The Science of Marine Protected Areas
California Ocean Communicator Alliance Workshop
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Marine Protected Area (MPA): "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features which has been reserved by law or other effective means to protect part or all of the enclosed environment."[1]

Marine Reserve: marine reserves are one type of MPA in which the extraction of marine resources is prohibited, sometimes known as a "no-take" reserve.

Benefits of marine reserves:
Scientists have studied more than 124 marine reserves around the world and monitored biological changes inside the reserves. A global review of the studies revealed that fishes, invertebrates, and algae in marine reserves usually had large increases in (Figure 1):

1. Biomass, or the mass of animals and plants, increased an average of 446%.
2. Density, or the number of plants or animals in a given area, increased an average of 166%.
3. Body size of animals increased an average of 28%.
4. Species diversity, or the number of species, increased an average of 21%[2].

Studies of marine reserves reveal that marine reserves are effective in both tropical and temperate areas. In both regions, the range of ecological responses is broad, from little or no response to thousands of percent change, but the average increase in biomass and density is greater in MPAs located in temperate climates than those in tropical areas (Figure 2)

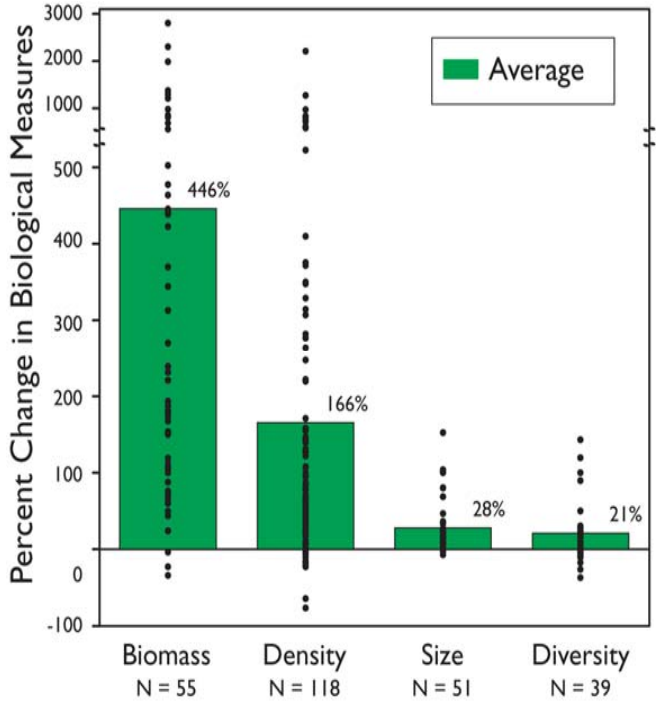

Figure 1: PISCO 2007

[1] International Union for the Conservation of Nature, 1988. '*Proceedings of the 17th session of the General Assembly of IUCN and 17th IUCN Technical Meeting*. San José, Costa Rica, 1-10 February 1988'.
[2] Partnership for Interdisciplinary Studies of Coastal Oceans. In prep. Anticipated November 2007. The Science of Marine Reserves. US version, 2nd edition. http://www.piscoweb.org. 22 pages.

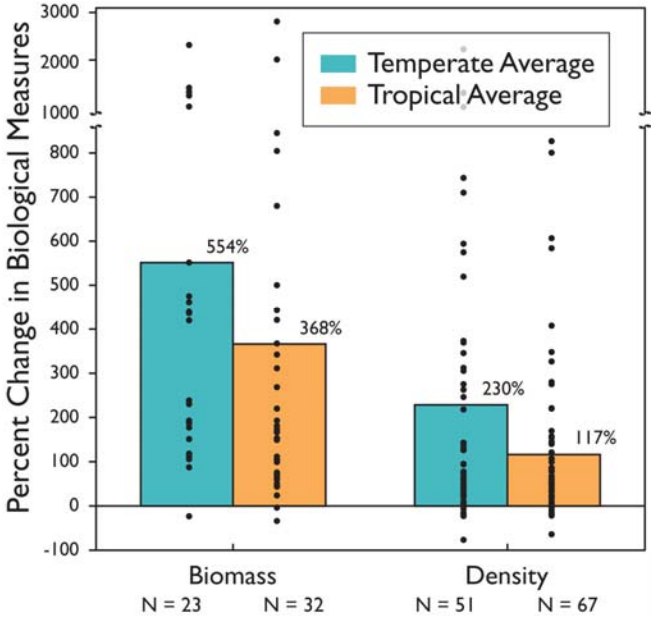

Figure 2: PISCO 2007

Adult Movement for Species of Interest

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
Invertebrates Abalone Mussel Octopus Sea Star Snail Urchin Rockfishes Blk. & Yellow China Gopher Kelp Other Fishes Gobie Sculpin * Seasonal Migration	Rockfishes Black Brown Copper Greenspotted Olive Vermilion Other Fishes Cabezon Ca. Halibut Lingcod	Invertebrates Dung. Crab* Rockfishes Bocaccio Canary Yellowtail Widow Other Fishes Anchovy Herring Sardine Birds Gulls Cormorants Mammals Harbor Seal Otter	Fishes Big Skate Pacific Halibut Sablefish* Salmonids* Sturgeon Whiting* Birds Gulls* Mammals Porpoises Sea Lions*	Invertebrates Jumbo Squid* Fishes Sharks* Tunas* Turtles* Birds Albatross* Pelican* Shearwater* Shorebirds* Terns* Mammals Dolphins Sea Lions* Whales*

Figure 3: MLPA Science Advisory Team 2005

Adult movement:

In order to protect species of interest, the MPA needs to be large enough to encompass the movement of adults. Figure 3 illustrates the range of adult movement for species of interest[3].

[3] Marine Life Protection Act Science Advisory Team. 2005. Presentation to the Marine Life Protection Act Blue Ribbon Task Force, November 29, 2005, Seaside, CA.

Juvenile movement:

As with adult movement patterns, the dispersal of juveniles, larvae and eggs varies enormously among species. Some barely move from their natal site. Others dispersevast distances (See Figure 4)[4]. MPAs will only be connected through the dispersal of young if they are close enough together to allow movement from one MPA to another. Any given spacing of MPAs will undoubtedly provide connectivity for some species and not for others. The challenge is minimizing the number of key or threatened species that are left isolated by widely spaced MPAs.

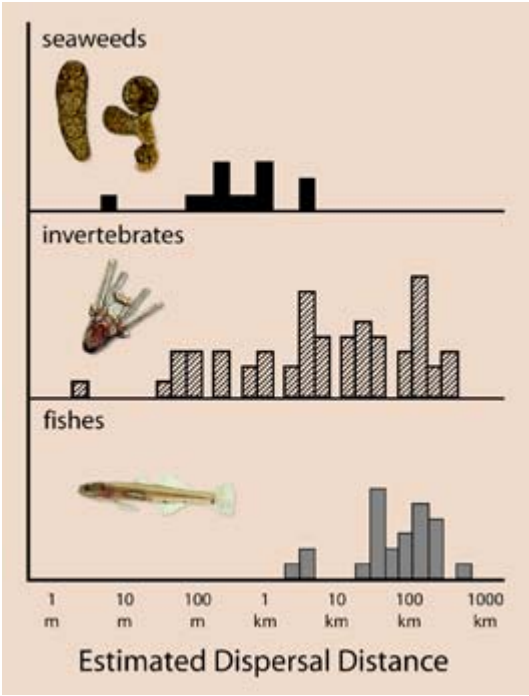

Figure 4: Kinlan and Gaines 2003

Networks of Marine Protected Areas

There are several important reasons for establishing networks of interconnected MPAs:

1. To increase the sustainability of populations of interest within the managed area. Populations are more sustainable if they do not rely entirely on replenishment from less protected populations outside of MPAs.

2. To protect genetic diversity, or the unique genetic characteristics of different populations within the managed area.

3. To protect several different patches of the same habitat type in order to reduce the risk that any single protected area will be impacted by a natural disaster, such as a large storm, or human-caused catastrophe, such as an oil spill.

4. To provide replicated study areas for scientific study so that data gathered from monitoring programs will provide meaningful insight about ecological and economic changes associated with the MPAs.

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[4] Kinlan, B.P. and S.D. Gaines. 2004. A comparative analysis of dispersal scale in marine and terrestrial systems. *Ecology.*