

Changes in kelp forest habitats in and around the Channel Islands Marine Protected Areas

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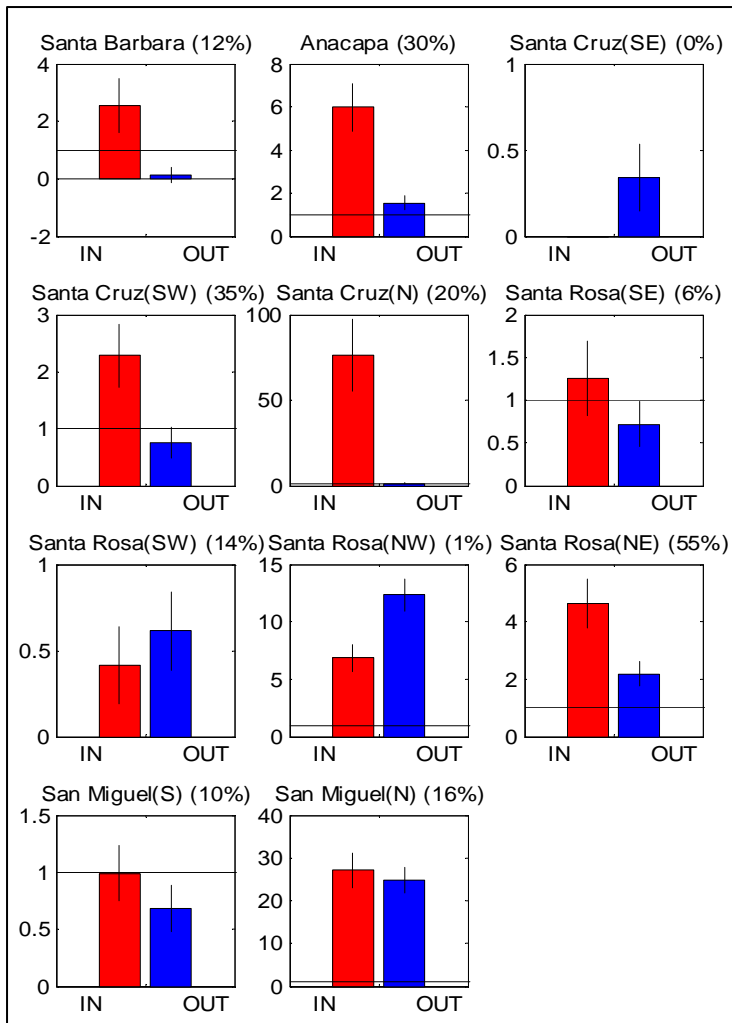
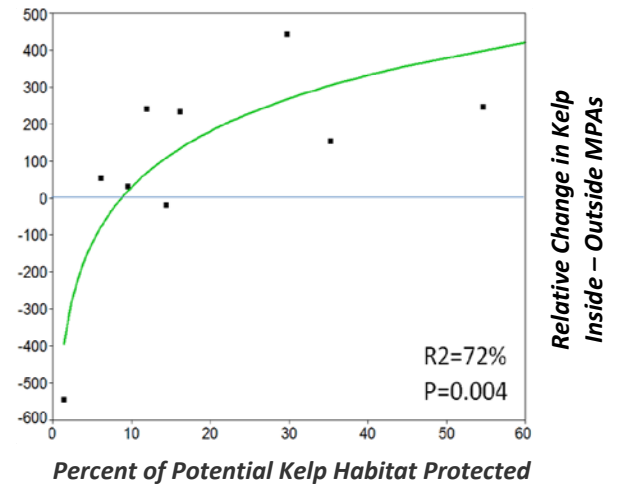
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Giant kelp (*Macrocystis pyrifera*) forms extensive underwater forests in Southern California, providing both food and habitat for many commercially and recreationally important species. Kelp forests form conspicuous floating canopies at the surface making them amenable to aerial mapping. Here, the abundance and extent of kelp forests inside and outside of protected areas at the northern Channel Islands is assessed using historical aerial surveys, infrared aerial photography, and recent advances in satellite remote sensing.

KEY POINTS

- Kelp forests are highly variable habitats in space and time
 - Potential for rapid response to protection, but detection of change is hard
- Kelp forests have increased in distribution, abundance, and persistence since establishment of the CINMS MPAs
 - Some of this is due to large-scale change in ocean climate (unrelated to reserves)
 - Evidence suggests an additional effect of reserves, which varies with the percent of potential kelp habitat protected (→)
- Frequent surveys of kelp habitats are necessary to detect changes inside and outside MPAs against a background of variable ocean conditions.

Increases in Kelp Were Greater Inside Reserves That Included More Potential Kelp Habitat



(←) Shown here, the abundance of giant kelp changed **INSIDE** (red) and **OUTSIDE** (blue) the Channel Islands marine protected areas (MPAs) following reserve establishment.

The response of kelp to MPAs was evaluated by comparing aerial survey measurements of kelp canopies from the period after reserve establishment (2003-2007) to the period immediately before reserve enforcement began (1999-2003), using the *relative change in kelp abundance*. The relative change in kelp is the difference between average kelp biomass (weight) in the 5-year period after reserve establishment and average biomass in the 5-year period immediately **before** establishment, divided by the **before** value. The relative change in kelp abundance is calculated separately for the portion of each California Dept. of Fish & Game-designated kelp bed that lies outside MPAs (OUT, blue) and for the portion that lies within MPA borders (IN, red). A relative change of 1.0 indicates a doubling (100% increase) in kelp from before to after reserve designation. Negative values of the relative change represent a decrease in kelp from before to after (e.g., -0.5 means a 50% decrease). If protection enhances the stability or growth of kelp forests, then relative changes inside reserves are expected to be greater than those outside reserves.

Two important results are evident from this graphic: first, kelp increased substantially both inside and outside reserves. Second, kelp tended to increase more inside of reserves than outside, with several notable exceptions (e.g., the northwest side of Santa Rosa Island).