



Coastal Biodiversity Surveys on rocky intertidal reefs

Rocky intertidal reef habitats make up an important part of the coastal ecosystem. Learning more about the community of algae and invertebrates that live in this habitat is key to understanding their ecology and results in better management and conservation of our coastal oceans.

The Coastal Biodiversity Survey is a large-scale research project designed to measure diversity and abundance of algae and invertebrates in rocky intertidal communities on the western coast of temperate North America. This study is unprecedented in size and scale with over 90 sites ranging from Glacier Bay, Alaska to Baja California Sur, Mexico. Information from this massive survey has set a baseline of knowledge that will enable scientists to detect future ecological shifts within and among sites along much of the west coast of North America.

The goals of the project are to:

- Examine patterns of biogeography with a particular emphasis on identifying where differences in species composition and diversity occur.
- Determine the diversity and site-wide abundance of intertidal algae and invertebrate species (community composition).
- Create topographic maps for use in assessing the spatial distribution of species within each site.



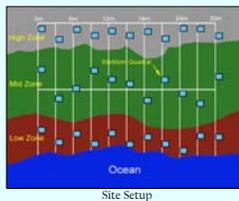
Sandhill Bluff

Here, data are presented from the entire range of sites sampled thus far, with particular emphasis on those sites within Monterey Bay National Marine Sanctuary (MBNMS). We will look at the community structure of sites in the MBNMS and at which species are dominant in those communities.

Sampling methods

Setting up a survey site

The ideal location to conduct a Coastal Biodiversity Survey is a bedrock intertidal bench that is at least 30 meters wide (along the shore) and gently sloping from the high splash zone to low areas only revealed during very low tides. A 30 meter baseline parallel to the ocean is established above the organisms in the high zone. Eleven transect lines are then laid out from the baseline to the ocean.



Site Setup



Pigeon Point

Biodiversity is measured with two sampling methods: **Point Intercept** identifies stationary algae and invertebrates and mobile invertebrate **Quadrat Counts** identify mobile invertebrates. Both methods measure relative abundance of species.

Each transect is surveyed using the **point intercept** method. At least 100 points per transect are sampled and at each point three organisms are identified. This method gathers information on species richness and is used to measure the percent cover and abundance of species. Palm pilots are used to expedite data recording and entry.

The abundances of **mobile invertebrates**, such as snails, limpets, crabs and chitons are measured using 30 x 50 cm quadrats. Three quadrats are sampled along each transect, one in each of the high, mid and low zones. Quadrats are randomly placed within each of the three zones on each transect line, resulting in 33 plots.

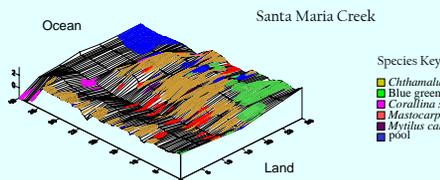
The **topography** of each survey area is measured using a rotating laser leveler and stadia pole. These data are converted to tidal height measurements and used to create topographic maps using 3D computer software. Species distributions can be overlaid to combine the biological and physical data on one map. (See example below.)



Point intercept method
Palm Lobos



Counting mobile invertebrates
Lucia



Species Key

- *Chthamalus* spp. (barnacle)
- Blue green algae (microalgae)
- *Corallina* spp. (coralline algae)
- *Mastocarpus papillatus* (red fleshy algae)
- *Mytilus californianus* (mussel)
- POC

Findings: Patterns in biogeography

Analysis of the data has revealed that the study sites group out into four distinct regions of similar species composition and abundance. (The Channel Island sites were not included in analysis.)

Region 1 (red) is made up of Southeast Alaskan sites and the northern coast of Haida Gwaii (Queen Charlotte Islands), British Columbia.

Region 2 (blue) ranges from Haida Gwaii to the San Francisco Bay.

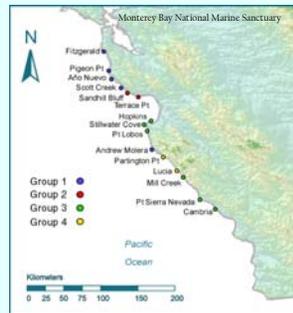
Region 3 (gold) includes the MBNMS. It ranges from San Francisco Bay to Point Conception and includes sites in Baja California Norte.

Region 4 (pink) ranges from Point Conception to San Diego.

Region 5 (green) consists of sites in Baja California Sur.



- Region 1 (red)
- Region 2 (blue)
- Region 3 (gold)
- Region 4 (pink)
- Region 5 (green)



These data show three general types of community structure:

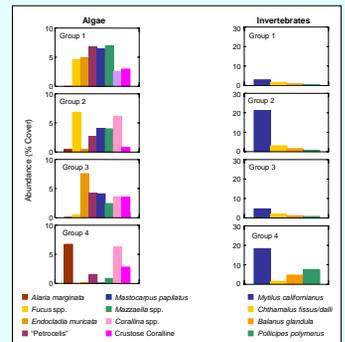
1. Algal dominated- Groups 1 and 3
2. Mussel dominated- Group 4
3. Equal abundance of algae and invertebrates- Group 2

Within the algal dominated communities, the relative contribution of algal species distinguishes group 1 from group 3. For example in group 3 *Endocladia muricata* and *Mazzaella* spp. make up a smaller percentage of cover than in group 1.

Also noteworthy is that the sites in each group do not necessarily occupy contiguous regions of the coastline. For example, Andrew Molera is separated from the other sites in group 1 by sites from group 2 and 3. Such differences may be the result of common physical characteristics of the site, such as bench slope or water temperature.

These large regions can be broken down further into groups. Sites within MBNMS fall into four groups. (See figure to the left.) These groups are defined more by differences in relative abundance of the same species than by differences in species composition.

This is illustrated in the figure below, which shows the relative abundance of eight common algal species and four common invertebrate species found in each group.



Patterns and ongoing surveys of intertidal biodiversity

Coastal biodiversity surveys have collected information on rocky intertidal community composition that illuminates four distinct biogeographic regions. In some cases, the resulting regional boundaries confirm previously known biogeographic boundaries, such as Point Conception, which is the northern/southern limit of many intertidal species along the California coast. In other cases, the results reveal previously unrecognized boundaries, such as San Francisco Bay, Monterey Bay National Marine Sanctuary falls into region 3 bound by San Francisco Bay and Point Conception.

Within the Monterey Bay National Marine Sanctuary there were four groups that had similar species composition but different abundances of those species. These differences may be driven by a number of variables including physical characteristics such as the slope of the bench and type of bedrock or environmental characteristics such as variable ocean currents, water temperatures, sand scouring, human use, or runoff. Future research may explore the relationship between physical and environmental variables and the structure of the community.

Unlike past efforts to measure biodiversity patterns, which are compromised by variations in sampling design, effort and taxonomic resolution, this survey has used the same protocol to sample all of the sites. This consistency will enable fundamental questions relating to biogeography, effects of human use, management of coastal resources and conservation at a relevant spatial scale to be addressed. Ongoing research will continue to survey these sites every four years as a long term monitoring project.



Partington Pt.

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