

Coastal Biodiversity Survey Protocols

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Coastal Biodiversity Survey Protocols

Selecting an appropriate location

The ideal location to establish a comprehensive survey is on a bedrock intertidal bench that 1) is at least 30m wide, 2) gently slopes from the high to low zone, and most importantly 3) contains a representative sample of the intertidal community of the entire site. If it is not possible to find a contiguous 30m stretch of coastline, the survey can either be split between two adjacent benches or setup along a contiguous 20m stretch of coastline. When split, the survey should be divided as evenly as possible between the two benches.

Set-Up

Once an appropriate area of shoreline has been selected, it is sampled using a series of parallel transect lines extending from the high zone to the low zone. To facilitate the setup of these lines, two permanent 30m horizontal baselines (parallel to the ocean) are first established. The upper baseline is placed in the high zone above the upper limit of the organisms, while the lower baseline, which should be parallel to the upper baseline, is established farther down the shore. Depending on the amount of beach traffic or site regulations, the ends of these lines are permanently marked with either hex or carriage bolts.

Once these two baselines have been established, parallel transect lines are run down the shore every three meters along the upper base line. To insure that these lines are parallel, they should intersect the appropriate meter mark on the lower baseline. In general the transect lines are allowed to follow the contours of the bench. When necessary, rocks are placed along the lines to prevent them from being shifted by heavy winds and a note is made of where each transect crosses the lower baseline.

To facilitate resurveys of the site, a map is drawn of the site showing the location of the bolts relative to notable landmarks or other, pre-existing permanent plots, GPS coordinates are recorded, and photographs are taken. The distance and bearing between the baseline end bolts are measured. When possible, measurements are also taken between the end bolts and any pre-existing permanent plots. Other information such as the compass heading of the vertical transects, coastal orientation and the sampling interval are also recorded. A rock sample is collected for determining geology of the bench.

Point-Contact Surveys

Each vertical transect is sampled using the point intercept method. Ideally 100 points are sampled on each transect line, so the interval between points should be 20cm for a 20m long transect, and 10cm for a 10m long transect. For each point two types of data are collected: data that are used to determine relative abundance (% cover), and data that are used to describe spatial distributions. The relative abundance data are collected

by identifying all taxa that fall directly under each point, including rock, sand, and tar. If there is layering, the taxa occupying the different layers are identified and assigned a letter: A for the top layer, B for the second layer, and C for the third. (Note: For this survey, each layer must be a different taxa). If the point falls on an epibiont living on a recognized host species (Table 1), the epibiont is denoted by the letter E and the host by the letter H. [Note: Designating a species an epibiont/host does not preclude it from also being a layer. For example, if the point hits an epibiotic alga whose holdfast is not under the point, it is recorded as both a canopy (A) and as an epibiont (E). The host would be recorded as canopy (B) and host (H)]. Also recorded is whether the species under the point are found in pools, on cobble, or on boulders. A total of up to three taxa are identified under each point.

Table 1: List of recognized hosts.

Although many species are host to a few epibiotic species, for this survey only those species that offer substrate to a multitude of epibiotic species are considered hosts.

<i>Balanus crenatus</i>	<i>Jania crassa</i>
<i>Balanus glandula</i>	<i>Jania tenella</i>
<i>Balanus nubilus</i>	<i>Lithothrix aspergillum</i>
<i>Bossiella</i> spp	<i>Lottia gigantea</i>
<i>Brachidontes/Septifer</i> spp	<i>Megabalanus californicus</i>
<i>Calliarthron</i> spp	<i>Modiolus</i> spp
<i>Chthamalus</i> spp	<i>Mytilus californianus</i>
<i>Corallina</i> spp	<i>Mytilus galloprovincialis/trossulus</i>
<i>Dendropoma lituella</i>	<i>Petalocochus montereyensis</i>
<i>Dendropoma/Petalocochus</i> spp	<i>Pollicipes polymerus</i>
<i>Dodecaceria fewkesi</i>	<i>Pseudochama exogyra</i>
<i>Dodecaceria</i> spp	Sabellariidae
Encrusting coralline	<i>Semibalanus cariosus</i>
<i>Haliptylon gracile</i>	<i>Serpula vermicularis</i>

If fewer than three taxa are recorded under a point, then data are collected on the identity of the next one or two species closest to that point (Table 2). These data are used to describe the spatial distribution of species, and are not used when calculating relative abundances.

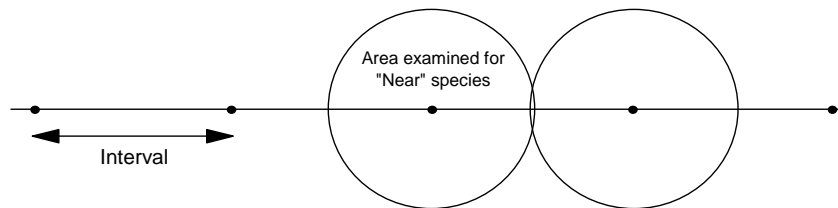
Table 2: Number of ‘nearby’ species recorded.

Taxa Recorded Under Point	Number of ‘Nearby’ Species
One taxa, (can be either an organism or bare space)	Two additional species
Two layers, with the bottom layer being bare space	Two additional species
Two layers, both of which are organisms	One additional species
Epibiont and Host	One additional species

Three layers, with the bottom layer being bare space	One additional species
Three layers, all of which are organisms	No additional species

These ‘nearby’ species must be different than those found under the point, and must fall within a circle centered over the point with a radius half the length of the sampling interval (Figure 1). Closeness is determined by location on the primary substrate. For example, if a frond of *Silvetia* is closer to the point than a barnacle, but its holdfast is farther away, the barnacle is considered the closer species. If all ‘nearby’ individuals are the same taxa as that found under the point, or there are no other ‘nearby’ species, ‘none’ is recorded. If the nearby species is an epibiont on a recognized host (Table 1), the host is denoted by the letter H and the epibiont the letter E. Again, note is made of whether these nearby species are found in pools, on cobble, or on boulders.

Figure 1: Diagram showing area examined for ‘near’ species.



Vouchers

When a species cannot be identified in the field, it is assigned an unknown number and a sample of it is collected. Samples are labeled with the date, site, name of sampler, transect line on which it is found, and the unknown number assigned to it. Samples are collected in seawater and are either immediately pressed (algae), and either desiccated or preserved in alcohol (invertebrates).

Mobile Invertebrate Quadrat Surveys

Although point-contact surveys are good at determining the abundance of spatially common species, they do not sample rare or spatially uncommon species very well. Because most mobile species are not spatially common, their abundances are determined in 50 x 50 cm quadrats placed at three locations along each transect. Each transect is first divided into three zones; the low zone is the area below the mussels, the mid-zone includes the mussels and the rockweeds (e.g. *Silvetia*, *Pelvetiopsis*), and the high zone is the area dominated by barnacles and littorines. Within each zone a quadrat is randomly placed on the transect, and all mobile species found within the quadrat are identified and counted. A random number table is used to select a number which

represents the location (in meters) along a transect line where the quadrat should be placed. When a definitive high, mid, or low biological zone does not exist, one of the following protocols is followed: (in order of preference) 1) the quadrat may be offset from the transect line in order to capture the missing zone, 2) only two quadrats are sampled on the transect. For example, on a transect where no true high zone exists: 1) the quadrat may be placed just above the upper baseline in the high zone, and “offset” is noted as the location, 2) quadrats are sampled in only the mid and low zones. Sub-sampling may be used when there are more than one hundred individuals of one species in a quadrat. If the location of a quadrat is in a deep pool or in an area dominated by sand, a new location is selected. The only mobile species not counted are worms, *Neomolgus littoralis* (red mites), and amphipods.

Swath Counts

Sea stars play an important role in the intertidal community, but often they are also not spatially common. As such, their abundances are measured along a two-meter swath centered over each vertical transect. Sites utilizing a 20m baseline also measure along a two-meter swath. Within this swath, the abundance and location along the transect (to the nearest 0.5m) of the following sea stars is recorded: *Asterina miniata*, *Dermasterius imbricata*, *Echinaster* spp, *Evasterias troschelii*, *Heliaster kubiniji*, *Henricia leviuscula*, *Pharia pyramidata*, *Pisaster ochraceus*, *Pisaster giganteus*, and *Pycnopodia helianthoides*. Sea stars measuring less than 5cm in total length are not counted. Species of *Leptasterias* are not counted in the swath counts, since these smaller stars are well represented in the quadrat surveys. Abundance and location are also recorded for individuals of *Cryptochiton stelleri*, *Haliotis cracherodii*, and *Haliotis rufescens*. The locations of any surge channels or pools that cannot be searched are also noted.

Topography

A three-dimensional map of the study area is created from topography measurements of each vertical transect line. A rotating laser leveler and a stadia rod are used to make the measurements. Ideally the laser leveler is positioned where the topography of all eleven transects can be measured. However, where this is not possible, and the laser leveler must be repositioned, it is important to make sure that several reference points are measured from both locations. This will ensure that the heights measured from the two locations will be compatible. Measurements are taken along each transect wherever there is a change in height. Thus, measurements are taken infrequently (every few meters) for gradual slopes, but more frequently (tens of centimeters) when necessary to capture the presence of smaller ridges and pools.

Modified Surveys

In some cases, biodiversity surveys will be completed using a modified set of protocols. Protocol modifications are typically made to the Point Contact Surveys only;

however a reduced number of transects may also be sampled for the other types of surveys. The type of survey completed is referenced in the data. Depending on what is desired for a specific project, there are 6 basic options for the types of modifications that can be made (Table 3).

Table 3: Survey Method Descriptions

Survey Method	Description
1) CBS standard (no modification)	CBS surveys are completed as described in the above survey protocols, with the full number of transects surveyed for all methods
2) CBS reduced	CBS surveys are completed as described in the survey protocols, with a reduced number of transects surveyed for one or more methods
3) CBS first point layering	CBS point contact surveys are modified. Only the first point is recorded at each location, but all layering and epi/host relationships on that point are also recorded. The full number of transects are surveyed for all methods.
4) CBS first point no layering	CBS point contact surveys are modified. Only the first point is recorded at each location, and layering and epi/host relationships are not recorded. If layering occurs, the top species is the organism recorded at this point, unless otherwise desired for a specific project. For example, if mussels are specifically of interest, layers over mussels may be ignored and mussels will be recorded at that point. In this case, the modification will be detailed in the project report and site notes. If epi/host relationships occur, the host species (the species attached to the substrate) is the organism recorded at this point. The full number of transects are surveyed for all methods.
5) CBS reduced first point layering	CBS point contact surveys are modified. Only the first point is recorded at each location, but all layering and epi/host relationships on that point are also recorded. A reduced number of transects are surveyed for one or more methods.
6) CBS reduced first point no layering	CBS point contact surveys are modified. Only the first point is recorded at each location, and layering and epi/host relationships are not recorded. If layering occurs, the top species is the organism recorded at this point (except if otherwise desired for a specific project as described in #4 above). If epi/host relationships occur, the host species (the species attached to the substrate) is the organism recorded at this point. A reduced number of transects are surveyed for one or more methods.

GPS Measurements

GPS measurements of latitude and longitude (WGS84) and height above mean sea level (meters above MSL GEOID03 Conus) are recorded at each permanent marker bolt. Trimble survey equipment is used, including a Zephyr antennae, ProXRT receiver, and Nomad computer running Terrasync software, all mounted upon a leveled bipod. The bipod is placed directly beside each bolt, and GPS measurements are recorded. Upon transferring the measurements to a personal computer, measurements are then post-processed using GPS Pathfinder Office software to increase precision. One bolt is selected as a “benchmark bolt,” upon which all topography measurements are to be correlated.

Stillwater Measurement

Sites that do not have GPS measurements must use a “stillwater measurement” to correlate to topography measurements. The topography measurements are converted to tidal heights (meters above MLLW) by taking a stillwater measurement (measuring sea level at low tide). Three locations are selected that are covered and uncovered by waves for equal amounts of time. The orientation of these locations should be towards the incoming tide. The height of these locations and the time the measurement was taken are recorded and later converted to actual tidal height values using a tidal table.