

## UCSB Research Explores Kelp Forest Ecology

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An interdisciplinary study of watersheds, streams, the coastal ocean, and kelp forests is underway at UC Santa Barbara. The Santa Barbara Coastal Long-term Ecological Research Program (SBC-LTER), funded by the National Science Foundation, is designed to investigate the relative importance of land and ocean processes in structuring giant kelp forest ecosystems. These ecosystems are an important resource, providing food and shelter for commercially harvested fish and kelp.

The goal of the SBC-LTER is to evaluate whether land use patterns in local watersheds influence kelp forest ecosystems through the runoff of nutrients (fertilizers), sediments, and other pollutants. To determine this, a group of ecologists, chemists, oceanographers, and geologists is comparing the levels of these pollutants in runoff from urban, agricultural, and less-developed lands. They are identifying how the pollutants are transformed as they flow downstream in rivers and creeks, measuring discharge into the ocean, and testing whether the discharge reaches and subsequently influences kelp forest communities. Watersheds in the Carpinteria Valley and the reef off shore are key focal points of the study.

Marine ecologists in the SBC-LTER have several research objectives. Research Biologist and SBC-LTER project leader Dan Reed and his graduate students are examining how nutrient inputs from the land and ocean influence the standing crop and production of giant kelp, *Macrocystis pyrifera* (Figure 1). Monthly measurements of kelp growth and nutrient concentrations in the water and in kelp tissues are collected at three reefs along the mainland coast, including Carpinteria.

SBC-LTER scientists are also using data on kelp biomass dating back to 1958 taken along the southern California coast by the kelp harvesting industry to analyze historical trends in kelp distribution and abundance. The long term population dynamics of over 150 species of kelp forest algae, invertebrates and fish are also being followed in permanent study sites at nine different rocky reefs, from Bulito Reef near Gaviota to Carpinteria Reef in the eastern end of the Santa Barbara Channel, and at 11 reef sites on Santa Cruz Island.

The kelp forest ecologists are working with SBC-LTER oceanographers, to determine how nutrients and sediments are transported and where they end up, and the ecological effects of these inputs to kelp forests. To understand the transport of inputs, the oceanographers are charting circulation patterns in the Santa Barbara Channel using land-based radar, satellite imagery, moored instruments, and monthly water sampling. Research cruises on the RV Point Sur measure seawater conditions, current speed and direction, and the chemical composition of coastal ocean water.

Results so far indicate that current patterns near the shore in the Santa Barbara Channel are far more complex than scientists originally expected. Whether runoff from land delivers enough sediment and pollutants to influence kelp forest communities is still under investigation. Sediments can bury young small stages of kelp, as well as alter the physical structure of the habitat so that it is better suited for other plants and animals. Pollutants, including various pesticides, metals, and petroleum products in runoff from city streets can harm marine organisms, but whether they significantly affect kelp forest species has yet to be determined.

SBC-LTER ecologists are monitoring long term changes in kelp forest communities and food webs. Kelp forest communities are composed of many algal, invertebrate, and fish species, as well as seabirds, seals, and sea otters. The species composition of kelp forest communities changes dramatically through time depending on the concentration of nutrients that control kelp growth, the abundance and behavior of sea urchin grazers, and the severity of storms that remove kelp plants, especially during El Nino events. Carpinteria Reef is an excellent example of these multiple processes in action. Using a series of field experiments, these ecologists are examining the dynamic processes that characterize kelp forest food webs.

Results obtained from SBC-LTER research should generate a better understanding of how oceanographic processes and land-based inputs from runoff influence kelp forest dynamics. This information will be useful in improving coastal resource management in the Santa Barbara Channel and elsewhere.

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Photo Captions:

Figure 1: Forests of giant kelp, *Macrocystis pyrifera*.

Figure 2: Garibaldi and purple sea urchins grazing in a giant kelp forest.