MARINe Data Assets and Use Guidelines

Overview

MARINe data can be categorized into two main survey types: Long-Term Monitoring (LTM) and Coastal Biodiversity Surveys (CBS). Temperature data are also collected at most MARINe sites. **In general, LTM data should be used for examining patterns in species dynamics and trends, and CBS data for examining patterns in species' abundances and distributions.** General methods for each survey type and guidelines for appropriate data use (i.e. types of questions best addressed by each data set) are described below. Detailed methods and protocol handbooks can be accessed here.

MARINe also supports two Community Science efforts 1) qualitative observations of sea stars/sea star health submitted via a webform, and 2) quantitative surveys for sea stars done by a handful of community science groups, using MARINe methods.

Most data are available for downloading from the MARINe website after filling out a brief data request form, but some MARINe partners have additional data sharing requirements (e.g., NPS data requires a separate research permit application), or share data by special request only. Links to data viewing/exploration tools and data use/citation information can be found here.

Long-Term Monitoring Surveys (annual surveys)

Long-Term Monitoring (LTM) surveys are done using permanently marked plots/transects that are typically sampled annually. All plots/transects were established in areas of highest abundance or percent cover for the species targeted by a given plot/transect. Thus, abundance/percent cover within LTM plots is NOT representative of the site as a whole, but is good for capturing changes in species dynamics and trends over time. In most cases, summary data (e.g. mean % cover, total count) are calculated using the same plots over time. However, occasional plot loss due to rock break-out or other factors means that new plots might be established and incorporated into data summaries. Plot history details can be provided by request. We have included "gaps" in the data sets to represent sampling periods when a survey would have normally been done, but wasn't for some reason (e.g., storm event, gap in funding). These gaps are useful for graphical purposes, but should be removed for data analysis.

Percent Cover Data from Photoplots and Transects

- *Methods and Data Files*

At each site, 5 fixed "photoplots" (50 × 75 cm) or 3 transects (typically 10 m long) are established within focal species assemblages, which generally form distinct bands within the intertidal zone. Replicate plots/transects are established in each assemblage in areas with high cover of a given focal species.

In photoplots, percent cover of all sessile species is quantified using a rectangular grid of 100 uniformly spaced points placed on top of each plot. At most sites, species' layering and spatial location data have been recorded since 2013, but to maintain backward-compatibility with historic data, only single layer, non-spatial data are available for downloading (layered and spatial data are available by request). Plots are photographed to create a visual archive of species present and photos are stored in a photo database (accessed by request).

For transects, a meter tape stretched between 2 permanent markers is used to sample points at evenly spaced intervals along the line (typically every 10 cm along a 10 m-long transect) to obtain percent cover data. Most transects were established to capture surfgrass (*Phyllospadix* spp.), but a handful of other species are also targeted using this method. Layering is recorded only when surfgrass occurs under another species. Surfgrass thickness measurements are taken at 10 locations along the transect and general condition is qualitatively assessed (e.g., presence of epiphytes, bleaching, etc.).

- *Data Use Guidelines*

Because plots/transects are established in areas of very high percent cover, trends for target species typically decline in the first few years of monitoring; starting from 100% cover means that cover can only remain stable or decline, not increase. Thus, when examining long-term trends for a given species, we recommend excluding the first few years of data to eliminate the initial "equilibration" period.

Count and Size Data

Large Mobile Invertebrates

- *Methods and Data Files*

Counts of large, mobile species (e.g., sea stars and abalone), and sizes for a subset of these species, are recorded within permanently marked, irregularly shaped plots established in areas of high focal species abundance. Size is measured to the nearest 10 mm. For sea stars, qualitative categories for sea star wasting disease (healthy/mild/severe) are also recorded. For abalone, nearest conspecific neighbor information is recorded. Because all intertidal species of abalone are endangered or declining, and are subject to poaching, data are only available by special request. Count and size data are also recorded for the black katy chiton, *Katharina tunicata*, and for urchins in sea star plots at most sites.

- *Data Use Guidelines*

For sea stars and abalone (and all other species counted within plots targeting these species), total counts (summed across all plots) should be used, NOT mean # per plot. This is because plots are irregular in size/shape/habitat makeup, and sometimes share borders, so they should not be treated as independent replicates.

Counts of sea stars, abalone, etc. in permanent plots are appropriate for looking at trends in #'s over time and shifts in size distributions, but not for calculating densities because the amount of "suitable habitat" contained within plots varies substantially among plots/sites. Thus, trends in #'s can be compared among sites, but not total numbers or densities.

When examining long-term *Pisaster* trends, it might be more appropriate to use counts that include only the larger individuals (e.g. > 50mm) rather than counts that include all *Pisaster* sizes to avoid false conclusions of "recovery". At some sites, substantial recruitment pulses will often be followed by significant loss within the smallest size classes, so using only the larger size classes will reveal more meaningful long-term trends.

We typically only survey sites 1 or 2x/year, so we don't have good information about the prevalence of disease (e.g. stars with wasting disease) in a population over time. Our data are better for assessing how disease might impact long-term trends in population numbers.

For urchin sampling, sample units vary widely across sites, depending on topography, urchin population size, movement, clustering, and other factors. When possible, urchins are counted/sized in 3 replicate sample units, often within already-established sea star plots. At some sites where urchins are abundant, subsampling is done using smaller sampling units. In these cases, "total" urchin counts are calculated using a multiplier to estimate the total for an entire plot.

Because of the variation in sampling methods outlined above, total numbers of urchins should only be compared over time within a site, not among sites. Counts of urchins in permanent plots are appropriate for looking at trends in #'s over time and shifts in size distributions, but not for calculating densities because the amount of "suitable habitat" contained within plots varies substantially among plots/sites. Among-site comparison of temporal trends in urchin numbers are ok.

Owl Limpets (*Lottia gigantea*)

- *Methods and Data Files*

Small permanent plots (typically five, 1 m-radius circular plots, but plot number, size, and shape vary at some sites) are used to collect count and size structure data for owl limpets. All owl limpets occurring within each plot are measured to the nearest mm. Because owl limpets are a harvested species, data are only available by special request.

- *Data Use Guidelines*

Although owl limpet plots are "standardized" in size across sites, in many cases, it is not appropriate to convert *Lottia gigantea* counts to densities for among-site comparison due to substantial variation in plot topography. Some sites have nearly flat owl limpet plots containing very few other organisms, whereas others are much more topographically complex, and/or contain mussels and other organisms that serve as 3D habitat for owl limpets. For many sites, qualitative estimates of the percent cover of mussels/gooseneck barnacles within owl limpet plots can be provided upon request.

Sea Palm (*Postelsia palmeformis*)

- *Methods and Data Files*

The sea palm is typically counted in 1 m swaths along 3 fixed transects of variable length, but transect number, size, and shape vary among sites. Because the sea palm is a harvested species that has experienced substantial decline at the southern end of its range, data are only available by special request.

- *Data Use Guidelines*

As with all most other species targeted by MARINe LTM surveys, *Postelsia* data are useful for tracking trends but not ideal for estimating site-wide abundance. Plots are established in areas of high density that can be safely and consistently sampled (*Postelsia* occurs in high wave energy areas that can be unsafe to survey).

Coastal Biodiversity Surveys (surveys done every 5-10 years)

A 30 m permanent, along-shore baseline transect is established in the very high zone (above biology) and 11 sampling transects are run at 3 m intervals from the baseline/very high zone to the low zone. Each of the four data types described below are collected along the sampling transects.

Coastal Biodiversity Surveys (CBS) capture species diversity, abundance, and distribution, particularly as they relate to site topography and tidal elevation. CBS data can be used to look at long-term shifts in individual species' distributions within and among sites. These data are also valuable for generating community metrics (e.g., diversity, evenness, stability) that are key for many ecological assessments. General methods and data types are summarized below. Please see the Biodiversity protocols handbook for more details.

Point Contact

Species occurring under approximately 100 points at evenly spaced intervals (interval length depends on length of transect) along each sampling transect are recorded, including layering. If < 3 distinct species layers occur under a given point, "nearest neighbor" species are recorded as well. Species classification is limited to what can be reliably identified in the field. For this reason, some species lumping does occur to ensure consistency across the entire region that we survey. We do, however, collect species vouchers and identify them further than the lumping allows, so in some cases (and for some species) finer species resolution is available.

Point contact data files typically include just "first point" (species recorded directly under sampling points) because these points can be converted to percent cover. "Nearest neighbor" data, which are good for providing a more comprehensive estimate of species richness, can be shared by request.

Swaths

Large mobile invertebrates (e.g. sea stars, abalone) found within a 2 m swath along each sampling transect are measured and locations along the line (to the nearest 0.5 m) are recorded. For sea stars, condition is also noted (healthy/mild/severe signs of sea star wasting). Densities for mobile invertebrates counted in swaths are calculated based on the entire biodiversity survey grid, and likely include habitat that isn't suitable for the organisms of interest (and thus will tend to be lower than other types of density surveys).

Quadrats

Smaller mobile invertebrates (e.g., snails, chitons) are counted in 0.25 m^2 quadrats that are randomly placed within the high, mid, and low zones (determined by biological community, not tidal height) along each sampling transect. Densities for mobile invertebrates counted in quadrats are calculated using the area of ALL quadrats sampled (across high, mid, and low zones), which likely includes non-suitable habitat for particular organism(s) of interest (and thus will tend to be lower than other types of density surveys). Raw data or data for a subset of zones can be shared upon request.

Topography and Tidal Height

Survey equipment is used to record elevation data along each sampling transect at intervals appropriate for adequately capturing changes in slope and topography. GPS measurements (X, Y, and Z coordinates)

are recorded for each permanent marker bolt, one of which is selected as a “benchmark bolt” that all topography measurements can be referenced to. This information can be used to relate species’ distributions to topography and tidal elevation, and to create 3-D site maps.

Temperature

Temperature loggers

At most sites, Hobo loggers record temperature data at 15-minute intervals. Because loggers are installed in locations that vary in terms of physical factors affecting temperature (e.g., shading, angle to sun, etc.), these data are best used for water temperatures, when loggers are submerged. The temperature file on the MARINe data download page contains daily mean water temperature.

Robo Mussels

At some sites, mussel mimics embedded with temperature loggers or “robo mussels”, are installed within mussel beds and provide an additional, biologically relevant, temperature data set.

Community Science

Sea Star Counts and Sizes

Community science groups use MARINe protocols to collect long-term monitoring data for sea stars at several locations. Please see methods and data use guidelines for “Count and Size Data, Large Mobile Invertebrates” in the Long-Term Monitoring section above.

Sea Star Observations

To help document the presence of various sea star species along the west coast of North America, and to track flare-ups of sea star wasting disease, observation data can be entered by researchers and members of the general public via the MARINe Sea Star Observation Log. These observations can be viewed on our Sea Star Map, and data can be downloaded from the MARINe website.

Number of MARINe sites by region and survey type.

REGION	Year of 1st Survey (LTM or CBS)	Long-Term Monitoring Sites (LTM)	Coastal Biodiversity Sites (CBS)	Mean # CBS surveys per site	Community Science Sites (sea stars)	Sites with Temperature Data
Southeast Alaska	1996	3	8	1.8	0	3
British Columbia	2003	0	6	1.5	2	0
WA Salish Sea	2008	10	0	0	23	7
WA Olympic Coast	2002	6	6	2.3	0	6
Oregon	2000	5	10	3.5	4	4
Northern California	1989	24	34	3	0	12
San Francisco Bay	1989	1	1	1	0	1
Central California	1992	36	36	3.2	1	35
Southern California	1990	24	36	3.2	0	11
N. Channel Islands	1981	20	20	2.2	0	11
S. Channel Islands	1985	12	16	3.3	0	9
Baja California, MX	2003	0	12	1.5	0	0
Gulf of California, MX	2003	0	4	1	0	0

Year of first survey is the year that the first Long-Term Monitoring or Coastal Biodiversity site was established in a region. The mean number of CBS surveys per site provides a rough idea of sampling frequency since 2000, when these surveys were first initiated. Some sites within a region might have been sampled 5 times, others only 1 time. Community science sites were established to better capture trends in sea star populations, following an outbreak of sea star wasting disease in 2013.