Presented at the Department of Conservation, Wellington, October 1998

MARINE RESERVES: THE TIME FOR A NEW APPROACH ?

Bill Ballantine

Leigh Marine Laboratory (University of Auckland), Box 349, Warkworth
phone: 09 422 6111 fax: 09 422 6113 e-mail: b.ballantine@auckland.ac.nz

SUMMARY

New Zealand has established 14 marine reserves, which were developed through a local and analytical approach. Many more reserve proposals are in the pipeline, and the idea has almost universal approval. It is now practical and advisable to aim for a system of reserves, organised through a policy based on simple and generally-agreed principles.

These principles would be: representation, replication, a network design and a self-sustaining amount. Moving up to principles permits the general public interest to over-ride local and sectional interests. Moving up to a system creates the necessary level of general public interest.

At present, three aspects of marine reserves – the socio-political, the scientific and the resource management aspects – are being developed almost independently. There is a real danger that each will be stalled by detailed and sectorial problems. However, applying basic principles and scaling our thinking up the level of a system will allow a convergence in theory and encourage sensible cooperation in practise.

INTRODUCTION

The most fundamental point about marine conservation is that there is only one sea. Although, for convenience, we name oceans, seas, gulfs, bays and harbours, there are no actual barriers, no absolute distinctions and all subdivisions are arbitrary.
All land consists of separate islands (with a vast range of size) and this fact governs much of what is necessary, advisable and practical in conservation. It also governs most thinking on the matter. But there is only one sea and the transfer of experience and principles from land to the sea should, at the very least, be regarded with great caution. In my view, we should avoid such transfers altogether unless there is actual evidence that such a transfer is sensible and appropriate.

The sea is very different from land. Physically, the sea is more like the atmosphere, where again there is only one on the planet, and we are just learning to plan and manage on that basis. But the time scales between atmosphere and ocean are

different by several orders of magnitude, and these are so large that for practical purposes the difference is qualitative.

Biologically the matter is more complex. A few very basic principles of conservation probably do transfer from land to sea - such as the representation of habitats and the importance of biodiversity at all levels - but these principles are very general statements. At more practical levels we are often surprised. Even children quickly appreciate that, on land, large plants intercept light and so out-compete smaller plants. We expect trees to dominate, unless fire, lack of soil or some such factor prevents them developing. But even professional marine ecologists took a long time to see that the reverse is true in the sea, where small, most microscopic plants overgrow large plants and deprive them of light. Kelps and other large seaweeds are unexpected and require very special arrangements in order to exist at all.

The most significant difference between the sea and the land, in science, is our low level of marine knowledge, and, hence, in politics, our low level of concern for sensible marine arrangements (Norse, 1993). Our sheer ignorance about the sea and its biota is so great, compared to land, that sanity-defending mechanisms automatically produce effective denial. We seize on the exceptions, we concentrate in small areas, we retreat to the immediately practical. This is entirely understandable, but it is not objective nor does it produce sensible policies.

Within my working life, we discovered the plant groups that form the bulk of primary productivity in the sea. We only learnt about one of these groups in the last decade. We think we have reached the limit since fempto-plankon appears to be mainly viruses and non-photosynthetic. But even I have difficulty in realising that this is equivalent to learning about grass just 40 years ago and to discovering lichens, mosses and ferns in the last ten years.

Fish are the *best* known group in the sea, the equivalent of birds. The number of fish species known from the New Zealand region has trebled since the 1960's (from ~350 to over a 1000) and the rate of discovery has not slackened (Roberts and Paulin, 1997). For bird species in New Zealand, this state of affairs was passed more than 100 years ago.

Unless we are prepared to admit our ignorance about the sea and make arrangements that allow for it, it is very unlikely we will be able to plan sensible management systems for our seas, or to conserve its ecosystems and biota. We like to plan on the basis of knowledge, of course, but when the level is very low, it is not intelligent to depend entirely on that approach. It would be sensible to add systems based on precautionary principles.

The discussion in this paper is on the boundary between science and politics. This generally sends everyone ducking for cover, but I am merely suggesting that we abandon the present role-reversal, and let the professions revert to their normal roles. At present in marine matters, conservation scientists are being asked to decide what are really political questions, while the politicians are left to decide the principles and constraints on which action will be based (Ballantine, 1997). The historical reasons for this state of affairs do have some logical justification. Furthermore, nobody in particular is to blame. But none of this alters the fact that the present situation is both absurd and unworkable.

Whichever way we look at our seas - from the social and political angle, from the scientific conservation side or from the resource management aspect – we see similar problems developing. In each case, there is a widening gap between what the public would like to aim for and the ability of existing methods to deliver along these lines.

I am suggesting that these problems all have the same basic cause, and can all be resolved in essentially the same way. I will be concentrating here on the scientific conservation aspect, which could be resolved relatively easily, given a new approach based on principle. If we took this approach, we would see that same route would help the resource management (especially fisheries), and would greatly simplify the social and political aspect (especially the basic policy issue).

THE SOCIAL AND POLITICAL ASPECTS

The political good news:

1. New Zealand now has 14 established marine reserves.
2. A large proportion of the general public know about and approve the idea of having pieces of the sea that are kept natural and undisturbed. (This is the only country in the world where this can be said with confidence.)
3. Despite initial problems, marine reserves become more popular over time and the principles are widely accepted (e.g. support for ‘no-take’ at the Poor Knights).
4. At least 6 more formal applications sit on the Minister’s desk awaiting decision.
5. At least 20 more proposals are under active public discussion.
(e.g. in Auckland conservancy - Great Barrier Is, Waiheke Is, Mid-Gulf)
6. At least 40 more ideas have been seriously suggested.
(e.g. in Auckland conservancy - Mokohinau, Miranda, Westmere, Kaipara Heads, Little Barrier, W. Coast)
7. All the major political parties support the idea and say they want more reserves.
8. The minister put marine reserves high on his ‘top 10’ list.
9. The minister has indicated he wants to approve up to 3 more reserves a year.
10. The minister has announced a $1million allocation for marine reserves.

The political bad news:

1. In many official circles, marine conservation is still considered as a minor add-on.
2. Fisheries interests are still given near veto powers over marine reserves.
3. Most of the established reserves and formal proposals derived from local initiatives.
4. Each reserve proposal is considered in isolation - maximising local opposition.
5. There is no clear policy for creating more marine reserves and our 2 major marine polices (Coastal Planning and Fisheries) specifically exclude marine reserves.
6. There is no clear aim for a system of marine reserves - minimising public support.
7. There are no formally-accepted principles to judge marine reserve proposals.
8. Only one marine reserve has been established in the past two years.
9. The recent rate of approval has barely matched the rate of formal applications.
10. Departmental action and 'grassroot' activism has stopped accelerating.

Correcting the mis-match.

How is it, that after 30 years of discussion, 20 years of working examples, 10 years of a Department in charge, and having achieved a wide measure of public support, the idea - instead of charging ahead, is actually in danger of faltering?

I submit it is simply a matter of failing to change gear. I this is a classic case of the need to change the approach when initial success has been achieved. It is sensible and practical to begin with an analytical approach - i.e. the careful build-up of examples one-at-a-time for local, sectional and special reasons. But, after a reasonable number of examples have been tried and tested, it is not just advisable to change the approach, it is necessary to do so. The new approach must be general - i.e. it must state *final* aims, define a *system* that would achieve these, and list the *principles* required.

The good news is that nobody is to blame - yet. No one has done anything wrong - yet. It could be said we are a little late in making the change, but even if this is true, it will merely make the change easier.

The idea that politicians need detailed scientific data to approve specific actions is not always true. They generally pretend they do, especially when the decision is controversial. But most political decisions are guided by principle. Faced with some angry fisherman saying "*Why shouldn't I fish off this rock?*", the politician wants to turn to the scientist and ask "*Why is it this rock?* " But there is no precise reason. It is just some rock like that, and every rock will have its fishermen. All parents know this dilemma - when their child asks "*Why do I have to go to school today?* ". They know perfectly well that one missed day will not have any real effect. But each day is one day. So despite the logical form of the question, it must NOT be given an answer at that level.

Politicians and the voters recognize this type of situation. It is common, but it is no problem provided they act on principle. When we are trying to arrange new schools, roads or fire stations we do not expect to find sites that suit everyone. Indeed we expect

that, even if you have school-age children, it is likely you will object to a noisy playground next door, and will do your best to get the planning changed. However, none of this prevents the community getting the schools, roads, etc. it needs, because everyone has already agreed, in principle, to adequate provision of such things.

When we start to promote a system of marine reserves based on clearly stated principles, the social and political situation will be much simpler. The local and sectional opposition based on NIMBY (Not in My Back Yard) will not diminish much, but it will be diluted to manageable proportions by widespread and genuine public support for the general aims and basic principles.

THE SCIENTIFIC ASPECTS

Scientific good news:

1. 'No-take' marine reserves (under a variety of names) now exist successfully in more than 20 countries, demonstrating the idea has universal value.
2. These reserves include many climate regions and a wide variety of habitats, showing the idea operates across biogeographic and ecological boundaries.
3. Marine reserves show many direct benefits to science, education, conservation and many forms of recreation, as well as indirect benefits to resource management (including fisheries). There is a broad base of potential support.
4. The scientific uses of reserves are many and varied, these increase in value over time; and multiply as the reserves include more regions, habitats and replicates.
5. The same points apply to the conservation values of marine reserves (i.e. it is not necessary to investigate the matter for each species or habitat).
6. The record of marine reserves and the generality of their benefits show it is sensible for science and necessary for conservation to upgrade to a system.
7. The principles for a system are also clear from existing experience:
    - It must be representative i.e. examples of all major habitats in all regions.
    - It must be replicated i.e. more than one of example of everything.
    - It needs a network design, which turns remote dispersal into an advantage.
    - The system would need to sufficiently large to be self-sustainable, even in the event of resource management mistakes outside.

The scientific bad news:

1. We have a very poor record of predicting particular benefits from single reserves.
2. Actual reserves must be established before any benefits can be demonstrated.
3. It takes years and much effort to demonstrate any particular effect.
4. Scientific conclusions come after the experiment, not before, but the present approach ask scientists to:

    select the areas for marine reserves (i.e. put priorities on regions and habitats)
    recommend boundaries for these (i.e. define 'correct' size)
    state in advance what benefits will accrue from establishing the reserves

5. We are not using the principles we have learnt.
6. Where we do use them, we separate them and argue about detail (e.g. endless argument about the boundaries of biogeographic provinces)
7. We are failing to combine the principles or to upgrade to systems.
8. As a result we are unable to give genuinely helpful advice to the politicians and
9. We are unable to recruit support in principle from the public at large.

Two of the principles for a marine reserve system – representation and replication – are virtually the same in terrestrial conservation, where their importance is widely regarded as axiomatic. In the sea, however, their application has barely started – although the Department has stated the need (DoC, 1998, page 36).

A network design for marine reserves is quite different to the situation on land, where single large reserves are generally more effective. However, in most marine species the recruitment of a population is decoupled from its reproduction. Small dispersive propagules (spores, eggs and larvae) drift in the plankton for long periods before settlement and/or metamorphosis to adult form. Consequently a *single* marine reserve is unlikely to be self-sustaining unless it enormous, which is impractical. However, a *system* of reserves based on a network design can be self-sustaining and turns remote dispersal into an advantage.

The final principle – governing the overall size of the system – has no strict parallel in terrestrial conservation, but is of crucial importance in the sea. The reasons are fundamental, multiple and interactive. They refer back to the point about 'only one sea'. They concern the fact that the sea (and its life and our uses of it) operates mainly on natural processes. Consequently sustainability is of these processes is essential to many of the 'uses' of the sea, especially fishing. Furthermore if a marine reserve network is self-sustaining it must automatically provide support for the areas between reserves. A 'no-take' terrestrial forest reserve does remove a potential resource from the timber industry and provides nothing directly in return. A 'no-take' marine reserve is an unfenced stud farm for fish and is likely to be of direct benefit to fisheries – even if many of those involved have yet to appreciate the point! (e.g. Allison et al, 1998; Bohnsack, 1996; Dugan and Davis, 1998; Roberts et al, 1995; Roberts, 1997)

The present scientific problems in marine conservation closely parallel the socio-political problems. Failure to move up a grade – to principles and a system – produce a regression into detail which maximises the difficulties and prevents broad support. The solution is basically simple. If we start using conservation principles as our primary scientific justification, rather than relying solely on measurable data, then we can avoid the traps. If we start to think about a system of marine reserves, rather than particular sites, the appropriate principles are reasonably clear.

THE RESOURCE MANAGEMENT ASPECTS

The fisheries good news:

1. It is now clear that 'no-take' areas provide real benefits to fisheries.
2. Some benefits are local and direct - e.g. spillover of catchable adults from reserves.
3. Some benefits are regional and indirect - e.g. increased larval supply.
4. But the most important benefits are general - increased insurance against stock collapses from a wide variety of causes including:

insufficient data	major changes in technology
inappropriate analysis	major changes in market
political interference	natural changes in stocks
inadequate enforcement	

Even the best stock management programmes face some of these problems so the point is general.

5. 'No-take' areas provide the simplest, cheapest and most effective way of controlling fisheries impact - including
   - physical effects (such as trawling and dredging),
   - by-catch impacts (on birds, mammals, reptiles or vulnerable fish species),
   - genetic effects within stocks (e.g. reduction in growth rates),
   - ecosystem effects (e.g. reduction of keystone predators).

Even when the reduction in impacts is not sufficient to 'solve' the problem, the existence of 'no-take' reserves makes it much simpler to measure these impacts.

6. Many recent models of fisheries and 'no-take' areas suggest that fishing the whole stock area until problems arise - is not sensible, even to maximise the sustainable yield. There is strong support for the argument that overall yields is highest when a large amount (30% or more) of the stock area is excluded from harvesting.

The fisheries bad news:

1. Fisheries management assumes that fishing is a right, until problems arise.
2. Virtually all fisheries management (and science) is stock-specific. It is nobody's business to think about 'no-take' areas.
3. It is assumed that more and better data about stocks will solve any problems.
4. We ignore the ecosystem – including
   - complex interactions between species
   - natural interannual variations
   - fisheries impact on non-target species
5. We discount the full effects of stock specific management – especially
   - costs of data collection
   - costs of detailed enforcement
   - the strong social and economic pressures
6. All management is detailed and data-dependent, with no extra level to provide an insurance or buffer against the effects of large, sudden or unpredictable changes (e.g. Ballantine, 1997b; Dayton et al, 1995; Lauck et al, 1998).

CONVERGENCE

The fact that the potential benefits of marine reserves are multiple and wide-ranging should give a major boost to their adoption. However, with the present detailed and analytical approach this advantage is lost. Indeed the local and sectorial approach (which appeals to precise data) can turn the wide range of benefits into a disadvantage. For example, faced with any *particular* reserve proposal, fisheries scientists are usually obliged to say there is no evidence that *this* reserve would support any *particular* stock in a *measurable* way. Then they feel unable to provide any approval for the proposal. So there is no counterweight to those who find it convenient to fish at that site and say so very loudly. While we are restricted to considering single proposals separately, stating that a representative network of reserves will conserve *all* biota (including all harvestable species and presently undescribed species) is not very effective. Appeals to the general value of marine reserves to science and education also lack force until we talk about a *system*.

If any significant progress is to be made on marine reserves we need to get above the measurable detail and focus on basic principles. All aspects – political, scientific and resource management –need an upgrade in approach. Their existing problems may be expressed in different terms but are all due to a restricted approach. New Zealand has enough examples and experience with marine reserves to make the upgrade to principles and a system. The public would welcome a lead. Political decisions would be simplified. Science and conservation would benefit greatly. Resource management would gain in many ways. The convergence provided by the new approach would encourage cooperation.

SUPPORTING LITERATURE AND REFERENCES

***examples of overseas marine reserves**

Allison, G.W., Lubchenco, J. and Carr, M.H. 1998 Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applicatons 8 (S)*: 79-92.

***Attwood, C.G. and Bennett, B.A**. 1995 Modelling the effect of marine reserves on the recreational shore-fishery of South-western Cape, South Africa. *S. African Journal of Marine Science 16:* 227-240.

Ballantine, W.J. 1991 *Marine reserves for New Zealand.* Leigh Marine Laboratory Bulletin 25: 196 pages. University of Auckland, Auckland, New Zealand.

Ballantine, W.J. 1995 Networks of 'no-take' marine reserves are practical and necessary. Pp 13-20 in Shackell, N.L. and Willison, J.H.M. (editors), *Marine Protected Areas and Sustainable Fisheries.* Science and Management of Protected Areas Association, Wolfville, Nova Scotia.

Ballantine, W.J. 1997a Design principles for systmes of 'no-take' marine reserves. *In Workshop on The Design and Monitoring of Marine Reserves.* UBC Fisheries Center, Vancouver.

Ballantine, W.J. 1997b 'No-take' marine reserve networks support fisheries. Pp 702-706 in *Proceedings of the Second World Fisheries Congress,* CSIRO, Brisbane.

Ballantine, W.J. 1997c Letter (3 pp) and video (20 min) to all Members of Parliament.

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

Creese, R.G. and Cole, R.G. 1995 Marine conservation in New Zealand. *Pacific Conservation Biology 2:* 55-63.

Dayton, P.K., Thrush, S.F., Agardy, M.T. and Hofman, R.J. 1995 Environmental effects of marine fishing. *Aquatic Conservation: Marine and Freshwater Ecosystems 5:* 205-32.

Department of Conservation 1995 *Marine Reserves: a Department of Conservation information paper.* 22pp. Department of Conservation, Wellington, New Zealand.

Department of Conservation 1998 *Restoring the dawn chorus.* 64pp. Department of Conservation.

Dugan, J.E. and Davis, G.E. 1993 Applications of marine refugia to coastal fisheries management. *Canadian Journal of Fisheries and Aquatic Science 50*: 2029-42.

***Marine Parks Working Group** 1994 *A representative marine reserve system for Western Australia.* 217 pp + 36 maps. Marine Parks and Reserves Selection Working Group, Department of Conservation and Land Management, Perth, Western Australia.

Lauck, T., Clark, C.W., Magel, M. and Munro, G. 1998 Implementing the precautionary principle in fisheries management through marine reserves. *Ecological applications 8 (S):* 72-78.

Ludwig, D., Hilbron, R. and Walter, C. 1993 Uncertainty, resource exploitation, and conservation: lessons from history. *Science 260:* pp 17 and 36.

***McClanahan, T.R. and Shafir, S.H**. 1990 Causes and consequences of sea urchin abundance and diversity in Kenyan coral reef lagoons. *Oecologia 83:* 362-370.

Norse, E.A. (editor) 1993 *Global marine biological diversity.* 383 pp. Island Press, Washington, D.C.

PDT (Plan Development Team) 1990 *The potential of marine fishery reserves for reef fish management in the U.S. southern Atlantic.* 45 pp. NOAA Technical Memorandum NMFS-SEFC-261. Southeast Fisheries Center, Miami.

Roberts, C.D. and Paulin, C. 1997 Fish collection and collecting in New Zealand. In *Collection building in Icthyology and Herpetology.* American Society of Icthyology and Herpetology.

Roberts, C.M. 1997 Ecological advise for the global fisheries crisis. *Trends in Ecology and Evolution: 12:* 35-38.

Roberts, C.M. and Pulunin, N.V.C. 1991 Are marine reserves effective in management of reef fisheries? *Review in Fish Biology and Fisheries 1:* 65-91.

Roberts, C., Ballantine, W.J., Buxton, C.D., Dayton, P., Crowder, L.B., Milon, W., Orbach, M.K., Pauly, D., Texler, J. and Walters, C.J. 1995 Review of the use of marine fisheries reserves in the U.S. southeastern Atlantic. *NOAA Technical Memorandum NMFS-SEFSC-376:* 31 p.

Rowley, R. 1994 Case studies and reviews, Marine reserves in fisheries management. *Aquatic Conservation: Marine and Freshwater Ecosystems 4:* 233-254.

***Russ, G.R. and Alcala, A.C**. 1996 Marine reserves: rates and patterns of recovery decline of large predatory fish. *Ecological Applications 6(3):* 947-61.

Schmidt, K.F. 1997 'Not-take' zones spark fisheries debate. *Science 277*: 489-91.

Towns, D.R. and Ballantine, W.J. 1993 Conservation and restoration of New Zealand Island Ecosystems. *Trends in Ecology and Evolution 8:* 452-7.

Walls, K. 1995 The New Zealand experience in developing a marine biogeographic regionalisation. Pp. 33-48 in Muldoon, J. (Editor) *Towards a marine regionalisation for Australia.* Great Barrier Reef Marine Park Authority.