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# **Marine Park Science in NSW**

## **– An Independent Review**

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**A report prepared for the Marine Parks Advisory Council, NSW**

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# **Marine Park Science in NSW – An Independent Review**

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## **Executive Summary**

Based upon our deliberations in Sydney on November 9 to 11 2009 and various discussions around that time, the Independent Review Panel makes the following recommendations to the Marine Parks Advisory Council:

### **Primary importance**

1. The Strategic Framework from 2004 and Strategic Research Plan 2005-2010 need internal review and rewriting with a view to their renewal and use over 2010-15.
2. The Strategic Framework now requires a thorough internal re-evaluation of the relative emphases across different parts within it, their relative progress toward being achieved, and their priority order for the next five years.
3. The next Research Plan (for 2010-15) needs more detail to guide potential contributors to that research, monitoring and evaluation.
4. Key Research Areas addressing issues of socio-economic or heritage values need to be emphasised more so than in the past. Thus we expect that 'Socio-economic Issues', 'Indigenous and Non-indigenous Culture and Heritage', and several aspects within 'Specific Impacts' to get more overt attention during 2010-15.
5. More emphasis should be placed in the future on integrating socio-economic studies with biophysical studies to improve the effectiveness of the management of MPAs.
6. From a socio-economic perspective, non use values of Marine Parks should be considered within the next Research Plan.
7. A central part of that new Strategic Research Plan should be a more transparent undertaking to conduct research in each Marine Park and articulate how it fits into the Statewide network. Such a plan should mandate goals and a timetable for a set of "core" activities are essential to be able to describe the condition of biodiversity within the network and each Marine Park.
8. Give more emphasis to the research program for NSW Marine Parks as a whole rather than attempting to test each general hypothesis in all parks, e.g. construct a statewide database of research undertaken, datasets and key findings.
9. Complete habitat mapping across the entire NSW coast to address the CAR principles.
10. Shift from Major Priority 1 to Major Priority 2 (as detailed in the Strategic Framework) regarding the main uses of the research being done in NSW Marine Parks.
11. Clarify marine biodiversity for the wider public of NSW, focussing upon concepts, values and examples, rather than a focus upon any arguable spin-offs for fishing.

## **Secondary importance**

1. Be more assertive about the science and other research behind the NSW Marine Park system but also acknowledge areas of uncertainty or disagreement with public arguments.
2. Organise lists of research being done in each Marine Park around a clear strategy, e.g. into core (i.e. network-oriented) activities versus special (i.e. park-specific) cases.
3. Publicise the securing of external funding, publication of findings in the scientific literature, and appointment of scientists within each Marine Park and of Park Managers very familiar with research.
4. Focus upon removing undue delays, potential bottlenecks or any other systemic impediments to the publication of biophysical and other research done in NSW Marine Parks.
5. Articulate better the nexus between routine monitoring and specific research activities, and promote a more transparent program of activities already being done by DECCW or DII staff within Marine Parks to allow piggy-backing of student projects at minor cost to the Marine Park Authority.
6. Publish annual lists of key research questions to be tackled within each Marine Park and across the network as a way of encouraging external partnerships for research in a directive manner that mobilises interest in academia (including students), research providers and the wider community.
7. Test the key assumptions involved in using ecosystem and habitat features as a surrogate for biodiversity *per se* as a priority over the next five years.
8. Review the utility of the zonation, in particular what is gained by having sanctuary zones in ocean beach and estuarine habitats.

## **Tertiary importance**

1. Compile species lists for each park, especially linked to community-based monitoring or the detection of climate change (including invasive species).
2. Focus upon assessing the condition of habitats and species, patterns of change (especially transience, loss or degradation), and the juxtaposition of habitats and microhabitats in relation to connectivity (among other more sophisticated scientific questions) within NSW Marine Parks.
3. Provide better scientific documentation upon the Marine Parks Authority website, as a demonstration of an open and responsive approach in the Communication Plan for the Marine Park system in NSW.
4. Promote Marine Parks as key focal points for surveillance of the arrival of invasive species.
5. Investigate avenues to disseminate the findings from research projects through NGOs, e.g. recreational fisher organisations, to remove the implications that research is by and for government only.

## Introduction

NSW has six multiple-use Marine Parks that contribute the majority of seafloor area to the statewide system of Marine Protected Areas (MPAs), along with other area-management tools like Aquatic Reserves (mainly focussed upon intertidal and estuarine areas near Sydney). This arrangement has grown and evolved since 2001 and the first five years covered by a Research Plan (Anon undated) is now coming to an end. With a statutory timeline in place now in NSW for reviewing the zoning and operation of Marine Parks, the time was right for an injection of new strategic thinking. What was needed was independent advice about the performance to date of science and research in the Parks because of the prior controversy over aspects of the Marine Parks system.

Thus, in mid-September 2009, the NSW Marine Parks Authority for the Marine Parks Advisory Council began to install an Independent Review Panel to undertake a Marine Parks Science Review for the State of NSW. Membership and Terms of Reference (see Appendix 1) for the Panel were then settled upon, hearing dates set and background material distributed. The Independent Review Panel was commissioned to give a dispassionate viewpoint about what critics and stakeholders had to say about the system. A comprehensive list of stakeholders was invited to address the Panel and fortunately most of them could (or at least sent an alternative representative).

The Independent Review Panel convened November 9 to 11 in Sydney to take testimony from relevant staff and a variety of stakeholders (Appendix 2). In addition, we considered voluminous written material both pre-existing and prepared for this review, copies of presentations made to us, and other communications out of session (mainly to clarify specific issues) in the days preceding or following the hearings. One of the main documents the Independent Review Panel used was an interim report of an incomplete review of the research Plan and recent research that was being done by the Marine Parks Science Panel (MPSP 2009); these notes were invaluable in that they represented the considered views of eminent scientists involved at all levels with the Marine Parks of NSW, even though we acknowledge that that review process was not completed.

This report of the Independent Review Panel is written for the Marine Parks Advisory Council and the public of NSW to review how the Strategic Framework (2004) and Research Plan 2005-2010 “best ensure ... the vision for research and monitoring ... is achieved”. That vision is articulated in the various documents under five points:

- The locations and boundaries of Marine Parks use the best science;
- Rigour is applied in research and monitoring, with appropriate resourcing;
- Science provide accurate, timely advice to managers;
- Marine Park Authority science is integrated with other organisations; and
- The NSW public and international science community has full confidence in the use of science in NSW Marine Parks.

We also note the four priorities (2 major, 2 minor) given in the Strategic Framework (2004).

The Independent Review Panel's specific tasks were to:

1. Assess the appropriateness of the Strategic Framework and Research Plan in light of the growth of the Marine Park system and of knowledge since they were written;
2. Review the implementation effectiveness of the Strategic Framework and Research Plan;
3. Consider key stakeholder issues with the Strategic Framework and RP; and
4. Report directly to the Marine Parks Advisory Council.

Thus, our findings and recommendations encompass research priorities and gaps for 2010-15, and revisions to the Strategic Framework and Research Plan to ensure effective and efficient research and foster collaboration in the NSW Marine Parks. We trust that this review can assist in ensuring that research plays a crucial role in NSW Marine Parks over the next five years.

## Substance of the review

### **The Strategic Framework for the Evaluation and Monitoring of Marine Parks in NSW (2004)**

The tone of the *Strategic Framework for the Evaluation and Monitoring of Marine Parks in NSW* (Anon 2004) (hereafter 'the Strategic Framework') is essentially correct in that it sets the scene for research and monitoring within the NSW Marine Park system. Most of its content is hard to argue with, verging upon "motherhood" statements.

Now, at the end of this first 5-year cycle, it is very appropriate to have a thorough internal re-evaluation of how the parts contained within the Strategic Framework relate to one another and have been performed against over 2005-10. In particular, we see value in assessing:

- the relative emphasis across the parts of the Strategic Framework (for the four priorities and parts thereof);
- their relative progress towards the achievement of the goals of each; and
- their future priority order for 2010-15.

Specific issues and our recommendations include:

- A shift from Major Priority #1 to Major Priority #2 is appropriate now as most of the Marine Parks are established and bedded down. This would serve to focus more on the performance of the Marine Park system within NSW, thus keeping faith with the stakeholders who wish to understand how it is performing and how marine biodiversity within NSW is being protected by the system. These results should be collected now but interpreted in terms of the nation-wide understanding we now have of how long changes within fully-protected marine areas take to manifest themselves (e.g. see Edgar et al. 2009).
- Regarding Major Priority #1, more emphasis is needed upon the socio-economics (e.g. see p. 13 of the SF) and heritage aspects of the Marine Park system;
- Regarding Major Priority #2, there needs to be a more overt plan for sequentially monitoring, evaluating and modifying the boundaries and zones of the marine Parks. Such increased transparency would allow others (e.g. external research partners, the wider NSW public) to plan ahead to be involved, which in turn would deliver better on promises made to the public.
- Regarding Minor Priority #3, we feel that there should be more overt co-ordination from park to park via identifying the core, statewide and system-level activities and reporting that is possible. This may require a timeframe longer than the 1-3 year research plans (p. 17 of the SF) for individual Marine Parks.
- Regarding Minor Priority #4, there was clear evidence provided to us of reporting at all levels but it seems to be uneven regarding the international scientific literature. It may be possible to shorten the time lags inherent between when the research is completed versus it being published by including requirements for such in the internal reporting. For example, just accepted research reports in the format of a specified international journal can speed up submission of them to that journal. Likewise it is wise to foster a culture where research is celebrated more overtly, e.g. via an electronic newsletter highlighting research outputs (those also feed directly into the media).

## The Research Plan (2005-10)

This document includes the policy to implement the Strategic Framework for the first five-year period. It is quite a short document and there may be situations where something more detailed or specific (but not down to the level of a Park-specific Zoning or Operational Plan) is needed. The lack of guidance across that step may be hampering external research providers from seeing opportunities for collaboration.

The Independent Review Panel also notes the incomplete review of the Research Plan and recent research that has been conducted during 2009 by the Marine Parks Science Panel (MPSP 2009). This investigation was made available to us a document in the form of notes, observations and preliminary conclusions from part of the panel, especially relating to the five Key Research Areas, as well as the co-ordination and communication of the research. The MPSP add some rich detail here but it is hard for the Independent Review Panel to see whether that is just their interpretation or whether it constitutes a more concrete and extensive viewpoint that the Marine Parks Authority and other agencies involved also feel committed toward.

The Independent Review Panel found evidence of much ongoing or completed research and monitoring (e.g. see Anon 2009a,b) that has taken advantage of established Marine Parks within NSW. These are resulting in presentations at conferences and scientific papers published in the international literature, and the reputation of the work being done is on the whole excellent. The published outputs listed for 2004 to 2009 in Anon (2009b) include:

Journal papers	18 (14 international, 3 national, 1 regional)
Reports	14
Student theses	10 (5 Honours, 2 Masters, 3 PhD)
Conference papers	3
Other	3 (incl. occasional papers, other departmental output)
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TOTAL	48

Broken down by subject area or research approach, this output looks thus:

Basic biology, ecological patterns & processes	12
Techniques or modelling	9
Surveys & inventories of biota	8
Human responses	7
Assessments of ecological impacts or changes	6
Socio-economics	3
Links to industries within Parks	1

Thus the outputs from research are uneven, with relatively little being published as yet in the heritage or socio-economic disciplines. It is also unclear how many completed projects listed in Anon (2009a) have not yet resulted in outputs listed in Anon (2009b). Encouraging the publication of completed research is one way to both link to international efforts to understand

the effects and effectiveness of MPAs and keep faith with the public of NSW about the importance and utility of research and monitoring in NSW Marine Parks.

The Independent Review Panel feels that the 5 Key Research Areas outlined in the Research Plan are appropriate but detailed information about what each covers (e.g. what is meant by the dot points given on p. 5) should also be given. We were unclear how much of that is left to be specified in Zoning Plans or Operational Plans for each Marine Park. Extra detail will also be necessary in the future to show how the plans for 2010-15 are differentiated from those during the initial 2005-10 period.

## **Key Research Areas**

Each of these five Key Research Areas has been considered in detail by the Independent Review Panel member with the closest background and experience in that area, utilising a variety of documents and considering testimony taken on November 9-11. Each (and its sub-points) will be discussed in turn.

### **1. *Biodiversity and ecological processes***

A first step in any natural resources management exercise (including biodiversity conservation) is to understand what resource you have to manage. In terms of the NSW Marine Parks system that requires a thorough inventory of what lies within the boundaries of the Marine Parks, in terms of habitats, ecosystems and species of special interest. So it is appropriate that a large part of the research and monitoring effort during this first phase of work under the Strategic Framework has been focussed upon cataloguing the holdings of the Parks. What is perhaps needed now is more focus upon the differences amongst Parks and what that means in terms of the biodiversity that can be documented. Like many Marine Protected Area programs around Australia and the world, data on extant biodiversity within the jurisdiction has been lacking and so the planning (e.g. selection and zoning) for the Marine Parks in NSW has also been based upon capturing differences in habitat and ecosystem features. Implicit in this pragmatic decision is a reliance upon the so-called 'surrogacy hypothesis', i.e. that protecting features of the broader-scale habitats and ecosystems will in fact also make sure that patterns of taxonomic and genetic biodiversity are also represented well within the Marine Parks system as a whole. This is standard practice in biodiversity conservation on land as well as in the seas (see e.g. Rodrigues & Brooks 2007 for a full discussion) but does require some *a posteriori* evaluation to ensure its effectiveness *in situ* and to allow for possible fine-tuning over time.

**1a. Habitat knowledge** – as described above, this is key area for describing the key natural values of each Marine Park and so fits into both Major Priorities identified in the Strategic Framework. It is also perfectly understandable that this is the best-developed of the sub-areas under Key Research Area #1. For example, high-technology mapping of the estuaries and the seabed along the open coast has been undertaken in every Marine Park and the percentage coverage is nearing 100% for several of them. The current capability in NSW for seabed mapping is probably the best within Australia. The research program extends to all Marine Parks in NSW. During the next phase of a research plan (e.g. 2010-2015), what are the plans to (a) fill any gaps in coverage for each park and then (b) assess changes over time?



**1b. Ecological biodiversity** – this sub-area should be very fruitful grounds for collaboration because it probably aligns most closely to the “blue-sky” or curiosity-driven research that only academics can do. Thus applications for Australian Research Council Linkage Grants or other external funding for collaborations, especially projects being done by students are likely to be the main *modus operandi* here. Overall the level of collaborations and the seeking of external (third-party) funding is very good but does the Marine Park Authority direct enough where these are sought?

A key example of what should be done under this sub-area is to test the key assumption that habitats and ecosystemic features can act as adequate surrogates (*sensu* Rodrigues & Brooks 2007) for biodiversity at species and genetic levels. Many projects in this field are possible across the different Marine Parks and they would represent a clear shift in emphasis from Major Priority #1 to Major Priority #2 (as suggested above).

In terms of assessing important components of the biota, the Baited Remote Underwater Video System (BRUVS) program to measure fish abundances, sizes and biomasses is expanding and this is probably second only to that in Western Australia. It is also the only research program in this sub-area occurring in each of the Marine Parks (others are operational in only 1, 2 or 4 Marine Parks, with most occurring in only one). What is the plan for BRUVS in the future? How does it link explicitly into zoning reviews and other assessment points in the future?

**1c. Ecosystem dynamics** – the assessment of ecological processes and linkages is essential to understanding how any ecosystem functions. This seems to be the least developed research sub-area under Key Research Area #1 at present.

## **2. Indigenous and non-indigenous culture & heritage**

Very little information was tendered to the Independent Review Panel regarding this Key Research Area and it is not a discipline that we claim much expertise in. This is not unusual in many Marine Protected Areas around the world, where the biophysical issues are easier to deal with more forthrightly. We note the inherent difficulty in some aspects of this Key Research Area and recommend that heritage experts be engaged to facilitate overcoming this situation. Therefore the Panel notes this relative paucity of information and suggest that more attention be given the Area by other experts with relevant experience.

## **3. Ecologically sustainable use**

The NSW system of Marine Parks aims to provide for the ecologically sustainable use of marine resources and opportunities for public appreciation, understanding and enjoyment. In this context, sustainable uses are seen as activities that have negligible and reversible impacts on the physical and biological attributes of the protected area. Activities that are not consistent with the protected area values of the park are specifically excluded. Ecologically sustainable use is achieved within a framework of spatial closures (zones) each with different sets of conditions, where different levels of extractive and non-extractive activities are permitted. The

highest level of protection is contained within sanctuaries where all forms of exploitation are disallowed.

The four key research sub-areas outlined in the 2005-2010 Research Plan (Anon undated) to assess ecologically sustainable use are considered below.

**3a. Assessment of marine park zoning** - the two over-arching priorities for research and monitoring in NSW Marine Parks were identified in the Strategic Framework as:

1. Identify and select the location and nature of marine parks and their zones.
2. Monitor and evaluate the effectiveness of marine park zoning and related management arrangements.

The Marine Parks Authority stated that assessment of the marine park zoning aimed to examine the optimum design of marine parks (size, patterns of zoning etc), investigate the effectiveness of marine parks in increasing propagation and extent of spillovers, and examine the effects on community structure and function due to removal of target species.

Those projects addressing these issues included:

- Mud crab monitoring program in SIMP
- Mapping of seabed habitats throughout all marine parks
- Long-term assessment of shallow reef assemblages in JBMP

The Marine Parks Authority stated that information from these projects fed directly into the current reviews of the SIMP and JBMP zoning plans.

Several submissions criticised the science or perceived lack of science underpinning the selection, location and zonation of MPAs in NSW (with an emphasis on the most recently proclaimed Batemans Marine Park).

An evaluation of CAR as it relates to the existing MPA network was beyond the terms of reference of the review; however, suffice to say that all stakeholders believed that the system adequately represented the diversity of the NSW coast other than in the Hawkesbury bioregion.

The zonation of the MPAs was severely criticised as lacking a robust scientific framework, skewed towards the exclusion of fishing as a threat and conversely failing to address several other threats including land-based activities, development and habitat modification – all of which threaten core MPA values.

Some of this criticism was levelled at what was perceived to be a bias in the Marine Parks Authority scientific argument in support of the Marine Parks strategy and as well as inappropriate or incorrect interpretation of the literature, especially its application to the NSW situation.

The Independent Review Panel agreed with some of these criticisms and felt that more could be done to better argue the case for MPAs, better communicate the science that had been done to support the implementation of the network, and better illustrate the motivations behind some of the decision process.

Just as sub-area 1a was the logical main focus of the first five years of research, this sub-area (Assessment of marine park zoning) should be the main focus of 2010-15. Thus more emphasis

is needed in this sub-area. Our understanding of the performance of the Marine Park system and the zones within each Marine Park needs to be routinely assessed and conveyed to the NSW public as an act of good faith toward them. Because of the research that has been done so far (or will be done with the external funds secured so far), much of the data to do this has been collected already but needs dedicated analysis and scrutiny.

Ongoing research and key gaps in knowledge may be summarised as follows:

- a. Continuation of the habitat mapping program to provide complete coverage of the MPAs;
- b. Evaluation of the role of zonation in the performance of the MPA against stated objectives in terms of biodiversity conservation, spillover benefits, community benefit (see below); and
- c. Against (b), evaluation of the socio-economic effects of zonation on the community, particularly the impact of displaced recreational fishing on adjacent areas.

**3b. Population biology and assessment** - knowledge of key population parameters such as abundance, age, growth, early life-history, reproduction, movement and connectivity are important to the understanding of the status of species protected within an MPA. Assessment of such parameters can inform a range of decisions including design, zonation, threats, vulnerability, risk and recovery.

The Marine Parks Authority noted that much of this research was undertaken by DII NSW and university projects, but a number of specific projects have been conducted by the Marine Parks Authority to provide specific information required for zoning and local management issues.

Examples of key research projects in this area include:

- Life-history and ecology of Bluefish at Lord Howe Island
- Review of life-history parameters for key fish and shark species throughout south-eastern Australia

Ongoing research and key gaps in knowledge may be summarised as follows (based substantially on the work of the Marine Parks Science Panel, see MPSP 2009):

- a. Extending the monitoring of abundances (currently focuses primarily on organisms in reef habitats) to other habitats and key species, e.g. soft substrates, seabirds, turtles.
- b. Movement and population connectivity for most organisms is poorly understood. The effectiveness of the network (in terms of size, location and zonation) is therefore unknown.
- c. Evaluating the direct and indirect effects of fishing and of protection (e.g. age-structure of exploited species, reproductive output, size at sex-change, genetic diversity).

- d. Climate change and threats other than fishing are not well understood.
- e. Understanding dispersal and connectivity of organisms at a range of spatial scales. More sophisticated methodologies should be incorporated e.g. modelling, acoustic tagging, genetics, otolith chemistry.

**3c. Fishing and collecting** - access to ecologically sustainable extractive uses such as fishing and collecting is a core value of the NSW system of MPAs. Within a multiple-use management framework, extraction is permitted as long as it is clear that such activities do not compromise the core values, goals and objectives of the MPA. It is clearly recognised that management of such activities needs to be underpinned by an understanding of the distribution and composition of recreational and commercial fishing catch and effort, and their direct and indirect impacts on the protected area values of the MPA.

The Department of Industry and Investment have the lead responsibility for fisheries management in NSW and thus lead catch and effort monitoring. The effectiveness of fishery dependent data for marine park management has been limited in ocean based fisheries. Until July 2009, all ocean catches (except lobster and abalone) were reported on a monthly basis as taken in 1 of 10 zones (representing degrees of latitude – each approx. 110km of coast) along the NSW coast. Hence, it has not been possible to ascertain the level of catch and effort at even the scale of an entire marine park. A new improved [commercial catch and effort reporting system](#), which commenced on 1 July 2009, will provide data on a much finer spatial (latitudinal grids at 6 minute intervals, and within/or outside of marine park) and temporal scale (fishing event-based reporting).

The Marine Parks Authority in conjunction with external collaborators (e.g. universities) have instigated a considerable number of monitoring programs to assess key questions relating to fishing and collecting.

Existing projects focus primarily on estimating abundance and size of benthic invertebrates and fishes in shallow and deep water reef habitats, using visual census and BRUVs. Sampling is designed to assess the effects of zoning and associated management on reef-fish community structure. These projects, when combined with habitat sampling (considered under 'habitat knowledge'), will provide a valuable basis to examine the efficacy of Marine Parks zoning (e.g. size, location) on exploited species, and to understand the effects of removal of marine organisms on community structure and function. In contrast, monitoring of organisms in soft-sediment, intertidal and estuarine habitats is disparate across the entire Marine Parks network (e.g. mud crab monitoring program in SIMP, intertidal monitoring in JBMP).

Ongoing research and key gaps in knowledge as may be summarised follows (based substantially on the work of the Marine Parks Science Panel, see MPSP 2009):

- a. Monitoring programmes focus upon reef habitats and need to be broadened to include a more representative range of habitats and biota found in the Parks. Data are required to assess key questions relating to fishing and collecting within soft-sediment, intertidal, and estuarine environments.

- b. Some key research questions need to be assessed at the level of the network rather than trying to repeat similar work in all MPAs (e.g. The effect of Marine Parks zoning on benthic fish assemblages on deep water reefs).
- c. Sampling designs and methodologies for some core-monitoring projects appear to be variable across the network. Current and future project designs should be standardised where possible (e.g. BRUVs program). Assessment of aquatic reserves (outside MPs) should also follow similar methodological guidelines. This approach will allow for easier comparison of results across protected areas and the generality of the response of key organisms and rates and mechanisms of recovery (e.g. immigration versus recruitment) to be assessed. For example, is the response of a species consistent across all protected areas?
- d. Data on distribution of fishers, fishing effort and catch composition (including compliance within sanctuaries) are inadequate for most Marine Parks. These data are imperative if fishing and collecting effects are to be accurately determined (e.g. understanding what types and levels of exploitation are associated with different zones). Where possible, the displacement of fishers from sanctuary zones should be assessed. Displacement may lead to increased pressure in control or 'unprotected-fished' sampling areas, confounding subsequent comparisons between 'protected' and 'unprotected' sites. Control locations situated outside of displacement areas (e.g. outside of Marine Parks) may be needed.
- e. There are no data to determine large-scale effects of the Marine Parks network on fishing and collecting. For example, comparisons could be made among Marine Parks versus regions without Marine Parks (e.g. the Hawkesbury and Twofold Shelf Bioregions). Collection of data within regions using similar methodologies would also allow identification of gaps in species protection within NSW.
- f. There are few research projects that focus on the indirect effects of fishing on the population biology of target organisms. Exploitation may significantly influence, for example, age-structure, reproductive biology and genetic diversity. Such projects may be considered under 'Population Biology and Assessment'.
- g. There are few data on the indirect effects of fishing and collecting (e.g. changes in marine food webs, endangerment by fishing gear) on other key species such as marine mammals, turtles, and sea birds.
- h. There are no studies which specifically address the potential for spillover of eggs, larvae and adults from MPs to improve the sustainability of exploited species or enhance fisheries in unprotected areas.

Assessments of fishing and collecting as factors should in the future focus upon contrasting fishing effort and fish populations (both target species and not) either inside versus outside the Marine Park, across zones (especially Sanctuary or Habitat Protection Zones) and other specific contrasts to better understand the effects of protection in NSW.

**3d. Recreation and tourism** - as was the case with fishing, NSW MPAs were managed to provide for other ecologically sustainable uses such as recreation and tourism.

This key research area aimed specifically to assess usage, impacts and threats of anthropogenic activity on habitats and species, and to examine interactions with marine mammals. The Independent Review Panel noted that there was little data relating to 'non-extractive'

recreation and tourism in NSW MPs. Most of the existing research work had focused on 'fishing and collecting'.

Examples of key research projects in this area included:

- Monitoring recreational SCUBA diving activities in CBMP and JBMP
- Assessment of dolphin populations and habitat use in PSGLMP
- Assessment of impacts from vehicles and horses to pipi populations in CBMP
- Interactions between dolphins and kayak tours in CBMP

These projects are providing information required to manage and minimise threats at the local scale and will input directly into zoning plan reviews.

While tourism and recreational activities were encouraged within MPAs and seen by many as being non-extractive and consistent with marine park values, it was recognised that they too may significantly impact local biodiversity, especially where they focus human activity in particular locations. Examples included threats of anthropogenic activity on habitats, interactions with marine mammals, diving impacts on sensitive habitats/species, and impacts on shorebirds.

As was the case for fishing, projects investigating impacts of recreation and tourism should be strongly linked to the zoning plans of individual Marine Parks.

Ongoing research and key gaps in knowledge as may be summarised follows (based substantially on the work of the Marine Parks Science Panel, see MPSP 2009):

- a. Inadequate data on 'non-extractive' tourism and recreational activities in all Parks.
- b. Poor knowledge of which activities constitute key threats to biodiversity within individual Parks.

Much more research could be done under the sub-area of Recreation and tourism because those impacts are likely to be of the right scale for student research projects (e.g. at undergraduate, Honours and post-graduate levels).

#### **4. *Specific Impacts***

Under this Key Research Area, more evidence needs to be gathered regarding patterns of human usage of the different zones, and of the population and ecosystem responses to management if we are to consider "how those zones function in biodiversity conservation" (p. 3 of Anon 2009a).

Links to the Statewide Monitoring, Evaluation and Reporting (MER) environmental program seem to be particularly important to this Key Research Area but they need to allow assessments within each Marine Park as well as across the network as a whole. The work mentioned under this Key Research Area seems to be rather less well aligned with Marine Parks and their objectives than other Key Research Areas.

#### **5. *Socio-economic influences***

## **Review of Socio-Economic Research**

### The intended role of socio-economic research

The *Strategic Framework for the Evaluation and Monitoring of Marine Parks in NSW* (2004) (hereafter 'the Strategic Framework') acknowledges that the creation of a Marine Protected Area (MPA) and the establishment of zones to stipulate the location of extractive uses can have consequences for people using these areas. The Strategic Framework suggests that a better understanding of the value of marine areas to indigenous, recreational and commercial users would provide valuable input to the selection of MPAs and to the identification of zones for specified uses. Socio-economic evaluation of MPAs was identified as an information gap in the Strategic Framework. To date, a substantial amount of effort has been expended on biophysical studies to develop a comprehensive data base on each of the MPAs. This is essential for understanding the ecology of these areas and for monitoring the efficacy of these areas to meet the stated objective of conserving marine biodiversity.

Monitoring the socio-economic consequences of MPAs requires a long-term commitment to detect changed values for these areas and to identify substantive anthropogenic impacts which could help to inform the periodic reviews of these areas. Two specific categories of supporting research programs require the contribution of economics research; namely the Key Research Areas of 'Ecologically sustainable use' and 'Socio-economic influences'. A third category of research, the Key Research Area of 'Indigenous and non-indigenous culture and heritage', is the province of the sociologists.

The Strategic Framework acknowledges that the support of the community is essential if MPAs are to be successful. More specifically, communication of incremental changes in the quality of the marine environment encompassed in MPAs is likely to result in changes to both use and non use values over time which, if monitored appropriately, would lead to greater societal awareness and therefore an appreciated value for these areas.

### Economic principles underlying economic evaluation and impact assessment of the environment

There are a number of economic concepts and principles underlying economic evaluation and assessment of environmental areas which it is worthwhile reiterating briefly before embarking on this review. At least some of these concepts and proposals to undertake socio-economic research on MPAs have been discussed at some length in a report prepared for the NSW Marine Parks Authority (Hassall and Assoc and Gillespie Economics, 2004). Two standard economic techniques are used for assessing the contribution of MPAs to society as a whole and to the economy of interest: evaluation using cost-benefit analysis (CBA) or extended forms of CBA, and impact assessment using relatively simple Input-Output analysis (IO).

## **Evaluation**

### Cost-Benefit Analysis (CBA)

The standard economic approach to evaluation of a project, such as the establishment of a MPA, to evaluate actions to manage an established Park, or to monitor the net benefits from



public sector investment in conservation of MPAs is to undertake a CBA of the net benefits to society as a whole (that is, the estimated costs less the estimated benefits). This requires an estimate of the Total Economic Value (TEV) of the MPA. The economic value of a conservation area can be valued also as the avoided cost of lost use and non use values from conservation areas if they are not protected. The concept of TEV is an attempt by economists to demonstrate that all aspects of the value of the environment provided by an area such as a MPA are encompassed in the monetary estimate.

The cost side of CBA requires all the costs associated with public sector investment to be identified and valued in monetary terms. Outlays in relation to initial capital costs and on-going costs of, for example, enforcement and general maintenance of facilities is generally available through the market cost of service provision. However, costs associated with loss of commercial fishing sites or reduced recreational fishing areas and scuba diving sites can be more problematic if information about the number of fishers, size and composition of catches and recreational values associated with fishing are not readily available. The more intangible the use values become, the more uncertain the estimates of value.

#### Total economic value (TEV)

Briefly, the TEV categorises values as use values and non use values, where the use values are further categorised as either extractive or non extractive. Hence, commercial and recreational fishing are extractive whereas swimming, boating and scuba diving are non extractive uses. The Strategic Framework suggested an interest in the "value of marine areas to indigenous, recreational and commercial users", but failed to acknowledge that the non uses for these areas are substantial. The non use values include the so called intangible values such as the value of existence or bequest, or the option value (an acknowledgement of a use or non use in the future). Although none of these examples of non use value are readily estimated in monetary terms, they are nevertheless important for evaluation of the benefits of conserving an area such as a MPA, and for demonstrating the benefits, over time from conservation. Estimation of the TEV of a MPA tells us what the conservation area is worth at a particular point in time. Evaluation of a change in management requires an estimate of the change in value over time, as a result of management. The incremental or marginal change needs to be monitored as one element in the management of a MPA, in short, to determine whether, or if, the conservation area is a continuing and growing benefit to society as a whole. There are a number of non market valuation approaches which could be used to estimate the willingness to pay (WTP) for a MPA and which, if implemented appropriately would provide an estimate of the TEV for these areas.

#### Other evaluation approaches

Other evaluation approaches that would be appropriate to assist with evaluating the management of MPAs include cost utility analysis (CUA) and multiple criteria analysis (MCA). Both of these techniques are considered particularly useful when there are multiple objectives for management to be considered and where at least some of these objectives are difficult to value in monetary terms. MCA is increasingly adopted for decisions where environmental impacts are concerned and where orders of magnitude of outcomes are more reliable and relevant than an estimate of the net worth of a project.



## Impact analysis

IO studies are commonly used to estimate the impact of a project on economic indicators, for example employment, gross output etc., for a specified regional economy. They can be particularly useful for identifying the extent of change in an economy and which industry sectors are likely to experience most change, both positive and negative.

### Relevance of socio-economic research for MPAs

- As each MPA in NSW comes under review and questions are raised about future management of the specified areas within each Park, the community will become increasingly concerned about the impact that these areas have had and could be having on their livelihood, their ability to earn an income, and on their lifestyle. Socio-economic studies have an important role in demonstrating to the community that MPAs are beneficial for their use and non use values. More importantly, socio-economic studies can provide valuable information to show how an economy in an area is evolving as some uses (extractive and non extractive) decline due to zoning restrictions and others increase.
- MPAs are designed for multiple uses. As MPAs come up for their scheduled zoning reviews, some modification in the zoning within these areas is inevitable, particularly where the results from studies have shown adverse impacts on the biodiversity of an area due to over-use (for example, diving around Julian Rocks, Byron Bay or recreation fisher pressure within the Jervis Bay MPA). Socio-economic studies become particularly important to demonstrate the magnitude of the trade-off if such areas are more closely managed.
- As the wider community (resident outside of areas adjacent to MPAs) become more aware of the extent of the biodiversity conserved within MPAs, the TEV of these areas becomes increasingly important, particularly the non use elements.

### Current status of socio-economic research

Although a number of studies have been commissioned to identify socio-economic research and data requirements, it is disappointing to see that the studies arising from the recommendations have been largely *ad hoc*. Some progress has been made to fill the information gaps but there are still substantial gaps in baseline information. Baseline information about the value, magnitude and nature of uses and non uses of each MPA is essential for assessing incremental or marginal change. It can be argued that this knowledge is needed prior to zoning; however, it is required also to inform on-going management and for the periodic reviews of re-zoning.

There have been a number of studies commissioned by the NSW Marine Parks Authority to identify socio-economic information requirements for the on-going management of existing MPAs and to prioritise future research areas. In particular, Hassall and Assoc and Gillespie Economics (2004) provided an overview of approaches to identify economic values, both direct and indirect, to estimate the direct and indirect economic impacts resulting from MPAs. This

study set up a number of economic principles underlying future research and proceeded to identify the information requirements on which to base future economic monitoring and impact assessments. Another study, also commissioned by the NSW Marine Parks Authority, by Marsden Jacobs (2004) was specifically required to identify the criteria on which to prioritise future research requirements for MPAs and, more importantly, to evaluate scientific research proposals and to explicitly consider the integration of scientific research and economics research. Disappointingly, the report falls far short of its intended requirements leaving a number of questions about research prioritization unanswered.

#### **Data collation**

Data collection to date has concentrated on establishing information about the users of the MPAs. Some baseline recreational fishing data has been collected for individual MPAs, in particular Jervis Bay and Solitary Islands, where recreational fishing is the largest extractive use for the Park and is likely to be most impacted by rezoning changes. Attitudinal studies have also been undertaken but not for all MPAs.

#### **Impact studies**

Impact assessments have been undertaken on the Port Stephens-Great Lakes and on Batemans Bay MPAs to estimate the economic impact of the reduction in commercial activities in these MPAs on the surrounding regional economies. These have been done well, despite incomplete or insufficient data availability about fishers' catches and income from fishing and the charter boat industry. It is particularly interesting to find that, in both these studies, the growth in population in these areas over the years since the declaration of the MPA has brought a substantial stimulus to the local economy which has more than compensated for the decline in commercial activities. Unfortunately, no data is available to determine if/whether the MPA was a specific motivation for the influx of population.

#### **Attitudinal studies**

A more descriptive and attitudinal socio-economic study was prepared for the Solitary Islands with similar findings to the impact assessments. Attitudinal surveys have also been undertaken for Jervis Bay. Although attitudinal studies are interesting for policy makers wanting to determine the level of support for MPAs, they have limited use for economic evaluation and impact studies.

#### **Key information gaps**

- Attitudinal surveys in a number of MPAs are on-going but more detailed information about the socio-demographic profile of those responding to these surveys would enable a more useful analysis from these studies.
- The Hassel and Assoc and Gillespie Economics (2004) report identified substantial information gaps which would need to be filled to facilitate socio-economic evaluation and monitoring of MPAs. For the most part, these identified information gaps have not been filled. In particular, the extent and value of extractive uses for MPAs and the current economic structure of regional economies likely to be impacted by MPAs.
- Evaluation of the socio-economic impacts of the exclusion of ocean beach fishing and the relative value of no-take zones in this dynamic environment.

## Recommendations for future research

The initial stated objectives for MPAs concentrated on users and use values for MPAs. NSW tax payers are all contributing to the management of MPAs in NSW and their preferences, in terms of their WTP, should therefore be included in the value of MPAs. In short, estimates of TEV need to be undertaken.

- *Estimates of TEV*

The most useful and arguably the most reliable WTP approach for estimating TEV of environmental areas is Choice Modelling. In its simplest form, Choice Modelling requires a survey to be undertaken of consumers' willingness to pay for an improvement in one or more specified attributes of an environmental good or service. This approach is particularly useful for estimating the TEV of a MPA because a range of attributes, including use and non use attributes, can be included within the choice sets. Information from a Choice Modelling study can be used to inform MPA managers about the direction and level of management preferred by the community.

- *Evaluation of reviews of zoning plans*

Given the current relatively-strong emphasis on biophysical studies of MPAs, evaluation of zoning reviews is likely to require a flexible and transparent evaluation technique that will facilitate the incorporation of qualitative and quantitative, monetary and non monetary measures to demonstrate the trade-offs and likely impacts from changes in re-zoning. It is recommended that MCA and variants of MCA be investigated to enable relatively greater transparency in evaluation which has the capacity to incorporate community opinions which is likely to lead to greater community acceptance of outcomes for on-going management.

- *Completion of impact assessments using consistent analytical approach*

Impact assessments for two MPAs have been undertaken. These assessments need to be undertaken for Byron Bay and Jervis Bay. A study for the Solitary Islands was undertaken but to enable the outcomes from the studies to be comparable, the same IO techniques need to be applied.

- *Evaluation of options to reduce land-based impacts on MPAs*

Given the heightened awareness of NSW MPAs, there is an understandably increased awareness of run-off from urban and rural land-use into MPAs. This issue has been identified through the consultative process undertaken by the Review Committee. Although most of the specified sanctuary zones within the MPAs are adjacent to National Parks or designated conservation areas, there remains a need to consider the wider impact of catchment land-use changes on MPAs and to manage land use to ensure the protection of MPAs. This issue is likely to become increasingly relevant as climate change impacts become more apparent.

Prioritisation of management options for land use requires economic evaluation. An evaluation approach that clearly establishes the anticipated trade-offs between changed land use and the health of MPAs is essential if compliance by the community is to be earned.

## Responses to Stakeholder Perspectives

Some of the testimony heard from external stakeholders was focussed on the philosophy and operational aspects underpinning the Marine Park system in NSW. While some of the issues raised had merit, the Independent Review Panel was firmly of the view that the review should be focussed on the Terms of Reference (Appendix 1), which was to look at the science underpinning the Strategic Framework and the Research Plan. The Panel did not think it was appropriate to comment on whether NSW should have marine parks or not – this was a whole-of-government decision agreed to by both the environmental managers and fisheries managers of NSW.

We heard some strident criticism of the quality of the review material that was used by the Marine Parks Authority to justify the Marine Parks system within NSW, in particular the declaration of the BMP. It seems that the standard of scholarship displayed in the original document (that was undated but available on the Marine Parks Authority website prior to 2008, and then replaced by an update, see Marine Parks Authority 2008) was particularly poor, as outlined in Kearney (2007, 2008, 2009). The updated version (Marine Parks Authority 2008) rectified a number of the problems that Professor Kearney and others identified but did not change any of the conclusions, nor did it acknowledge the criticisms in any way.

Kearney (2008, 2009) went on to criticise that outcome as being unacceptable scientific behaviour. While the Independent Review Panel was sympathetic, it noted that the so-called 'science paper' was an educational tool aimed at the wider public of NSW. The fact that it presented only the benefits with none of the costs of Marine Protected Areas (as criticised by Kearney) is not uncommon in such advocacy documents available on government websites. Such documents are not subject to peer review in themselves and do not conform to all of the expectations of the primary scientific literature. However, they do use the scientific literature, and we concur that this should be done in a proper, correct and transparent manner.

The Independent Review Panel believes that there is merit in a formal response by either DECCW or the Marine Parks Authority to Professor Kearney's concerns.

Several stakeholders made reference to the use of global compendia of the outcomes of Marine Protected Areas (especially no-take reserves) being inappropriate, especially where the case studies did not appear to be very relevant to the NSW situation. The Independent Review Panel considers this to be a valid criticism where that use extends beyond just alerting the NSW public to the experience with Marine Protected Areas elsewhere. For example, the use of tropical examples or case studies coming from countries where there is no or little formal fisheries management is not deemed appropriate (see also Appendix 3).

In addition to the presentations put to the Independent Review Panel and the broad ranging discussion of topics of interest, we put a series of questions to the external stakeholders which aimed to obtain a broad understanding of several key issues. They were:

- Does the current Marine Park system represent the marine biodiversity of NSW?

The majority of respondents felt that the current system of Marine Parks by and large represented the marine biodiversity of NSW. However, most highlighted the fact that, while the central Hawkesbury Marine Bioregion had some smaller Aquatic Reserves, it lacked the protection of a Marine Park. The Twofold Shelf was also highlighted as lacking a Marine Park but it was acknowledged that this Bioregion largely fell within other States. The unevenness of this coverage caused some respondents concern about how well the system could perform. Given that this is not well understood here or in many other areas of the world, the Independent Review Panel thought this should be part of the ongoing research plan.

Zonation drew a lot of comment. Most were comfortable with multiple-use parks, although some interest groups (e.g. recreational fishers) thought that the current no-take coverage (6.5% of NSW waters) was excessive, while others (e.g. National Parks Association) thought that a target of 20% no take was needed.

- Does the current MPA system effectively contribute to the conservation & maintenance of biodiversity? If so, how does it do that?

There was a healthy scepticism as to whether the current MPA system was effectively contributing to the conservation & maintenance of biodiversity. This was either in terms of how the Marine Parks operated or about whether they could address the real threats to marine biodiversity within NSW waters (see below). There was a dichotomy in views between internal (where satisfaction was expressed) versus external stakeholders (less so). The latter group was itself polarised into some environmentalists wanting more Parks and better enforcement or more highly-protective zoning versus extractive users who wanted less restrictions upon their activities.

Several respondents felt that fishing was unfairly targeted as a threatening process and that closures were unlikely to achieve major conservation outcomes or were not a cost effective method of addressing major threats to the environment.

There were divergent views on spillover and the contribution of Marine Parks to the sustainability of fisheries. Most agreed that more should be done to understand this possibility in a NSW context.

- What do you understand to be meant by biodiversity conservation?

Notwithstanding the Independent Review Panel's view that more needed to be done to promote the MPA system, the stakeholders had a good grasp of the essential concept of "biodiversity conservation".

The Independent Review Panel believed that the understanding of the concepts of how biodiversity was threatened, and how MPAs would assist in securing the future, was less well understood than the concept of biodiversity conservation itself.

The range of threats as identified by Marine Parks Authority and national bodies (e.g. Marine Biodiversity Decline Working Group 2008) was ventured by most respondents although the perceived risk from them varied considerably. For example, the emphasis on fishing varied from 'has no effect' to 'is the main threat' according to the sector that representatives came from. Some respondents ventured that the Marine Parks system allows for both direct

influences via zoning upon mainly extractive uses but also could play a less-clear role in influencing off-site issues such as pollution, land-use decision, development, etc. Very few proposed any role for the Marine Parks system in tackling threats from invasive species or climate change.

- Does the current system adopt appropriate and up-to-date methods & approaches?

There was a varied appreciation of the science that underpinned the system.

The internal researcher respondents spoke of the methodologies utilised in the habitat mapping, BRUVS and other work that was being done within various Marine Parks. In contrast, Professor Kearney was scathing in viewing the outputs from the Marine Parks Authority as indicating a very low level of capability to interpret scientific findings.

The Independent Review Panel was alarmed at the bumper stickers and other indications that a large portion of the NSW public seems to have been convinced that there is no science at all behind the Marine Parks system in NSW. Clearly this is not the case, and the Department's own scientific advisors should be concerned about that misrepresentation of their advice to the fishing lobby. But it also points to the bigger problem of how the Marine Parks Authority, DECCW and DII communicate about the Marine Parks; the Independent Review Panel would expect to see a better outcome for the level of investment in research and monitoring in NSW.

- Does the current system find resourcing from the appropriate places and opportunities?

Respondents with scientific background alluded to collaboration opportunities for individual projects but perhaps did not see that as part of a bigger plan or framework to roll out over the coming years and decades.

- Does the current system allow for collaboration with external scientists and community groups?

Collaboration was seen by most respondents as being central to the ongoing research and monitoring. Some of the recreational fishers requested more opportunity to be involved in day-to-day management of Recreational Fishing Havens (which, of course, are not part of the Marine Parks). More positively they also offered themselves as resources for use in research and monitoring (especially putting single observations of events or findings into a longer and wider context). The opportunities for collaborative research with external scientists are probably being taken up more than for monitoring, but that situation could change as the MER program gets bedded down more securely in the future. Articulation of how the MER timetable can be made to dovetail with the needs for evaluation and reporting in the cycles for each Marine Park would allow better future planning of scientific activities in each of the Marine Parks.

- Does the current system allow for timely and clear communication of findings to the public of NSW?

Many of the external stakeholders expressed dissatisfaction with this aspect of Marine Parks management, in particular some of the media releases of recent times. The Independent

Review Panel was concerned that the message is not getting out to the wider NSW public in the best fashion.

- Does the current system contribute to the global understanding of marine protected area management and biodiversity?

The Independent Review Panel felt that the research scientists involved were plugged into the national and international networks for MPA research and monitoring. These links were leading to fruitful collaborations, success with gaining grants and publication success with the findings and outcomes of that scientific activity. The placement of an active scientist within most of the parks and the appointment of managers with scientific backgrounds was innovative for Australia and should continue to bear fruit in the future.

## **Findings and Recommendations**

These recommendations are split into three groups that begin as very general and important but then narrow to be more specific. In each case they are justified by our relevant finding.

### **Primary importance**

- The Strategic Framework from 2004 and Strategic Research Plan 2005-2010 need internal review and rewriting with a view to their renewal and use over 2010-15.

The Strategic Framework from 2004 and Strategic Research Plan 2005-2010 have served the Marine Park Authority well during this first phase of establishing the Marine Parks as operating entities but now both need to be reviewed internally and rewritten with a view to their renewal and use over 2010-15.

- The Strategic Framework now requires a thorough internal re-evaluation of the relative emphases across different parts within it, their relative progress toward being achieved, and their priority order for the next five years.

Broadly the Strategic Framework covers the correct issues for the NSW system of marine parks but it is timely now that a thorough internal re-evaluation be done of the relative emphases across different parts within it, their relative progress toward being achieved, and their priority order for the next five years.

- The next Research Plan (for 2010-15) needs more detail to guide potential contributors to that research, monitoring and evaluation.

Similarly the Research Plan 2005-2010 covers the policy needed to implement the Strategic Framework but there is an argument that this document needs more detail to guide potential contributors to that research, monitoring and evaluation.

- Key Research Areas addressing issues of socio-economic or heritage values need to be emphasised more so than in the past. Thus we expect that 'Socio-economic Issues', 'Indigenous and Non-indigenous Culture and Heritage', and several aspects within 'Specific Impacts' to get more overt attention during 2010-15.

The five Key Research Areas identified in the Research Plan are appropriate but the emphasis across them in 2005-2010 has been rather uneven. So far the attention to issues of socio-economic or heritage values seems to be much less than the biophysical aspects of NSW Marine Parks. Although we are heartened that they appear in the five strategic areas for research, they now need to be emphasised more so than in the past. Thus we would expect to see the Key Research Areas of 'Socio-economic Issues', 'Indigenous and Non-indigenous Culture and Heritage', and several aspects within 'Specific Impacts' to require more overt attention during 2010-15.



- More emphasis should be placed in the future on integrating socio-economic studies with biophysical studies to improve the effectiveness of the management of MPAs.

There are many instances where our knowledge would be strengthened by joining socio-economic studies with biophysical ones. For example, one issue identified in the Research Plan under the Key Research Area of 'Ecologically sustainable use' is Recreation and Tourism. Given the high level of overlap between the biophysical and socio-economic implications for most aspects of this issue, it would be timely for such problems to be attacked via integration of these two disciplines.

- From a socio-economic perspective, non use values of Marine Parks should be considered within the next Research Plan.

From a socio-economic perspective, the Strategic Framework has previously concentrated on the use values of MPAs, both extractive and non extractive. It is timely that the non use values for MPAs be considered within a future research plan.

- A central part of that new Strategic Research Plan should be a more transparent undertaking to conduct research in each Marine Park and articulate how it fits into the Statewide network. Such a plan should mandate goals and a timetable for a set of "core" activities are essential to be able to describe the condition of biodiversity within the network and each Marine Park.

A central part of that new Strategic Research Plan would be a more transparent undertaking to conduct research in each Marine Park and to articulate how it fits into the network Statewide. Goals and a timetable for a set of "core" activities are essential to be able to describe the condition of biodiversity within the network and each Marine Park. Such a plan should mandate the return times of monitoring activities within each Marine Park (e.g. how often is BRUVs run on the same reefs?) to allow repeated monitoring to document habitat changes over time. This would, in turn, feed directly into MER and other reporting frameworks to allow for the statutory reviews of zoning and other management.

- Give more emphasis to the research program for NSW Marine Parks as a whole rather than attempting to test each general hypothesis in all parks, e.g. construct a statewide database of research undertaken, datasets and key findings.

Given limited resources, it is worth considering the research program for NSW Marine Parks as a whole rather than attempting to test each general hypothesis in all parks. Construction of a statewide database of research undertaken, datasets and key findings will facilitate a shift in focus from each park to the whole network. This is the norm for, say, Antarctic or Great Barrier Reef research but does require ongoing resources provided at a central level.

- Complete habitat mapping across the entire NSW coast to address the CAR principles.

Completion of habitat mapping across the entire NSW coast remains a priority because it is needed to address the CAR principles. Appropriate zonation of permitted activities depends upon this information. The habitat mapping program is making good progress but obviously

needs to continue. Perhaps integrating it more closely into other research being done by CERF or other external partners (e.g. in other states) could put it on a more certain footing.

- Shift from Major Priority 1 to Major Priority 2 (as detailed in the Strategic Framework) regarding the main uses of the research being done in NSW Marine Parks.

The time is nigh for most NSW Marine Parks to shift from Major Priority 1 to Major Priority 2 (as detailed in the Strategic Framework) regarding the main uses of the research being done in them. The latter needs to be the main focus of research and monitoring within established Marine Parks over 2010-15.

- Clarify marine biodiversity for the wider public of NSW, focussing upon concepts, values and examples, rather than a focus upon any arguable spin-offs for fishing.

There should be an attempt to clarify marine biodiversity for the wider public of NSW, focussing upon concepts, values and examples. Focus in the future should be more on that than any arguable spin-offs for fishing.

## Secondary

- Be more assertive about the science and other research behind the NSW Marine Park system but also acknowledge areas of uncertainty or disagreement with public arguments.

Much research is being done in each of the Parks but that broad canvas seems to be hard to convey to the wider public of NSW. A more assertive stance about the science and other research behind the NSW Marine Park system seems to be needed, in the light of some stakeholder testimony and other evidence (e.g. bumper stickers). That message is not being heard in those quarters. This is also despite the scientific community's vocal support for MPAs (e.g. from AMSA NSW, see Gladstone & Booth 2008). Some of the criticisms, particularly those that relate to scientific quality of the 'Science Paper' that was used to justify the Batemans Marine Park proposal specifically and the MPA Strategy more broadly, are justified.

- Organise lists of research being done in each Marine Park around a clear strategy, e.g. into core (i.e. network-oriented) activities versus special (i.e. Park-specific) cases.

The lists of research being done in each Marine Park are impressive but they don't seem to be organised around a clear strategic framework, e.g. into core (i.e. network-oriented) activities versus special (i.e. Park-specific) cases. Their relative contributions to Statewide versus local priorities and decision-making are thus very hard to discern.

- Publicise the securing of external funding, publication of findings in the scientific literature, and appointment of scientists within each Marine Park and of Park Managers very familiar with research.

The appointment of scientists within each Marine Park and of Park Managers very familiar with research is seen as a very positive initiative that seems to be paying off in terms of secured external funding and publication of findings in the scientific literature.

- Focus upon removing undue delays, potential bottlenecks or any other systemic impediments to the publication of biophysical and other research done in NSW Marine Parks.

Thus the biophysical research done in NSW Marine Parks seems to be getting published in the international scientific literature but it is unclear whether there are undue delays, potential bottlenecks or any other systemic impediments that need to be worked upon.

- Articulate better the nexus between routine monitoring and specific research activities, and promote a more transparent program of activities already being done by DECCW or DII staff within Marine Parks to allow piggy-backing of student projects at minor cost to the Marine Park Authority.

The nexus between routine monitoring and specific research activities needs to be articulated better because there is a tendency for research projects by students or external staff to be short-lived (= a scholarship or grant duration), yield little of ongoing value (e.g. translation into monitoring options), and more focussed upon scientific outcomes more than any managerial uses. Promotion of a more transparent program of activities already being done by DECCW or DII staff within Marine Parks may allow piggy-backing of student projects at quite low (or none) costs to the Marine Park Authority.

- Publish annual lists of key research questions to be tackled within each Marine Park and across the network as a way of encouraging external partnerships for research in a directive manner that mobilises interest in academia (including students), research providers and the wider community.

A better way of encouraging external partnerships for research may be to publish annual lists of key research questions to be tackled within each Marine Park and across the network. This is more directive than in the past but would serve to mobilise interest in academia (including students), research providers and the wider community.

- Test the key assumptions involved in using ecosystem and habitat features as a surrogate for biodiversity *per se* as a priority over the next five years.

Testing the key assumptions involved in using ecosystem and habitat features as a surrogate for biodiversity *per se* should be a priority over the next five years because it is a key aspect to demonstrating the good design of Marine Protected areas but has not been emphasised so far.

- Review the utility of the zonation, in particular what is gained by having sanctuary zones in ocean beach and estuarine habitats

One thread of criticism has been that the utility of sanctuary zones is unproven for a number of habitat types in NSW, in particular open ocean beaches and within estuaries. Notwithstanding a recognition that all habitats need to be represented in sanctuary zones under the CAR

principles, the Independent Review Panel felt the inclusion of some of these areas (e.g. ocean beaches and estuaries) needed more careful consideration, especially in terms of associated socio-economic impacts and putative conservation benefits. A thorough review of their worth and expected benefits could include more explicit consideration of how a particular zone (and the activities not permitted within it) can address specific threats, predictions made about what protection is expected from zones in particular Marine Parks, and how the different zones contribute to meeting the Comprehensive-Adequate-Representative principles for the Marine Parks system.

### **Tertiary**

- Compile species lists for each park, especially linked to community-based monitoring or the detection of climate change (including invasive species).

Compilation of species lists for each park should be a priority, especially if either community-based monitoring or the detection of climate change are deemed to be desirable.

- Focus upon assessing the condition of habitats and species, patterns of change (especially transience, loss or degradation), and the juxtaposition of habitats and microhabitats in relation to connectivity (among other more sophisticated scientific questions) within NSW Marine Parks.

More attention seems to be needed in the future upon the condition of habitats and species, patterns of change (especially transience, loss or degradation), and the juxtaposition of habitats and microhabitats in relation to connectivity (among other more sophisticated scientific questions).

- Provide better scientific documentation upon the Marine Parks Authority website, as a demonstration of an open and responsive approach in the Communication Plan for the Marine Park system in NSW.

Better scientific documentation is required upon the Marine Parks Authority website, written in lay language but without dumbing-down or glossing over key issues in dispute. These should address both sides of the argument about the desirability of MPAs and address key concerns arising from the public. That would make for an open and responsive approach and should form part of the Communication Plan for the MP system in NSW.

- Promote Marine Parks as key focal points for surveillance of the arrival of invasive species.

Marine Parks provide an opportunity to focus the attention of scientists, departmental staff and the public upon detecting the arrival of potentially invasive, pest or disease species. Using area management to provide key focal points for such surveillance would improve our detection network and allow for more swift and probably cost-effective management actions (e.g. possible eradication), especially given that introduced species are likely to be more common under climate change.

- Investigate avenues to disseminate the findings from research projects through NGOs, e.g. recreational fisher organisations, to remove the implications that research is by and for government only.

Much of the public distrust surrounding the NSW Marine Parks system and in particular the motives and activities of the government, Marine Parks Authority and DECCW could perhaps be assuaged by broadening the involvement of the public in the research that is being done within the Marine Parks. It is well known that fostering a sense of stewardship within local or regional community is a prime way to get people onside about "their" Marine Parks. It also would serve to bring to fruition objectives about facilitating public education about, and enjoyment of, the Marine Parks system in NSW.

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- Rodrigues ASL & Brooks TM (2007) Shortcuts for biodiversity conservation planning: the effectiveness of surrogates. *Annual Review of Ecology, Evolution & Systematics* 38: 713-737.

## **Appendices**

1. Terms of Reference for this independent review
2. List of staff and stakeholders presenting to the Independent Review Panel on Nov 9-11
3. Replotting of global data on no-take effects by the Chair of the Independent Review Panel



## Appendix 1



### Marine Parks Authority

Terms of Reference

### Marine Parks Science Review

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#### Purpose and Scope

The Marine Parks Authority recognises the importance of scientific information and analysis in the establishment, zoning, review and monitoring of marine parks.

The [Marine Parks Advisory Council](#) is the representative body for peak marine park stakeholders in NSW. The Council advises the Marine Parks Authority and the Ministers for Climate Change and the Environment and Primary Industries on marine parks from a statewide perspective.

The Marine Parks Authority has requested that the Marine Parks Advisory Council review the [Strategic Framework for the Evaluation and Monitoring of Marine Parks in NSW – March 2004](#) (the 'Strategic Framework') and the [NSW Marine Parks Strategic Research Plan 2005-10](#) (the 'Research Plan').

The Strategic Framework sets out the priorities for research in marine parks:

- major priority 1 – selecting marine parks and their boundaries
- major priority 2 – monitoring, evaluating and modifying marine park boundaries and zoning arrangements
- supporting research – developing a comprehensive research portfolio for each marine park
- reporting research – developing a comprehensive research portfolio for each marine park.

The Research Plan guides current marine park research priorities, the research program for the system of six marine parks in NSW and the research programs for individual marine parks. It is based on the priorities set out in the Strategic Framework.

An expert-based independent review team is to prepare a report to the Marine Parks Advisory Council on the review of the Strategic Framework and Research Plan.

Review of the Strategic Framework and Research Plan is timely given the:

- establishment of large marine parks at Port Stephens–Great Lakes and Batemans
- NSW system of marine parks now includes approximately one-third of NSW marine waters, and
- commitment to review zoning plans initially after five years of operation (as set out in the *Marine Act 1997*)
- increasing awareness of the need to build resilience in marine ecosystems to help adaptation to climate change.

#### Objectives

The general objective of the review is to assess how the Strategic Framework and the Research Plan can best ensure that the vision for research and monitoring for NSW marine parks is achieved.

The vision set out in the Strategic Framework is:



- locations and boundaries for marine parks and the zoning arrangements within them will have been derived from thorough scientific assessments of all available information and data, to provide the best combination of areas for the conservation of biodiversity
- rigorous research and monitoring are accepted as vital components of ongoing marine park management, and are resourced accordingly
- accurate and timely scientific advice is provided to marine park managers
- scientific information systems and services are established and integrated with those of other organisations with an interest in coastal protection
- the public of NSW and the international scientific community have full confidence in the quality of the research conducted in marine parks.

Specifically, the review is to:

- assess of the appropriateness of the existing Strategic Framework and the Research Plan, in light of the growth of the marine park system and any recent developments in scientific knowledge
- review the effectiveness of implementation of the existing Strategic Framework and the Research Plan
- consider key stakeholder issues with the Strategic Framework and the Research Plan
- report on these matters directly to the Marine Parks Advisory Council.

### **Reporting**

The independent review team will provide a written report to the Marine Parks Advisory Council by 30 November 2009. The report should make recommendations on future directions including:

- research priorities and any existing research gaps
- revisions to the Strategic Framework and the Research Plan
- an effective and efficient research program for the NSW system of marine parks
- development of collaborative research programs.

The report and recommendations should recognise the current resources available for research in marine parks and indicate priorities. The report will be provided to the Minister for Climate Change and Environment and Minister for Primary Industries by the Marine Parks Authority.

### **Consultation**

The independent review team will consult with the Marine Parks Advisory Council's Science Sub-Committee convened by its marine science representative and including marine scientists appointed to local marine park advisory committees. The review team will also consult with key stakeholders representing a broad range of views, through invited presentations made directly to it. NSW Government staff working on marine parks will be available to address the review team.

## Appendix 2

### List of interviewees, Nov 9-11

Dr Pat Hutchings	Senior Principal Research Scientist, Australian Museum
Dr Alan Jordan	DECCW, Head, Marine Conservation Unit
Dr Rodney James	DECCW, Protected Areas Section
Dr Brendan Kelaher	DECCW, Manager, Batemans Marine Park
Professor Maria Byrne	University of Sydney; Convener MPA Science Advisory Committee
Associate Professor Andy Davis	University of Wollongong; member MPSP
Professor Alistair McIlgorm	National Marine Science Centre, Coffs Harbour
Dr Belinda Curley	University of Sydney
Nicky Hammond	Marine Campaigner, National Parks Association NSW
Dr Bob Creese	Research Leader, NSW Department of Industry and Investment
Max Castle	Advisory Council on Recreational Fishing NSW
Professor Bob Kearney	Emeritus Professor of Fisheries, University of Canberra
Ken Thurlow	CEO, Ecofishers NSW
Dr David Godden	DECCW, Manager Environment & Conservation Economics

### Appendix 3 Replotting global data on MPA effects but using only locally-relevant cases

One persistent line of criticism has been the use of a global dataset on the effects of no-take reserves compiled by PISCO (e.g. see Lester *et al.* 2009) – because it is global in nature it includes many situations totally irrelevant to NSW such as tropical studies from places that lack any fisheries management and use destructive fishing practices such as dynamite or cyanide. Uncritically citing such examples would be particularly poor if the case studies were not at all relevant to the NSW situation. Illustrations such as Fig. 2 of Lester *et al.* (2009) (see Fig. A1 below), the latest global compendium, are sometimes quoted as showing that overseas experience “promises” that we would get a 446% increase biomass from having a no-take reserve. This would be a very simplistic use of such compiled data because it does include data from tropical or inappropriate sites amongst the data points shown. That value is the mean response and the median (a different measure of the central tendency or “average” outcome) is considerably low, around a 200% increase. Even more importantly individual cases show a wider range of behaviour from small decreases (roughly -20%) to increases close to 3000%, and so it is unclear what the particular future behaviour of a Marine Park in NSW or any other place is likely to be like. Interestingly, Lester *et al.* (2009) have responded to some similar criticisms by contrasting temperate with tropical outcomes (e.g. see Fig. A2 below) and then conclude that the responses in temperate areas are at least as strong as in tropical studies.

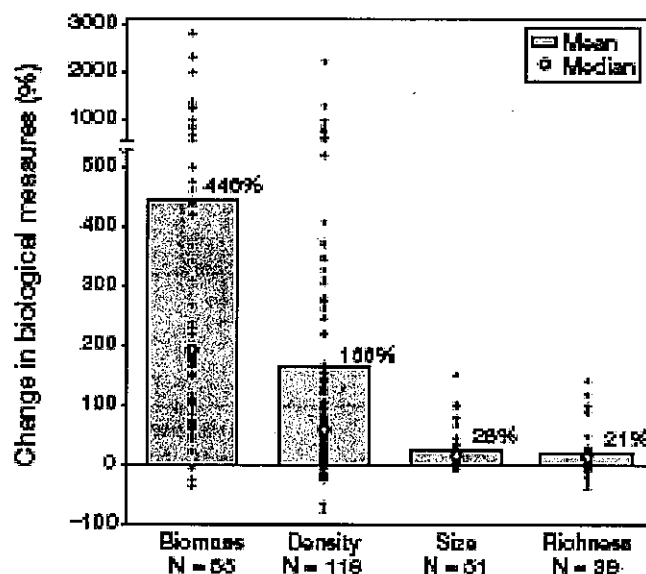


Fig. 2. Average (gray bars) and median (°) percent change in biomass, density, organism size, and species richness calculated from reserve response ratios. All 4 biological variables show statistically significant increases (1-sample 2-tailed t-test,  $p < 0.0001$  for biomass, density, and organism size and  $p = 0.002$  for species richness). (°) Individual reserve responses. N: number of reserves for which each biological variable was measured

Fig. A1. Lester *et al.* (2009) summary diagram of effects of no-take marine reserves from around the world.

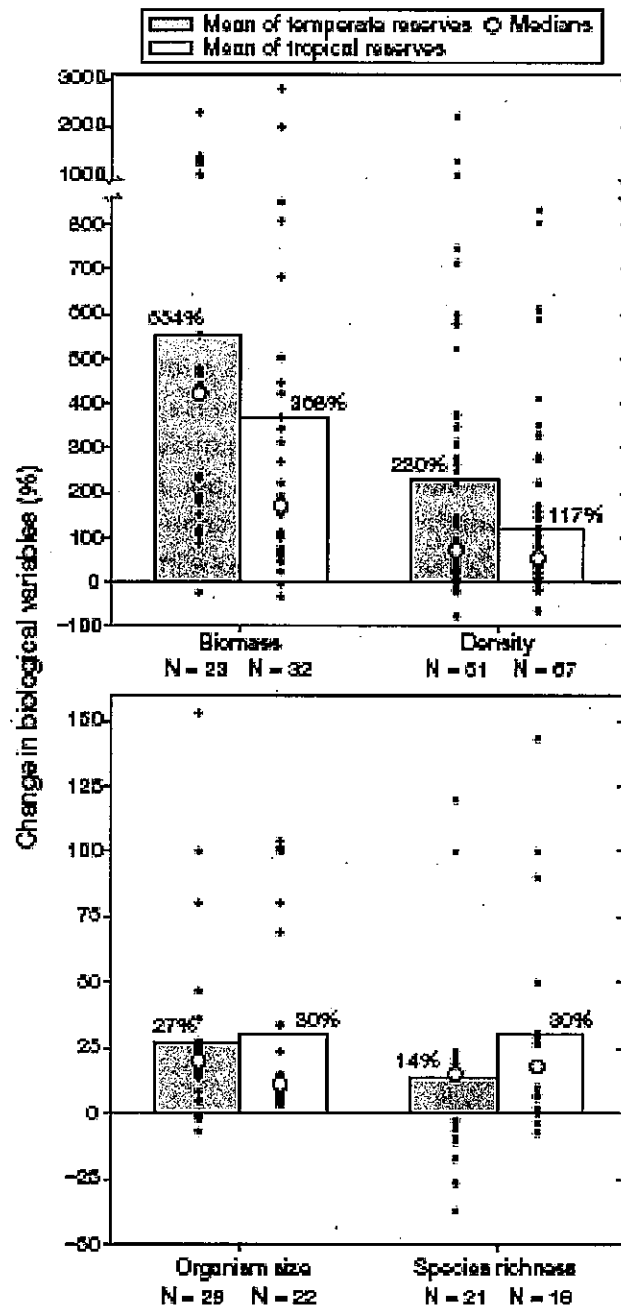


Fig. 5. Average (gray bars) and median (○) percent change in biomass, density, organism size, and species richness, calculated from reserve response ratios, with data plotted separately for reserves in temperate versus tropical environments. (●) Individual reserve responses. Percent increases by environment are statistically significant in all cases except species richness in temperate reserves (1-sample, 2-tailed *t*-tests, temperate reserves:  $p < 0.0001$  for biomass, density, and size and  $p = 0.166$  for richness; tropical reserves:  $p < 0.0001$  for biomass and density,  $p = 0.0002$  for size, and  $p = 0.003$  for richness)

Fig. A2. Lester *et al.* (2009) summary diagram comparing temperate to tropical no-take marine reserves.

But that conclusion may still be open to the criticism that it includes places with poor fisheries management and so what you see is relief from overfishing, which is unlikely to be the case in NSW or other Australian examples, rather than any protection of biodiversity. To explore that criticism a little more, in a spirit of empirical discovery, the Chair of the Independent Review Panel extracted the raw data from the online appendix to Lester *et al.* (2009, Table S1, the latest publication from the PISCO dataset) but limited consideration only to temperate cases similar to NSW (e.g. including rest of Australia, New Zealand, Canada). The previous figure of a mean = 446% actually then increased to 975% in that case (and the median increased to 882%). When the USA was also included (arguable due to their different approach to fisheries management), the figures were actually mean = 733% and median = 464%. See Fig. A3 below for these replotted data for changes in density, size and richness as per the figures shown in Lester *et al.* (2009). Thus The Chair would conclude from this simple re-analysis that the size of effects realised is not merely an artefact of where the research studies came from and that the most comparable Marine Park sites in terms of geography or fisheries management still showed comparable increases in biomass, density, size and richness of organisms.

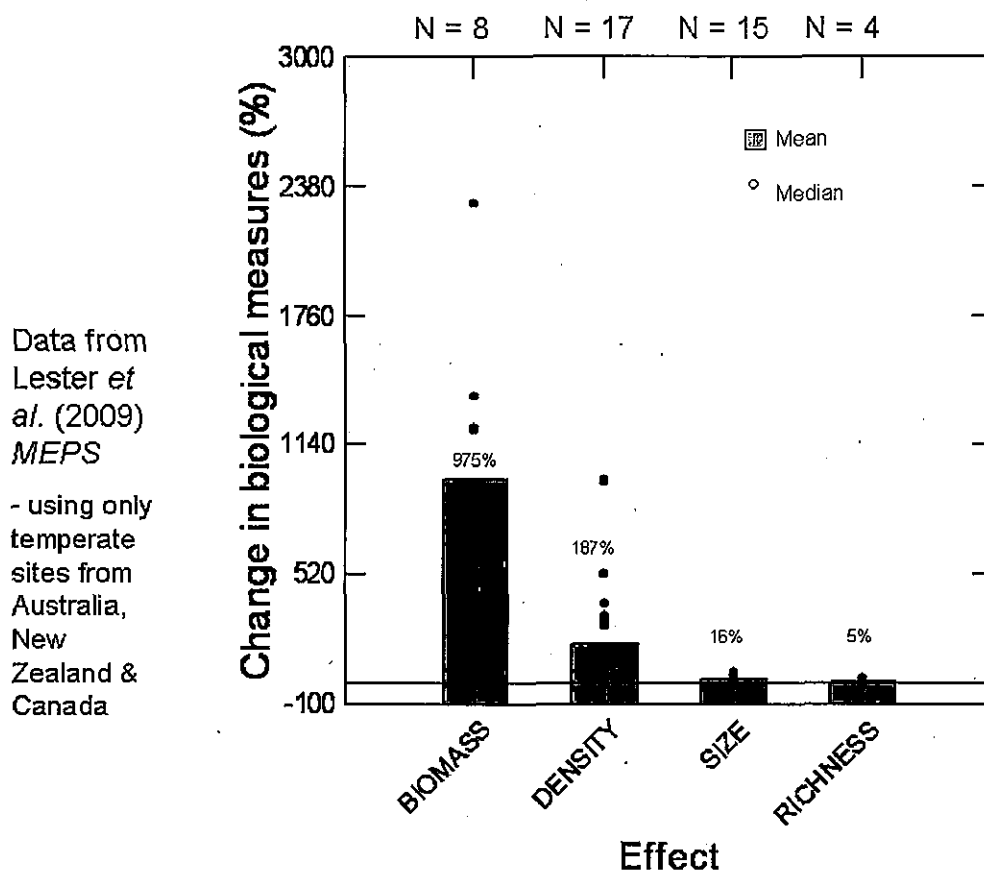


Fig. A3. Re-plotted raw data from Table S1 in Lester *et al.* (2009) including only case studies from temperate sites in Australia, New Zealand and Canada. Percentages refer to the means (grey bars), medians (where they differ substantially from the means) are shown as open circles, and individual values from case studies are shown as filled dots.