possible to your study site. When the crosshair at the center of the screen is over your location, record the latitude and longitude from the lower corner of the screen.

How to Access Shoreline Aerial Photos

The aerial photos available online will not give you the latitude and longitude of your site, but they will give you a different look at the beach you are monitoring. They may help you confirm where you are and the names of local landmarks, etc. Go to the Department of Ecology Shoreline Aerial Photo web page at: http://apps.ecy.wa.gov/shorephotos/index.html.

Google Earth

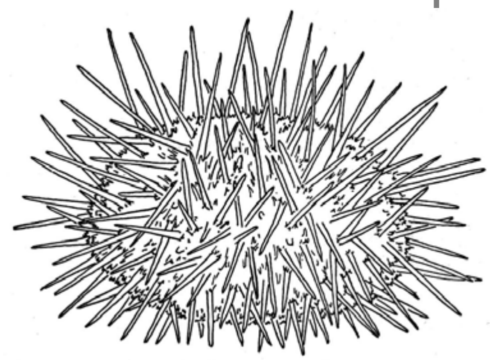
Google Earth lets you view anywhere on Earth satellite imagery, maps, and terrain. You can explore rich geographical content, save your toured places, and share with others. Google Earth will provide latitude and longitude coordinates for your site.
earth.google.com

Record Your Observations-*Beach Monitoring Guidelines*

As you review these guidelines, refer to *NatureMapping* Data Collection Form on page 19.
*__Remember__ for best viewing, arrive at the site at least 1 hour before low tide.

Tidal Section

Observer Name and ID
Write your first and last name. If you have not already, register on-line to get your observer id number at: http://depts.washington.edu/natmap/about/howto.html



City/County/State
Include the city/county/state of the area you are observing.

Low Tide Time/Elevation
Look up and record low tide before monitoring.

Beach Name
When available, fill in the name of the beach you are monitoring.

Start/End Times
Record the start and end times of your survey so that the data can be related to the tidal stage in the future. Be sure to record in military time (24hr clock time); e.g. 2:20pm is recorded as 14:20 hr.

High Tide Features (Optional)
Next, walk down to the beach and determine the site you would like to begin monitoring at high tide zone. You may record this at the top of the data sheet if you wish (Optional):
High tide feature examples:

1. *Barnacle Line:* Where you begin to see a large number of barnacles or mussels on a rocky or cobble beach.
2. *Debris Line:* Last line of drift debris such as seaweed, small pieces of wood, ***flotsam*** or ***jetsam*** on a sandy beach or mud flat.

Tidal Zones Monitored
After you have completed your survey, circle ONLY the ***Tide Zones*** where you gathered data. **Please Note:** Only circle "low" if you have observed the beach a 0-ft or minus tide, or if you can wade out to see areas at this tide level.

Record Your Observations-*Beach Monitoring Guidelines Continued*

Species Data Entry Section

Date
Write the Day/Month/Year

Species Name and Code
Reference Appendix I for the fish and invertebrate species codes beginning on page 35 . The datasheet can also be used to record wildlife data. For wildlife species codes and procedures, refer to the *NatureMapping* Guidelines for Fish and Wildlife (Dvornich and Tudor, 2000).

Unsure?
Only fill in this field if you are unsure of your observation.

- Write a "1" if you are not sure you identified the species correctly.
- Write a "2" if you are sure the species id is correct, but feel it "should not be there."

How Observed?
Options are live organisms or signs including, eggs, shells, molts, carcasses, or tracks. If you collect wildlife data, additional signs will include: scat, feathers, or hearing calls.

Lat/Long
When using lat/long, record a new location if you move more than 100m (the length of a football field.) within the survey area.

How Many/Estimate
Fish and invertebrate species listed in Appendix I on page 35 do not need to be counted or estimated. Presence and absence data are the only data requested. When entering data in the Excel spreadsheet put a "1" to indicate the presence in the quantity field or a numeric estimate if you have made one.

Habitat and Substrate Code(s)
Where was the species when you observed it? Identify the overall habitat type of the monitoring site. Select from the commonly used Beach Habitat Code List located on page 22. Next for each species, select the substrate type on which it was located. Instructions to combine the habitat and substrate codes are on page 22.

To download the Marine *NatureMapping* datasheet please go to:
http://depts.washington.edu/natmap/marine/data_entry.html

For instructions on how to submit your data, please visit:
http://depts.washington.edu/natmap/about/howto.html

The *NATUREMAPPING* Program
Data Collection Form

Observer Name/ID:________________________________ **City/County/State:**____________________

For Intertidal Species:

Beach Name____

Start Time (24hr)_________________ **End Time**_________________

From Tide Table: Low Tide (Time/Elevation)__________________

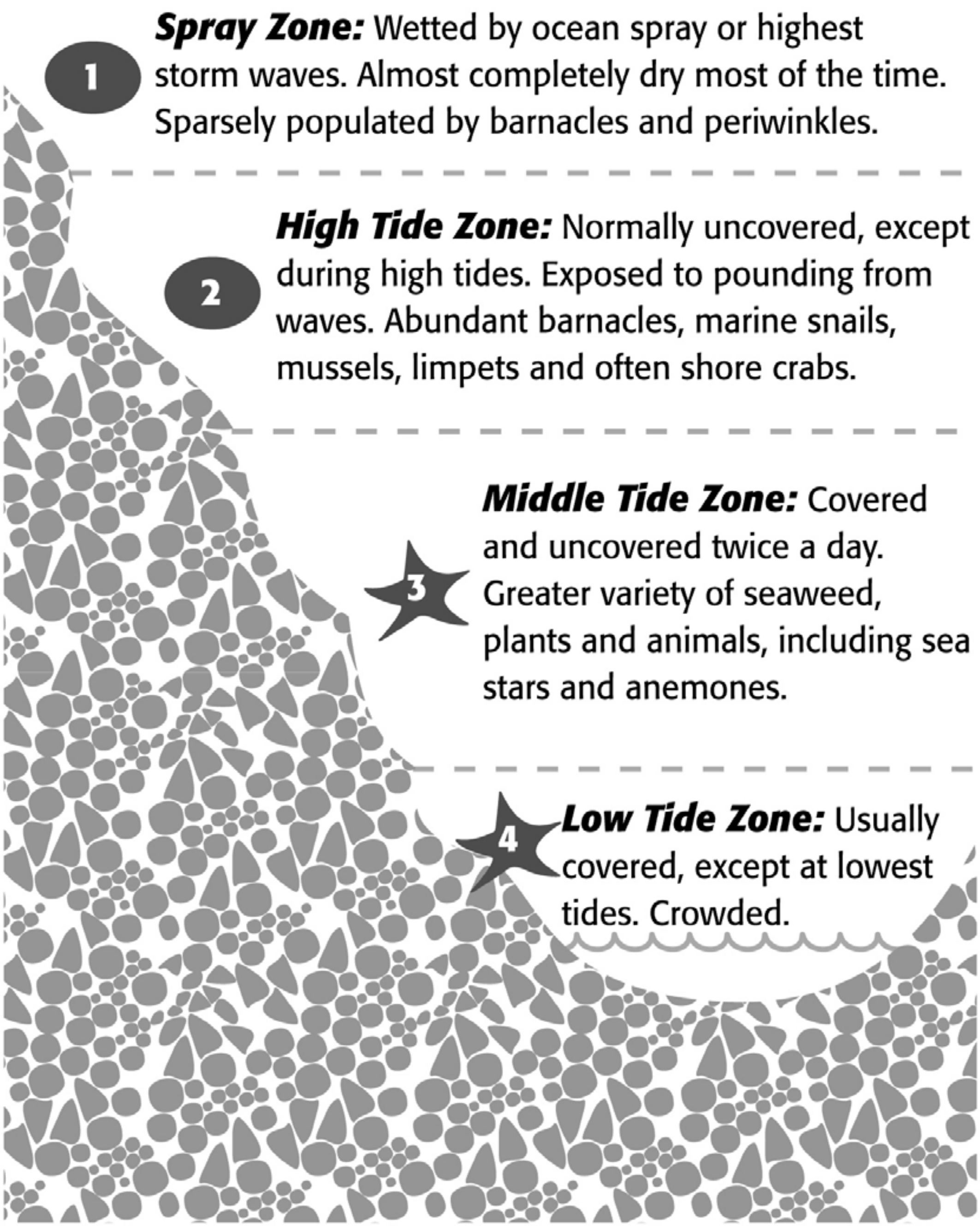
Circle Tidal Zones Monitored: **Above Splash** **Splash** **High** **Mid** **Low**

OPTIONAL: **High Tide Feature (select one): Barnacle Line**_______ **Debris Line**_______

Date	Species Name	Species Code	Unsure (1 or 2)	How Observed: (see, hear, shells, scat, etc.)	TRS/ Lat Long	*How Many/ Estimate	Habitat / Substrate Code

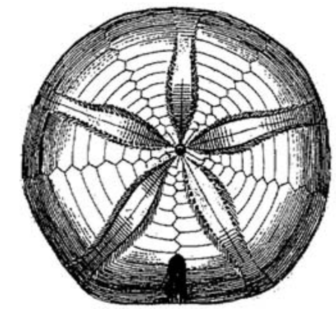
*Note that the number of invertebrate and plant species not needed, only documenting presence/absence.

Identifying Tidal Zones on Rocky Intertidal
(bedrock, boulder, and cobble beaches)



SEATTLE AQUARIUM

Identifying Tidal Zones on Sandy and Mud Flat Beaches…



1

***Spray Zone*:** Wetted by ocean spray or highest storm waves. This area may have organisms in boulders, drift wood, and salt grasses.

2

High Tide Zone: Normally uncovered, except during high tides. Beach hoppers, amphipods, isopods, and pickle weed are common in these areas.

3

***Middle Tide Zone*:** Covered and uncovered twice a day. A greater variety of species live in this zone, including, sand dollars, moon snails, small clams, mud or ghost shrimp.

4

Low Tide Zone: Usually covered except at lowest tides. Commonly has eelgrass, crabs, and sea cucumbers.

Common *NatureMapping* Beach Habitat Codes

Instructions: *Where was the species when you observed it?*

(1) First identify the overall habitat of the survey site from the list below. The following examples can commonly be used for beach monitoring. For a full list of Habitat Codes, please refer to the *NatureMapping* Guidelines for Fish and Wildlife (Dvornich and Tudor, 2000).

(2) Next, for each species observed on the beach, select the appropriate one of six Substrate Codes as described on pages 23 and 24.

(3) Finally, combine the two codes and record on the data sheet. *Example:* A clam shell recorded at a rocky beach on a cobble substrate should be coded as: **110.4** *Example:* A sea star recorded on a beach with emergent vegetation and attached to a ***boulder*** should be coded as **552.3**

Habitat Code Format

XXX.X

Habitat Code (XXX) . Substrate Code (X)

Code	Description
110	Rocky beach with no vegetation Example: Cobble, boulder, or rocky.
130	Sand or mud beach with no vegetation
320	Aquaculture areas *Example: Planted geoduck beds or farmed oyster or clam beds (not natural beds).*
212	Heavy industrial development on a beach *Example: An area with commercial docks or piers on or over the beach such as a port.*
231	Light residential-related development on a beach *Example: A family dock or pier.*
420	Open saltwater *Example: Used for observations of birds, fish, or mammals in the water, nearshore or offshore.*
510	Estuarine marsh ***wetland*** with a variety of flora *Example: Brackish wetland with various plants (pickleweed and Scirpus).*
550	Beach with a variety of flora *Example: Beach with various plants such and algae.*
551	Beach with submerged or floating plants *Example: Beach with kelp or eelgrass.*
555	Beach with overhanging vegetation *Example: A beach with Douglas fir or Pacific madrone trees.*

NatureMapping Beach Substrate Types

A **Mud** substrate has fine silt-sized materials, but can also have a combination of mixed sand or gravel. Mud beaches, also called mudflats can also have scattered rocks and boulders along the beach. Mud flats form in protected bays and estuaries where fine sediments can settle. They can range from firm to soupy depending on the mix of mud, water, and other substrate materials. Below the surface, mud may contain decaying plant and animal materials and bacteria. Animals tend to live at or near the surface because of the difficulty in moving and breathing in the mud. ***Code: 1***

A **Sandy** substrate can have material from the size of sugar to that of rice. This beach is a very unstable one as the substrate is in constant motion. It therefore makes poor habitat for many organisms. Those that thrive there must be able to bury themselves or reestablish after the sand settles. In protected areas eelgrass beds can stabilize sand and provide habitat for a variety of creatures. ***Code: 2***

NatureMapping Beach Substrate Types

A **Bedrock/boulder** dominant substrate is generally a very stable beach. Falling tides leaves tide pools. Many organisms live in these as well as under the protection of thick growths of seaweed. ***Code:* 3**

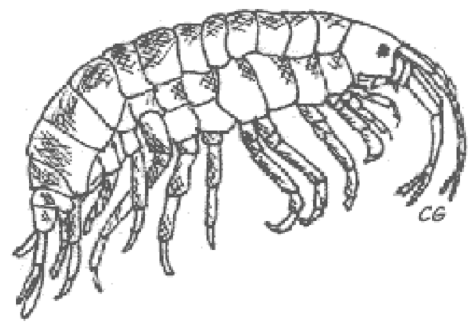
Cobble substrates can range from egg to basketball size. It is common to find beaches that have a mixture of mud or sand, gravel and cobble. Seaweeds may be abundant due to the larger sized rocks that are more stable. Most animals burrow beneath the surface, attach to the larger cobbles or hide beneath them. ***Code:* 4**

Gravel or pebble substrate ranges in size from a pea to an egg. ***Shell debris*** is a common part of this beach type. This habitat still tends to be fairly mobile. Material erodes from one place and moves with the currents along the beach. Fine gravel habitat located in the upper intertidal area may be used for spawning by surf smelt and sand lance, important forage fish. ***Code:* 5**

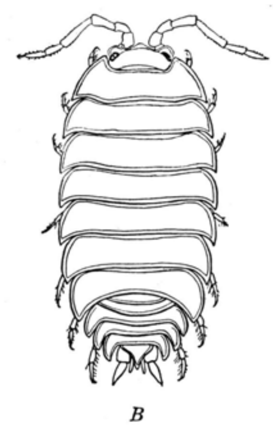
Species Groups Defined

Jointed-Leg Animals: Arthropoda (ahr-throp-*uh*-d*uh*)

Amphipods (am-f*uh*-pod), Isopods (ahy-s*uh*-pod), Sea Spiders and Mites

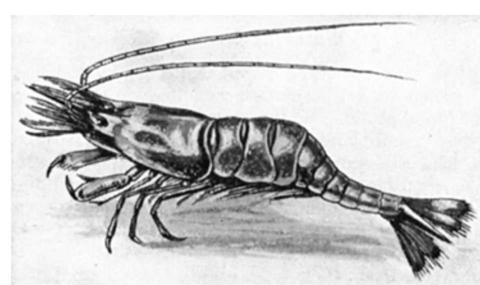


Amphipods include a wide variety of small, shrimp-like crustaceans. Their forms are highly variable as are their diets. Some species are an important part of the diets of juvenile salmon. Marine isopods are a diverse order of crustaceans found from shallow waters to the deep sea. Like amphipods, different species of isopods perform multiple important functions as ***carnivores, herbivores***, ***detritivores***, or ***parasites***. Although physical characteristics are diverse, isopods tend to superficially resemble “sow bugs” or garden “rolly-pollies.” They can be found clinging to rocks or on the sand in the intertidal zone. Sea spiders are often mistaken for being in the crab family. However, they have eight legs and are not closely related to either crab or shrimp. The red velvet mite is another spider relative. These bright red 8-legged organisms can be found on seaweed or on logs in the intertidal.

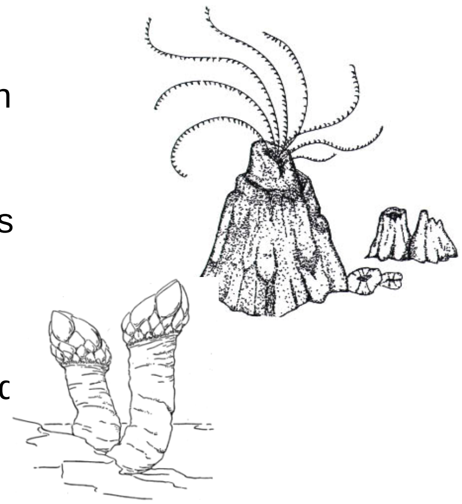


Shrimp

True shrimp are small, free-swimming decapod crustaceans (having ten legs), however, a number of unrelated crustaceans also have “shrimp” in their common name. Like all arthropods, shrimp have an exterior skeleton, jointed legs and two pairs of antennae. They feed on tiny crustaceans and zooplankton.

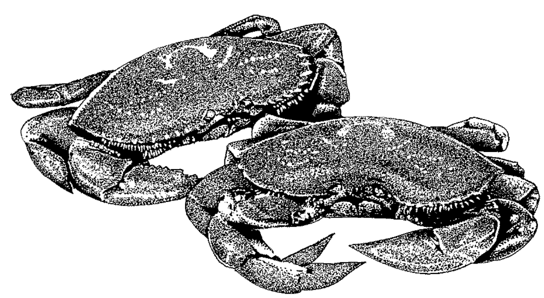


Jointed-Leg Animals: Arthropoda (ahr-throp-*uh*-d*uh*)



Barnacles

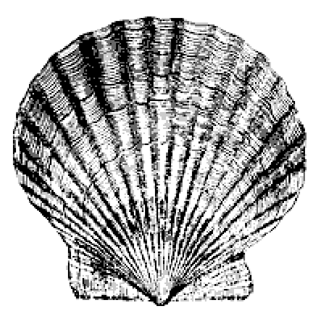
Barnacles are a diverse group of crustaceans. They can most commonly be recognized by their conical shells, which can be found on rocks, logs, man-made structures, and even other marine organisms. Barnacles live with their heads down, reaching their feet out through the opening in their shell to gather food. Goose barnacles are found on exposed coastal areas subject to strong wave action. They have white plates supported by a flexible stalk. Goose barnacles are often found along with California mussels.



Crabs

Crabs are also decapod (having 10 legs) crustaceans with a single pair of claws, or chelae. Most crabs are sexually dimorphic, meaning males and females can usually be easily differentiated. Male crabs have narrow abdominal flap while females have wider, oval-shaped abdominal flaps. Hermit crabs borrow the empty shells of other organisms. They carry the borrowed shell around as protection and look like a snail or clam with little crab legs. Crabs only grow by shedding their old shells (or molts), so empty crab shells are commonly found.

Bivalves and Brachiopods (brey-kee-*uh*-pod)

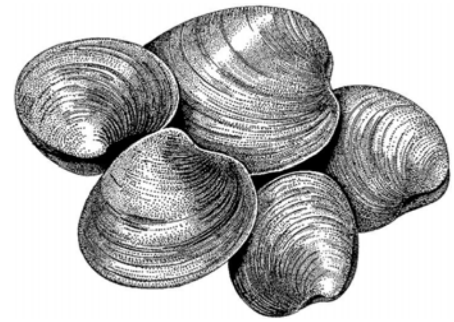


Scallops

Scallops have a wavy-edged shell that they can open and close quickly to swim through the water. They may be found anchored or cemented to substrate or swimming freely. Scallops are the only migratory bivalve mollusk. The age of a scallop can be determined by counting the number of concentric rings in its shell. They are often covered in encrusting sponges. When a scallop opens its shell, an observer can see a row of black or blue dots all the way around the animal inside. These dots are primitive eyes, capable of detecting light and dark that helps the scallop to detect an approaching predator.

Bivalves and Brachiopods (brey-kee-*uh*-pod)

Clams



"Clam" is a general term used to refer to bivalve mollusks that are not oysters, mussels, or scallops and have a generally ovoid shell, an exception being the jack knife and razor clam, which are more rectangular. Clams typically burrow in the sand, and extend their siphons to the surface. Clams are also filter feeders.

Oysters

Oysters are also filter-feeding mollusks with a highly calcified shell. They are most often found in water from 8 to 25 feet deep where they may form large reefs. Oyster reefs serve as habitat for a wide variety of organisms, which in turn can feed larger animals. Healthy oysters can filter up to five liters of water per hour and contribute to good water quality.

Mussels

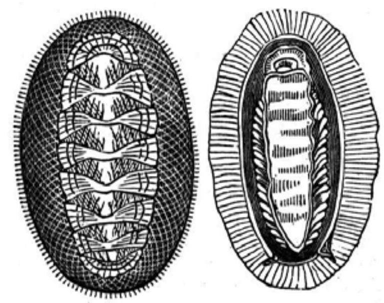
Mussels are bivalve mollusks with shells that are usually blue to black in color, but can have a brown to orange covering. They generally can be found in clumps clinging to rocks in the low to mid intertidal zone. Marine mussels are eaten by sea stars, which use their strong limbs to force open the shell. They have many other predators, including predaceous snails, crabs, some birds, and humans. Mussels are filter feeders and feed on plankton.

Brachiopods

Another group of animals with two shells are the Brachiopods. Commonly known as lampshells, they have two unequal sized shells and are in a completely different order from bivalves. Compared to clams, the brachiopods have their shells turned 45 degrees. In a sense, clams have one shell to the "right" and the "left" of their body, while brachiopods have one shell above their body and the other below it.

Gastropods and Chitons (kahyt-n)

Chitons (kahyt-n)
Chitons are a large group of mollusks that have a series of eight plates held together by an outer girdle. Chitons can vary widely in coloration and texture. They are most frequently found attached to rocks in the intertidal and subtidal zones where they creep along slowly on a muscular foot (similar to a snail). If a chiton is dislodged from a rock, it can roll tightly into a ball to protect itself from predators. Chitons are eaten by gulls, sea stars, crabs, fish, and anemones.



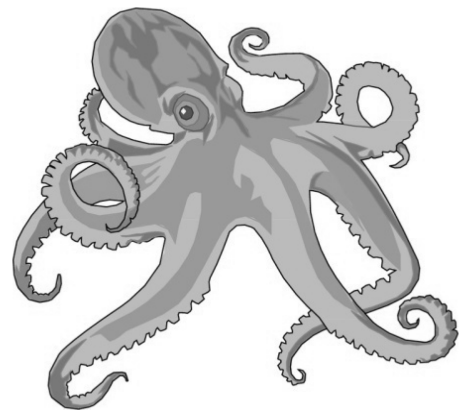
Limpets (lim-pit)
Limpets are marine mollusks with flattened, cone-shaped shells. They are found throughout the intertidal zone and the subtidal zone where they attach to rocks and appear as disks or bumps on the rock surface. Most limpets eat marine algae and stay in the same general area their whole lives.

Sea Slugs (Nudibranchs - noo-d*uh*-brangk**)**
This strange and wonderful group is part of the snail family or Gastropoda. Species range in size from barely 1 cm for some to one that is can grow to almost 30 cm. Nudibranchs are often very specialized in what they eat and are tied to the organisms on which they feed. Common foods include anemones, sponges, and the attached life history stages of jellyfish. The nudibranchs commonly concentrate the stinging cells from their respective food sources in their dorsal processes. This adaptation provides the nudibranch with protection from predators.

Snails
Snails are gastropods with a coiled shell. They often cling to rocks in the intertidal zone. Periwinkles and whelks are common marine “snails.” Some snails are herbivores, and others are carnivores. For example, whelks feed on barnacles and moon snails feed on clams and other bivalves.

Cephalopods (sef-*uh*-l*uh*-pod)

Octopus
These are eight-legged cephalopods with large eyes and "beaks" on their underside for crushing prey. An octopus is a mollusk although its only "shell" is its beak located completely inside its body. This beak is used for crushing other mollusks, crabs, and fish for food.



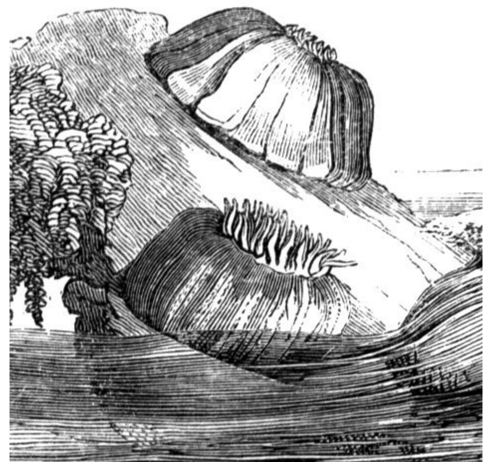
Puget Sound is home to the largest octopus in the world. They are rarely found in the intertidal areas, but occupy rocky dens close to shore or in deeper waters. The giant Pacific octopus can grow to have a leg spread of 14 feet and weigh over 30 pounds, and live for only 3-5 years.

Worms

Worms
Worms are a general grouping of a variety of worm-like marine organisms. There are many thousands of species of marine worms, which are divided into three main types: segmented (Phylum Annelida), ribbon (Phylum Nemertea), and flat (Phylum Platyhelminthes). Marine worms can be found in gravel, under rocks, in sand, mud, or in mussel beds. Some commensal worms can be found on a variety of host animals, including sea stars, chitons, and sea cucumbers.

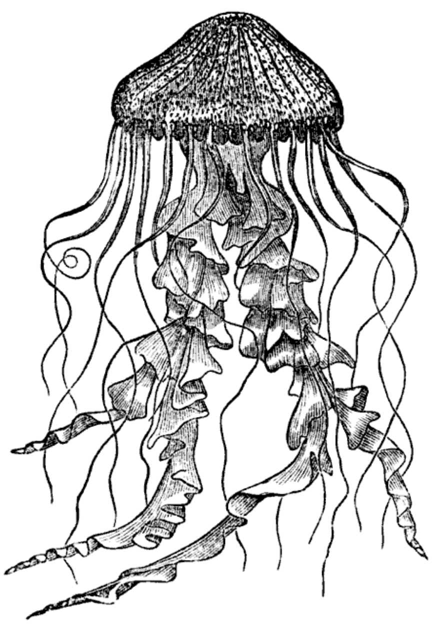
Stinging-Cell Animals: Cnidaria (nahy-dair-ee-*uh*)

Anemones (*uh*-nem-*uh*-nee) **and Corals**



Anemones, like jellyfish, are ***cnidarians***. Sea anemones are a filter-feeding animal closely related to coral and jellyfish. Most species attach to rocks, although some others attach to kelp or are free-swimming. Although normally ***sessile***, or immobile, anemones that are under attack or in unfavorable conditions can detach themselves and swim away. Much like jellyfish, anemones use stinging cells on their tentacles for defense and for capturing prey. Anemones can reproduce by cloning through growing a genetically identical replicate of themselves. While most people think of corals as tropical animals, there are a variety of solitary species that live in local waters. They are found in similar habitat to bryozoans and sponges but are more closely related to jellyfish and anemones. Like their distant relatives, corals have stinging cells to catch prey. Many species get food from algae cells that live inside them in a symbiotic relationship.

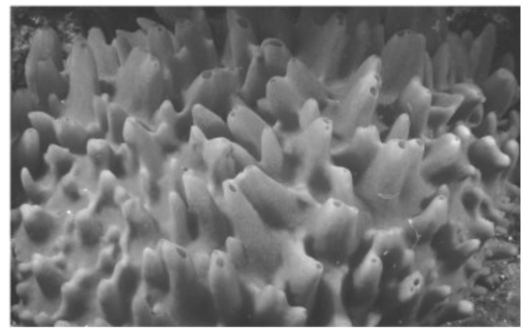
Jellyfish



Jellyfish include the Class Hydrozoa & Scyphozoa (True Jellyfish). Both of these groups have a two-stage life history with an attached phase and a free-swimming phase. They are cnidarians (“with stinging nettles”), invertebrates with stinging tentacles around the mouth. Hydroids are generally small colonial animals that grow on rocks or vegetation. They often look bushy or furry. The free-swimming phase of jellyfish is the best-known part of their life. Jellyfish drift passively, trailing stinging tentacles below a gelatinous, bell-shaped body. Jellyfish can swim slowly by rhythmically opening and closing their body. Tentacles are used for defense and for feeding, mainly on zooplankton. Jellyfish themselves are eaten by some fishes and sea turtles. Moon jellies are the kind most often seen washed up on beaches, especially after storms. Even when stranded or dead on the beach, orange or red jellies can deliver a painful sting to people.

Encrusting Organisms

Sponges and Bryozoa (brahy-*uh*-zoh-*uh)*



Sponges or Poriferans are filter feeders and among the most primitive animals. They may be tube-like, vase-like, encrusting, or branching. Most species attach to hard surfaces ranging from the intertidal zone to the deep sea. Sponges are eaten by sea stars, snails, chitons, and nudibranchs. Sponges generally require fairly still and clear water so that sediments do not block their pores. Bryozoa are described as the "moss-animals" and superficially resemble corals. These colonial animals attach to a variety of hard surfaces ranging from rock or sand to kelp and manmade structures.

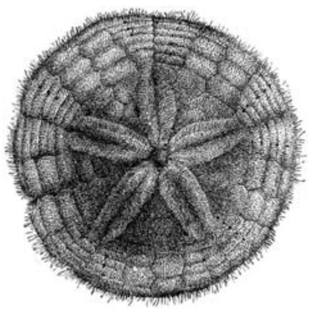
Tunicates (too-ni-kit) **or Sea Squirts**

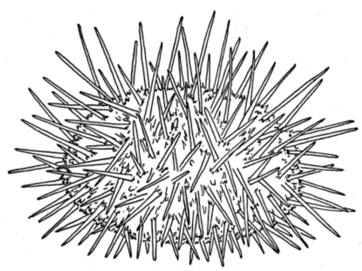
Tunicates, or sea squirts, are sac-like filter feeders that are most commonly found on rocks or man-made structures. Although tunicate larvae look similar to tadpoles, they quickly find a place to settle down and transform into a more barrel-shape form. When a tunicate is cementing itself to a surface and undergoing transformation, it "eats its brain", the part of the larval stage that controls locomotion. Tunicates are the only animals able to create cellulose. Some tunicates are solitary, and others are colonial and encrusting. All sea squirts have 2 siphons, one for respiration and feeding and the other for excretion.

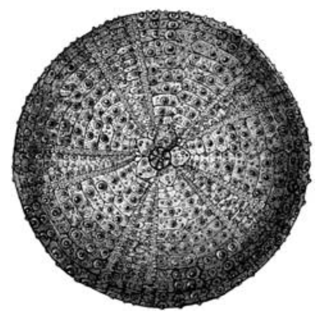
Spiny Skinned -Echinoderms (i-kahy-n*uh*-durm)

Sand Dollars, Sea Urchins and Sea Cucumbers

These animals are all in the phylum echinoderms or spiny skinned animals. Like starfish, they are animals with radial symmetry or a five-sided structure, spines on the outside and multiple tube feet that often provide locomotion. Sand dollars are flattened and move on their short spines. Live ones are very dark due to the spines and tube feet, while dead ones are white after the spines fall off. Sea urchins also have a solid shell or test, shaped like a ball and covered in spines that are longer than the sand dollars. Sea cucumbers do not resemble other members of this five-sided family. They are soft and elongated, looking more like a kind of very large worm, often with featherlike tentacles for feeding at one end. Their spines are embedded in the skin and invisible to the eye.

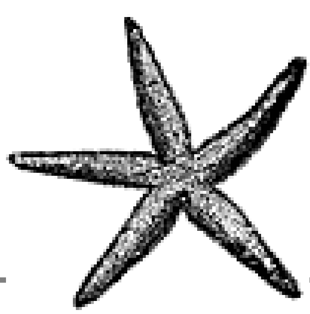


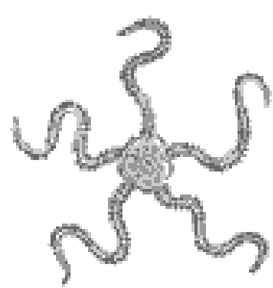




Sea Stars

The best-known members of the echinoderms, these animals are common from the intertidal to the deepest parts of the oceans. Although some have far more than five arms, all have a five-sided organization internally. The bottom of these animals is usually covered in tube feet, which are used for locomotion and feeding. The tiny suction cups at the ends of the tube feet can open clams or cling to rocks in the crashing surf. These animals have an internal water-vascular system that uses fluid pressure to create both movement and the suction of its tube feet. A related group called the Brittle Stars, moves by waving its long snaky arms and feeds by tangling drifting material in them.





Fishes

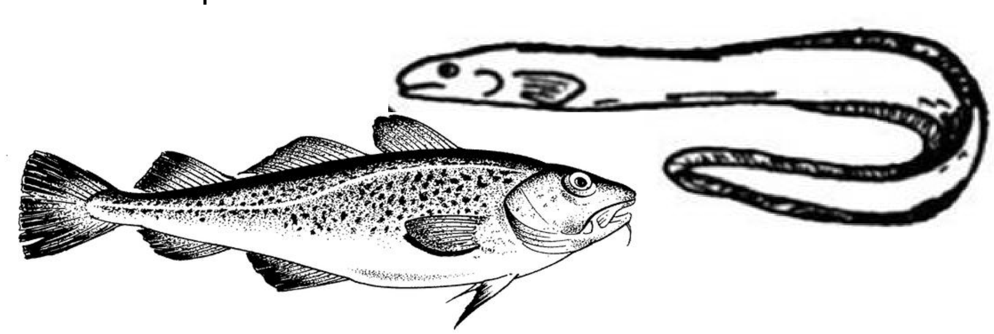
Intertidal fish

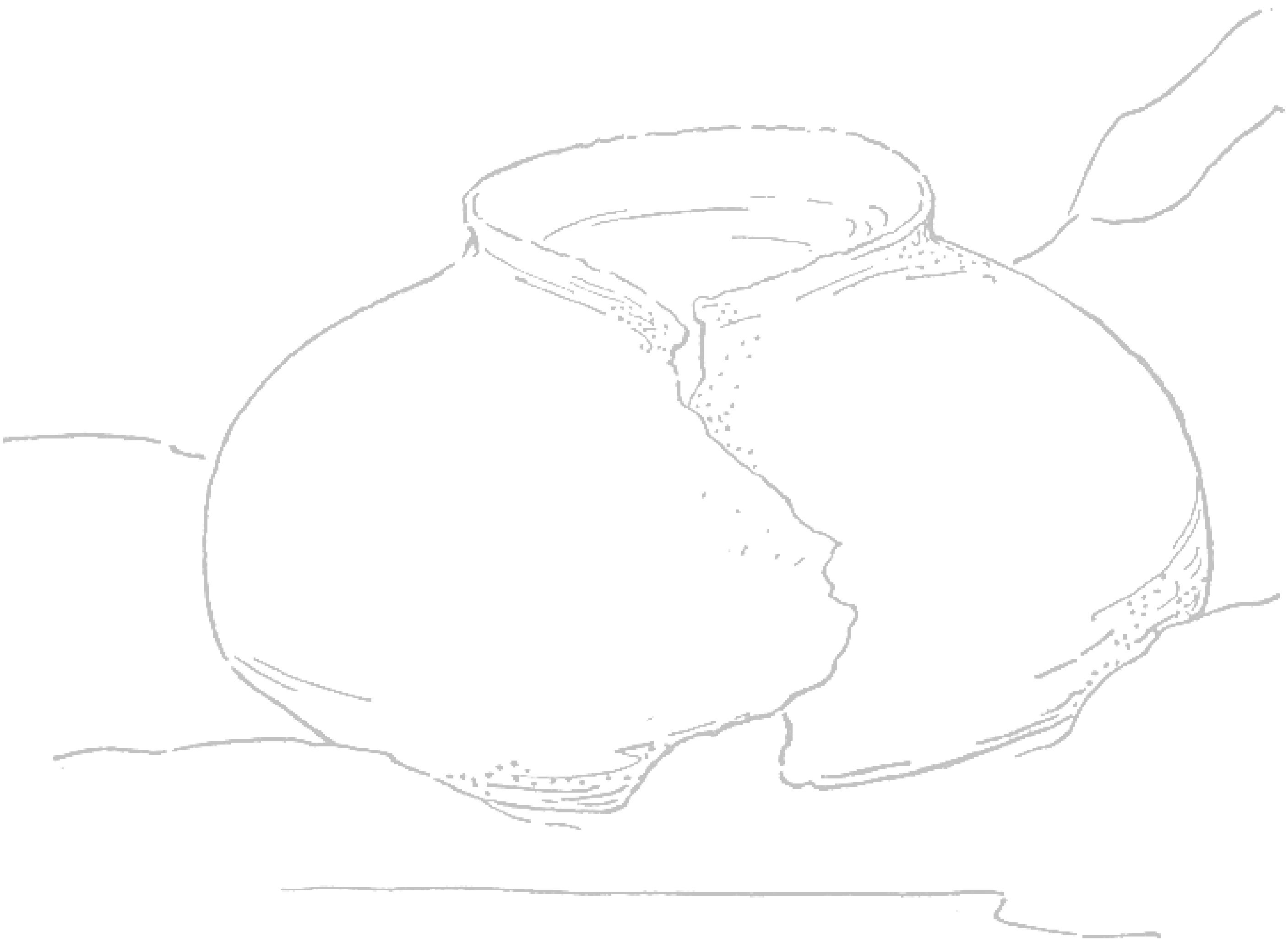
There are a variety of fish that are commonly found on Puget Sound beaches. In addition, others use the shallow water close to the tide line.

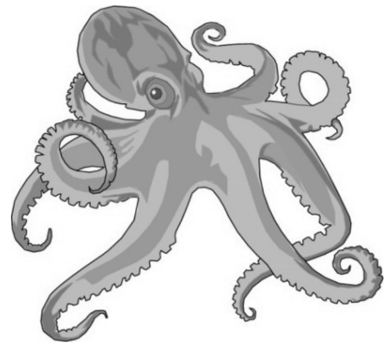
Some fish that stay in the intertidal area when the tide recedes hide under rocks in moist areas while others may stay in pools. Fish that may stay on the beach when the tide goes out include sculpins, blennies, pricklebacks and gunnels. Sculpins have broad heads flattened from top to bottom and round bellies that taper to their tail. Blennies, pricklebacks and gunnels are sometimes mistaken for eels but all have fins (on their tail, back and belly), which eels do not.

Another species sometimes seen on the beach at low tide is the midshipman. While the adults normally live in deep water, the females lay their eggs on the underside of rocks and the male guards them under the rock until the eggs hatch. When observing any of the fish, make sure they stay moist and out of bright sunlight.

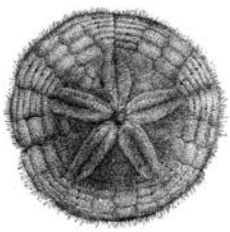
In addition, some fish are often seen in the shallow water very close to shore or in tide pools. These include shiner perch, some juvenile salmon and several kinds of "forage fish." When they first leave streams, juvenile Chinook, pink and chum salmon rely on beaches for food and to escape from predators that live in deeper water. Forage fish are a group of fish eaten by a variety of birds, mammals and fish. A crucial link in the food chain, the group "forage fish" includes herring, sand lance, smelt, and candlefish. Determining the species of salmon or forage fish as they swim by is very difficult even for trained biologists. Please note that some species of salmon receive special protection under the federal Endangered Species Act so any attempt to capture these free-swimming fish would require special written permission.

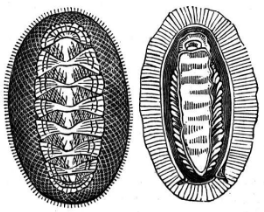


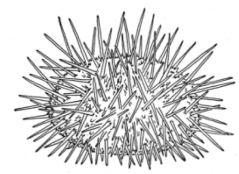


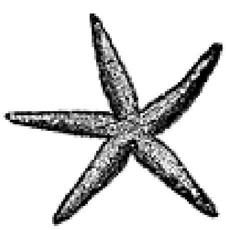


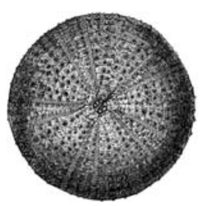
Beaches Species Codes
Appendix I

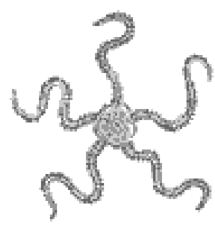


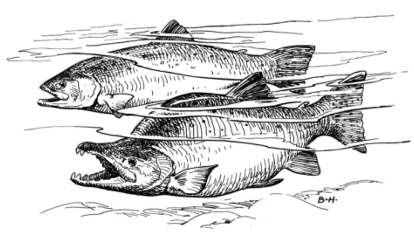












NatureMapping for Beaches - Species Codes

Bivalves

Clams, Mussels, Oysters and Scallops

CLAM99	Clam spp.	
MUSSEL99	Mussel spp.	
OYSTER99	Oyster spp.	
SCALLOP99	Scallop spp.	

PECO	Abalone piddock	*Penitella conradi*
LAAD	Adanson's lepton	*Lasaea adansoni*
PAAMP	Ample roughmya	*Panomya ampla*
HIAR	Arctic hiatella	*Hiatella arctica*
PANO	Arctic roughmya	*Panomya norvegica*
MAPO	Arctic surfclam	*Mactromeris polynyma*
MABA	Baltic macoma	*Macoma balthica*
MANA	Bent-nose macoma	*Macoma nasuta*
MYNU	Bladderclam	*Mytilimeria nuttalli*
TEBO	Bodega Tellin	*Tellina bodegensis*
PLCA	Boring softshell-clam	*Platyodon cancellatus*
SAGI	Butter clam	*Saxidomus gigantea*
ADCA	California datemussel	*Adula californiensis*
LYCAL	California lyonsia	*Lyonsia californica*
MYCAL	California mussel	*Mytilus californianus*
CRCA	California softshell-clam	*Cryptomya californica*
GACA	California sunsetclam	*Gari californica*
GLCA	Carpenter's cardita	*Glans carpenteri*
TECA	Carpenter's tellin	*Tellina carpenteri*
MACAL	Chalky macoma	*Macoma calcarea*
NUOB	Dark mahogany-clam	*Nuttallia obscurata*
MAEX	Expanded macoma	*Macoma expansa*
TRCA	Fat gaper	*Tresus capax*
BASE	Feathery shipworm	*Bankia setacea*
PATE	Fine-lined lucine	*Parvilucina tenuisculpta*
MAMO	Flat macoma	*Macoma moesta*
PEPEN	Flat-tip piddock	*Penitella penita*
MYTR	Foolish mussel	*Mytilus trossulus*
CRGIT	Giant rock scallop	*Crassadoma gigantea*
POMA	Green false-jingle	*Pododesmus macrochisma*
SEGR	Greenland cockle	*Serripes groenlandicus*
PHSE	Hairy philobrya	*Philobrya setosa*

Bivalves

Clams, Mussels, Oysters and Scallops

PECAR	Hearty petricolid	*Petricola carditoides*
SIFA	Hooked surfclam	*Simomactra falcata*
MUSE	Japan mussel	*Musculista senhousia*
KESU	Kellyclam	*Kellia suborbicularis*
HUKE	Kennerley's venus	*Humilaria kennerleyi*
NULO	Lord dwarf-venus	*Nutricola lordi*
VEPH	Manila clam	*Venerupis philippinarum*
HIPH	Nestling saxicave	*Hiatella pholadis*
AXSE	Northern axinopsid	*Axinopsida serricata*
MOMO	Northern horsemussel	*Modiolus modiolus*
CLNU	Nuttall's cockle	*Clinocardium nuttallii*
MAOB	Oblique macoma	*Macoma obliqua*
OSCO	Olympia oyster	*Ostrea conchaphila*
MYED	Pacific blue mussel	*Mytilus edulis*
TRNU	Pacific gaper	*Tresus nuttallii*
PAAB	Pacific geoduck clam	*Panopea abrupta*
PRST	Pacific littleneck	*Protothaca staminea*
CRGI	Pacific oyster	*Crassostrea gigas*
SIPA	Pacific razor-clam	*Siliqua patula*
TEMO	Plain tellin	*Tellina modesta*
MAIN	Pointed macoma	*Macoma inquinata*
PAPUN	Punctate pandora	*Pandora punctata*
NUTA	Purple dwarf-venus	*Nutricola tantilla*
ROTU	Robust mysella	*Rochefortia tumida*
ENNA	Rock entodesma	*Entodesma navicula*
CRGIG	Rock scallop	*Crassadoma gigantea*
SERUB	Rose-painted clam	*Semele rubropicta*
DIIMP	Rough diplodon	*Diplodonta impolita*
ZIPI	Rough piddock	*Zirfaea pilsbryi*
TENU	Salmon tellin	*Tellina nuculoides*
SOSI	Sickle jackknife-clam	*Solen sicarius*
CHRU	Smooth pink scallop	*Chlamys rubida*
MYAR	Softshell clam	*Mya arenaria*
CHHA	Spiny pink scallop	*Chlamys hastata*
MORE	Straight horsemussel	*Modiolus rectus*
PRTE	Thin-shell littleneck	*Protothaca tenerrima*
MYTRU	Truncated softshell-clam	*Mya truncata*

NatureMapping for Beaches - Species Codes

Bivalves
Clams, Mussels, Oysters and Scallops

GLSE	Western bittersweet	*Glycymeris septentrionalis*
LUAN	Western ringed lucine	*Lucinoma annulatum*
MASE	White sand-macoma	*Macoma secta*
PSRU	Wrinkled montacutid	*Pseudopythina rugifera*
MAYO	Yoldia shape macoma	*Macoma yoldiformis*

Brachiopods
Lampshells

LACA	Lampshell sp 1	*Laqueus californianus*
TETR	Lampshell sp 2	*Terebratalia transversa*

Cephalopods
Octopus and Squid

ENDO	Giant pacific octopus	*Enteroctopus dofleini*
OCRU	Red octopus	*Octopus rubescens*
ROPA	Stubby squid	*Rossia pacifica*

Chitons
CHITON99 Chiton spp.

KATU	Black katy chiton	*Katharina tunicata*
LECO	Cooper's chiton	*Lepidozona cooperi*
CRST	Giant Pacific chiton	*Cryptochiton stelleri*
LEDE	Gould's baby chiton	*Lepidochiton dentiens*
MOCI	Hairy chiton	*Mopalia ciliata*
MOHI	Hind's mopalia	*Mopalia hindsii*
TOLI	Lined chiton	*Tonicella lineata*
LEME	Merten's chiton	*Lepidozona mertensii*
MOMU	Mossy chiton	*Mopalia muscosa*
LEFL	Painted dendrochiton	*Lepidochitona flectens*
MOSP	Red-flecked mopalia	*Mopalia spectabilis*
MOSW	Swan's mopalia	*Mopalia swanii*
LETR	Three-rib chiton	*Lepidozona trifida*
PLVEL	Veiled-chiton	*Placiphorella velata*
TOIN	White-lined chiton	*Tonicella insignis*

NatureMapping for Beaches - Species Codes

Chitons

MOLI	Woody chiton	*Mopalia lignosa*

Encrusting Species

Bryozoan

BRYOZO99	Bryozoan spp.	
HIIN	Fluted bryozoan	*Hippodiplosia insculpta*
MEME	Kelp encrusting bryozoan	*Membranipora membranacea*
PHLAB	Lacy bryozoan	*Phidolopora labiata*
FLCO	Leather bryozoan	*Flustrellidra corniculata*
SCUN	Orange encrusting bryozoan	*Schizoporella unicornis*
EUBI	Rosy bryozoan	*Eurystomella bilabiata*
DELI	Sea-lichen bryozoan	*Dendrobeania lichenoides*
HEMA	Staghorn bryozoan	*Heteropora magna*
DICAL	White branching bryozoan	*Diaperoecia californica*

Sea Squirts (Tunicates)

TUNICATE99	Tunicate spp.	
DILI	Compound ascidian	*Diplosoma listerianum*
ASCA	Flattened sea squirt	*Ascidia callosa*
ASPA	Glassy sea squirt	*Ascidia paratropa*
BOSC	Harbor star ascidian	*Botryllus schlosseri*
CHPR	Horseshoe ascidian	*Chelyosoma productum*
BO99	Lined compound ascidian	*Botryllus spp.*
CYLO	Lobed ascidian	*Cystodytes lobatus*
STMO	Monterey stalked sea squirt	*Styela montereyensis*
DIOC	Mushroom ascidian	*Distaplia occidentalis*
META	Orange social ascidians	*Metandrocarpa taylori*
DICAR	Pacific white crust	*Didemnum carnulentum*
DISM	Paddle ascidian	*Distaplia smithi*
STGI	Peanut sea squirt	*Styela gibbsii*
APSO	Red ascidian	*Aplidium solidum*
PEAN	Sea grapes	*Perophora annectens*
APCA	Sea pork	*Aplidium californicum*
CIIN	Sea vase	*Ciona intestinalis*
CNFI	Shiny orange sea squirt	*Cnemidocarpa finmarkiensis*

NatureMapping for Beaches - Species Codes

Encrusting Species

Sea Squirts (Tunicates)

HAHI	Spiny sea squirt	*Halocynthia hilgendorfi igaboja*
BOVI	Stalked hairy sea squirt	*Boltenia villosa*
COIN	Transparent sea squirt	*Corella inflata*
COWI	Transparent sea squirt	*Corella willmeriana*
DIALB	White glove leather	*Didemnum albidum*
PYHA	Wrinkled sea squirt	*Pyura haustor*
PYSTA	Yellow social ascidians	*Pycnoclavella stanleyi*

Sponges

SPONGE99	Sponge spp.	
POPA	Aggregated vase sponge	*Polymastia pacifica*
HAPA	Bread crumb sponge	*Halichondria panicea*
LEHEA	Bristly vase sponge	*Leucandra heathi*
RHDA	Chimney sponge	*Rhabdocalyptus dawsoni*
STDO	Chimney sponge	*Staurocalyptus dowlingi*
APVA	Cloud sponge	*Aphrocallises vastus*
CHCA	Goblet sponge	*Chonelasma calyx*
SUSU	Hermit crab sponge	*Suberites suberea*
TECAL	Orange ball sponge	*Tethya californiana*
HAPE	Purple encrusting sponge	*Haliclona permollis*
ACER	Red volcano sponge	*Acarnus erithacus*
MYINC	Rough scallop sponge	*Myxilla incrustans*
PECOR	Salt and pepper sponge	*Penares cortius*
MYAD	Smooth scallop sponge	*Mycale adhaerens*
LENU	Stalked sponge	*Leucilla nuttingi*
CRVIL	Tennis ball sponge	*Craniella villosa*
LEEL	Tube ball sponge	*Leucosolenia eleanor*
LENA	Tube sponge	*Leucosolenia nautilia*
OPPE	Velvety red sponge	*Ophlitaspongia pennata*
CLCE	Yellow boring sponge	*Cliona celata californiana*

Gastropods

Abalone, Snails and Whelks

SNAIL99	Snail spp.	
URCI	Atlantic oyster drill	*Urosalpinx cinera*
OLBA	Baetic olive	*Olivella baetica*
RIPU	Barrel shell	*Rictaxis punctocaelatus*
TEFU	Black turban	*Tegula funebralis*
CALI	Blue topsnail	*Calliostoma ligatum*
OPBO	Boreal wentletrap	*Opalia borealis*
TEPU	Brown turban	*Tegula pulligo*
ALCA	Carinate dovesnail	*Alia carinata*
NUCA	Channeled dogwinkle	*Nucella canaliculata*
CACANA	Channeled topsnail	*Calliostoma canaliculatum*
LISCU	Checkered periwinkle	*Littorina scutulata*
BOOR	Corded trophon	*Boreotrophon orpheus*
CAFA	Cup-and-saucer snail	*Calyptraea fastigiata*
HOLU	Dark dwarf turban	*Homalopoma luridum*
LIDI	Dire whelk	*Lirabuccinum dirum*
NULI	File dogwinkle	*Nucella lima*
HICR	Flat hoofsnail	*Hipponix cranioides*
NULA	Frilled dogwinkle	*Nucella lamellosa*
NAFO	Giant western nassa	*Nassarius fossatus*
OPIN	Gray snakeskin-snail	*Ophiodermella inermis*
MAHE	Helicina margarite	*Margarites helicinus*
CRAD	Hooked slippersnail	*Crepidula adunca*
CEIN	Japanese rocksnail	*Ceratostoma inornatum*
AMVE	Joseph's coat amphissa	*Amphissa versicolor*
CEFO	Leafy hornmouth	*Ceratostoma foliatum*
EULE	Lewis's moonsnail	*Euspira lewisii*
OCLU	Lurid rocksnail	*Ocinebrina lurida*
EPIN	Money wentletrap	*Epitonium indianorum*
BAZO	Mudflat snail	*Batillaria zonalis*
HAKA	Northern abalone	*Haliotis kamtschatkana*
CRNU	Northern white slippersnail	*Crepidula nummaria*
FUOR	Oregon triton	*Fusitriton oregonensis*
LILI	Pearly topsnail	*Lirularia lirulata*
MAPU	Puppet margarite	*Margarites pupillus*
OLBI	Purple olive	*Olivella biplicata*

NatureMapping for Beaches - Species Codes

Gastropods

Abalone, Snails and Whelks

CAANN	Purple-ring topsnail	*Calliostoma annulatum*
LIGI	Red turban	*Lithopoma gibberosa*
NELY	Ridged whelk	*Neptunea lyrata*
OCIN	Sculptured rocksnail	*Ocinebrina interfossa*
LISI	Sitka periwinkle	*Littorina sitkana*
BIAT	Slender bittium	*Bittium attenuatum*
VEPR	Smooth velvet snail	*Velutina prolongata*
CICI	Spiny topsnail	*Cidarina cidaris*
NUEM	Striped dogwinkle	*Nucella emarginata*
BIES	Threaded bittium	*Bittium eschrichtii*
NITI	Tinted wentletrap	*Nitidiscala tincta*
LISU	Tucked topsnail	*Lirularia succincta*
LAVA	Variable lacuna	*Lacuna variegata*
KUCR	Violet-band mangelia	*Kurtziella crebricostata*
NAME	Western lean nassa	*Nassarius mendicus*
CRPE	Western white slippersnail	*Crepidula perforans*
HAVE	White bubble shell	*Haminoea vesicula*
LAVI	Wide lacuna	*Lacuna vincta*
AMCO	Wrinkled amphissa	*Amphissa columbiana*
CRDO	Wrinkled slippersnail	*Crepipatella dorsata*

Limpets

LIMPET99	Limpet spp.	
LOAS	Black limpet	*Lottia asmi*
LOAL	Eelgrass limpet	*Lottia alveus*
TEFE	Fenestrate limpet	*Tectura fenestrata*
LOLI	File limpet	*Lottia limatula*
TEPE	Mask limpet	*Tectura persona*
TESC	Plate limpet	*Tectura scutum*
LODI	Ribbed limpet	*Lottia digitalis*
DIAS	Rough keyhole limpet	*Diodora aspera*
DIIN	Seaweed limpet	*Discurria insessa*
LOPE	Shield limpet	*Lottia pelta*
TEPA	Surfgrass limpet	*Tectura paleacea*
FIBI	Two-spot keyhole limpet	*Fissurellidea bimaculata*

NatureMapping for Beaches - Species Codes

Gastropods

Limpets

LOIN	Unstable limpet	*Lottia instabilis*
ACMI	Whitecap limpet	*Acmaea mitra*

Nudibranchs

NUDIBRANCH99	Nudibranch spp.	
ONBI	Barnacle nudibranch	*Onchidoris bilamellata*
TRCAT	Clown dorid	*Triopha catalinae*
DOST	Cryptic nudibranch	*Doridella steinbergae*
DEDA	Dall's dendronotid	*Dendronotus dalli*
TRFE	Diamond back tritonia	*Tritonia festiva*
DEIR	Giant (nudibranch) dendronotid	*Dendronotus iris*
DERU	Giant red dendronotid	*Dendronotus rufus*
AROD	Giant white dorid	*Archidoris odhneri*
MELEO	Hooded nudibranch	*Melibe leonina*
ACHU	Hudson's dorid	*Acanthodoris hudsoni*
ONBO	Leather "limpet"	*Onchidella borealis*
DISA	Leopard dorid	*Diaulula sandiegensis*
ARMO	Monterey sea lemon	*Archidoris montereyensis*
ACNA	Nanaimo dorid	*Acanthodoris nanaimoensis*
HECR	Opalescent (aeolid) nudibranch	*Hermissenda crassicornis*
TOTE	Orange peel nudibranch	*Tochuina tetraquetra*
TRDI	Pink tritonia	*Tritonia diomedea*
ROPU	Red sponge nudibranch	*Rostanga pulchra*
ANNO	Sea lemon	*Anisodoris nobilis*
AEPA	Shaggy mouse (aeolid) nudibranch	*Aeolidia papillosa*
FLTR	Three-lined (aeolid) nudibranch	*Flabellina trilineata*
DEDI	Variable dendronotid	*Dendronotus diversicolor*
DEAL	White dendronotid	*Dendronotus albus*
DIALT	White-lined dirona	*Dirona albolineata*
CALUT	Yellow margin dorid	*Cadlina luteomarginata*

NatureMapping for Beaches - Species Codes

Joint-legged Species

Amphipods, Isopods, Mites and Sea Spiders

AMPHIPOD99	Amphipod spp.	
ISOPOD99	Isopod spp.	
TRTRA	Beach hopper	*Traskorchestia traskiana*
MECA	California beach hopper	*Megalorchestia californiana*
IDWA	Kelp isopod	*Idotea wasnesenskii*
NELI	Red velvet mite	*Neomolgus littoralis*
CA99	Skeleton shrimp	*Caprella spp.*
CALAE	Smooth skeleton shrimp	*Caprella laeviuscula*
PYST	Stearn's sea spider	*Pycnogonum stearnsi*

Barnacles

BARNACLE99	Barnacle spp.	
BAGL	Acorn barnacle	*Balanus glandula*
BANU	Giant barnacle	*Balanus nubilus*
POPOL	Goose barnacle	*Pollicipes polymerus*
CHDA	Little brown barnacle	*Chthamalus dalli*
HEHE	Shell barnacle	*Hesperibalanus hesperius*
SECA	Thatched barnacle	*Semibalanus cariosus*

Crabs

CRAB99	Crab spp.	
HCRAB99	Hermit crab spp.	
PAOC	Alaskan hermit crab	*Pagurus ochotensis*
PABE	Bering hermit crab	*Pagurus beringanus*
LOBE	Black-clawed shore crab	*Lophopanopeus bellus*
PAAR	Blackeyed hermit	*Pagurus armatus*
PASAM	Blueband hermit	*Pagurus samuelis*
PAKE	Bluespine hermit	*Pagurus kennerlyi*
LOFO	Brown box crab	*Lopholithodes foraminatus*
SCGR	Burrow pea crab	*Scleroplax granulata*
CRTY	Butterfly crab	*Cryptolithodes typicus*
PURI	Cryptic kelp crab	*Pugettia richii*
CAMAG	Dungeness crab	*Cancer magister*

NatureMapping for Beaches - Species Codes

Joint-legged Species

Crabs

PECI	Flat porcelain crab	*Petrolisthes cinctipes*
MIFO	Foliate kelp crab	*Mimulus foliatus*
PAUL	Furry hermit	*Paguristes ulreyi*
PILI	Gaper pea crab	*Pinnixa littoralis*
PAHE	Gold ring hermit crab	*Pagurus hemphilli*
PAGR	Grainyhand hermit	*Pagurus granosimanus*
OEIN	Granular claw crab	*Oedignathus inermis*
CAMAC	Green crab	*Carcinus maenas*
PACA	Greenmark hermit	*Pagurus caurinus*
CAORE	Hairy cancer crab	*Cancer oregonensis*
PAHI	Hairy hermit crab	*Pagurus hirsutiusculus*
HAME	Hairy lithodid	*Hapalogaster mertensii*
PAPU	Hairy porcelain crab	*Pachycheles pubescens*
CAJO	Hairy rock crab	*Cancer jordani*
HEOR	Hairy shore crab	*Hemigrapsus oregonensis*
PHPA	Heart crab	*Phyllolithodes papillosus*
TECH	Helmet crab	*Telmessus cheiragonus*
PIFA	Mantle pea crab	*Pinnixa faba*
FASU	Mussel crab	*Fabia subquadrata*
PUPR	Northern kelp crab	*Pugettia producta*
ELGI	Orange hermit crab	*Elassochirus gilli*
CAANT	Pacific rock crab	*Cancer antennarius*
EMAN	Pacific sand crab	*Emerita analoga*
PITU	Pinnixia crab	*Pinnixa tubicola*
PEERI	Porcelain crab	*Petrolisthes eriomerus*
HENU	Purple shore crab	*Hemigrapsus nudus*
ACHI	Red fur crab	*Acantholithodes hispidus*
CAPR	Red rock crab	*Cancer productus*
PLWO	Scaled crab	*Placetron wosnessenskii*
SCAC	Sharp-nosed crab	*Scyra acutifrons*
CAGR	Slender cancer crab	*Cancer gracilis*
ORGR	Slender decorator crab	*Oregonia gracilis*
PUGRA	Slender kelp crab	*Pugettia gracilis*
PARUD	Thickclaw porcelain crab	*Pachycheles rudis*
DISC	Tubeworm hermit	*Discorsopagurus schmitti*
CRSI	Umbrella crab	*Cryptolithodes sitchensis*
ELTE	Widehand hermit crab	*Elassochirus tenuimanus*

NatureMapping for Beaches - Species Codes

Joint-legged Species

Shrimp

SHRIMP99	Shrimp spp.	
HEPU	Barred shrimp	*Heptacarpus pugettensis*
NECA	Bay ghost shrimp	*Neotrypaea californiensis*
CRNI	Blacktail shrimp	*Crangon nigricauda*
UPPU	Blue mud shrimp	*Upogebia pugettensis*
CRFR	California bay shrimp	*Crangon franciscorum*
HICA	California grass shrimp	*Hippolyte californiensis*
LEGRA	Candy stripe shrimp	*Lebbeus gradimanus*
LECAT	Cataleptic shrimp	*Lebbeus catalepsis*
PADA	Coonstripe shrimp	*Pandalus danae*
CRHA	*Crangon handi*	*Crangon handi*
SPPR	Deep blade shrimp	*Spirontocaris prionota*
EUPU	Doll eualid	*Eualus pusiolus*
BESE	Fuzzy hooded shrimp	*Betaeus setosus*
HICL	Grass shrimp	*Hippolyte clarki*
PAGO	Humpy shrimp	*Pandalus goniurus*
MEMU	Miniature spinyhead	*Mesocrangon munitella*
CRAL	Northern crangon	*Crangon alaskensis*
BEHA	Northern hooded shrimp	*Betaeus harrimani*
PAPL	Prawn (Spot prawn)	*Pandalus platyceros*
HESI	Sitka shrimp	*Heptacarpus sitchensis*
HECA	Smalleyed shrimp	*Heptacarpus carinatus*
LIST	Smooth bay shrimp	*Lissocrangon stylirostris*
LEGR	Spiny lebbeid	*Lebbeus groenlandicus*
HESTY	Stiletto shrimp	*Heptacarpus stylus*
HESTI	Stimpson's shrimp	*Heptacarpus stimpsoni*
HEBR	Stout coastal shrimp	*Heptacarpus brevirostris*
SCBO	Tank shrimp	*Sclerocrangon boreas*
HETR	Threespine shrimp	*Heptacarpus tridens*

Spinny-skinned (Echinoderm)

Sand Dollar

DEEX	Eccentric sand dollar	*Dendraster excentricus*

NatureMapping for Beaches - Species Codes

Spinny-skinned (Echinoderm)
Sea Cucumbers

PACAL	California sea cucumber	*Parastichopus californicus*
PSCH	Creeping pedal sea cucumber	*Psolus chitonoides*
CUMI	Orange sea cucumber	*Cucumaria miniata*
PSBI	Pale creeping pedal sea cucumber	*Psolidium bidiscum*
CUPA	Pale sea cucumber	*Cucumaria pallida*
EUQU	White sea cucumber	*Eupentacta quinquesemita*

Spinny-skinned (Echinoderm)
Sea Stars

STAR99	Sea star spp.	
CEAR	Arctic cookie star	*Ceramaster arcticus*
ASMI	Bat star	*Asterina miniata*
AMPU	Black and white brittle star	*Amphipholis pugetana*
HELE	Blood star	*Henricia leviuscula*

Sea Stars

OPAC	Daisy brittle star	*Ophiopholis aculeata*
AMSQ	Dwarf brittle star	*Amphipholis squamata*
OPLU	Grey brittle star	*Ophiura lutkeni*
DEIM	Leather star	*Dermasterias imbricata*
AMUR	Long arm brittle star	*Amphiodia urtica*
SODA	Morning sunstar	*Solaster dawsoni*
EVTR	Mottled star	*Evasterias troschelii*
SOEN	Northern sunstar	*Solaster endeca*
PIOC	Ochre star	*Pisaster ochraceus*
ORKO	Painted star	*Orthasterias koehleri*
CRPA	Rose star	*Crossaster papposus*
LEHE	Six-rayed star	*Leptasterias hexactis*
LUFO	Spiny mudstar	*Luidia foliolata*
PIBR	Spiny pink star	*Pisaster brevispinus*
SOST	Striped sunstar	*Solaster stimpsoni*
PYHE	Sunflower star	*Pycnopodia helianthoides*
MEAE	Vermilion star	*Mediaster aequalis*

NatureMapping for Beaches - Species Codes

Spinny-skinned (Echinoderm)

Sea Urchins

URCHIN99	Sea urchin spp.	
STDR	Green sea urchin	*Strongylocentrotus droebachiensis*
STPU	Purple sea urchin	*Strongylocentrotus purpuratus*
STFR	Red sea urchin	*Strongylocentrotus franciscanus*

Stinging Organisms

Anemones and Corals

ANEMONE99	Sea anemone spp.	*Anthopleura elegantissima*
ANEL	Aggregate green anemone	*Anthopleura elegantissima*
EPLI	Brooding anemone	*Epiactis lisbethae*
TECO	Buried anemone	*Tealia coriacea*
ANAR	Buried green anemone	*Anthopleura artemisia*
EPFE	Fernald brooding anemone	*Epiactis fernaldi*
URPI	Fish-eating anemone	*Urticina piscivora*
ANXA	Giant green anemone	*Anthopleura xanthogrammica*
MEFA	Giant plumose anemone	*Metridium farcimen*
HALI	Lined anemone	*Haliplanella lineata*
BAEL	Orange cup coral	*Balanophyllia elegans*
PTGU	Orange sea pen	*Ptilosarcus gurneyi*
EPSC	Orange zoanthid	*Epizoanthus scotinus*
URFE	Painted anemone	*Urticina felina*
STVE	Pink hydrocoral	*Stylaster verrilli*
MESEP	Plumrose anemone	*Metridium sepile*
EPPR	Proliferating anemone	*Epiactis prolifera*
ST99	Purple encrusting hydrocoral	*Stylaster spp.*
EPRI	Ritter's brooding anemone	*Epiactis ritteri*
MESEN	Short plumose anemone	*Metridium senile*
COCAL	Strawberry anemone	*Corynactis californica*
HADE	Ten-tentacled anemone	*Halcampa decemtentaculata*
PAFI	Tube-dwelling anemone	*Pachyceriapthus fimbriatus*
TELO	White-spotted anemone	*Tealia lofotensis*

NatureMapping for Beaches - Species Codes

Stinging Organisms

Hydroids and Jellyfish

HYDROID99	Hydroid spp.	
JELLYFISH99	Jellyfish spp.	

PLBA	Cat's eye comb jelly	*Pleurobrachia bachei*
GOVE	Clinging jellyfish	*Gonionemus vertens*
PL99	Glassy plume hydroids	*Plumularia spp.*
HYMI	Hedgehog hydroid	*Hydractinia milleri*
ABGR	Hydroid	*Abietinaria greenei*
CYCAP	Lion's mane	*Cyanea capillata*
AULA	Moon jellyfish	*Aurelia labiata*
GAAN	Orange hydroid	*Garveia annulata*
AGST	Ostrich plume hydroid	*Aglaophenia struthionides*
TUCR	Pink mouth hydroid	*Tubularia crocea*
TUMA	Pink mouth hydroid	*Tubularia marina*
ST99	Purple encrusting hydrocoral	*Stylaster spp.*
POPE	Red-eye medusa	*Polyorchis pencillatus*
VEVE	Sail jellyfish	*Velella velella*
AB99	Sea fir	*Abietinaria spp.*
SETU	Turgid garland hydroid	*Sertularella turgida*
AE99	Water jellyfish	*Aequorea spp.*
OB99	Wine-glass hydroid	*Obelia spp.*

Worms

WORM99	Worm spp.	

GOPR	Agassiz's peanut worm	*Phascolosoma Agassizii*
POPU	Bat star worm	*Podarke pugettensis*
ABCL	Black lugworm	*Abarenicola claparedi*
GLAM	Blood worm	*Glycera americana*
EU99	Bloodworm	*Euzonus spp.*
SEVE	Calcareous tube worm	*Serpula vermicularis*
SACE	Cemented tube worm	*Sabellaria cementarium*
NEVE	Clam worm	*Nereis vexillosa*
DOCO	Coralline fringed tube worm	*Dodecaceria concharum*
PIEL	Fibre-tube worm	*Pista elongata*
HAIM	Fifteen-scaled worm	*Harmothoe imbricata*
DOFE	Fringed tube worm	*Dodecaceria fewkesi*

NatureMapping for Beaches - Species Codes

Worms

NEBR	Giant pile worm	*Neanthes brandti*
EMGR	Green and yellow ribbon worm	*Emplectonema gracile*
KAEX	Large leaf worm	*Kaburakia excelsa*
TUSE	Lined ribbon worm	*Tubulanus sexilineatus*
EUVA	Northern feather duster worm	*Eudistylia vancouveri*
SATRI	Orange tube worm	*Salmacina tribranchiata*
ABPA	Pacific lugworm	*Abarenicola pacifica*
TUPO	Primitive ribbon worm	*Tubulanus polymorphus*
ARPU	Red commensal scaleworm	*Arctonoe pulchra*
ARVI	Red-banded commensal scaleworm	*Arctonoe vittata*
ARFR	Ruffled scale worm	*Arctonoe fragilis*
NE99	Sandworm	*Nephtys spp.*
HABR	Scale worm	*Halosydna brevisetosa*
MYIN	Slime tube worm	*Myxicola infundibulum*
THE99	Spaghetti worm	*Thelepus spp.*
SPI99	Spiral tube worm	*Spirorbis spp.*
LESQ	Twelve-scaled worm	*Lepidonotus squamatus*
AMBIM	Two-spotted ribbon worm	*Amphiporus bimaculatus*

Fish

GUNNEL99	Gunnel spp.	
PRICKL99	Prickleback spp.	
SCULP 99	Sculpin spp.	
CLIO	Arrow goby	*Clevelandia ios*
SASA	Atlantic salmon	*Salmo salar*
SYLE	Bay pipefish	*Syngnathus leptorhynchus*
XIAT	Black prickleback	*Xiphister atropurpureus*
RHNI	Black-eyed goby	*Rhinogobiops nicholsii*
ENBI	Buffalo sculpin	*Enophrys bison*
SCMA	Cabezon	*Scorpaenichthys marmoratus*
CLEM	Calico sculpin	*Clinocottus embryum*
ONCLCL	Coastal cutthroat	*Oncorhynchus clarki clarki*
PHLA	Crescent gunnel	*Pholis laeta*
SAMA	Dolly varden	*Salvelinus malma*
PAVE	English sole	*Parophrys vetulus*
THPA	Eulachon	*Thaleicthys pacificus*
OLSN	Fluffy sculpin	*Oligocottus snyderi*
MYPO	Great sculpin	*Myoxocephalus polyacanthocephalus*

NatureMapping for Beaches - Species Codes

Fish

RHRI	Grunt sculpin	*Rhamphocottus richardsonii*
ANPU	High cockscomb	*Anoplarchus purpurescens*
HEDE	Kelp greenling	*Hexagrammos decagrammus*
PHCL	Longfin gunnel	*Pholis clemensi*
SPTH	Longfin smelt	*Spirinchus thaleichthys*
CLGL	Mosshead sculpin	*Clinocottus globiceps*
CHNU	Mosshead warbonnet	*Chirolophis nugator*
GOMA	Northern clingfish	*Gobiesox maeandricus*
ENTR	Pacific lamprey	*Entosphenus tridentatus*
AMHE	Pacific sand lance	*Ammodytes hexapterus*
TRTR	Pacific sandfish	*Trichodon trichodon*
LUSA	Pacific snake prickleback	*Lumpenus sagitta*
EUOR	Pacific spiny lumpsucker	*Eumicrotremus orbis*
LEAR	Pacific staghorn sculpin	*Leptocottus armatus*
APFL	Penpoint gunnel	*Apodichthys flavidus*
PONO	Plainfin midshipman	*Porichthys notatus*
COAS	Prickly sculpin	*Cottus asper*
HEHEM	Red Irish lord	*Hemilepidotus hemilepidotus*
PHCH	Ribbon prickleback	*Phytichthys chirus*
XIMU	Rock prickleback	*Xiphister mucosus*
PABI	Rock sole	*Paraplagusia bilineata*
BOSW	Rockhead poacher	*Bothragonus swanii*
APFU	Rockweed gunnel	*Apodichthys fucorum*
ASRH	Rosylip sculpin	*Ascelichthys rhodorus*
PHOR	Saddleback gunnel	*Pholis ornata*
OLRI	Saddleback sculpin	*Oligocottus rimensis*
ARHA	Scalyhead sculpin	*Artedius harringtoni*
CLAC	Sharpnose sculpin	*Clinocottus acuticeps*
CYAG	Shiner perch	*Cymatogaster aggregata*
BLCI	Silverspotted sculpin	*Blepsias cirrhosus*
ANIN	Slender cockscomb	*Anoplarchus insignis*
ARLA	Smoothhead sculpin	*Artedius lateralis*
CIST	Speckled sanddab	*Citharichthys stigmaeus*
PLST	Starry flounder	*Platichthys stellatus*
PSPA	Tadpole sculpin	*Psychrolutes paradoxus*
TITI	Tench	*Tinca tinca*
GAAC	Three-spine stickleback	*Gasterosteus aculeatus*
OLMA	Tidepool sculpin	*Oligocottus maculosus*
LIFL	Tidepool snailfish	*Liparis florae*

NatureMapping for Beaches - Species Codes

Fish

HEST	Whitespotted greenling	*Hexagrammos stelleri*
ANOC	Wolf-eel	*Anarrhichthys ocellatus*
SALMON99	Salmon spp.	
ONTS	Chinook salmon (KING)	*Oncorhynchus tshawytscha*
ONKE	Chum salmon (DOG)	*Oncorhynchus keta*
ONKI	Coho salmon (SILVER)	*Oncorhynchus kisutch*
ONGO	Pink salmon (HUMPBACK)	*Oncorhynchus gorbuscha*
ONNEANA	Sockeye salmon (RED)	*Oncorhynchus nerka*
ONMY	Steelhead	*Oncorhynchus mykiss*

Appendix II
Marine Glossary of Terms

Algae. Photosynthetic organisms lacking true roots, stems and leaves such as single-celled diatoms or multi-cellular seaweeds such as sea lettuce or bull kelp.

Arthropoda. Jointed-legged invertebrates such as crabs, shrimp, barnacles and insects.

Backshore. Above the upper high tide mark including berms and cliffs .

Backshore elevation. The elevation of the upper portion of a beach from a permanent upland reference point to the berm crest; used to determine year to year slope changes.

Beach. The seashore or the area at the edge of the sea. Specifically, the geological landform most heavily influenced by the marine waters, usually consisting of loose particles of rock such as sand gravel, shingle, pebbles or cobble. In this guide, the intertidal area is located within the beach.

Berm. A nearly horizontal portion of backshore with an abrupt face; most commonly composed of sand and littered with drift logs.

Berm crest. Ridge of berm marking the starting point of the study in some cases.

Biodiversity. A measure of the number of species found in a given habitat.

Boulder. Rocks that are basketball-sized; larger than 256 mm.

Carnivore. An organism that feeds on live animals.

Centimeter. 1"= 2.54cm; 100cm = 1m.

Clay/silt. Tiny, slippery beach sediment with microscopic grains, found in mud beaches.

Cnidaria. Stinging invertebrates such as jellyfish (jellies), anemones and sea pens.

Cobble. Chicken egg to basketball-sized rocks; 65-256 mm.

Commensal relationship. Two organisms living together where one benefits and the other is not significantly harmed or benefited.

Detritus. A decaying material such as dead plants. In detritus-based food chains, decomposers are at the base of the food chain, and sustain the carnivores which feed on them.

Detritivore. An organism that feeds on detritus or organic waste. Detrivores include bacteria, which can break down organic matter such as body remains or excreted waste into its basic elements making nutrients available to producers.

Diversity index. A community-level measure used to indicate ecosystem health and well-being.

Marine Glossary of Terms Continued

Ebb tide. The period between high tide and low tide when water is going out.

Echinodermata. Spiny-skinned invertebrates such as sea stars, urchins and sea cucumbers.

Epifauna. Non-buried animals living on surface of the substrate such as limpets and barnacles.

Flotsam. Historically defined as parts of wreckage of a ship or cargo found floating on the sea after a shipwreck. The common phrase *flotsam and jetsam* is now used loosely to describe any objects found floating or washed ashore.

Flood or flow tide. The period between low tide and high tide when water is coming in.

Gravel (pebble). Pea to chicken egg-sized rocks; 4.0-64 mm.

Habitat. The environment where an organism or population lives.

Habitat characterization. Documentation of beach substrate, slope, and habitat type.

Habitat type. Defined by a beach substrate plus any overlying vegetation.

Herbivore. An organism *(primary consumer)* that feeds on producers such as plants, algae, and photosynthesizing bacteria.

High tide. The highest point reached by the water at a given location.

Intertidal. That area of the nearshore between the highest high tide and the lowest low tide. When reading maps, the intertidal may look very different sizes on different maps. Some maps draw the water as if it started at mid-tide and others at zero tide.

Invertebrates. Animals without backbones such as crabs, snails, worms, and sea urchins.

Jetsam. Historically defined as cargo or equipment thrown overboard from a ship in distress and either sunk or washed ashore. It is now a common phrase to loosely describe any objects discarded and floating in waterways or the ocean.

Keystone species. A species that changes its environment or that other species depend upon.

LLW (lower low water). The lower of the two low tide heights during a day.

Low tide. The lowest point reached by the water at a given location.

Marine debris. Human-created waste that has deliberately or accidentally released in the ocean. It is also called marine litter.

Marine Glossary of Terms Continued

Macroflora. Multi-cellular algae (seaweeds) and true plants such as eelgrass.

MLLW (mean lower low water). The mean (average) height of the lower of the two low tides (LLW) for a particular location; also known as 0.0' tide height in the U.S. (and not the same as sea level).

MLW (mean low water). The mean average low water or the average of all low tides.

Mollusca. Soft-bodied invertebrates such as snails, clams, chitons and octopus.

Neap tide. A tide that produces more moderate (lower high and higher low) tides than normal.

Nearshore. The shallow water area close to shore. This term has various definitions, but for this guide means both the intertidal area when it is underwater and the waters less than 30 feet deep.

Oviparous. A species that lays eggs.

Ovoviviparous. Keeps young in the body within an egg layer, when born, performs a live birth.

Parasite. An organism which obtains its food and shelter from another organism (for example sea lice). The parasite lives at the expense of its host.

Pebble. Pea to a chicken egg sized rocks. 4-64mm. See gravel.

Relative abundance (of species). Frequency of the presence of a given species (group of species) observed over time.

Richness (of species). The biodiversity or number of species in a given area.

Riprap. Large boulders brought in to reinforce a shoreline, often along railroad tracks.

Sand. Sugar to rice-sized sediment; 0.1 – 4.0 mm.

SCALE (Spatial Classification and Landscape Extrapolation of Intertidal Biotic Communities in Central and South Puget Sound). An intertidal monitoring program of the Wash. State Dept. of Natural Resources.

Sea Level. This often means the level of the sea at any given time. In some mapping systems, it refers to the average of a specific tide, such as Mean Tide (the average of all tides) or MLLW.

Sessile. Relatively stationary and attached animals such as sea anemones and barnacles.

Shell debris. Ground shell fragments of varying sizes found on a beach.

Marine Glossary of Terms Continued

Slack tide. The period at high and low tides when the tide is turning.

Slope. The average incline of the beach from the backshore to the water, or the incline over a particular section of beach.

Spring tide. A tide that produces more extreme (higher high and lower low) tides than normal.

Starting point. The location to begin laying the profile line at a beach unit.

Substrate. The sediment, rock, etc making up the beach and seafloor.

Symbiotic relationship. Two or more species living together in order to survive.

Taxon (pl. taxa). A category of scientific classification such as family, genus or species.

Tide height. Vertical measurement of tidal movement on a beach measured in feet (and tenths of a foot) and/or meters (and hundredths of a meter) from the mean lower low water mark (MLLW) on west coast of U.S. waters. A 1.0' tide height is approximately equal to 0.3m; a 2.0' tide height is approximately equal to 0.6m.

Tidal range. The maximum difference between the highest high water and lowest low water on a beach (vertical difference, not horizontal). Average Puget Sound tidal ranges are about 8' at Port Townsend, 11' for Seattle and about 14' for Olympia. Worldwide extreme is Bay of Fundy, Canada with a potential 50' daily tidal range. Daily tidal ranges increase several feet during or near a full or new moon.

Tide Zones. Tide zones designate different general elevations on the beach. This term refers to Zones 1-4 (see pages 22-23).

Water horizon. The line where a body of water intersects the land when seen from a distance.

Wetland. An area where the soils are saturated with water and may be inundated occasionally as compared to a beach which is inundated on a regular basis by the tides.

Width. A measurement taken perpendicular to the shore (parallel to the profile line).

Ulvoids. A collective term for the green algae Ulva and related species.

Zero Tide. The average of the lower low water (MLLW) and represented as zero tide. All tidal heights are calculated as being above that point on the beach (e.g. +9.2 ft) or below it (-0.5 ft).

Appendix III

Selected Marine Reference List

NatureMapping Resources

Dvornich, Karen, and Margaret Tudor. 2000 (revision). The *NatureMapping* Program: Guidelines for Fish and Wildlife, *NatureMapping*, University of Washington, Cooperative Fish & Wildlife Unit, various pagination. http://depts.washington.edu/natmap/

Recommended Marine Field Guide Resources for the Beach!

Island County Beach Watchers Laminated Intertidal Invertebrate ID Card Set. 2004, Periwinkle Press http://www.beachwatchers.wsu.edu/ezidweb/ID_cards/

Harbo, Rick M. 2003. Pacific Reef and Shore: A Photo Guide to Northwest Marine Life, Harbor Publishing – Madeira Park, BC, ISBN 1-55017-304-9, 80 pp.

Mac's Field Guide. 1984 Mac's Field Guide To Northwest Coastal Fish, The Mountaineers – Seattle, WA

Mac's Field Guide. 1997 Mac's Field Guide To Northwest Coastal Intertebrates, The Mountaineers – Seattle, WA

Mac's Field Guide. 2000 Mac's Field Guide To Northwest Coastal Water Birds, The Mountaineers – Seattle, WA

Seattle Aquarium. Seattle Aquarium Field Guide- Exploring Puget Sound Beaches www.seattleaquarium.org

Sept, J. Duane. 1999. The Beachcombers Guide to Seashore Life in the Pacific Northwest. Harbour Publishing – Madeira Park, BC, ISBN 1-55017-204-2, 240 pp.

Recommended Marine Website Resources

Island County Beach Watchers: http://www.beachwatchers.wsu.edu/island/

The National Invasive Species Center: http://www.invasivespeciesinfo.gov/index.shtml

The *NatureMapping* Program: http://depts.washington.edu/natmap/

The NOAA Marine Debris Program website: http://marinedebris.noaa.gov/

The Washington Department of Fish and Wildlife Aquatic Nuisance Species: http://wdfw.wa.gov/fish/ans/index.htm

The Washington State Invasive Species Council: http://www.rco.wa.gov/invasive_species/default.htm

The Washington State Department o f Fish and Wildlife: http://wdfw.wa.gov/education/

Marine Habitats and Species Reference Guides

Dethier, M.N. 1990 A Marine and Estuarine Habitat Classification System for Washington State. Washington Natural Heritage Program, Dept. Natural Resources 55pp. Olympia, WA

Druehl, Louis D. 2000. Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast, Harbour Publishing – Madeira Park, BC, ISBN 1-55017-240-9, 190 pp.

Eschmeyer, William N., and Earl S. Herald. 1993. Peterson Field Guide to Pacific Coast Fishes, Houghton Mifflin Company – Boston, ISBN 0-395-33188-9, 336 pp.

Gotshall, Daniel W. 2005. Guide to Marine Invertbrates – Alaska to Baja California (2nd edition (Revised), Sea Challengers, Monterey CA, ISBN 0-930118-37-5, 117 pp.

Harbo, Rick M. 2003. Pacific Reef and Shore: A Photo Guide to Northwest Marine Life, Harbour Publishing – Madeira Park, BC, ISBN 1-55017-304-9, 80 pp.

Harbo, Rick M. 2997. Shells and Shellfish of the Pacific Northwest, Harbour Publishing-Madeira Park, BC, ISBN 1-55017-146-1, 270pp.

Harbo, Rick M. 1999. Whelks to Whales – Coastal Marine Life of the Pacific Northwest, Harbour Publishing – Madeira Park, BC, ISBN 1-55017-183-6, 245 pp.

Harbo, Rick M. 1995. Tidepool & Reef: Marinelife Guide to the Pacific Northwest Coast, Hancock House Publishers – Blaine, WA/Surrey, BC, ISBN 0-88839-039-4, 57 pp.

Jensen, Gregory C. 1980. Pacific Coast Crabs and Shrimps, Sea Challengers – Monterey, CA, ISBN: 0-930118-20-0, 96 pp.

Kozloff, Eugene N. 1993. Life of the Northern Pacific Coast. University of Washington Press – Seattle/London, ISBN 0-295-96084-1, 370 pp.

Lamb, Andy, and Phil Edgell. 1986. Coastal Fishes of the Pacific Northwest, Harbour Publishing – Madeira Park, BC, ISBN 0-920080-75-8, 224 pp.

Lamb, Andy, and Bernard Hanby. 2005. Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrate, Seaweeds and Selected Fishes, Harbour Publishing-Madiera Park, BC, ISBN-10 1550173618, 398pp.

Morris, Percy A. 1974. Peterson Field Guide to Pacific Coast Shells. Houghton Mifflin Company – Boston, ISBN 0-395-18322-7, 297 pp.

Murray, Steven N., Richard F. Ambrose, and Megan N. Dethier. 2006. Monitoring Rocky Shores, Berkeley: University of California Press.

Sept, J. Duane. 2009. The Beachcombers Guide to Seashore Life in the Pacific Northwest (Revised Edition). Harbour Publishing – Madeira Park, BC, ISBN 13: 9781550174533 , 223 pp.

Sheldon, Ian. 1998. Seashore of the Pacific Northwest. Lone Pine Publishing, Renton, WA; Edmonton, AB; Vancouver, BC, ISBN: 1-55105-161-3,192 pp.

Wrobel, David, and Claudia Mills.1998. Pacific Coast Pelagic Invertebrates, Sea Challengers and Monterey Bay Aquarium – Monterey, CA, ISBN 0-930118-23-5, 108 pp.

Appendix IV

Marine Educator's Reference Section

Pacific Northwest Marine Education References

Kingfisher Press specializes in Marine Education materials. Prices below may not be current but were taken from their web site when this list was created. For current information and more information about specific publications, check http://www.kingfisherpress.ca/

Or contact them at:
Kingfisher Press – Address: 31 Seagirt RoadSooke,
BC, Canada V0S 1N0
phone: 250-642-6901 and fax: 250-642-6902

Below is a partial list of some of their publications:

Pacific Coast Information Cards for Grades 5–10. G. Snively. 1998. 86 cards. $16.95 plus $1.95 shipping and handling. ORESU-E-98-001. This set of illustrated cards is designed for use with the Beach Explorations publication listed above. However, either the cards or the book can be used alone.

Beach Explorations: A Curriculum for Grades 5-10. G. Snively. 1998. 290 pp. $29.95 plus $3.50 shipping and handling. ORESU-E-98-001. This resource guide enables any teacher--beginner to expert--to help students understand basic seashore ecology.

Once Upon a Seashore. G. Snively. Length: 304 pages. Published: 2001. Price: $39.95. ISBN# 0-9687811-0-1. Audience: grades K to 6. A comprehensive illustrated curriculum that uses the seashore as a source of inspiration for integrating the subject areas; art, creative writing, drama, music, science, mathematics and social studies.

Ocean Animal Clue Cards. Length: 72 cards. Published: 2000. Price: $23.00 set. Six pack class set includes one free set: $115.00. Audience: grades K and up. Students will enjoy trying to discover the mystery plants and animals from the 72 educational clue cards.

Exploring the Seashore in British Columbia, Washington and Oregon: A Guide to Shorebirds and Intertidal Plants and Animals. G. Snively. Length: 240 pages. Published: 1978. Price: $24.95. ISBN# 0-919574-25-4. Audience: ages 12 and up. Length: 240 pages

Appendix V: Aquaria, Marine Science Centers, and Marine Laboratories

Contact/Location Info	Description
Blakely Island Field Station 1 University Drive Blakely Island, WA 98222 Seattle Pacific University http://www.spu.edu/depts/biology/blakely/	Blakely Island Field Station supports education and research in field-based environmental and physical sciences and the preservation and wise use of Blakely Island ecosystems. The field station is operated by Seattle Pacific University, and runs summer programs cooperatively with Seattle University.
Feiro Marine Life Center 315 N. Lincoln Street P.O. Box 625 Port Angeles, WA 98362 http://www.olypen.com/feirolab/	The Feiro Marine Life Center emphasizes its multi-role purpose as a public Aquarium for display of marine organisms and ecosystems, teaching lab for Peninsula College, and Port Angeles and area schools, and a center for marine studies designed to serve the needs of the public. Feiro Marine Life Center is a partnership between Peninsula College and the City of Port Angeles.
Friday Harbor Laboratories 620 University Rd Friday Harbor, WA 98250 University of Washington http://depts.washington.edu/fhl	The Friday Harbor Laboratories are located on San Juan Island. The 484-acre tract of land on which the Laboratories are sited, and the marine waters of the region in general, are biological preserves. The Laboratories also control biological preserves at False Bay and Argyle Lagoon on San Juan Island, at Point George and Cedar Rock on Shaw Island, and some other areas. These preserves provide a wide range of protected terrestrial and marine environments available for short- and long-term research projects through the University of Washington. The Friday Harbor Laboratories also offer seminars, education programs, and work locally with San Juan County schools.
Mary E. Theler Wetlands Exhibit Center PO Box 1445 22871 NE State Route 3 Belfair WA 98528 http://www.thelercenter.org/education/index.php	The Hood Canal Watershed Project is based at the Theler Wetlands Environmental Education Center in Belfair, WA. The wetlands, which are entrusted to the North Mason School District, total approximately 150 acres of diversified ecosystems located at the end point of the Puget Sound's Hood Canal. The acreage hosts a community center that offers various classes, an interpretive center that presents an in-depth look at the more technical and ecological sides of the wetlands, and a North Mason High School classroom where students have completed extraordinary projects for the benefit of the wetlands and the community.
Nisqually Reach Nature Center 4949 D'Milluhr Drive NE Olympia, WA 98412-2311 http://www.nisquallyestuary.org	The Nisqually Reach Nature Center is located on the Nisqually River delta in view of the river's headwaters on Mount Rainier. This Center has been offering estuarine environmental education at Luhr Beach since 1982. Through the years our emphasis has changed from general public outreach to our current focus on providing supplemental classroom, laboratory, and field trip opportunities for schools in the Thurston and Pierce counties area and beyond.

Aquaria, Marine Science Centers, and Marine Laboratories

Contact/Location Info	Description
Padilla Bay Research Reserve and Interpretive Center 10441 Bayview-Edison Road Mount Vernon, WA 98273-9668 http://www.padillabay.gov	The interpretive center overlooking Padilla Bay features hands-on exhibits that focus on the Padilla Bay watershed and is very popular with local students for field trips. A library open to the public offers resources for study. The Reserve is managed cooperatively by NOAA and the Washington State Department of Ecology.
Point Defiance Zoo and Aquarium In 700 acre Point Defiance Park 5400 N. Pearl Street Tacoma, WA 98407-3218 www.pdza.org	This zoo and aquarium is an intimate little place specializing in animals of the Pacific Rim. The Aquarium has a Marine Discovery Center. All the exhibits, though small in size and number, are well organized and informative. Point Defiance also has school programs, family programs, and conducts conservation research.
Port Townsend Marine Science Center Fort Worden State Park 532 Battery Way, Port Townsend WA, USA 98368 http://www.ptmsc.org/	The Port Townsend Marine Science Center is a 25-year old educational organization offering exciting, field-based experiences to students of all ages. Dedicated professional educators, assisted by interns and trained volunteers, share their passion and knowledge of the marine environment through classes, beach investigations, organized tours, residential programs, teacher workshops and summer camps. The Marine Science Center is operated by a local non-profit organization, the Port Townsend Marine Science Society. PTMSC programs are offered in cooperation with the Washington State Parks and Recreation Commission.
Poulsbo Marine Science Center 18743 Front St NE Poulsbo, WA 98370 www.poulsbomsc.org	The Poulsbo Marine Science Center is newly reopened and supported by the Marine Science Center Foundation. The main focus of the center is to educate children through various programs, and reaching into Kitsap County regional schools. The science center is also open to the public.
Seattle Aquarium 1483 Alaskan Way, Pier 59 Seattle, WA 98101 www.seattleaquarium.org	Opened in 1977, The Seattle Aquarium is a major center for marine conservation. The Seattle Aquarium has over 800,000 visitors annually, including 50,000 students each year. The Aquarium's goal is to help the public become aware of the wonders of the marine environment and understand the impact we all have on the ocean through our daily lives. This is accomplished by exhibits, school programs, special events, outreach, and conservation research.
Shannon Point Marine Center 1900 Shannon Point Road Anacortes, WA 98221 Western Washington University http://www.ac.wwu.edu/~spmc/	The Shannon Point Marine Center consists of state-of-the art educational and research facilities located on a forested 87 acre biological preserve that adjoins a 1/2 mile (1000 m) long cobble beach on Rosario Strait. The Marine Center also operates the Mosquito Pass Study Site, a 2.75-acre waterfront property located on the northwest corner of San Juan Island.

The *NatureMapping* Program
Guidelines for Beaches

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