

Percent Cover of Algae, Invertebrates and Bottom Substrate

Overview: One of the main strengths of the long term ecological research program is that it allows us to evaluate changes in the ecological community against the background of natural long-term variability. This long-term context is particularly important when we seek to distinguish between changes caused by natural processes and those caused by human activities. SBC LTER has undertaken long-term measurements of the abundance of reef algae, invertebrates and fish within permanent transects at 11 kelp forest sites in the Santa Barbara Channel that have been converted to estimates of biomass. These data represent one of the core research activities of SBC LTER and they provide a comprehensive description of community structure and dynamics of kelp forest communities within our study region.

Study Sites: Time-series data on the abundance of ~250 species of algae, invertebrates and fish are collected each summer on replicate 40m x 2m permanent transects (n = 2 to 8 transects per site) at nine mainland (Arroyo Burro 34° 24.007' N 119° 44.663' W; Arroyo Hondo 34° 28.312' N, 120° 08.663' W; Arroyo Quemado 34° 28.127' N, 120° 07.285' W; Bulito 34° 27.533' N, 120° 20.006' W; Carpinteria 34° 23.545' N, 119° 32.628' W; Goleta Bay 34° 24.827' N, 119° 49.344' W; Isla Vista 34° 24.170' N 119° 51.472' W; Naples 34° 25.340' N 119° 57.176' W; Mohawk 34° 23.660' N, 119° 43.800' W) and two Santa Cruz Island reefs (Diablo 34° 03.518' N, 119° 45.458' W; Twin Harbors West 34° 02.664' N, 119° 42.908' W) that have historically supported giant kelp forests.

The time period of data collection varied among the 11 kelp forest sites. Sampling at Bulito, Carpinteria, and Naples began in summer 2000, sampling at the other six mainland sites (Arroyo Burro, Arroyo Hondo, Arroyo Quemado, Goleta Bay, Isla Vista, Mohawk) began in summer 2001 (transects 3, 5, 6, 7, 8 at IVEE were added in fall 2011). Data collection at the two Santa Cruz Island sites (SCTW and SCDI) began in summer 2004. All sites were sampled annually in summer to provide information on community structure, population dynamics and species change.

Methods: Uniform Point Contact (UPC) sampling is done to determine the percentage cover of algae and sessile invertebrates and different types of bottom substrate. UPC data are collected at 80 points uniformly positioned within a 1 m wide area centered along each 40 m transect (Figure 1). A diver records all organisms intersecting an imaginary vertical line passing through each point and species percent cover is determined as the fraction of points a species intercepts x 100. A species is only recorded once at a given point even if it intersects the imaginary line multiple times. Using this technique the percent cover of all species combined on a transect can exceed 100%, but the percent cover of any individual species cannot. Species are recorded from top-down as they are encountered and are entered from left to right on the datasheet in such a way that primary space holders occupy the left side of the "SP_CODE" column. Species growing attached to other organisms are not counted, except those species growing on the ornate tube worm (*Diopatra ornata*). Additionally, the substrate type under each point is recorded and if the substrate is sand, then the depth of the sand is measured to the nearest cm. Mobile organisms occurring at a sampling point are not counted and are moved so that the species and substrate beneath them can be recorded. Only the holdfast is recorded to estimate the percent cover of the kelps *Macrocystis pyrifera*, *Pterygophora californica*, *Eisenia arborea* and *Laminaria farlowii*; the blades and stipes of these species, which extend into the water column, are ignored if they

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intersected a sampling point. Unlike the sampling of algal and invertebrate density done in fixed quadrats and swaths, the number of taxa sampled by UPC is not fixed; instead all sessile species encountered are recorded. Species that are difficult to identify underwater are lumped into broader taxonomic categories (e.g., crustose coralline algae) to facilitate sampling.

Figure 1. Diagram of Uniform Point Contact Sampling showing 80 points sampled

