California Marine Life Protection Act Initiative
Draft Methods Used to Evaluate Marine Protected Area Proposals in the MLPA South Coast Study Region
ADDITIONS TO Chapter 3 – Protection Levels (proposed concepts for designing an MPA network for adaptive management)

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Designing MPA networks for adaptive management

Because of the short history of marine protected areas (MPAs) along the west coast of North America, there is some uncertainty in how design aspects of individual MPAs (e.g., size, shape, allowed activities) and a network of MPAs (e.g., spacing, replication) will translate into individual MPA, and overall network performance. The number and diversity of MPAs created by the MLPA, and replication of design aspects across the network, provide managers with an unprecedented opportunity to assess how MPAs perform in meeting their identified objectives and to consider refinements to MPA design to better meet objectives.

If developing an MPA network includes designs for comparing design criteria, such as replication of different sizes or allowed activities, then scientists, managers and stakeholders can consider possible refinements of the design of individual MPAs and their networks. This approach, referred to as adaptive management, is the hallmark of informed evolution of a management approach. The SAT endorses incorporating this approach with designs based upon our current best understanding of design criteria. An adaptive management approach is one in which ecosystems (e.g., kelp forests) and levels of design criteria (e.g., different MPA sizes, different habitat sizes, different allowed activities) are replicated to allow comparison of the average response of selected variables of an ecosystem (e.g., the size and size structure of populations, species richness, productivity, resiliency) to the different levels of the design criterion.

One example that could be fruitful in the MLPA South Coast Study Region is assessment of the relative effects of human take of sea urchins in shallow kelp forests on a number of ecosystem variables directly related to the goals of the MLPA. The red sea urchin, *Strongylocentrotus franciscanus*, has been shown repeatedly to deforest large areas of shallow rocky reefs. To the extent that human harvest of red sea urchins can prevent deforestation of kelp forests, urchin harvest may protect or enhance the many functional roles of algae, their productivity and diversity of species associated with algal habitats. On the other hand, many examples of urchin outbreaks and deforestation occur in regions where their natural predators have been heavily fished, often depleted, such that the role of urchin harvest could be compensated by protection of the other predators of sea urchins (California sheephead, lobsters, seastars, and others). Moreover, human harvest and these other predators may compete with one another for sea urchins, such that human harvest can diminish protection for these other species identified for protection within MPAs. Thus, there is substantial uncertainty in the ecosystem-wide consequences of urchin harvest.

An example of MPAs designed for assessing the relative effects of urchin harvest and other urchin predators on a variety of ecosystem variables would include replicate states of each of the following four conditions:

	Take of Urchins	**No-Take of Urchins**
Take of urchin predators	Non-MPA	SMCA that allows the take of urchin predators but not urchins
No-take of urchin predators	SMCA that allows only the take of urchins, not their predators	SMR

Comparison of the average response of ecosystem variables (e.g., kelp abundance, productivity, resilience, abundance and larval production of urchin predators) among these four states would allow managers to better understand the ecosystem-wide consequences of human take of red sea urchins and their predators. This, or similar designs, could be applied to many aspects of MPA design including other fishing activities (species or gears), or MPA size. Alternatively, regression approaches that test for significant directional responses across a gradient in a design criterion (e.g., over a span of MPA or habitat sizes) or coupled with additional criteria (allowed take) can be used to assess the interactive effects of two variables (in an analysis of covariance). Multivariate responses (e.g., the relative abundance of species in a fish assemblage) can be used as response variables in any of these designs.