

# UC San Diego

## Research Summaries

### Title

Ghost Forests in the Sea: The Use of Marine Protected Areas to Restore Biodiversity to Kelp Forest Ecosystems in Southern California

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## Ghost Forests in the Sea: The Use of Marine Protected Areas to Restore Biodiversity to Kelp Forest Ecosystems in Southern California

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### Background

Just past the breaking surf of Southern California, there are places where the ocean surface becomes smoother and darker than surrounding waters. These dark, glassy patches are the canopies of the local kelp forest.

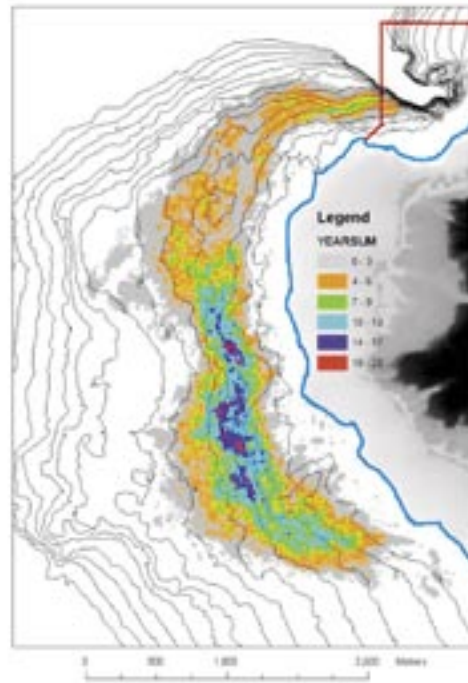
Fifty years ago, these kelp forests, arguably one of the richest marine ecosystems on the planet, were home to a remarkable number of large fish and invertebrates. Four-hundred pound black sea bass, 100-pound groupers, 20-pound lobsters swam through the kelp's towering fronds, sometimes in great numbers.

The absence of once common marine organisms, especially the scarcity of the largest ones, has prompted marine scientists Paul Dayton and Ed Parnell of Scripps Institution of Oceanography (SIO) and others to describe Southern California's kelp forest as a veritable "ghost forest." Their interest in reversing the trend toward greater depletion of these habitats has led them to study the use of marine protected areas as a tool for restoring marine biodiversity.

### Ghost Forest Project

California Sea Grant funded Dayton and colleagues for a set of recommendations on how to best design a reserve in the La Jolla kelp forest. These recommendations, the scientists say, serve as a framework applicable to other kelp forests in California. The research findings are also directly applicable to the Marine Life Protection Act of 1999, which requires the state to consider establishing a comprehensive network of no-take marine reserves.

The La Jolla kelp forest was selected as a study site for this Sea Grant project for a number of reasons, some of which boil down to practicality. This



(Left) The boundaries of the San Diego/La Jolla Ecological Reserve are shown upper right in red, and the shoreline in blue. Kelp persistence from 1967–99 is denoted by the colored boxes. The color pertains to the number of years kelp was observed at that site. Data courtesy Larry Deysher, Ocean Imaging, Inc. (Below) Sea perch swimming in the kelp forest. Photo: Eric Hanauer



kelp forest (approximately 8 km long and 1.5 km wide) encompasses a variety of kelp habitats and is subject to a variety of user conflicts and societal needs. In addition, its northern edge sits within one of the state's oldest no-take marine reserves, the San Diego-La Jolla Ecological Reserve, located in and around La Jolla Cove, just south of SIO. Although only about one percent of the kelp forest is protected from all forms of fishing, the reserve nonetheless offers a rare chance to compare species abundance, diversity and sizes of key organisms within and outside of a protected area. Its proximity to SIO has the added benefit of making fieldwork logistically easier.

### Method

Some focal points of the field, statistical and socioeconomic research are outlined below. The scientists:

1) Completed comprehensive diver surveys of algae, invertebrates and

fishes throughout the kelp forest. Separate surveys were conducted for green abalone, sea urchins and rockfish.

2) Conducted multivariate analyses of survey data to ensure comparisons of marine life were statistically significant.

3) Mapped important habitats for harvestable gastropods, urchins and other animals.

4) Held discussion sessions with commercial sea urchin divers, recreational spear fishers, kayakers and other stakeholders to learn what areas of the kelp forest they utilize and to solicit their help in monitoring these areas.

5) Began establishing a program in which about 100 volunteer divers were taught how to survey sites. This was part of a broader goal of educating the public about the vulnerability of marine ecosystems to human activity and the importance of protecting and preserving these habitats.

6) Worked with an anthropologist at

UC San Diego to design a survey of 250 people stratified into five groups (beachgoers within the reserve, the general public, fishermen, divers/snorkelers and kayakers). Their opinions were gathered on marine reserves and their knowledge of the ecological reserve in La Jolla.

7) Continued collecting historical notes and archived biological data to better understand what kelp forests were once like and the history of their depletion.

## Findings

- There were no significant differences in the sizes of sheephead (male and female), kelp bass or sand bass within and outside the reserve.

- Red urchins inside the reserve were significantly larger than those outside it. This was not observed for purple urchins. (Unlike red urchins, purple urchins are not commercially harvested.)

- In areas of similar habitat structure, there were more green abalones within the reserve.

- There were also more vermilion rockfish inside the reserve, and these individuals were larger than those observed outside the reserve.

- Surveys of local residents revealed that there is overwhelming public support for marine reserves (more than 90 percent of people polled were in favor of them). Most surveyed believe there is more total area set aside than is the case. There was also a general lack of knowledge about the rules and boundaries of the San Diego-La Jolla Ecological Reserve.

- Although the public supports the idea of protecting marine life, efforts to equip recreational divers with sampling equipment (transect reels, meter sticks and slates) and to then teach them the skills needed to collect marine data were met with limited success. Of the 100 divers trained, only about 18 were willing to put in enough time and labor to help in the collection of scientifically significant survey data.

## Recommendations

Based on available scientific data and a variety of socioeconomic pressures, the scientists recommend placing a marine reserve in the southern half of the kelp forest between Law Street in Pacific Beach and Windansea Beach in La Jolla. This, they say, is the most biologically diverse area and the area with the most persistent kelp habitat (i.e., it is less impacted by El Niño events than other areas).

Some of the details of the suggested reserve design are beyond the scope here, but one recommendation is to extend part of the reserve to the edge of state waters (3 miles from shore). This, they reported, would provide protection for spiny lobsters, which migrate offshore in winter. A wider reserve would also benefit other animals whose home ranges are relatively small but yet larger than the current reserve.

Political and socioeconomic considerations also suggested establishing a reserve in the south, as urchin divers believe that the best urchin recruitment occurs in the northern portion of the bed. This northern portion is also very popular with kayakers, recreational divers and boaters.

The biologists also urge the establishment of a reserve in the southern Channel Islands that is sufficiently large and situated so as to be effective at its conservation goals. Kelp forests in these areas are less impacted by coastal runoff and pollution than those on the mainland and hence they provide a rare opportunity to protect healthier ecosystems from fishing.

## Trainees

Cynthia Catton  
Tonya Huff

## Publications

Parnell, P.E. 2003. Patterns of habitat and abundance in the La Jolla Kelp Forest. *Southern Calif. Acad. Sci.* 102(S2):38.  
Parnell, P.E., C.E. Lennert-Cody, K.E. White-side, L.D. Stanley, L. Geelen, M. Tegner,



Dr. Paul Dayton. Photo: Scripps Institution of Oceanography

and P.K. Dayton. Establishment and effectiveness of a small marine park. *Mar. Ecol. Prog. Ser.* In press.  
Parnell, P.E., P.K. Dayton, C.E. Lennert-Cody, and L. Rasmussen. Marine reserve design: Optimal size, fine-scale habitats, species affinities, diversity, and ocean microclimate. In review.

## Presentations

Parnell, P.E. 2004. The La Jolla Kelp Bed and Reserve: "In the Footsteps of Connie Limbaugh, Jay Quast, Wheeler North, and Jimmy Stewart", Ecology Seminar, Scripps Institution of Oceanography, La Jolla.  
Parnell, P.E. 2004. "Recommendations for a Reserve in La Jolla Based on Patterns of Habitat, Diversity, and Oceanographic Climate", Southern California Academy of Sciences, Rocky Reef Symposium, California State University, Long Beach.  
Parnell, P.E., P.K. Dayton, and C. Lennert-Cody. 2005. "Marine Reserve Design: Determining an Optimal Size and Location", Southern California Academy of Sciences, Rocky Reef Symposium, Loyola Marymount University, Los Angeles.

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