Collecting 25 years of data from the kelp forests of Channel Islands

Some of the world's largest kelp forests encircle the islands of Channel Islands National Park, which was established in 1980 to preserve self-sustaining examples of coastal ecosystems in southern California. These extensive kelp forests can stretch up to 200 feet (60 m) from their anchors on the seafloor to the surface, providing a vertical infrastructure that is home to more than 1,000 species of plants and animals (see photo).

In 1981 the National Park Service instituted a "vital signs" monitoring program to inform, guide, and evaluate stewardship of the park. In order to measure change over time, managers established fixed monitoring sites, which are physically marked and geo-referenced to ensure that sampling occurs in precisely the same places every year. Nine of the original kelp-forest monitoring sites have giant kelp (*Macrocystis pyrifera*) forests, one site is in a state of transition possibly to a kelp forest, and echinoderms dominate the remaining six sites. Of these six sites, purple sea urchins (*Strongylocentrotus purpuratus*) dominate two of them; purple and red sea urchins (*S. franciscanus*) dominate two; spiny brittle stars (*Ophiothrix spiculata*) dominate one; and spiny brittle stars and red sea urchins dominate one.

Managers selected the monitoring sites on the basis of physical setting and biogeographical zone. With respect to physical setting, kelp forests north of the islands are exposed to winter storm waves from the Gulf of Alaska, while those on the southern shores are protected from winter storms. Southern coast kelp forests are exposed to large summer swells generated from winter storms in the Southern Hemisphere and nourished by seasonal upwelling from adjacent oceanic basins (Davis 2005). These different physical settings create three large biogeographical zones, which are defined by warmer and cooler water masses that bathe the islands. Managers established a total of 16 monitoring sites that punctuate these zones, including sites for comparing fished with unfished kelp forests. The California Department of Fish and Game owns and manages the marine resources out to 3 miles (5 km) from the park's boundary. In 2003 the State of California created a network of marine protected areas around the Channel Islands, closing off about 20% of park waters to fishing.

Generally speaking to monitor the 16 sites, divers perform 750 dives with 625 hours of bottom time during a typical field season (June through October) (David Kushner, Channel Islands National Park, written communication, October 2005). In addition to NPS and volunteer divers, the California Department of Fish and Game and Channel Islands National Marine Sanctuary provide

Pacific jack mackerel in kelp forest at Channel Islands National Park, California.

trained divers to aid in data collection. In 2005 the park's kelp-forest monitoring program added an additional 16 monitoring sites, effectively doubling the monitoring program. In order to evaluate the effectiveness of the marine protected areas, managers strategically placed these new sites inside and adjacent to four of the marine protected areas.

The kelp forest monitoring program has now accumulated 25 years (1982–2006) of data, which includes population dynamics of 69 taxa of algae, fish, and invertebrates. Mangers used information collected in conjunction with the kelp-forest monitoring program to support the implementation of new marine reserves at Channel Islands National Park and the closure of the abalone fishery in southern California. The monitoring program has provided some of the only fishery-independent data on species such as abalones, sea urchins, and sea cucumbers (Channel Islands National Park, Kelp Forest Monitoring Program Summary, 2005). According to Davis (2005), data from Channel Islands has helped to change fishery management strategies, develop and evaluate population and ecosystem restoration methodologies, and recognize and demonstrate unsustainable uses.

In addition, researchers find the data set useful because it is relatively long term and covers a wide range of conditions with several major El Niño events, consists of a diverse number of sites (i.e., 16 fished and un-fished sites on five islands), and is biologically comprehensive (i.e., includes data on fish, invertebrates, and algae) (Dan Reed, University of California–Santa Barbara, written communication, September 2005). Researchers have used the data set to examine the spatial variability in species assemblages (Reed et al. 2000); document the management of sustainable fisheries (Schroeter et al. 2001); aid in the restoration of white, pink, and green abalone (Rogers-Bennet et al. 2002); evaluate habitat of the endangered white abalone (Lafferty 2003); determine that fishing for lobsters indirectly increases epidemics in sea urchins (Lafferty 2004); and investigate how rocky reefs change over time, transitioning between kelp forests and urchin barrens (Lafferty and Behrens 2005).

According to Davis (2005), the vital signs program at Channel Islands National Park has endured "because it proved to be a cost-effective way to reduce uncertainty [in management decisions] and increase success of conservation efforts." Furthermore, Kate Faulkner, chief of Resource Management at Channel Islands National Park, attests that the dataset supports research that "highlights the importance of both long-term monitoring and un-fished marine protected areas in gaining understanding of marine ecosystem dynamics."

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