Foundations of Marine Reserves in the California Channel Islands

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Channel Islands National Park, off the coast of Southern California, includes the waters one nautical mile around each of the five islands. Overlapping designations for these waters include Channel Islands National Marine Sanctuary, International Biosphere Reserve, and Areas of Special Biological Significance (ASBS). Many people see these layers of special names (park, sanctuary, reserve) and assume that the marine life is fully protected. In fact the National Park has no management authority over the marine life, the National Marine Sanctuary protects the habitat with prohibitions to mining and hydrocarbon development, the Biosphere Reserve goals are "to promote and demonstrate a balanced relationship between humans and the biosphere," and ASBS regulations protect water quality. Until 2003, with the creation of State Marine Reserves and Conservation Areas that prohibit or limit exploitation of marine life in about 20% of those waters, only one small area, the Anacapa Ecological Reserve, fully protected the fish and invertebrates in the area.

The islands lie at an area of mixing cold and warm water currents, which creates a strong regional temperature gradient, representing the environmental conditions of a large portion of the California coast within an area of less than 100 km. This environmental gradient results in a highly diverse and productive marine ecosystem. California Department of Fish and Game (CDFG) landings data show that nearly 20% of the state's overall fish landings come from the park and sanctuary waters. However, the park islands only constitute about 5% of the total California coastline. The marine resources are owned and managed by the state.

When the park was created in 1980, Congress mandated that the National Park Service report on the condition of the resources of the new park. Gary Davis and others established a long-term marine monitoring program, including the monitoring of kelp forest, rocky intertidal, and sand beach communities. Since the state owns and manages the marine resources, CDFG scientists were brought in early to collaborate in the design of the marine monitoring program. Their experience and local area knowledge were especially valuable in the early phases. We also worked closely with research and monitoring programs from other partners, such as Minerals Management Service, National Marine Fisheries Service, various universities, and local governments.

So why monitor park resources, and spend money and time to determine the condition of these resources? They are already 'protected' in many people's minds. As mentioned above, people often make the assumptions about protections and are surprised to learn that the National Park and National Marine Sanctuary only play an advisory role for management of marine life. Unfortunately, habitat and population fragmentation, unsustainable exploitation, invasion by alien species, and pollution threaten the integrity of park ecosystems across the nation. Marine ecosystems are no different. Park managers must convince others to protect and preserve parks, and the required collaboration requires factual information about ecosystem health. The NPS understands that knowledge is necessary for proper management.

An example of the importance of long term monitoring information is provided by the example of the Anacapa Ecological Reserve. What we learned about this reserve laid the foundations of the network of Marine Protected Areas that is now in place at the islands.

Soon after beginning the kelp forest monitoring, Southern California was affected by largest El Niño on record, in 1983. Warm water events such as this cause great disruption in the marine environment. As much as 80% of the region's kelp beds disappeared. Beyond the immediate effects of the storms and warm water, this El Niño event brought to light many of the issues that had been brewing for years. Decades of unsustainable fishing, the dumping of pollutants, and the spread of alien species and disease had destabilized the Southern California marine ecosystem.

By the 1980s, after becoming one of the most popular seafood items in the area, rockfish were recognized as being severely depleted. Boccacio and cow cod populations declined to about 5% of the un-fished population. Large closures for cow cod were established in Southern California in 2001, restricting both commercial and sport fishing.

All abalone take in Southern California was banned in 1997 as most species were severely depleted by fishing and disease. Two abalone species are now listed as endangered, and other species were viewed with concern.

Giant seabass are large groupers that can reach a size of two meters, and over 200 kg. Nearly wiped out by over-fishing, the species has been recovering since being protected in 1978. Recovery was given an additional boost with the ban on gillnets in nearshore waters. As word of their recovery spread, divers started going to the islands just to observe and photograph these giant fish. This was significant, because fish were finally being seen as having value as a non-consumptive commodity.

At the same time, other resource conflicts were appearing faster than management could deal with them. New fisheries began impacting species once thought undesirable, such as hagfish or sea cucumbers. Often fisheries were already in collapse before any management actions were taken. Ecological conflicts arose, such as the potential impacts on seabird populations caused by squid fishing. Several boats will work together in this fishery to attract squid to the surface with up to 50,000 watts of light. We became concerned that the fleet fishing immediately below colonies of nocturnal nesting seabirds at Santa Barbara and Anacapa Islands could cause disorientation, and expose the birds to predation.

These are examples of events that changed public and agency views of marine management. By the 1990s, environmental groups and the ocean-going public, dissatisfied with ocean management, began to demand action. In 1992, the gill-net issue was taken to a public vote. Policy makers and scientists were pushed aside by emotions and advertising campaigns. This act also set up the creation of several highly contested marine reserves along the coast that resulted in poorly planned sites. These situations were a wake up call for many managers.

In 1998, a group of recreational fishermen, unhappy with the declines in catches that they had observed over the years, proposed that marine reserves be established at the islands to protect 20% of the islands. The Channel Islands National Marine Sanctuary, with the California Department of Fish and Game, spearheaded a community-based plan to design a network of marine reserves at the islands. Thus the Marine Reserve Working Group (MRWG) was formed, consisting of 22 stakeholder groups from involved members of the public, government agencies, fisheries representatives, and conservation groups. Science and socio-economic panels provided information and professional review (Davis 2005). Even with a few irreconcilable objections, in the end it was a collaborative effort which would not have been possible without the local knowledge of biologists and fishermen, the determination of local citizens, and the combined resources of different agencies.

Support for the reserve proposal was spawned from monitoring data that showed the benefits of a small no-take marine reserve that had been established at East Anacapa Island in 1978. The Anacapa Ecological Reserve was only 15 hectares, but showed remarkable differences in diversity and abundance when compared to nearby kelp forest sites. Two of the kelp forest monitoring sites are within the reserve area, and kelp forest monitoring data made it possible to convince managers and the public that the reserve had a positive effect on the marine environment. Divers could see the value, but anecdotal descriptions do not carry as much weight as factual data.

Fishing industry lobbyists often identify pollution, not fishing, as the cause of declines in abalone and urchin populations. Southern California coastal waters are not pristine. Pesticides, including DDT, were dumped off the coast of Southern California for decades. Storm drains, agricultural runoff, and over a billion gallons of sewage enter the southern California Bight daily. Nevertheless, the waters of the Anacapa Reserve are equally polluted, if not more polluted, than other parts of the park more distant from mainland sources of contamination. We were able to demonstrate that abalone and urchin populations in the Anacapa Reserve remained at healthy levels, while adjacent fished populations declined (Figure 1). Scientists and managers could see that having an un-fished area available as a control allows detection and measurement of the combined effects of pollution, climate change, and fishing.

The effects of fishing may seem obvious, but the cascade of indirect effects from resource exploitation may not be so noticeable. When purple sea urchins were released from competition with abalone and red sea urchins in the fished parts of the park, their densities jumped from a few thousand per hectare to hundreds of thousands per hectare (Figure 2). Disease now appears to be the major limiting factor on purple sea urchins in these areas (Behrens and Lafferty 2004). These high densities of purple urchins graze virtually all kelps, and physically exclude other species, creating vast areas known by divers as 'urchin barrens.'The beneficial effects of reserves seem clear. Inside the reserve, where competition and predation keep the population in check, purple sea urchin densities remained consistently lower, showing only minor, temporary increases following El Niño events. Here, giant kelp recovers quickly (1–2 years) after El Niño events, providing primary production of food and shelter among its fronds. The physical structure of kelp slows currents, creates eddies that entrain passing larvae, and enhances local recruitment of other organisms.

We know from past studies that predator-prey interactions can lead to changes at many levels of the food web. In kelp forests, one of the key dynamics is between kelp, urchins, and

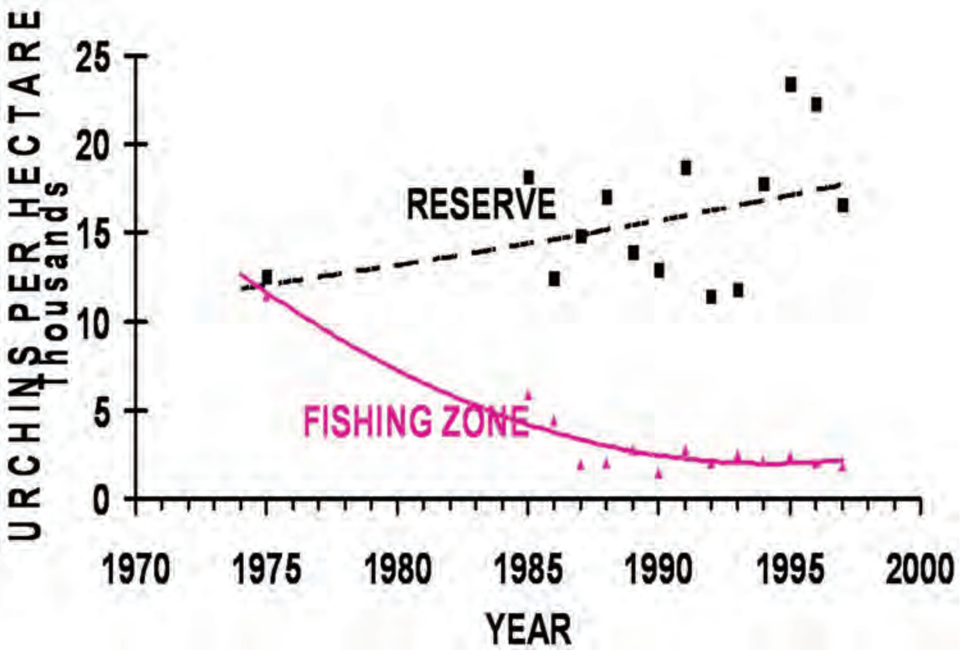

Figure 1. Large red sea urchins (>83 mm), *Strongylocentrotus franciscanus,* declined in fished areas, but the population remained stable inside the Anacapa reserve (relative to 1974 data from NSF study of feasibility of red sea urchin fishery, number of urchins >105 mm).

urchin predators. In places where sea urchin predators are rare, sea urchins, when starved of drift algae, will leave the safety of their crevices and denude whole kelp forests, holding them in that state until some disturbance reduces the urchin population. However, in places where urchin predators like lobsters are common, such as the Anacapa Ecological Reserve, urchin densities are maintained at normal levels and kelp can flourish (Lafferty 2004). Sheephead have a similar impact on sea urchin numbers. They were found to feed on purple urchins, not the commercially valuable red urchins.

Our kelp forest monitoring data was the only fishery-independent data available for evaluation of reserve effects. In the Anacapa Reserve, we could demonstrate that the problems in the kelp forest community of Southern California were moderated within the reserve compared with fished areas. Because of the monitoring program, we could demonstrate the value of no harvest areas. When the Marine Reserve Working Group was formed, evidence from previous monitoring was important in convincing fishermen to set aside nearly 20% of the island waters for protection. Having a monitoring program in place was also important in convincing fishermen that management attention would continue, and that results would be tested and evaluated. One of the biggest fears of fishermen was that the reserves would be set aside, simply locked up and forgotten. Fishermen feared they would lose valuable fishing grounds with no way to prove or disprove the value of reserves.

After three years, a plan was developed by the Marine Reserve Working Group that everyone could live with (though enthusiasm varied among groups). The California Fish and

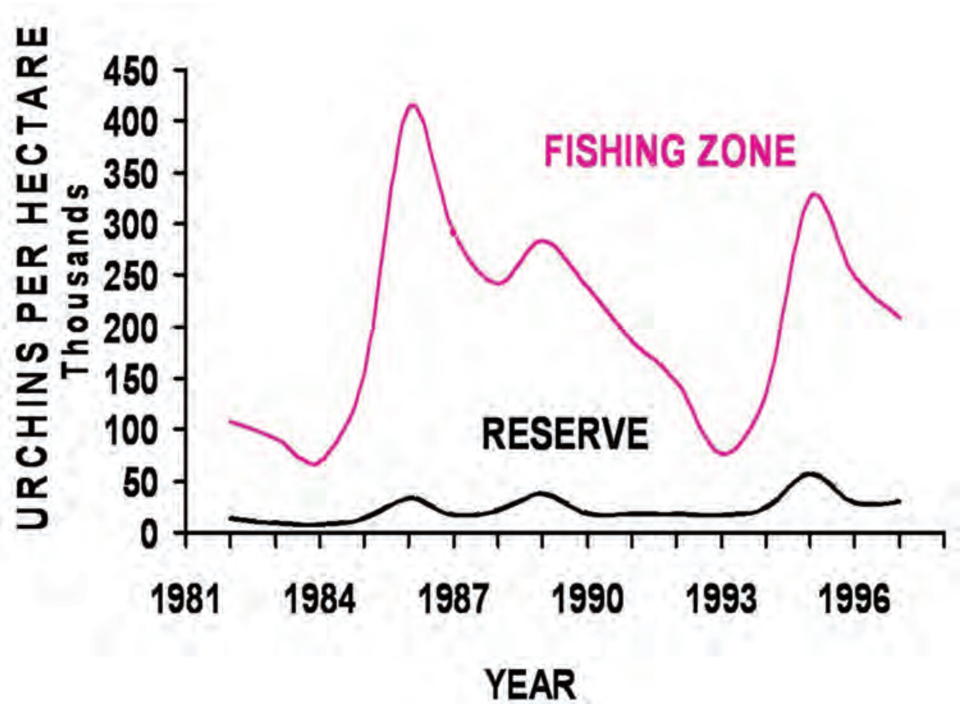

Figure 2. Purple sea urchins, *Strongylocentrotus purpuratus,* underwent dramatic population fluctuations in fished areas. Inside the Anacapa reserve, purple sea urchin numbers remained stable in the presence of predator and competitor populations.

Game Commission adopted the plan, and the reserve network went into effect in April, 2003, placing approximately 20% of the park waters into Marine Protected Areas. The reserves were extended into federal waters in the summer of 2007. The network now encompasses 318 square miles, making it the largest reserve network in the continental United States. The Anacapa Ecological Reserve is incorproated into the much larger Anacapa Island State Marine Reserve. Currently the Marine Life Protection Act initiative is underway to try to establish a network of reserves throughout Southern California. There are about 70 stakeholders involved, and the issues are very complex.

Five years after the establishment of the reserves, a review conducted by the National Center for Ecological Analysis and Synthesis analyzed data from the kelp forest monitoring and other programs (Aireme and Ugoretz 2008). No one expected to see much from the first five years, but surprisingly there were strong positive trends supporting predicted changes in the reserves. Analysis showed that there are strong differences in community structure within the parts of the Anacapa Reserve protected since 1978. It also appears that the new reserve is starting to resemble the old reserve.

Results show there are more and bigger fish in reserves. Older reserves had twice the biomass of new reserves. Reserves are characterized by high abundances of lobsters, turban snails, and sponges. Non-reserves tend to have high abundances of purple urchins, sunflower stars (which are purple urchin predators), and Kellet's whelk. Targeted fishery species tend to be larger in reserves. This is important because larger fish produce more eggs.

In summary, through a well designed and consistent monitoring program with a lot of collaboration, we were able to show the value of a small protected area, and change the way we look at and manage marine resources in California.

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