Paper presented at the 'SeaViews' conference in Wellington, February 1998:
Marine Ecosystem Management: Opportunities and Obligations

A SYSTEM OF MARINE RESERVES: THE OPPORTUNITY AND THE OBLIGATION

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SUMMARY

Over the past 30 years, New Zealand has discussed the practicality and value of 'no-take' marine reserves. The first was established 20 years ago. There are now 14 in place. At least 25 more proposals are under active public discussion. All the major political parties say they favour more marine reserves. However, up till now each reserve proposal has been considered separately. Despite steadily increasing approval, there is no overall policy, no final aim and no timetable for the process.

The opportunity now exists to create a full system of marine reserves based on clear and generally-agreed principles:
(i) Full representation - of all regions, and all major habitats in each region.
(ii) Suitable replication - adjusting to popularity and guarding against accidents.
(iii) Network design - making the remote dispersal of most marine species an advantage.
(iv) Sufficient total amount to make the system self-sustainable (at least 10% by area).

Our uses of the sea depend on its natural processes. Our power of positive control over these processes is minimal, but our ability to disrupt these processes is already large and is increasing rapidly. Our knowledge of these processes is still very limited. There is thus an obligation to keep areas in the sea maintained in their natural state as far as possible. This is important for science, valuable to education, helpful to many forms of recreation, and essential for marine conservation at all levels. Natural and unexploited areas in the sea are also required as insurance against ignorance and errors; and as support for exploited stocks.

Clear policy aims for a marine reserve system should be included in both general marine planning (e.g. the New Zealand Coastal Policy and Regional Coastal Plans) and in the management of exploited species (i.e. the Fisheries Policy). At present marine reserves are specifically excluded from consideration under either.

THE OPPORTUNITY

New Zealand has been considering 'no-take' marine reserves for more than 30 years. The first proposal - by the University of Auckland - was made in 1965. It took 6 years to get general empowering legislation passed (Marine Reserves Act, 1971), 4 more years to get the actual site gazetted and a further 2 years to establish the first reserve. Since then the rate of creating of new reserves has slowly but steadily increased. There are now 14 reserves in place, 5 more proposals sit on the Minister of Conservation's desk awaiting final approval, and at least 25 more suggestions are under active public discussion. The range of organisations making or strongly supporting the existing reserves included government departments, conservation societies, commercial fishermen, Maori groups, educational organisations, diving clubs and local citizen associations. At the last election all the major political parties stated that they favoured the creation of more marine reserves.

Despite increasing support for the idea, so far the whole process of selection, dicsussion and approval has been conducted in isolation for each case. The approach has been localised, analytical and sectorial. 'Policy' has been restricted to approving reserves only after local groups have gained large amounts of support through their own efforts. This means that the pros and cons used in discussion focus on the particular case. Special features of the site and the opinion of small sectional interests become very important. It is difficult to raise general issues, to involve the wider public or to see where the whole process is heading.

It is now sensible and appropriate to move to a clear policy, based on generally-agreed principles. We can raise our thoughts above single reserves and aim for a system. We can consider what we want such a system to do. The opportunity exists to create a full and proper system of marine reserves.

We have had enough time to get used to the concept of permanent 'no-take' marine reserves - pieces of the sea with no extractions, no dumping, and no constructions. Places where people are welcome to appreciate and study the full natural development of marine life. Despite problems in setting up each new one, they are clearly practical in socio-political terms. Indeed, the longer reserves are in place the more popular they become. We have enough examples in place to work out what a system could and should do. The existing reserves cover a wide range of region, habitats and size. They have demonstrated their direct usefulness in science, education, recreation and conservation. Their indirect benefits - in support of exploited stocks, as insurance against ignorance, accidents and errors, and in measuring the effects of general management - are likely to be even more important.

THE PRINCIPLES

The principles for a system of marine reserves must be clear, basic and generally-agreed. This is quite possible. The four principles listed below are relatively simple and easily understood; they are firmly based on fundamental science and general experience: and they have widespread agreement amongst anyone who has taken the trouble to think about the matter. If accepted, however, they are both subtle and far-reaching in their effects. The order of consideration is important. If followed, it allows simple and conservative distinctions to be effective. Any 'difficulties' at one level are much easier to resolve at the next.

1. Representation

On land, it took almost 100 years to realise that all regions should have some reserves and that within each region all major natural habitats should be represented by at least one reserve. Not just pretty bits, not just remote areas, not even just the high-diversity places, but examples representing all. The same arguments apply equally well to the sea. Whether the approach is moral, religious or strictly rational, the conclusion is the same. If there are to be reserves at all, for whatever reasons, it makes sense to include examples of all major types.

Each region which has different life and conditions should have reserves (biogeographical representation) and, within each, all major habitats should be included in at least one reserve (ecological representation). The definition of difference should be kept simple and highly conservative - to maintain widespread agreement and to prevent nit-picking.

In New Zealand seas, there would probably be broad support for around 7 marine geographic regions in waters out to the continental shelf edge - (i-iii) round the three off-shore island groups (Kermadecs, Chathams and Sub-antarctic islands);
(iv-vi) northern, central and southern parts of the eastern coastal waters, and
(vii) all west coast waters. It is perfectly possible to subdivide further, but for our present purpose it is not necessary. Finer distinctions or additions can easily be made under ecological distinctions, replication and network design (see below). For the open ocean (out to 200 nautical miles) it would sufficient to use the major oceanic fronts or convergences as regional boundaries.

Ecological distinctions can be made to any desired level, but again, clear and minimal distinctions are best. For example, off the northeast coast, it would be sufficient for present purposes to distinguish simply between four major habitat groups - (i) harbours and estuaries (ii) semi-enclosed waters, like the inner Hauraki Gulf (iii) the open coast out to the mid-shelf (iii) the open ocean beyond that.

2. Replication

If something is important, we must ensure it cannot be destroyed by a single accident. As Granny used to say " Don't put all your eggs in one basket". So in a marine reserve system each region should include more than one estuary, more than one piece of open coast, etc.

There are many other reasons for replication, including scientific (to exclude chance and measure variation), and social ones (some reserves are so popular there is danger of them being 'loved to death'). Replication also allows 'finer' ecological distinctions to be included - e.g. since harbours and estuaries vary greatly in size, it helps to have 'replicates' that cover this range.

3. Network design

The sea is different from land. On land single large reserves are generally best for the conservation of natural habitats and populations. But in the sea this is unlikely to be true. Most marine species have small dispersive stages in their life cycle - spores, eggs, or larvae - that drift in the currents for days or weeks before settling somewhere well away from their parents. Because of this feature, *single* marine reserves will not be self-sustaining, unless they are enormous - which is impractical.

However a *network* of reserves, which allows the drift of larvae from one reserve to reach others, is potentially sustainable. The 'mesh' of the network will vary. In complex inshore areas, where different habitats form a dense mosaic, reserves would be relatively small and closely spaced. Further out in open waters with much less variation in depth and habitat, the reserves would be larger and further apart.

The purpose of a network is to maximise the variety of 'connections' (distances and directions between reserves) as well as their number. Since we rarely know the 'sources and sinks' of the larvae, we must take this precaution. But even if we could design optimally for one species, other species would have quite different requirments, so a network design is necessary (Roberts, 1997).

4. Self-sustainable amount

While a network design is a essential for sustainability, a series of tiny reserves would not be sufficient. The system must be large enough to sustain its full natural processes indefinitely, even when our management of the rest of the sea is imperfect. The key point is not the size of particular reserves (or their number) but the size of the whole system. This size is measured as a proportion of the whole sea - a percentage of area, and is maintained at all scales - regional, ecological, etc.

The aim is clear, but we do not know how much is required to achieve it. We must go back to even more basic principles. General experience and ecological principles make it likely that the self-sustainable amount is more than 10%. The same experience strongly suggests that the total required is less than 50%. Even this limited knowledge is sufficient to act on principle.

The immediate policy must to be place 10% of all major habitats in all regions into the 'no-take' reserve system. This is equivalent to standard business practice of '10% contingencies' in a building contract. When and where we feel it is sensible to increase this amount, we should do so. Until recently, 'no-take' areas were generally regarded as a net loss to fishermen. Many fisheries scientists now believe that 'no-take'areas are helpful to fisheries, and that 20-30% 'no-take' actually increases overall yields (Bohnsack, 1996; Schmidt, 1997).

THE OBLIGATION

Compared to land, the sea is still largely natural. Despite the many and various changes we have made in the sea, its processes still proceed mainly in ways which would have occurred in our absence. Most of our uses of the sea, especially the harvesting of fish and shellfish, depend on the natural processes. Our power of positive control over these processes is minimal, although our power to disrupt them is already large and is increasing. Our knowledge of these processes is still very limited - the *continuing* rapid increase in our knowledge demonstrates this.

There is thus a real obligation to keep areas in the sea maintained in their natural state as far as possible. This is important for science, valuable to education, and helpful to many forms of recreation. It is essential for marine conservation at all levels. We need such areas as a base-line for evaluating management; as a hedge against unpredictable changes; as an insurance against ignorance or error; and as support for exploited stocks.

REFERENCES

Bohnsack, J.A. 1996 Maintenance and recovery of reef fishery productivity. In Polunin, N. and Roberts, C.M. (editors) *Reef Fisheries*. Chapman and Hall, London.

Roberts, C.M. 1997 Connectivity and management of Caribbean coral reefs. *Science*: 278, 1454-7.

Schmidt, K. 1997 'No-take' zones spark fisheries debate. *Science*: 277, 489-91.