VI MARINE PARK PROJECT

Potential Benefits of Marine Reserves

Marine Reserves offer many potential benefits, which include; protecting ecosystem functions, improving recreational and educational opportunities, improving fishery yields, and increasing knowledge and understanding of marine systems.

I. Protects Ecosystem Structure, Function, and Integrity

- Protects physical structure of habitat;
- Protects ecological processes;
- Restores population structure of fisheries(size and age);
- Restores community composition (presence and abundance of plant and animal species);
- Protects biodiversity at all levels;
- Protects important species;
- Protects vulnerable species;
- Protects threshold effects;
- Protects food web and trophic structure;
- Reduces incidental damage; and
- Facilitates ecosystem recovery after major human or natural disturbances.

II. Improves Support to Human/Economic Systems

- Reduces fishing gear impacts;
- Maintains high quality feeding areas for fish and wildlife;
- Improves non-consumptive opportunities, especially recreation;
- Enhances and diversifies economic activities;
- Enhances and diversifies social activities;
- Enhances aesthetic and spiritual experiences;
- Improves wildlife opportunities;
- Provides opportunities for education;
- Increases sustainable employment opportunities;
- Creates public awareness about environment;
- Reduces the impacts from irresponsible development activities;
- Encourages holistic approach to natural resources management; and
- Stabilizes the local economy.

III. Improves Fishery Yields

- Protects spawning fish stocks;
- Increases spawning stock biomass;
- Provides undisturbed spawning conditions, habitats, sites;
- Increase egg and larval production;
- Enhances recruitment;
- Provides spill over of adults and juveniles to areas outside reserve;
- Reduces chances of recruitment overfishing;
- Reduces overfishing of vulnerable species;
- Protects diversity of fishing opportunities;
- Enhances recovery from stock collapses and management failures;
- Reduces bycatch fishing mortality
- Simplifies enforcement and compliance;
- Reduces conflicts among users;
- Maintains sport trophy fisheries;
- Reduces variance of yield;
- Allows increased fish outside reserves;
- Facilitates stakeholder involvement in management;
- Provides fishery management data to improve fisheries;
- Increases understanding and acceptance of fishery management;
- Reduces impacts of environmental variability; and
- Provides some protection with limited resources and without data or information.

IV. Increases Knowledge and Understanding of Marine Systems

- Provides long-term monitoring sites;
- Provides focus for study;
- Provides continuity of knowledge;
- Provides opportunity to restore or maintain natural behaviors;
- Reduces risks to long-term experiments;
- Provides experimental sites needing natural areas;
- Provides controlled natural areas for assessing anthropogenic impacts, including fishing and other impacts;
- Provides sites for enhanced primary and adult education; and
- Provides sites for high-level graduate education.

For more information on the benefits of marine reserves read Sobel 1996.

Sobel, J. 1996. “Marine Reserves: Necessary Tools for Biodiversity Conservation?”, in Global Biodiversity. 1996: 8-18.

Examples of Effects of Marine Reserves on Fisheries (Roberts & Hawkins, 2000)

Reserve Name and Location	Years of Protection	Habitat Type	Effects Reported
Leigh Marine Reserve, New Zealand	21	Warm-temperate rocky reef	The most common predatory fish, *Pagrus auratus*, was 6 times more common in the reserve than outside, while the spiny lobster, *Jasus edwardsii*, was 1.6 times more abundant, and had a bigger carapace (a part of their horny outer skeleton: average size=110mm in reserve, 94mm outside). In 18 years, sea urchin densities declined from 4.9m^2 to 1.4m^2 in the reserve, while urchin cover rose from 14% to 40% in unprotected areas (Babcock 1999).
Tawharanui Marine Park, New Zealand	14	Temperate rocky reef	The most common predatory fish, *Pagrus auratus*, was 9 times more common in the reserve than outside, while the spiny lobster, *Jasus edwardsii*, was 3.7 times more abundant, with a carapace about 16mm bigger (Babcock 1999).
Mayotte Island, Indian Ocean	3	Coral reef	Total numbers of species present did not differ between protected and unprotected areas. However, most large carnivores were more diverse and abundant in the reserve. The mean biomass of commercial species was 202g/m^2 in the reserve, compared to 79g/m^2 outside (Letourneur 1996).
Looe Key, Florida, USA	2	Coral reef	15 species that were targets of spear fishers increased in abundance after spearfishing was banned: snappers by 93%, grunts by 439% (Clark et al. 1989).
Cousin Island, Seychelles	15+	Coral reef	Groupers, emperors, and snappers were more abundant and diverse within the reserve than in fished sites (Jennings 1998).
Sainte Anne, Seychelles	11	Coral reef	Despite the fact that a few families retain fishing rights and poaching is fairly common in this reserve, the diversity of target species and total fish biomass was higher than in heavily fished areas. The biomass of prey did not increase when predators were removed by fishing (Jennings et al. 1995, Jennings et al. 1996).
Merritt Island Wildlife Refuge, Florida, USA	28	Sub-tropical estuary	Experimental catch per unit effort (the amount caught for every unit of fishing effort) was 2.6 times greater in the reserve for all game fish combined, 2.4 times for spotted sea trout (*Cynoscion nebulosus*), 6.3 times for red drum (*Sciaenops ocellata*), 12.8 for black drum (*Pogonius cromis*), 5.3 for snook (*Centropomus undecimalis*), and 2.6 for striped mullet (*Mugil cephalus*). Fish in the refuge were larger and more abundant, and anglers were preferentially targeting the reserve boundary (Johnson et al. 1999).

Reserve Name and Location	Years of Protection	Habitat Type	Effects Reported
Kisite Marine National Park, Kenya	5	Coral reef	Snappers, emperors, and groupers were more abundant in the park and appear to be spilling over into fishing grounds. Protection did not affect species number of diversity (Watson et al. 1996).
Punta El Lacho, Chile	2	Temperate rocky intertidal	The commercially important marine snail, the Loco (*Concholepas concholepas*), increased in density from 5 to 14 times, and doubled in body size following protection (Castilla & Duran 1985).
Barbados Marine Reserve	11	Coral reef	Large, trapable fish were approximately twice as abundant in the protected area, and 18 of 24 species were bigger (Rakitin & Kramer 1996, Chapman & Kramer 1999).
Exuma Cays Land and Sea Park, Bahamas	36	Tropical seagrass meadow	The average density of adult queen conch (*Strombus gigas*) was 15 times higher in the reserve, and late stage larval densities were 4-17 times higher (Stoner & Ray 1996).
Exuma Cays Land and Sea Park, Bahamas	10	Coral reef	The reproductive output of Nassau grouper (*Epinephelus striatus*) was 6 times greater in the reserve (Sluka et al. 1997).
Hawaii Marine Life Conservation Districts	Not reported	Coral reef	Fishes were 63% more abundant in areas protected from fishing (Grigg 1994).
De Hoop Marine Reserve, South Africa	2	Warm-temperate rocky reef	Experimental catch per unit effort increased by up to five-fold for 6 out of 10 of the most commercially important species (Bennett & Attwood 1991).
Saba Marine Park, Saba, Netherlands Antilles	4	Coral reef	In the no-take zone the biomass of target species was over twice that in fishing grounds (Polunin & Roberts 1993).
Hol Chan Marine Reserve, Belize	4	Coral reef	Biomass of target species in the reserve was on average almost double that in fishing grounds, while in certain parts of the reserve it was 10 times greater (Polunin & Roberts 1993, Roberts & Polunin 1994).
Anse Chastanet Reserve, St. Lucia	2	Coral reef	Total biomass of commercially important species was more than double that in fishing grounds, and the reserve contained 3 easily caught species found nowhere else (Roberts & Hawkins 1997).
Ras Mohammed Marine Park, Egypt	15	Coral reef	Mean biomass of fish was 1.2 times greater on protected reefs, while differences for 7 target species were much greater. Individuals of the lunartail grouper (*Variola louti*) were 3 times larger in the reserve (Roberts & Polunin 1993).
Kisite Marine	Kisite 20,	Coral reef	Abundances of key commercial species (groupers,

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National Park and Mpunguti Marine National Reserve, Kenya	Mpunguti 0 (open to fishing using traditional methods		snappers, and emperors) were up 10 times higher in the fully-protected Kisite Marine National Park compared to the fished Mpunguti reserve. Furthermore, keystone species such as triggerfish (a predator of urchins) were also more abundant in the Kisite Park, while their urchin prey were much more abundant in the fished Mpunguti reserve (Watson & Ormond 1994).
Three Kenyan Marine Parks: Malindi, Watamu, Kisite	Malindi 24 Watamu 20 Kisite 19	Coral reef	Reserves helped to support regional diversity by protecting species that were unable to persist in fished areas. Of the 110 species recorded on protected reefs, 52 were not found in fished areas (McClanahan 1994).
South Lagoon Marine Park, New Caledonia	5	Coral reef	Within protected areas the species richness of fish populations increased by 67%, density by 160%, and biomass by 246%, but the average size of most species did not increase (Wantiez et al. 1997).
Banyuls-Cerbere Marine Reserve, France	6	Warm-temperate rocky reef	18 target species were bigger in reserves (Bell 1983).
Shady Cove, San Juan Islands, Washington, USA	7	Temperate rocky reef	Lingcod (*Ophiodon elongatus*) were nearly 3 times more abundant in the reserve (Palsson & Pacunski 1995).
Edmonds Underwater Park, Washington, USA	27	Temperate rocky reef	The number of rockfish eggs and larvae originating from within the park is 55 times greater than outside. For lingcod (*Ophiodon elongatus*), the figure is 20 times as many (Palsson & Pacunski 1995).
Anacapa Island, Channel Islands, California, USA	20	Warm-temperate rocky reef	Densities of the commercially exploited red sea urchin (*Strongylocentrotus franciscanus*) were 9 times higher in the reserve than in nearby fished areas (Gary Davis, quoted in Fujita 1998).
Tsitsikamma National Park, South Africa	22	Rocky reef	Of the 3 species studied, 1 was 4 times more abundant in the reserve and another 13 times more. Bream (*Petrus rupestris*) were on average twice as large when protected. The biggest individuals for all species were found in the reserve, and maximum sizes in fished areas were depressed (Buxton & Smale 1989).
Sumilon Island Reserve, The Philippines	10	Coral reef	18 months after fishing was resumed in the reserve, catch per unit effort fell by a half, and the total yield of fish was 54% less, despite a greater area available for fishing (Alcala & Russ 1990).

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Apo Island Reserve, The Philippines	6	Coral reef	The biomass of large predators increased 8-fold in the reserve. In fishing grounds, mean density and species richness of large predators also increased (Russ & Alcala 1996).
Kyoto Preture Closure, Japan	4	Temperate sand and mud bottom	The proportion of large male snow crabs (*Chionoecetes opilio*) rose by 32% in the closed area (Yamasaki & Kuwahara 1990).
Maria Island Reserve, Tasmania	6	Termperate rocky reef	The densities of rock lobster (*Jasus rubra*) and bastard trumpeter fish (*latridopsis forsteri*) increased by 1 and 2 orders of magnitude respectively within the reserve. The numbers of species also increased for fish, invertebrates, and algae, as did the densities of fish larger than 33cm (Edgar & Barrett 1999).

For more on the design, size, location, and benefits of marine reserves, read:

Roberts, C.M. and J.P. Hawkins. 2000. Fully-protected Marine Reserves: A Guide. WWF Endangered Seas Campaign and University of York.