
Photo: Malcolm Francis, 2004

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Photo: NIWA 2004

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Biodiversity benefits of MPAs

Closing areas to potentially destructive fishing practices like bottom trawling or dredging can protect sea-floor habitats and the creatures that live there. Such closures made under the Fisheries Acts already protect certain seamount communities, and some coastal bryozoan beds.

Complete fishing closure, such as with marine reserves, can protect significant or representative areas, restore habitats and rebuild food chains broken by the removal of highly sought-after species.

A MPA can also address the effects of fishing on the abundance of non-target (by-kill) species, as is the case with marine mammal sanctuaries.

Marine environments are highly interconnected and currents will carry larvae and eggs produced in a MPA out into adjacent waters and across many (sometimes hundreds of) kilometres of ocean.

Research shows that within marine reserves, some heavily-fished species like snapper, rock lobster and blue cod grow larger and become more abundant. Because larger fish produce far more eggs than an equivalent weight of smaller fish, MPAs may be a useful management tool where egg production is constraining population growth of a species.

One role that these larger fish play lies in preserving genetic diversity. Over generations, fishing pressure can sometimes end up selecting for fish that grow slower and mature smaller: fish that grow quickly and mature at a larger size are removed more frequently before they breed, while fish that mature smaller end up dominating the gene pool. The fact that MPAs can harbour larger fish that contribute their genes to the wider gene pool may help offset this effect. Fisheries restrictions, like maximum size limits, can also help achieve this.


Photo: Malcolm Francis, 2004

Example: Restoring a food chain

The Cape Rodney – Okakari Point (Leigh) Marine Reserve is the oldest in New Zealand, and has been the site of several long-term studies that document gradual but pronounced habitat regeneration.

In 1978, the Leigh Marine Reserve was classified into various habitat types. One habitat – which comprised 30% of the rocky reef at that time – was termed the 'urchin barrens'. Here, heavy grazing by sea urchins had removed virtually all seaweed. Large seaweeds like kelp were absent, and the small encrusting algae known as pink paint algae dominated the seabed. Experimental sea urchin removals showed that urchins were indeed responsible for keeping the habitat in this state.

Before the reserve was established, local fishing pressure on species like snapper and rock lobster that eat sea urchins had allowed urchins to increase to unusually high densities. With the reserve established, the numbers of these predators increased, thereby slowly reducing urchin densities. Consequently, kelp started to re-establish in the reserve.

Subsequent habitat mapping spanning 20 years of protection has shown the 'urchin barrens' have disappeared (see figure below). Seaweed communities and their associated fauna regenerated, and reef habitats became quite different in the reserve compared to non-reserve sites where urchin-grazed areas persisted. Primary productivity of kelp within the marine reserve is now estimated to be as much as 58% greater than in areas outside.

As the abundance of the dominant urchin predators has remained high at reserve sites compared to non-reserve sites, the macroalgal forests and other indirect benthic effects are likely to persist in the Leigh Marine Reserve.

While these changes have been observed at Leigh, one cannot assume this extent of change will occur everywhere a Marine Reserve is created – as many habitats chosen for the MPA network will be in places that have been less affected by fishing.

Photo: Malcolm Francis, 2004

Photo: Steve Mercer, NIWA 2004

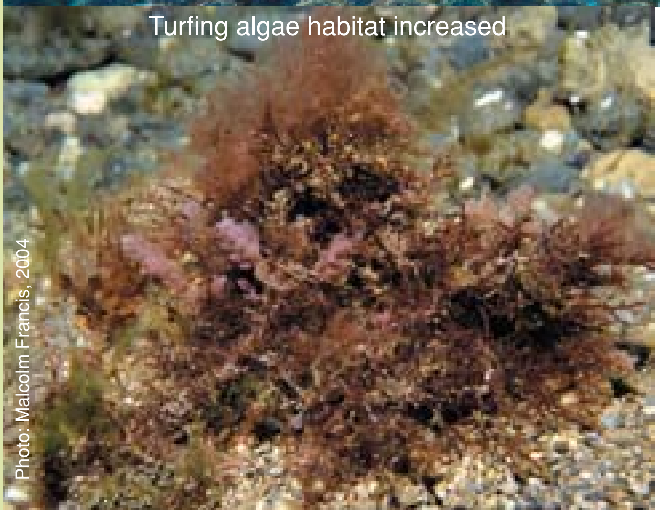
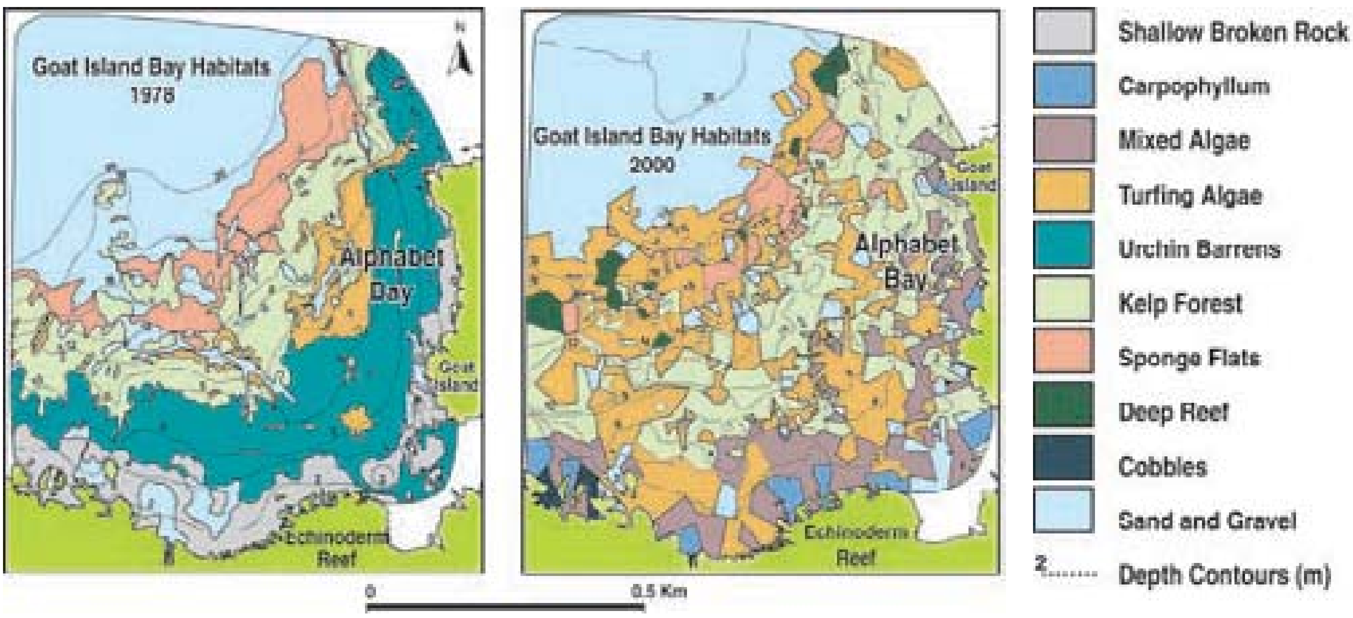


Photo: Malcolm Francis, 2004



Map: Darren Parsons, 2004

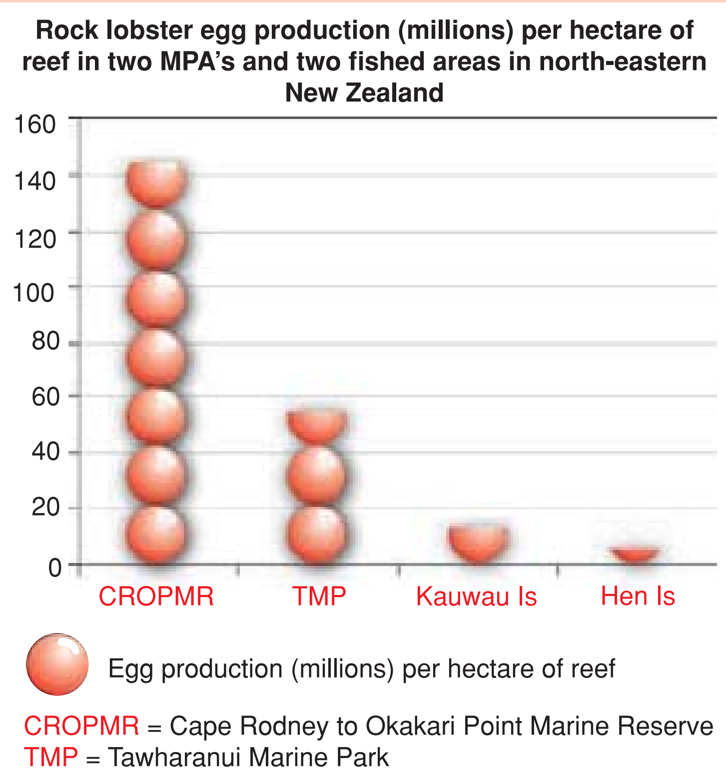
Example: Increase in size and egg production

Studies of rock lobsters, or crayfish, illustrate the potential contribution that protected populations can make to the regional production of eggs and larvae of otherwise exploited species.

A comparison was made between protected lobster populations within Cape Rodney – Okakari Point (Leigh) Marine Reserve and Tawharanui Marine Park (which is also a 'no-take' area) and two populations heavily exploited by commercial and recreational fishers at Kawau and Hen Islands. Divers counted and estimated the size of every lobster within a total area of one hectare of suitable rocky reef at each location.

They found that more large legal-sized females lived within the two protected areas, while the two fished areas had significantly fewer large females.

A direct consequence of there being more and larger female lobsters within the protected populations is that their total estimated egg production per hectare of reef (see bottom chart) was on average 10 (range 4 – 24) times higher than the fished populations. Another way of looking at this is that the egg production of lobsters within the 5 km long Leigh Marine Reserve is estimated as similar to the egg production along 76 km of heavily fished rocky coastline. Similar results have been found in other New Zealand reserves. Fishing restrictions that protect larger individuals of a target species may also be useful for maintaining a viable spawning stock as long as fishing mortality enables sufficient individuals to survive to this size.



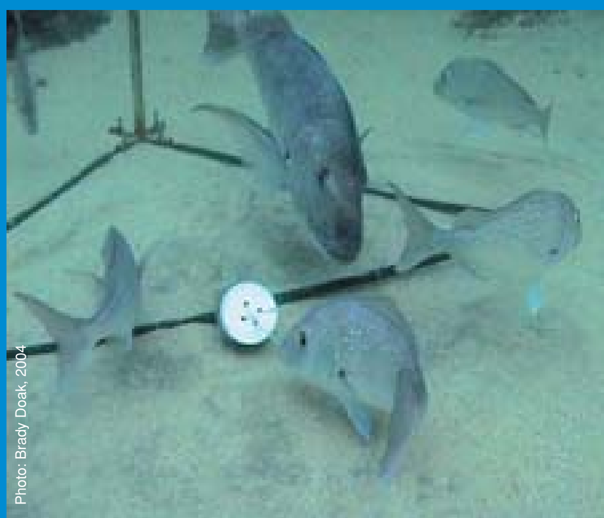
Graph: NIWA, 2005

Example: Increase in population density

A number of studies documenting population density inside and outside of 'no-take' marine reserves have been carried out. The majority of these studies indicate that marine reserves increase the abundance of species previously targeted by fishers.

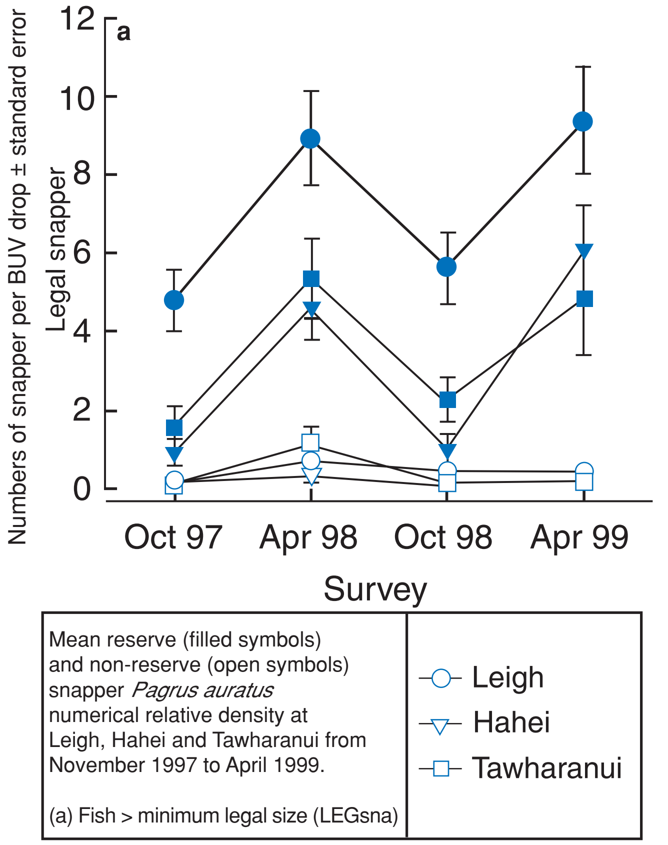
A two-year study of snapper density in three northern protected areas clearly demonstrates population density increase. Snapper is heavily exploited by both commercial and recreational fishers. The three MPAs which had been established for varying lengths of time were sampled by baited underwater video (BUV). Estimates of relative abundance, size, biomass, and egg production were obtained inside and outside of the three MPAs during spring and autumn each year. Egg production was estimated from existing data relating number of eggs produced to size of female fish.

This study demonstrated that relative total abundance, biomass and estimated egg production were all greater within reserves than in adjacent fished areas. Legal sized fish were also estimated to be more abundant in areas afforded protection than in fished areas, and estimated egg production was greater.



Snapper attracted to the baited video camera

Estimates of relative abundance of snapper at protected and fished sites in NE New Zealand



Graph: T.J. Willis, R.B. Millar & R.C. Babcock. 2003. Protection of exploited fish in temperate regions: high density and biomass of snapper *Pagrus auratus* (Sparidae) in northern New Zealand marine reserves. Journal of Applied Ecology 40: 214-227, Blackwell Publishing.

Designing a MPA network

The first stage in designing an EEZ–wide network of MPAs lies in describing and classifying the different ecosystems and habitats.

Following this, areas can be identified that are rare, have special significance, or are representative of more common habitats.

Something that must be taken into account is that many marine species have complex life cycles, with a larval phase that is carried by ocean currents, and juvenile and adult phases that may be free-swimming, bottom-dwelling or directly attached to the sea bed.

Also, species differ in the degree to which they stay in an area over time, for example paua live their lives within a small area; kahawai do not.

So the larger the MPA the greater the range of species that will be protected. However, the choice will have to be made about what size MPA is practical in a given situation.

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Community Involvement

The government encourages community participation in all aspects of marine protection.

Visit the Department of Conservation website **www.doc.govt.nz** to keep up with the Marine Protected Areas policy and for other information about marine protection.

Visit the Biodiversity website **www.biodiversity.govt.nz** to read the government's approach to maintaining and recovering our marine biodiversity.

Visit the Ministry of Fisheries website **www.fish.govt.nz** to keep up with fisheries management and marine protection.

Visit the Ministry for the Environment website **www.mfe.govt.nz** for information on local authority initiatives in water quality and land use practices, and for information on the development of a New Zealand Oceans Policy.

Visit the Ministry for Agriculture and Forestry website **www.maf.govt.nz** for information on marine biosecurity.

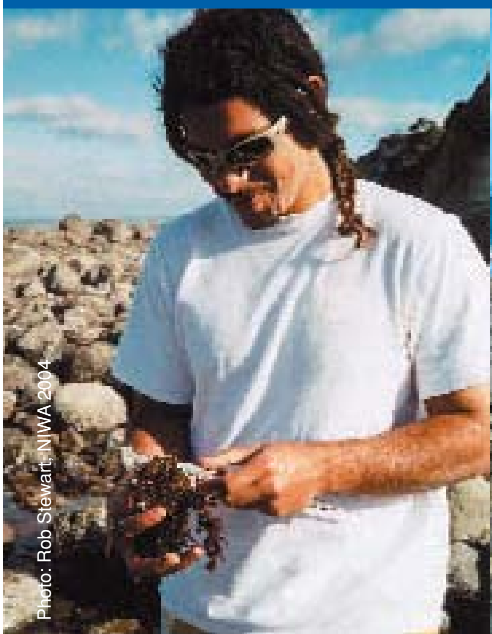

Photo: Rob Stewart, NIWA 2004

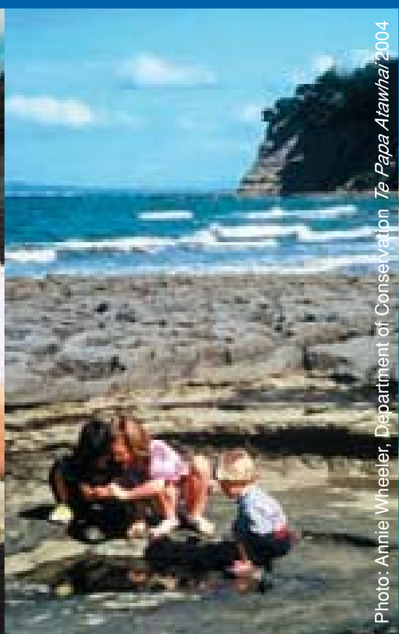

Photo: Annie Wheeler, Department of Conservation *Te Papa Atawhai* 2004

Photo: P. Thompson

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