

Report of the Independent Scientific Audit of Marine Parks in New South Wales

To Minister for Primary Industries, the Hon Katrina Hodgkinson MP
and Minister for the Environment, the Hon Robyn Parker MP



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the Hon Katrina Hodgkinson MP
and
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by
Beeton RJS, Buxton CD, Cutbush GC, Fairweather PG,
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Fishing trawler—Nelson Bay, NSW, March 2007. Photo by Duncan Paterson.

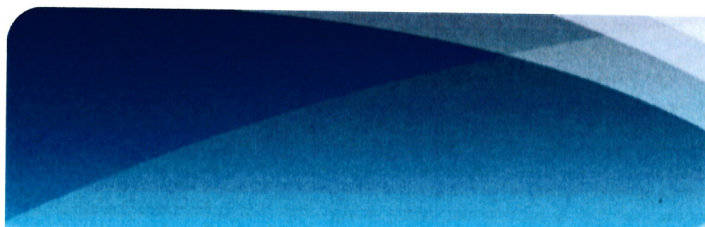
Obese sea pen (*Cavernularia obesa*), Clifton Gardens, Sydney Harbour, NSW, February 2009. Photo by Duncan Paterson.

(top) Sea slug, or nudibranch, known as the blue dragon by divers (*Pteraeolidi ianthina*), Bare Island, Botany Bay, NSW, April 2010. Photo by Duncan Paterson.

(bottom) Eastern blue devil (*Paraplesios bleekeri*), Voodoo dive site on the seaward side of Botany Bay, NSW, June 2009. Photo by Duncan Paterson.

Beach fishing—an angler hooked up to an Eastern Australian salmon (*Arripis trutta*) on a metal slice lure equipped with a single hook for catch-and-release purposes. Far South Coast, NSW, May 2008. Photo by Tom Kaminskis.

Letter of transmittal



Independent Scientific Audit of Marine Parks in NSW

www.marineparksaudit.nsw.gov.au

Dear Minister Hodginkson and Minister Parker,

I hereby transmit the report of the Independent Scientific Audit of Marine Parks in New South Wales.

The report has been prepared by the Audit Panel appointed by you and supported by a very able Secretariat. The website created by the Audit is a very large resource and should be kept for the use of the Government and people of New South Wales for many years. There would also be merit in it being further developed.

The report calls for significant change and the Panel understand that its consideration will take time.

On behalf of the Panel I thank you both for the opportunity to undertake this challenging task and commend the report to you.

Yours faithfully,

Robert J S Beeton AM FEIANZ

Chair, Independent Scientific Audit of Marine Parks in New South Wales

6 February 2012

Notes

Throughout this report the term NSW marine estate is used. The Audit Panel has defined this as the sea enclosed within the three-nautical-mile limit including all marine related bays, rivers under a detectable tidal influence, mangrove systems, islands, wetlands and lakes that are intermittently connected to the sea. It also includes coastal systems such as dune systems and headlands that are strongly influenced by the oceanic processes even though they are not episodically inundated.

Referencing

Referencing is in several forms:

1. Published works are cited in the normal way, along with the corresponding Audit document number acknowledged as a footnote, and appear in the list of references at the back of this report.
2. Unpublished documents are cited in the text as numbered Audit documents, using the numbering in the Audit Document Tracking Database. This database and all Audit documents are available from the Audit website at:
<http://www.marineparksaudit.nsw.gov.au/relevant-documentation/>.
3. Submissions are referenced according to submission numbers, available at Appendix 3 or at: <http://www.marineparksaudit.nsw.gov.au/submissions/submissions-received/>.
4. Workshops are referenced according to the workshop number. A list of workshops is available at Appendix 4 or at <http://www.marineparksaudit.nsw.gov.au/consultation/>.

Acknowledgments

The Audit Panel acknowledges the full cooperation of the NSW Department of Primary Industries (DPI) and Office of Environment and Heritage (OEH) whilst conducting the Audit and the considerable amount of time and effort individual officers spent in providing the Audit with the large volume of material requested. The Audit Panel also expresses its appreciation to all the organisations and individuals that made submissions to the Audit and those who participated in the Audit workshops.

The Audit Panel expresses its sincere appreciation to its Secretariat, Ms Petrina Alcock and Dr Fiona Powell, without whose efforts the Audit Panel's task would have been inordinately difficult.

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List of abbreviations

ANZECC	Australia and New Zealand Environment Conservation Council
CAR	Comprehensive, Adequate and Representative
DPI	Department of Primary Industries
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services (NSW Trade and Investment)
IUCN	International Union for Conservation of Nature
MER	Monitoring, Evaluation and Reporting
NRSMMPA	National Representative System of Marine Protected Areas
NSW	New South Wales
OEH	Office of Environment and Heritage

Executive summary

Australians are a coast-loving people, and it is not surprising that controversy and conflict accompanies the management of our coastal waters and their resources. The Independent Scientific Audit of Marine Parks in New South Wales (NSW) (the Audit) was established in such a context.

The Audit Panel was asked to evaluate nine specific terms of reference namely:

1. Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments, and the effectiveness of these actions.
2. Review the scientific data provided to the Panel by NSW Department of Primary Industries and the Office of Environment and Heritage.
3. Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat.
4. Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary.
5. Recommend ways to increase the cost-effectiveness of marine park zoning arrangements.
6. Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks.
7. Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks.
8. Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them.
9. Make other recommendations as appropriate, related to achieving better management of the NSW marine environment.

These terms of reference range from specific operational questions to general questions about the future of the management of the NSW marine jurisdiction. The Audit brief also was to conduct a fully transparent evaluation of the terms of reference. To do this a public website was established and it remains available to readers of this report (see <http://www.marineparksaudit.nsw.gov.au/>).

As the Audit assembled information from government departments and the scientific literature, each item was given a document accession number, added to the document database and posted on the Audit website.

When the Audit called for public submissions, it was made clear that all submissions would be published on the website as would be any rebuttal of submissions that were made to the Audit. Offers of confidential information were made to the Audit but were rejected: the persons offering such information were invited to instead provide it in the form of a public submission. In addition to this material, the Audit website also hosted summary minutes of Audit Panel meetings as well as the agreed summaries of discussions during workshops and interviews conducted by the Audit. Consequently, all information available to the Audit Panel in preparing its report is also available to the public.

The Audit findings are presented as a report that incorporates 16 recommendations. The report and recommendations are organised around questions that are clearly identified against specific terms of reference.

Principal recommendations

The two over-arching recommendations of the Audit Panel are:

- A.** The governance of the NSW Marine Estate be reorganised by bringing the entire estate under one legislative and administrative structure that is closely aligned with the five catchment management authorities covering the NSW coastal drainage systems.
- B.** Science for the NSW Marine Estate be reorganised under an independent Scientific Committee. The Audit Panel also makes recommendations about the organisational approach that this Committee should take and suggests a number of research priorities. In particular, these priorities call for greater emphasis on research in the social and economic sciences and the application of these findings to management.

Other recommendations of the Audit deal with details that either address specific terms of reference or further aspects of the two principal recommendations.

It is a view of the Audit Panel that NSW has an opportunity to establish a management framework for its Marine Estate that will future-proof it against public policy failure and natural catastrophe, while at the same time providing for a balanced and equitable system of the management of all the demands we place on the resources of the NSW Marine Estate.

The Audit Panel recommends to the NSW Government the following 16 specific actions.

Recommendations for Term of Reference 1

Term of Reference 1: Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments, and the effectiveness of these actions

- (R1)** In a strict sense, NSW is obliged to do only what it agrees with the Australian Government, which is the Party to the international conventions and agreements covered by the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). In the Audit Panel's opinion, the current arrangements pose no risk to the NSW Government that in regard to its management of marine parks it will be found in breach of international conventions.

- (R2) The Audit Panel is of the further opinion that the current system of marine parks as established in NSW be maintained and mechanisms be found for enhancing the protection of biodiversity in the identified gaps, namely within the Hawkesbury and Twofold Shelf marine bioregions.

Recommendations for Term of Reference 2

Term of Reference 2: Review the scientific data provided to the Panel by NSW Department of Primary Industries and the Office of Environment and Heritage

- (R3) The Audit recommends the formation of a Scientific Committee, which is independent of government agencies and established to oversee strategic research in the Marine Estate in NSW. It is further recommended that this Committee be composed of experts in the marine sciences, economics and social science with an independent chair who reports directly to the Minister(s). In its work:
1. The Committee should review the five-yearly and annual work plans for science in the NSW Marine Estate (this includes but is not exclusive to marine parks and fisheries) as its major task. The Committee should then make specific recommendations to the Minister(s) relating to the adoption and modification of the plans.
 2. The Committee must consult as a matter of course with the community as well as resource users in addition to direct research stakeholders. The Committee should be empowered and resourced to commission independent reviews by acknowledged international experts where it believes this would be useful in improving the science and its application to management. A particular area needing attention is a close examination of the incorporation of social and economic data into decision-supporting algorithms that are used in identification of various conservation areas and the level of management that should be applied to them.
- (R4) The Audit Panel recommends that funding be allocated to addressing research shortcomings. Some of the priority areas identified by the Audit were:
1. Well-directed work is needed to incorporate social and economic data into decision-making in order to help all parties—taxpayers, consumers, industry participants, agencies and the wider NSW community—to better understand the social and economic benefits and costs of marine parks.
 2. Resource-use activities in all areas of the NSW Marine Estate must be estimated, and improved social-network building, public participation and educational strategies developed to enhance the management of the Marine Estate.
 3. With research that is publicly funded, priority should be given to projects on the potential threats to marine and estuarine biodiversity and ecological integrity within NSW waters that are considered by experts likely to be most significant. Candidates should include all five classes of threats identified by the Natural Resource Management Ministerial Council Marine Biodiversity Decline Report

(2008¹) and should extend to the less-direct consequences of otherwise low-impact usage.

4. Resilience and multi-stressor research is needed to better understand the response of marine ecosystems to threat combinations.
5. The performance of the marine park system should be assessed against its primary objectives of conserving biodiversity and maintaining ecosystem integrity and function.
6. The NSW Government needs to ensure that complementary fisheries research is done to improve the understanding of the threat that fishing poses to the conservation of biodiversity in NSW and the environmental protected values of the Marine Estate. The focus of this research should include:
 - a. expanding the scope of ongoing assessments of fish stocks to assess ecological sustainability and management of fisheries rather than just stocks (for example, data-driven assessment of effects on habitats from by-catch, trophic flow-on and ecosystem-wide impacts)
 - b. developing strategies for improving fish stocks and managing them in a positive way to meet the reasonably expected needs of recreational anglers
 - c. estimating recreational fish catches (currently estimated to equate to around 30 per cent of the commercial catch in NSW).

Recommendations Relating to Terms of Reference 3, 4 and 9

Term of Reference 3: Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat

Term of Reference 4: Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R5) From the information available to the Audit Panel, it would appear that there is a need to further extend the Monitoring, Evaluation and Reporting (MER) system to include a greater focus on marine, estuarine and inshore environments as a priority. This should include monitoring for invasive species in and around areas where boating or shipping activity is particularly intense.

Several further improvements to coastal management and protection should include the following:

1. Threats to marine parks should be assessed as part of a statewide risk assessment, including any indirect effects of activities such as tourism and fishing (for example, anchoring). This risk assessment should be used to guide a similar process that is

¹ Document 28

done independently for each marine park. The park-specific process would interrogate the system at a much finer scale, both spatially and temporally. The risk assessments should be used to guide management actions commensurate with the park objectives.

2. Zoning and rezoning should also more explicitly and transparently consider the assessment of risks. In developing this framework, priority should also be given to determining how subsets of threats are being dealt with by the current configuration of the marine parks network as a (i) primary, or (ii) secondary, or (iii) subsidiary (i.e. much less assured and possibly only incidentally) goal for the network. Explicit detail on how current management practice addresses each potential threat can then be added to the framework and additional strategies developed where it is shown that marine parks are insufficient to address particular threats. Management actions should be in proportion to risk and must be cost-effective.
3. Greater clarity and attempts to communicate actions should be taken across the entire NSW Marine Estate to manage each threat type and the biological, social and economic justification for these actions.
4. Within the framework developed by the risk assessment and as a possible extension of the MER, the Audit recommends:
 - a. the development of an early detection pest-monitoring program that targets high-risk locations and pest species. Assessment of the ability of this program to deliver early detection of marine pests (e.g. estimates of detection probabilities) should be an integral part of this program. Existing pest-response strategies must integrate tightly with the monitoring program. Within the Marine Estate, marine parks should be considered as areas that warrant additional scrutiny with regards to biosecurity
 - b. that beyond the assessment of nutrient and sediment impacts in coastal waterways, a statewide survey of contaminant levels across NSW waters utilising both bio-monitor and sediment grab approaches would provide important information as to where ANZECC/ARMCANZ sediment-quality guidelines are exceeded, or emerging contaminants of concern are identified. This should allow for the identification of current sources and the nomination of areas that should be targeted for remediation. This should be accompanied by a clear and consistent approach to understanding and managing the fate and effects of contaminants (including transport and remobilisation) for the NSW Marine Estate.

5. New legislation is required to implement Recommendation R15, which should include provision for a risk framework that allows the targeting of management resources towards high-risk vectors (e.g. boats that have come from areas with known pest species or large marinas) and a management regime for ballast-water exchange. The legislation should also provide for closure powers across the NSW Marine Estate to support management of pest or disease outbreaks. We have already recommended (Recommendation R4) that better understanding the risk to marine biodiversity posed by non-indigenous species (not just the currently-named pest species) be considered a high-priority research area.
6. The management and licensing of dredging activities within the NSW Marine Estate be reviewed, consolidated and updated to require world's best practice.
7. A regulatory framework for better managing stormwater inputs of contamination should be provided.

Recommendations Relating to Terms of Reference 5, 6 and 9

Term of Reference 5: Recommend ways to increase the cost-effectiveness of marine park zoning arrangements

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R6) Recognising the continuing improvement in fisheries management and resulting recovery and improvement in the status of several fish stocks, the Audit Panel sees the need for the following:

1. Better information is needed on the ecosystem effects of fishing and the integration of this information into the annual stock assessment of commercial and recreational fishing.
2. Recreational fishing (including distribution of effort, catch, discards of by-catch and ecosystem impacts) must be evaluated and the results of that incorporated into marine park management.
3. Approaches to zoning should be re-assessed to be based upon management objects that are specifically geared to ecological and biodiversity outcomes, rather than being merely surrogacy-based, and that utilise economic and social assessments in their implementation and evaluation. This will of necessity require:
 - a. clarifying the role and purpose of the various types of zones currently in use
 - b. reviewing of the 1998 ANZECC approach to zoning in marine parks, which is currently based on principles of being comprehensive, adequate, and representative (CAR) and uses habitat as a surrogate for biodiversity *per se*

- c. taking into account social and economic objectives and utilising appropriate tools
- d. recognising that the needs of user groups should be included in any future zoning in the context of a much expanded NSW Marine Estate. This could extend to innovation such as havens for particular forms of fishing or other specific uses. This would be facilitated by the amendments to legislation and administration suggested in Recommendations R12 to R15.

Recommendation for Term of Reference 6

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

(R7) Rigorous social impact assessments are to be made a central component of the methods used to establish and manage NSW marine parks. The social impact assessment framework needs to analyse, monitor and manage the intended and unintended social consequences (both positive and negative) of marine parks and any social change processes that are invoked. The ongoing evaluation of social impacts and benefits are to be reported in the same reporting cycle as environmental impacts.

In particular, marine park and NSW Marine Estate planning processes should be improved immediately to allow for a more strategic and cross-disciplinary approach to considering social impacts, which should include:

1. specific and targeted consideration of social impacts (incorporating qualitative research techniques) that is separate from (but informed by) consideration of economic impacts, with particular attention given to key groups within the community
2. integration of improved public participation exercises with social and economic impact assessment to add value to each of these processes, with each informing the other
3. the conduct of ongoing education for sustainability relevant to the marine park and wider Marine Estate
4. incorporation of social science expertise into planning and management processes to ensure social data are gathered and analysed in a meaningful and scientifically robust manner.

Recommendation Relating to Term of Reference 5

Term of Reference 5: Recommend ways to increase the cost-effectiveness of marine park zoning arrangements

(R8) In order to improve approaches to zoning, the Audit Panel recommends that:

1. The Marine Parks Authority and the NSW Department of Primary Industries allocate significant resources to research that are directed at operationalising the

policy use of the available high-quality analytical tools for guiding the socially optimal zoning of marine park and NSW Marine Estate areas.

2. In order to ensure significant conceptual progress, the work should be focused for the next three years at least on one marine park, namely the Solitary Islands Marine Park, where in 2010–11 a project trialled, among other things, Marxan applications.
3. The research projects that are commissioned include a high quality social impact assessment process to that may be applied elsewhere and allow statewide benchmarking of community valuation of the NSW Marine Estate.
4. A further research project be commissioned as a high-quality economic-policy exercise that follows up on the 2002–07 Greenville work and that this work be under the control of the Department of Trade and Investment, Regional Infrastructure and Services' Chief Economist with expert oversight by economists qualified in the field.
5. Public participation and education for sustainability protocols be developed for marine parks along with sufficient resourcing for these processes to be undertaken effectively.

Recommendations relating to Term of Reference 6

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

(R9) The proposed Coastal and Marine Management Authority (see Recommendations R12 to R15) should include in its legislation drafting brief the following:

1. NSW Marine Estate planning is required to incorporate properly constituted cost-benefit evaluations that cover all values into decision-making frameworks, and that these be in conjunction with appropriate social impact assessments.
2. In NSW Marine Estate planning, social and economic benefits and impacts are assessed as an integral part of zoning and management process.
3. Better integration of land-use planning regulations with NSW Marine Estate management protocol is to be mandatory. For instance, any land-based development or activity proposal that is within a prescribed distance upstream from a marine park ought to be automatically referred to the Coastal and Marine Management Authority for assessment of potential impacts under State Environmental Planning Policy No 71. In addition the Coastal Protection and Marine Management Authority should have a concurrence role in local government planning decisions.
4. Provide for the design and management protocols of the NSW Marine Estate to be overseen by the Independent Scientific Committee (Recommendation R3). Each of the five proposed sections of the NSW Marine Estate should have appointed, in collaboration with the relevant catchment management authority and the regional

bodies proposed in this report, a local scientific committee for planning of sections of the Marine Estate (see Recommendations R3 and R12 to R15). The bodies would have expertise in both natural and social sciences.

Recommendation on Terms of Reference 5, 6, 7 and 9

Term of Reference 5: Recommend ways to increase the cost-effectiveness of marine park zoning arrangements

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Term of Reference 7: Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R10) Local Indigenous knowledge and expertise of land and sea management to be explicitly incorporated into the establishment and ongoing management of NSW marine parks and the NSW Marine Estate. To facilitate this, the Audit Panel recommends the employment of an Aboriginal Liaison Officer in each marine park, along with ongoing support of the Aboriginal Cadet Program in each marine park.

Recommendations Relating to Terms of Reference 7 and 9

Term of Reference 7: Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R11) The Audit Panel recommends that the NSW Government mandate better integration of land-use planning regulations with the NSW Marine Estate and marine park management as follows:

1. Overhaul and standardise the structure and process for stakeholder and public participation with clear principles that correspond with the objectives of the *Marine Parks Act 1997* (NSW) and relevant management strategies.
2. Acknowledge the biophysical realm as having intrinsic value in NSW Marine Estate planning.

Recommendations on Terms of Reference 6, 7, 8 and 9

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Term of Reference 7: Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks

Term of Reference 8: Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R12) The Audit Panel recommends the replacement of the Marine Parks Authority, the Coastal Management Panel, NSW Fisheries and any other relevant bodies with a Coastal and Marine Management Authority. This Authority should be supported by a rationalisation of the plethora of legislation that currently overlays the NSW Marine Estate. This new Authority, to be effective, must be given concurrent rights on land use developments that have the potential to affect the NSW Marine Estate.

(R13) The Audit Panel recommends that the NSW Marine Estate be managed by the Coastal and Marine Management Authority, with the estate being divided into five sections that correspond with the adjacent catchment management authorities.

An issue that will have to be resolved in determining these boundaries is that of the marine bioregions that do not entirely correspond to terrestrial boundaries. This will clearly be a technical issue for resolution.

(R14) The Audit Panel recommends that new legislation consolidating all relevant Acts be drafted, and that this legislation give this authority real powers to coordinate with the activities of the Natural Resources Commission and work on a day-to-day basis with the catchment management authorities, terrestrial and marine park authorities, and local government (inasmuch as it relates to the coastal environment).

(R15) The Audit Panel recommends that there be a formal relationship between the Coastal and Marine Management Authority and the independent Scientific Committee (Recommendation R3). This would probably best achieved by the chair of the Scientific Committee being a member of the Coastal and Marine Management Authority.

Recommendation on Term of Reference 9

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

(R16) The Audit Panel recommends that compliance rangers be integrated with other ranger staff in the new authority and that no staff carry batons, handcuffs or any other such intimidating paraphernalia.

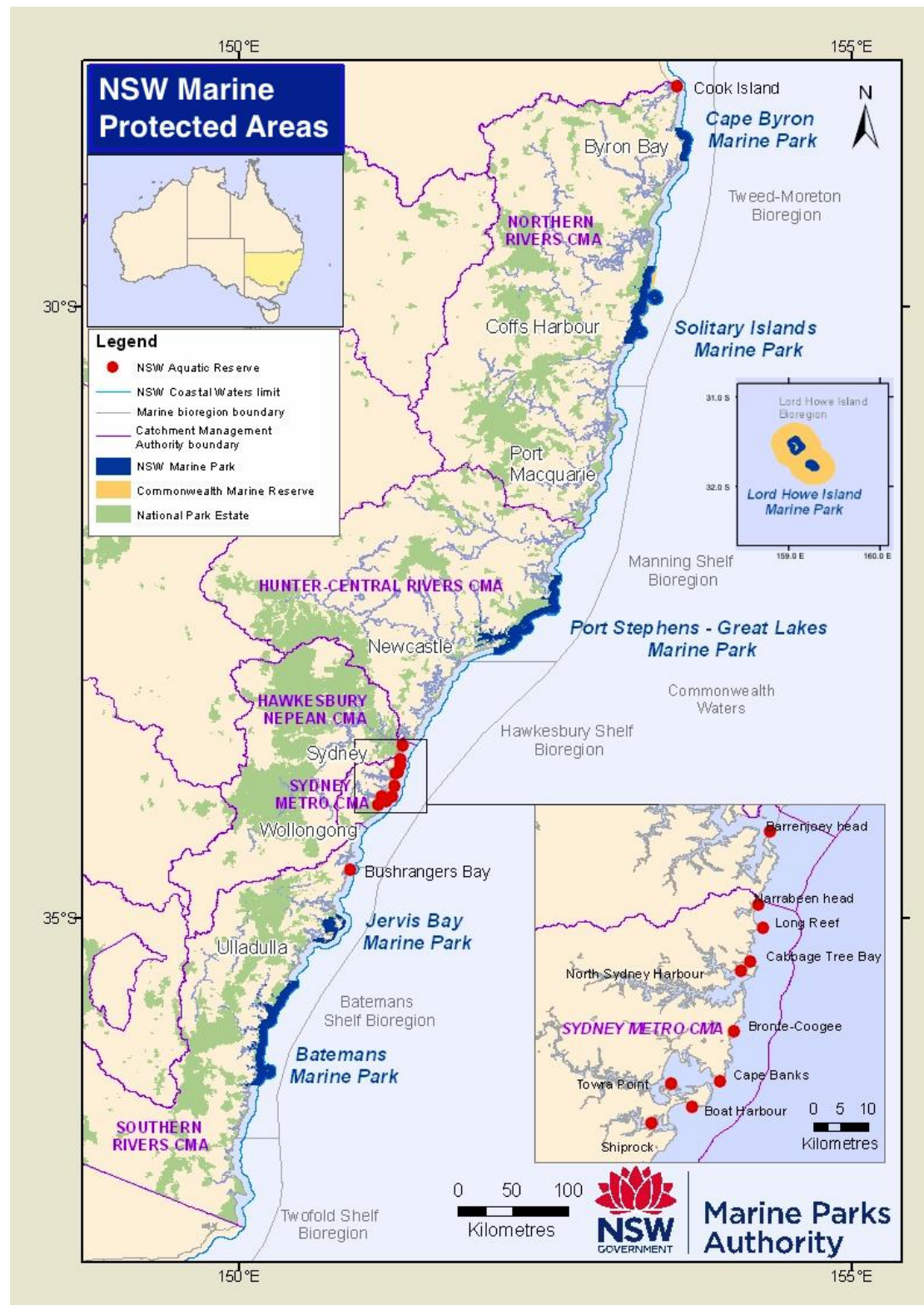
1. Introduction

Marine parks and reserves have existed in Australia for more than 50 years. However, it is only since the establishment of the Great Barrier Reef Marine Park in 1975 that they have become a conservation priority. In 1986, the IUCN appointed the Chair of the Great Barrier Reef Marine Park to the position of Vice-chair of the World Commission on Protected Areas. The position was specifically designed to cover marine conservation, and since then, marine parks and marine protected area development has been an increasing priority for governments worldwide. In 1997 the New South Wales (NSW) Government, largely in response to Commonwealth and state commitments to establish a National Representative System of Marine Protected Areas or NRSMPA (ANZECC 1998²), legislated for the establishment of marine parks in that jurisdiction (*Marine Parks Act 1997* (NSW)). Since then, a marine park system has been established on the basis of the principles of comprehensiveness, adequacy and representativeness (CAR, see Box 1). These CAR principles are the same as those applied to systematic planning for terrestrial parks (Documents 18, 19 and 20).

There are now six marine parks in NSW, incorporating almost 345,100 hectares, or almost 35 per cent of the NSW marine jurisdiction (Figure 1). Together with a number of small aquatic reserves and marine and estuarine components of national parks, 355,291 hectares or about 36 per cent of the NSW marine jurisdiction is within NSW marine protected areas (IUCN Categories I–VI). About 6 per cent (some 66,000 hectares) of these are zoned as marine sanctuaries (IUCN Category Ia, see Table 1).

Since at least 2007, controversy about marine parks has been building in NSW, culminating in it becoming a significant issue in the March 2011 NSW state election. This Audit is a result of the current Government's commitment to review NSW marine parks (Document 1; Appendix 1).

² Document 18

Figure 1: NSW marine protected areas

CMA = catchment management authority

The Independent Scientific Audit of Marine Parks in NSW (the Audit) was commissioned by the NSW Government on 25 May 2011 and announced on 7 June 2011 (Ministers Hodgkinson & Parker 2011³; Appendix 1) with the following nine terms of reference and a six-month reporting deadline:

1. Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments, and the effectiveness of these actions.
2. Review the scientific data provided to the Panel by NSW Department of Primary Industries and the Office of Environment and Heritage.
3. Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat.
4. Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary.
5. Recommend ways to increase the cost-effectiveness of marine park zoning arrangements.
6. Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks.
7. Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks.
8. Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them.
9. Make other recommendations as appropriate, related to achieving better management of the NSW marine environment.

The terms of reference were obviously interrelated and the NSW Marine Parks Independent Scientific Audit Panel (hereafter referred to as the Audit Panel, Appendix 2) proceeded to map the relationships between the nine terms of reference (Figure 2). This figure was then used to identify which Audit documents related to which terms of reference to ensure all relevant matters were addressed.

³ Document 2

Box 1: What is a CAR system of protected areas?

Marine protected areas are a place-based management arrangement (*sensu* Crowder & Norse 2005; Roberts 2005⁴) within marine environments. They have existed in a few different forms around the world since at least the 1960s (Agardy 1997; Ballantine 2001; Sobel & Dahlgren 2004; Roberts 2005⁵). The National Representative System of Marine Protected Areas (NRSMPA), of which the New South Wales (NSW) marine parks system is part, is based on the concept of it being Comprehensive, Adequate and Representative (CAR). The primary goal of the NRSMPA is biodiversity conservation (ANZECC 1998⁶) but because our understanding of marine biodiversity is relatively poor in many parts of Australia, most jurisdictions have chosen to apply the CAR perspective by considering habitat types as a surrogate for biodiversity. An integral part of this approach was to utilise the national marine and coastal bioregionalisation (Commonwealth of Australia 2006⁷) for all NSW waters as the physical framework for the planning and implementation of marine parks. The principles described below can apply to all protected area design—on land as well as in the sea—to derive a CAR reserve system.

Comprehensive: A network of marine parks will include the full range of ecosystems recognised at an appropriate scale within and across each bioregion (ANZECC 1998).

The first principle behind a CAR system states that it should cover the full range of marine ecosystems and habitats that exist in the state. In other words, 'none of the components should be left out'. This concept is embodied in use of the marine and coastal bioregionalisation for NSW as the basis for planning and distribution of marine parks for the State. It also contains a recognition that there are potentially many types of habitat existing within any marine area, and that such habitat-level diversity is valuable in itself, both for ensuring that a wider variety of them gain protection and also to ensure protected examples of the overlaps between different habitats. The boundaries between bioregions or habitats (called 'ecotones' in ecological theory), should be of particular interest because they are likely to manifest some uniqueness in terms of sharing mixes of species from both habitats. Thus ecotones tend to be richer in species than either of the habitats they bound and may have unusual combinations of them. If we were to leave out any particular habitat from a park system, then not only would the preserved set fail to cover the full range, but the protected boundaries would not reflect all natural ecotones.

Adequate: A marine parks system should have the required level of reservation to ensure the ecological viability and integrity of populations, species and communities (ANZECC 1998).

This CAR principle hinges upon ensuring the success of what is being protected. There are many aspects of a marine park, or system of marine parks, that may contribute to adequacy: time; the size of each area; connectivity between areas; buffering between areas; integrity (i.e.

⁴ Documents 416 and 421

⁵ Documents 411, 414, 423 and 421

⁶ Document 18

⁷ Document 428

protection of all components and processes within the system); length of time protected; and the level of enforcement or compliance.

Representative: Those marine areas that are selected for inclusion in marine protected areas should reasonably reflect the biotic diversity of the marine ecosystems from which they derive (ANZECC 1998).

This third principle of a CAR system states that each of the marine habitats characterising the reserve system needs to reflect the range of biodiversity and variability naturally present in our waters. This concept is easily confused with comprehensiveness, but it should be distinguished by focusing on the overall levels of biodiversity being protected by the system as opposed to the habitat level alone. This focus in terms of biodiversity *per se* seems to be a reasonably customary use now, but it is probably impractical to ever expect to that we can ever know about all taxa of biota, genomes or ecosystem processes in any marine habitat. Instead of such direct measures, we tend to use one form or other of surrogacy to guide our choices (see Rodrigues & Brooks 2007 or Caro 2010 for reviews⁸). Essentially, we seek to make choices that maximise the diversity protected within well-known or easily studied taxa and assume that other taxonomic groups will also benefit. Biodiversity *per se* is mostly not known, but that does not mean we should try to measure everything on a routine basis; hence the need for judicious use of surrogates.

The high cost of assessing and representing the full biodiversity of coastal and marine ecosystems means that we tend to use a surrogate, such as habitats that are more easily measurable rather than biodiversity. There are many intensive research projects that would be based on assessing how well surrogacy has worked for our parks. We could take any pattern from a reserve system based on studies done at one level (in this case, habitats) and then test how the other (e.g. species diversity) compares when mapped onto it. A good example is the test of surrogacy done at Lord Howe Island by Lindsay et al. (2008⁹).

It is also the case that habitats (e.g. a seagrass bed) should not be ignored or undervalued in most parks just because they are preserved somewhere else. The CAR approach expects that the region-specific expressions of what seagrass is like as a habitat (especially its variability) will be protected across the state as a whole. Representativeness is thus a hierarchical concept in that it can be determined for a range of nested levels in space—across the state, bioregions, parks, bays, headlands, habitat patches, and any other relevant units. In terms of NSW waters, we are concerned with representing each bioregion well, so the issue of how unique these habitat features are from bioregion to bioregion needs to be assessed empirically to have confidence in planning and park establishment, and this should be done primarily at the bioregional scale.

For more discussion on zoning see section 2.4.2.

⁸ Documents 422 and 415

⁹ Document 420

1.1 Auditing methodology

A six-member Audit Panel and two-person Secretariat were subsequently established by the NSW Government. The Audit Panel (Appendix 2) had their first meeting by teleconference on 26 July 2011. The Chair had previously met with the responsible Ministers, the Hon Katrina Hodgkinson MP and the Hon Robin Parker MP, who conveyed to the Audit Panel the NSW Government's guarantee that it would have full access to all documents held by NSW Government departments that were relevant to the Audit and that all material considered by the Audit should be made available to the public. The Chair's recommendation that the Audit use a website as its principal form of communication and public access to material was accepted. The public website (<http://www.marineparksaudit.nsw.gov.au/>) carries all information about the Audit, including a summary of Audit Panel meeting minutes, all documents that were made available to the Audit Panel, submissions (Appendix 3), workshop and interview summaries, supplementary material provided during and after workshops and other relevant information. There were no exceptions.

From the material received by the Audit, a series of 25 workshops and interviews involving 113 people was held during November and early December 2011 (Appendix 4). Summaries were prepared and sent to participants for checking. The final workshop summaries of the outcomes were, when agreed to by all participants, then posted on the Audit website¹⁰.

The Audit Panel drew on all of the Audit documentation and submissions in writing this report, which is structured around 14 questions that were themselves based on the terms of reference. This format provides a systematic framework for the exploration of each term of reference in the light of the body of material as available on the Audit website. These questions guide the major headings of this report and are in the form they took in the workshop briefing packages, see Appendix 5.

Core questions

1. Do you have any comments on how NSW is contributing to Australia's international commitments to protect marine biodiversity?
2. Do you have any comments on how science is conducted and used by the Marine Parks Authority and the departments responsible for managing marine parks in NSW?
3. What are the most significant issues with respect to the management of NSW fishing and the interaction of this with the management of NSW marine parks?
4. What are the most significant threats to the maintenance of the biodiversity of marine parks and are these being appropriately managed?
5. Do you think the NSW marine park system as it is today is the best mechanism for managing the state's marine biodiversity?

OR if you prefer

¹⁰ Workshop summaries are available at <http://www.marineparksaudit.nsw.gov.au/consultation/>

How can NSW more effectively and efficiently achieve marine and estuarine biodiversity conservation?

6. Do you think that the social benefits and costs of marine parks are understood / assessed when marine parks are established? And do you have any suggestions for improvements?
7. Do you think that the social benefits and costs are understood and used when the zoning of existing parks is reviewed? And do you have any suggestions for improvements?
8. Do you think that the economic benefits and costs of marine parks are understood when marine parks are established? And do you have any suggestions for improvements?
9. Do you think that the economic benefits and costs of marine parks are understood and used when the zoning of existing parks is reviewed? And do you have any suggestions for improvements?
10. Can you comment on how consultations involving marine parks are conducted? And do you have any suggestions for improvements?

Final questions

11. Considering the answers to date, are there any other significant information gaps hindering robust, evidence-based decision-making on marine parks?
12. Considering the answers to date about all current and potential threats to the marine environment, which bodies or agencies would be the most appropriate to address these threats?
13. Considering the answers to date, are there any additional mechanisms (legislative or administrative) that would achieve better management of the NSW marine and estuarine environment?
14. Do you have any other matters to raise with the Audit Panel?

For each workshop or interview, a specific briefing package was prepared, which in addition to including the questions above, directed participants attention to relevant material on the Audit web site and provided guidance on the information being sought by the Audit Panel from participants. At the workshops many additional issues and questions were raised by the Audit Panel members present and the participants. An example of this is material in Appendix 5.

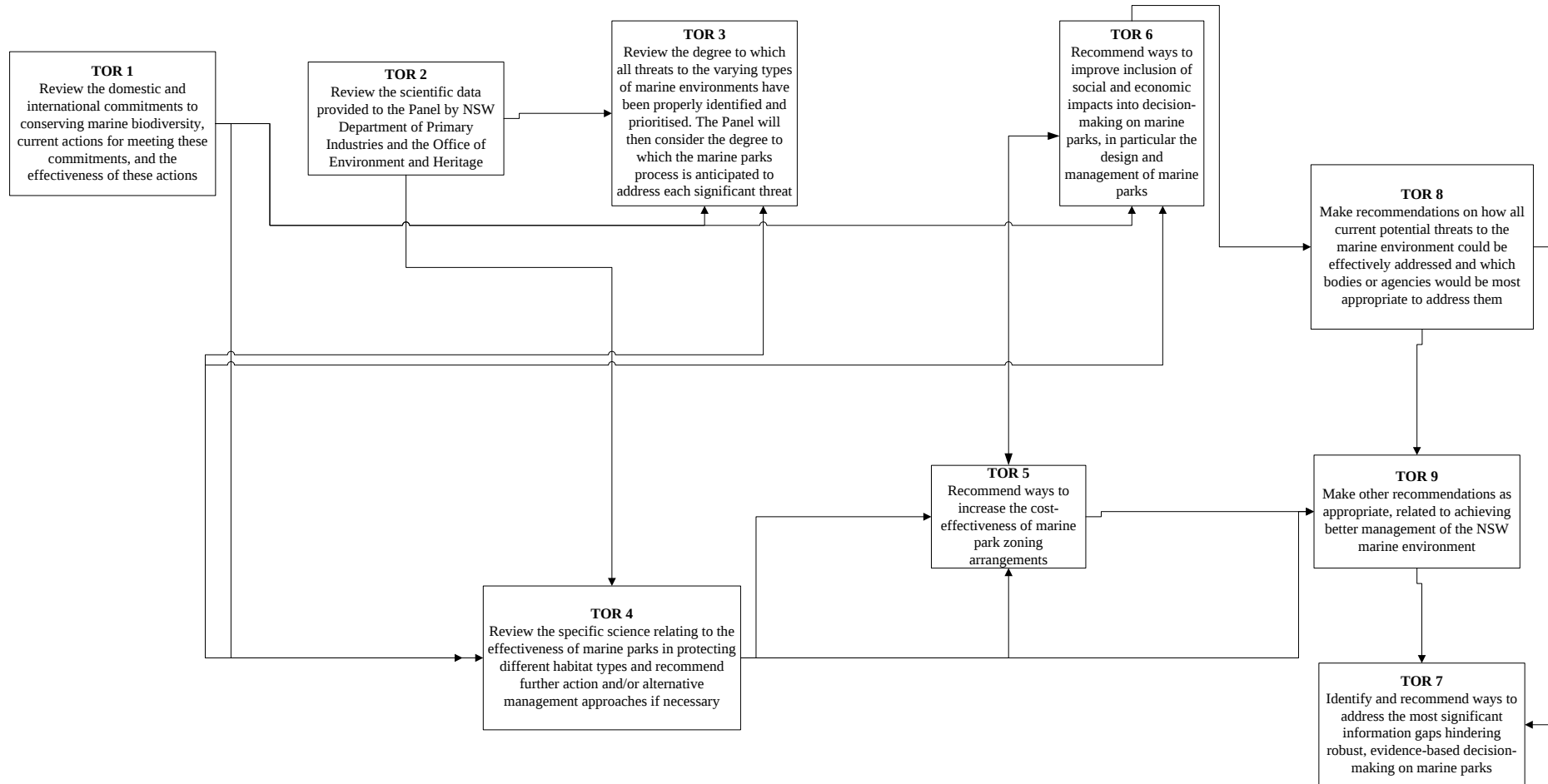
1.2 Principal recommendations

The Audit Panel's findings are presented as a report that has two principal recommendations (A and B). The principal recommendations set out a framework that will improve the management of both NSW marine parks and the NSW Marine Estate. The sixteen other recommendations address either individual terms of reference, the interactions between them, or further aspects of the two principal recommendations.

The two over-arching recommendations of the Audit Panel are:

- A.** The governance of the NSW Marine Estate be reorganised by bringing the entire estate under one legislative and administrative structure that is closely aligned with the five catchment management authorities covering the NSW coastal drainage systems.
- B.** Science for the NSW Marine Estate be reorganised under an independent Scientific Committee. The Audit Panel also makes recommendations about the organisational approach that the committee should take and suggests a number of research priorities. In particular, these priorities call for greater emphasis on research in the social and economic sciences and the application of these findings to management.

Figure 2: Report logic based on relationships between the terms of reference



2. Terms of reference addressed

Several terms of reference appear under a number of headings. This is because the Audit Panel has grouped together the terms of reference and reviewed the issues associated around focusing questions. Consequently the recommendations cover both the individual terms of reference and the interactions between them.

2.1 How is NSW contributing to Australia's national and international commitments to protect marine biodiversity?

Term of Reference 1: Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments, and the effectiveness of these actions

The Audit requested and received information from the Australian Government on Australia's international obligations with respect to the conservation of marine biodiversity (Document 205). Australia's principal obligation is established by the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), which under section 520 provides a mechanism for Australia to meet its obligations:

Regulations may be made for and in relation to giving effect to any of the following agreements ¹¹:

- (a) the Apia Convention;
- (b) the Convention for the Protection of the Natural Resources and Environment of the South Pacific (the SPREP Convention) signed at Noumea on 24 November 1986;
- (c) the Bonn Convention;
- (d) CAMBA¹²;
- (e) JAMBA¹³;
- (f) an agreement between the Commonwealth and one or more other countries relating to whales;
- (g) the World Heritage Convention;
- (h) the Ramsar Convention;
- (i) the Biodiversity Convention;
- (j) CITES¹⁴;
- (k) the Framework Convention on Climate Change done at New York on 9 May 1992.

From a biodiversity perspective, the Biodiversity Convention, for which the official title is the Convention on Biological Diversity, is the most important. The Convention was mentioned in a large number of submissions (e.g. Submissions 31, 37, 43, 50, 58, 74, 84, 87, 99, 101, 102, 105, 110, 113, 115, 123, 124, 128, 135, 147, 148, 149, 150, 158, 195 and 198).

¹¹ There has subsequently been a Republic of Korea Migratory Birds Agreement signed, which also falls under this Act

¹² China Australia Migratory Birds Agreement

¹³ Japan Australia Migratory Birds Agreement

¹⁴ Convention on International Trade in Endangered Species

Its stated objectives are as follows:

... to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

Article 8 of the convention provides for *in situ* conservation as follows:

Each Contracting Party shall, as far as possible and as appropriate:

- (a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
- (b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;
- (c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;
- (d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;
- (e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
- (f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, *inter alia*, through the development and implementation of plans or other management strategies;
- (g) Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health;
- (h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species;
- (i) Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components;
- (j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilisation of such knowledge, innovations and practices;
- (k) Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations;
- (l) Where a significant adverse effect on biological diversity has been determined pursuant to Article 7, regulate or manage the relevant processes and categories of activities; and
- (m) Cooperate in providing financial and other support for in-situ conservation outlined in subparagraphs (a) to (l) above, particularly to developing countries.

Under the *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee 1992¹⁵), Australia confirmed a commitment to develop NRSMPA (as mentioned in Submission 195). All states and territories agreed¹⁶ to this approach through the Intergovernmental Agreement on the Environment (Commonwealth of Australia 1992¹⁷). This planning framework and its subsequent development has allowed Australian governments, both state and Commonwealth, to work towards Australia's international commitments agreed to within the Convention on Biological Diversity.

The objectives of the Convention on Biological Diversity are not internationally binding; they are open to the policy settings of both national and state governments. Both the NSW and Australian governments have biodiversity conservation strategies or plans and marine conservation strategies or plans (e.g. Document 21), which set out goals for the conservation of biodiversity. These obligations are reflected in how Australia has taken steps to protect its biodiversity but do not prescribe implementation mechanisms, including metrics¹⁸, to measure the degree to which this has been achieved.

The issues that arise in this situation typically revolve around protected area targets¹⁹, metrics and management-related statements that are set in various non-binding documents and declarations from Conferences of Parties and international meetings, or are proposed by organisations such as the IUCN. In many of the documents reviewed by the Audit and in some submissions to the Audit (e.g. Submissions 31, 181 and 198), such metrics are seen as absolute objectives rather than aspirations. The assertion by advocates for marine protected areas is that these should be binding on governments as they represent the path to comprehensive biodiversity protection. From time to time, governments and political parties adopt these targets, but they are policy settings rather than international obligations.

The system of marine parks that was established in NSW from 1997 through the *Marine Parks Act 1997* (NSW) goes a long way to meeting the Australia and New Zealand Environment Conservation Council objectives (ANZECC 1998²⁰) to establish a CAR system (see Box 1) of marine protected areas and the subsequent *National Strategy for Ecologically Sustainable Development* (1992²¹) and its successor agreements (Document 252). The Fairweather et al. review (2009²²) previously noted gaps in the NSW system in the Hawkesbury and Twofold Shelf marine bioregions (see Figure 1). The Audit believes that the management of biodiversity and threats to it can be improved and will make corresponding recommendations under Terms of Reference 7, 8 and 9.

¹⁵ Available at <http://www.environment.gov.au/about/esd/publications/strategy/index.html>

¹⁶ Under the Australian Constitution, agreements between the Commonwealth and the state governments are, while appearing to be formal documents, frequently repudiated or ignored by subsequent governments in both jurisdictions and there is no easy legal redress to this. For instance the Intergovernmental Agreement on the Environment of 1992 has been frequently ignored by the parties as has the *National Strategy for Ecologically Sustainable Development* of 1992. The only binding agreements are those under the constitutional referral of powers provision (Australian Constitution Section 52 xxxvii).

¹⁷ Available at <http://www.environment.gov.au/about/esd/publications/igae/index.html>

¹⁸ The metrics referred to are usually expressed as a percentage of land or sea area that should be protected, and within this, the percentage that should be in some categories of protection (see Table 1 and Table 3)

¹⁹ Targets can be particular expressions of the land and seascape for inclusion or a percentage of them

²⁰ Document 18

²¹ Available at <http://www.environment.gov.au/about/esd/publications/strategy/index.html>

²² Document 7

There is a suite of major tenure types of protected areas recognised by the IUCN that may be used in zoning a protected area system (Table 1). These range from strictly protected areas to multiple use areas with increasing degrees of permitted human activity.

Table 1: IUCN protected area management categories system

CATEGORY	DESCRIPTION
Ia Strict Nature Reserve	Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphical features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.
Ib Wilderness Area	Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II National Park	Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.
III Natural Monument or Feature	Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV Habitat/Species Management Area	Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V Protected Landscape/ Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI Protected area with sustainable use of natural resources	Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Source: IUCN 2008²³

²³ Available at http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/

As pointed out in a letter signed by Australia's Minister for the Environment Tony Burke and tabled at an Audit workshop (Document 263), there are no binding rules for the proper application of these; consequently the system provides considerable flexibility for sustainably managing the NSW Marine Estate.

As will be recommended later in this report, there is a need to modify the approach taken to the management of marine parks as well as the entire NSW Marine Estate. The intention is to encompass NSW marine parks within a statewide approach to management (section 2.8).

That said, the Audit Panel noted Australia's various commitments to the protection of marine biodiversity and found that the present system of marine parks in NSW was contributing to Australia's commitment to the establishment of an NRSMPA.

Recommendations for Term of Reference 1

- (R1)** In a strict sense, NSW is obliged to do only what it agrees with the Australian Government, which is the Party to the international conventions and agreements covered by the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). In the Audit Panel's opinion, the current arrangements pose no risk to the NSW Government that in regard to its management of marine parks it will be found in breach of international conventions.
- (R2)** The Audit Panel is of the further opinion that the current system of marine parks as established in NSW be maintained and mechanisms be found for enhancing the protection of biodiversity in the identified gaps, namely within the Hawkesbury and Twofold Shelf marine bioregions.

2.2 How is science conducted and used by the Marine Parks Authority and the departments responsible for managing marine parks in NSW?

Term of Reference 2: Review the scientific data provided to the Panel by NSW Department of Primary Industries and the Office of Environment and Heritage

2.2.1 Overview

Comprehensive documentation of the research carried out in NSW under the auspices of the Marine Parks Authority, Office of Environment and Heritage (OEH) and Department of Primary Industries (DPI) was provided to the Audit Panel. This research includes work that has been carried out through a wide range of other individuals and organisations, particularly from the university sector, both independently and through partnerships with NSW Government scientists. Much of this material has been collated and is provided on the Audit

website at <http://www.marineparksaudit.nsw.gov.au/relevant-documentation/>, including an overview of all Audit documents in an Audit Document Tracking Database. The *Strategic Framework for the Evaluation and Monitoring of Marine Parks in NSW* identified the two major research priorities as (MPA 2004, pp. 14–15²⁴):

1. Identify and select the location and nature of marine parks and their zones.
2. Monitor, evaluate and modify marine park boundaries and zoning arrangements.

Consistent with these two key elements, the supporting priorities are identified as:

3. Develop a comprehensive research portfolio for each marine park.
4. Manage and professionally report the information arising from research and monitoring in marine parks.

Through the *Marine Parks Strategic Research Framework 2010–2015* (MPA 2010d²⁵), the Marine Parks Authority provides guidance to the marine research community on the principal research and monitoring needs that would assist effective management of marine parks in NSW.

For convenience, the Audit Panel reviewed the scientific documentation against the research themes and key research areas outlined in the *Marine Parks Strategic Research Framework 2010–2015* (MPA 2010d²⁶) (Table 2). Here the Audit Panel makes brief comment in the context of the scope of the research results available and works published. The Audit Panel also comments on the management of research. This material is subsequently drawn upon in addressing other terms of reference.

Scientific documentation fell into two categories, the primary published literature and a variety of internal reports and other material. The latter made up the majority of the information provided, but notably the amount of published research had increased significantly since the review of NSW marine parks science in 2009 (Fairweather et al. 2009²⁷).

²⁴ Document 103

²⁵ Document 8

²⁶ Document 8

²⁷ Document 7

Table 2: Marine Parks Strategic Research Framework 2010–2015 research themes and key research areas

RESEARCH THEMES	KEY RESEARCH AREAS
Biodiversity and ecological processes	Habitat knowledge Biological diversity Ecological processes
Ecologically sustainable use	Assessment of zoning Recreation and tourism Population biology and assessment of key species Fishing and collecting
Specific environmental impacts	Pollution and development Pests and diseases Climate change
Social and economic influences	Economics research Social research
Culture and heritage	Aboriginal culture Heritage

Source: MPA (2010d²⁸)

2.2.2 Biodiversity and ecological processes

Much of the biophysical research on the sea floor that underpins habitat knowledge and biodiversity patterns is of a high standard, as evidenced by several refereed publications as well as a substantial body of unpublished reports and dissertations that came to the Audit's notice. This work has provided a much better understanding of the range of NSW coastal marine assemblages than that which existed when the marine park system was initially established. This research was designed primarily to provide the knowledge and understanding needed to establish a CAR system. Although the Audit considers other factors need to be taken into account, the research has provided baselines against which later reviews of the marine park system and its zoning could be evaluated. Only recently has work begun focusing on the CAR guidelines to seek an understanding of ecological processes, including work on the effect of marine parks on reef communities, threatened species, connectivity and larval dispersal. The situation becomes more complex when issues of ecosystem function are considered. These are subject to complex interactions with multiple variables and threats (see section 2.3). Attention needs to be given to long-term research that starts to create better understanding of these processes. The existence of marine parks also provides an experimental design that would allow research into large-scale ecosystem function to be conducted across the entire state, but as far as the Audit Panel can determine research remains focused on ecosystem structure.

²⁸ Document 8

2.2.3 Ecologically sustainable use

Zone types in NSW marine parks include sanctuaries, habitat protection areas, general use and special purpose zones (Table 3). Statewide monitoring of these zones using Underwater Visual Census and Baited Remote Underwater Video Systems has begun, but because many of the parks are so young this research is in its infancy. For this reason, the Marine Parks Authority has drawn extensively on the broader international published literature to examine and support the *Marine Parks Strategic Research Framework 2010–2015* (MPA 2010d²⁹) for NSW.

Research conducted elsewhere on the east coast of Australia shows that changes in the biodiversity of reef areas occur over fairly long time frames, especially in terms of trophic cascades (where the effects of consumers high up in a food web cascade onto species lower down). For example Edgar & Barrett (1999), Edgar et al. (2004), Barrett et al. (2009), Edgar et al. (2009) and Babcock et al. (2010)³⁰ have all shown that for the first five to 10 years of protection, most of the observed changes occurred in targeted species. In contrast, second-order predator–prey relationships (such as decrease in urchin populations and increases in kelp populations) were evident after 10 to 15 years.

The literature provides ample support for the observation that no-take marine protected areas provide reference areas against which the effects of fishing on the environment can be assessed.

Some of the findings of this research have been presented to justify the existence of marine parks in terms of enhancing fisheries. This area is contentious, and the debate is global in scale. The general literature shows that, in areas where the fisheries resource have been significantly depleted, the protection of areas as 'no-take' or 'no-go' has detectable outcomes both within and outside of the protected areas. Where stocks are not severely over-exploited, and this includes most commercially targeted fish within the marine estate of NSW, detectable changes to fish populations (e.g. increased size and abundance of targeted fish) are expected inside protected areas, but broad-scale spillover benefits are unlikely to be significant even though catch per unit effort might improve close to the boundary of the sanctuary. It should be noted that it is technically difficult to detect fisheries benefits outside of marine protected areas and it requires substantial research over long time scales (Halpern et al. 2010³¹). Spatially explicit data that allow an examination of this potential effect have not been collected in NSW.

One of the problems that beset understanding of these issues is the tendency for management agencies to over-emphasise the spillover effect in Australian systems, which reduces the focus

²⁹ Document 8

³⁰ Documents 462, 350, 394, 391, 379 and 248

³¹ Document 5

Table 3: NSW marine park zones

ZONES	ZONE OBJECTIVES
Sanctuary	Objects of sanctuary zone The objects of the sanctuary zone are: (a) to provide the highest level of protection for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone; and (b) where consistent with paragraph (a), to provide opportunities for the following activities in the zone: (i) recreational, educational and other activities that do not involve harming any animal or plant or causing any damage to or interference with natural or cultural features or any habitat, research; (ii) scientific activities.
Habitat protection	Objects of habitat protection zone The objects of the habitat protection zone are: (a) to provide a high level of protection for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone; and (b) where consistent with paragraph (a), to provide opportunities for recreational and commercial activities (including fishing), scientific research, educational activities and other activities, as long as they are ecologically sustainable, do not have a significant impact on fish populations within the zone, and have a negligible impact on other animals, plants and habitat.
General use	Objects of general use zone The objects of the general use zone are: (a) to provide protection for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone; and (b) where consistent with paragraph (a), to provide opportunities for recreational and commercial activities (including fishing), scientific research, educational activities and other activities so long as they are ecologically sustainable.
Special purpose	Objects of special purpose zone The objects of the special purpose zone are: (a) to provide for the management of biological diversity, habitat, ecological processes and natural and cultural features in the zone, where phenomena, sites or items in the zone warrant special management; or (b) to cater for special facilities and features in the zone such as slipways, breakwaters, berthing facilities and shipwrecks; (c) such objects as may be set out in the zoning plan for a marine park.

Source: Sections 1.7–1.10, Marine Parks (Zoning Plans) Regulation 1999, available at <http://www.legislation.nsw.gov.au/fullhtml/inforce/subordleg+102+1999+cd+0+N>

on the key purpose of marine parks—biodiversity protection. In the Australian context, improving fisheries is not the primary justification for sanctuary zoning. Confusion about spillover has therefore significantly contributed to the acrimonious debate about the science surrounding protected areas, and it is the view of the Audit Panel that the spillover argument is a sterile one that should be abandoned. Marine park managers and scientists are encouraged to emphasise the conservation benefits in their educational strategy rather than emphasising possible spillover benefits.

This is not to deny that good fisheries management can make good use of various well-established spatial techniques for the benefit of fish stocks. This issue is related to the appropriate sustainable management of the marine estate and should be seen as synergistic with the issues of spillover from marine parks discussed above. This again adds weight to the argument for better-integrated management of the whole marine estate.

2.2.4 Specific environmental impacts

Research on specific environmental impacts in the marine parks has not progressed far, and most of the evidence reported in section 2.3 of this report relies on the work of other institutions in the wider NSW marine context. Given the short time that some NSW marine parks have operated (as little as about five years)³², many of the potential effects on biodiversity or ecosystem function would not be expected to be detectable for at least another five to 10 years (Babcock et al. 2010³³; Submissions 146 and 154). This work is of value as it identifies the threats to biodiversity and how they may operate. However, we still know little of the specificities associated with various threats in the context of marine parks. That said most threats have to be dealt with on a broader scale than that of individual parks or even the collective marine park system. This is an important point because of the connectivity that exists across the entire NSW coastal marine system—individual marine parks can be affected by events that occur outside the boundaries of the park. The impacts on parks—both local and external—will be understood only through appropriately scaled scientific monitoring and evaluation.

2.2.5 Social and economic influences

In section 2.6, the Audit has indicated the significant deficiencies that exist in social and economic research. This is disappointing given the clear guidance given in the report by Fairweather et al. (2009³⁴). The importance of such work is clear, not only for its potential contribution to the management of the marine park system, but also because it provides a basis for the sophisticated resolution of the conflicts around the science described above. An understanding of the biology, ecology, and social and economic sciences should assist with resolving such debates. The objective must be to build legitimacy and public acceptance not through enforcement but through understanding and engagement.

³² NSW marine parks have progressively been established since 1998 with the most recent in 2006: Jervis Bay, 1998; Solitary Islands, January 1998; Lord Howe Island, February 1999; Cape Byron, November 2002; Port Stephens-Great Lakes, December 2005; and Batemans, April 2006

³³ Document 248

³⁴ Document 7

2.2.6 Economic and social research

Whether research has been directed at establishing baselines or not, the Audit Panel has reservations about both the quantity and quality of the social and economic research on marine parks that has been conducted and used by the Marine Parks Authority and relevant departments. The following summary comments are elaborated later in this report (see section 2.6).

Both economic and social fields have been deficient in their contribution to the peer-reviewed literature. Further, a significant proportion of the commissioned work had not been made public prior to the Audit.

The main shortcoming of economic research has been the narrow scope of the work and the lack of any genuine cost-benefit analysis in relation to NSW marine parks. Indeed, there have been no attempts to estimate the economic value to NSW of the full range of potential benefits of marine park declarations. The same can be said of the work on local impacts; that is, local non-market ecosystem benefits that might have accrued to the local community have not been valued. Moreover, the results of the local impact analysis tend to have been expressed in gross rather than net economic terms, exaggerating the local downsides by not allowing for the fact that material costs of any activities displaced, if they ceased, would not need to be incurred. This could become a serious matter if the impact studies were to be used to establish the basis for compensation payments to affected parties in matters such as commercial fisheries buy-outs. Admittedly, the valuation of the potential non-market benefits of marine parks is technically challenging and expensive; however, this is not a sufficient reason for neglecting such work.

The 2009 review of NSW marine parks science (Fairweather et al. 2009³⁵) made a number of recommendations for greater resourcing of social and economic research, especially in regard to heritage and other non-market values of marine parks.

Soon after the 2009 review, the Marine Parks Authority commissioned AgEconPlus Consulting & Gillespie Economics (2010³⁶) to review all of its past socio-economic projects. They identified several shortcomings, including those we have noted above. The report has only recently been made public, but the contents of the most recent version of the *Marine Parks Strategic Research Framework 2010–2015* (MPA 2011³⁷) provide little evidence for the report having influenced the Marine Parks Authority's approach to project selection.

Rigorous social impact assessment needs to be a central component of the methods used to establish and manage NSW marine parks. The social impact assessment framework (see section 2.6) needs to cover the intended and unintended social consequences (both positive and negative) of marine parks and any associated social changes. The ongoing evaluation of social impacts and benefits needs to be reported in the same reporting cycle as biophysical impacts.

³⁵ Document 7

³⁶ Document 140

³⁷ Document 258

Further, the social values of marine parks and the marine environment to the NSW community are required to provide the framework for making judgements about the relative worth of investments and impacts.

2.2.7 Culture and heritage

Fairweather et al. (2009³⁸) recommended that more emphasis be given to cultural and heritage research by the relevant government departments. In the material supplied to the Audit Panel, there is no evidence that this has been seriously acted upon. The need for this work is commented on again in section 2.6.

2.2.8 Summary

In summary, the research that is needed in support of the NSW marine parks, and particularly in terms of the monitoring and assessment of marine park benefits, is in its infancy. This is particularly the case for biodiversity conservation. One of the major recommendations from the Fairweather et al. (2009³⁹) report was that the emphasis of the research should shift from habitat characterisation and assessment to monitoring the effectiveness of marine parks and their zones against stated objectives. The 2010–2015 research framework (MPA 2011⁴⁰) has not addressed this recommendation.

This research particularly relates to obtaining a better understanding of the functional ecology of lower taxa⁴¹ and the importance of predation as a factor in organising the sessile component⁴² of marine systems via trophic cascades. In addition, the relationship between estuarine and littoral systems and the wider marine environment needs attention. Research inadequacies probably reflect a lack of resources, the manner in which resources are allocated, and the relatively young age of most of the NSW marine parks.

Most scientific work has investigated assets held within each park, identified potential areas that warrant protection, or established benchmark readings on the present status of marine ecosystems as distinct from the impact on that status of sanctuary zoning and other protective provisions that have been applied. Consequently, there is little information on how marine parks in NSW might have affected the biodiversity conservation status of the NSW marine environment. Many of the potential effects on biodiversity or ecosystem function would not be expected to be detectable until at least 10 to 15 years after park establishment (Babcock et al. 2010⁴³; Submissions 146 and 154; Workshop 1b), but three of the six NSW marine parks were established less than 10 years ago. The Audit Panel considers the recent addition of research officers to most of the NSW marine parks staff as a positive initiative that is resulting in greater understanding of the ecology and biodiversity of those parks and providing information that is directly useful to management; however, there is little evidence that this has yet improved the social and economic research output.

³⁸ Document 7

³⁹ Document 7

⁴⁰ Document 258

⁴¹ Organisms other than fish or other vertebrates

⁴² Organisms that are not mobile or with limited mobility

⁴³ Document 248

The relative scarcity of publicly available research that might illustrate how marine parks and their zoning have affected the biodiversity conservation status of the NSW marine environment has been fuelling the complaints of those who question the basis for establishing the parks in the first place. The Audit Panel noted that a similar lack of progress in this direction was also criticised in the Victorian 2010 audit of its marine parks (Victorian Auditor-General 2011⁴⁴). There were strong arguments for increased funding of long-term research programs that assess biodiversity conservation (see Submissions 146 and 150; Workshops 1b and 12). Moreover, the quality of the economic research that has been conducted is open to some criticism, as is the absence of high-quality social impact research (see sections 2.2.6 and 2.6). There are also concerns that the Marine Parks Authority has had an undue focus on research that has not always been readily applied in the field. Besides choosing relevant projects to support, an agency like the Marine Parks Authority needs to be alert to the findings of research more generally and to have a good capacity for translating the knowledge so gained into management action. The Audit Panel has some reservations about the Marine Parks Authority's approach to the commissioning and implementation of research findings into management actions as evidenced by the comments on social science and economics elsewhere in this report.

In addition, the Marine Parks Authority does not always seem to have the capacity to harness the information it obtains in a way that enhances the effective management of the entire NSW Marine Estate by informing the public. Also, in terms of the marine parks management's interactions with the public, there appears to be a public perception of too much emphasis on enforcement and insufficient emphasis on extension (Submission 146; Workshop 6e).

Both of these shortcomings may require a change in thinking and approach to the application of the biophysical science knowledge base within more a sophisticated social and economic framework. This is itself a researchable subject and research effort needs to be directed to this area, directed at public participation, education for sustainability and communications approaches, along with improved governance arrangements around the conceptualising of what is required and the implementation of what is found.

Another issue is the more general application of this information to the effective management of other reserve and planning interventions across the entire NSW Marine Estate. There are many existing legislative mechanisms that could be used to achieve this in co-operation with the NSW public.

⁴⁴ Document 31

Recommendations for Term of Reference 2

(R3) The Audit recommends the formation of a Scientific Committee, which is independent of government agencies and established to oversee strategic research in the Marine Estate in NSW. It is further recommended that this Committee be composed of experts in the marine sciences, economics and social sciences with an independent chair who reports directly to the Minister(s). In its work:

1. The Committee should review the five-yearly and annual work plans for science in the NSW Marine Estate (this includes but is not exclusive to marine parks and fisheries) as its major task. The Committee should then make specific recommendations to the Minister(s) relating to the adoption and modification of the plans.
2. The Committee must consult as a matter of course with the community as well as resource users in addition to direct research stakeholders. The Committee should be empowered and resourced to commission independent reviews by acknowledged international experts where it believes this would be useful in improving the science and its application to management. A particular area needing attention is a close examination of the incorporation of social and economic data into decision-supporting algorithms that are used in identification of various conservation areas and the level of management that should be applied to them.

(R4) The Audit Panel recommends that funding be allocated to addressing research shortcomings. Some of the priority areas identified by the Audit were:

1. Well-directed work is needed to incorporate social and economic data into decision-making in order to help all parties—taxpayers, consumers, industry participants, agencies and the wider NSW community—to better understand the social and economic benefits and costs of marine parks.
2. Resource-use activities in all areas of the NSW Marine Estate must be estimated, and improved social-network building, public participation and educational strategies developed to enhance the management of the Marine Estate.
3. With research that is publicly funded, priority should be given to projects on the potential threats to marine and estuarine biodiversity and ecological integrity within NSW waters that are considered by experts likely to be most significant. Candidates should include all five classes of threats identified by the Natural Resource Management Ministerial Council Marine Biodiversity Decline Report (2008⁴⁵) and should extend to the less-direct consequences of otherwise low-impact usage.
4. Resilience and multi-stressor research is needed to better understand the response of marine ecosystems to threat combinations.

⁴⁵ Document 28

5. The performance of the marine park system should be assessed against its primary objectives of conserving biodiversity and maintaining ecosystem integrity and function.
6. The NSW Government needs to ensure that complementary fisheries research is done to improve the understanding of the threat that fishing poses to the conservation of biodiversity in NSW and the environmental protected values of the Marine Estate. The focus of this research should include:
 - a. expanding the scope of ongoing assessments of fish stocks to assess ecological sustainability and management of fisheries rather than just stocks (for example, data-driven assessment of effects on habitats from by-catch, trophic flow-on and ecosystem-wide impacts)
 - b. developing strategies for improving fish stocks and managing them in a positive way to meet the reasonably expected needs of recreational anglers
 - c. estimating recreational fish catches (currently estimated to equate to around 30 per cent of the commercial catch in NSW).

2.3 What are the most significant human threats to the marine environment, are these being appropriately managed and what is the role of marine protected areas in the management of these threats?

Term of Reference 3: Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat

Term of Reference 4: Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary

2.3.1 Threats

Human threats to the coastal marine environment are generally well understood. Crain et al. (2009⁴⁶) noted that habitat loss was initially the most widespread and pressing threat to coastal habitats. Areas were often drained, dredged, and in some way converted to upland habitat, artificial substrate, or open water. They argue that with industrialisation, additional threats have emerged, particularly pollution from toxins or fertilisers, over-harvesting, and the by-products of globalisation such as invasive species and disease. More recently, the effects of widespread threats associated with global climate change—such as warming temperatures,

⁴⁶ Document 289

increasing rates of sea-level rise, ocean acidification, and ultraviolet exposure—are being documented (Document 106; Workshop 5).

There are several overlapping threats to biodiversity along the NSW coast, and the relative importance of each threat varies through space and time. Threats to the biodiversity and ecosystem function of the NSW Marine Estate have been individually identified and assessed by multiple agencies within the NSW government. These threats are covered later in this section.

Many submissions to the Audit suggested that pollution or invasive species represent a more substantial threat to marine biodiversity than fishing (Submissions 3, 4, 11, 13, 14, 15, 16, 18, 45, 46, 53, 64, 139, 167, 169, 176, 177, 179, 186, 193, 194 and 196). The Audit Panel noted that there is insufficient evidence to allow a comprehensive assessment of this claim. A formal comparison or ranking of threats has yet to be conducted for the NSW coast, but it is currently underway (Documents 116 and 200).

Ranking threats is a difficult process; the outcomes are sensitive to the exact nature of the question being asked and the context in which it is being asked. For example, threats within a particular marine park are likely to be ranked differently from those for the entire NSW marine environment. Moreover, the management of threats must depend upon their exact nature, how intense they are and where they are occurring.

There have been several recent attempts to rank threats to marine and coastal ecosystems in an international context (Crain et al. 2008, 2009⁴⁷). Studies that focus on marine species or groups of species, and base their rankings on the percentage of threatened species affected by each threat, consistently rank over-exploitation and habitat loss as the first- and second-most severe threats, while invasive species and pollution are consistently ranked within the top six threats. When threats are ranked based on ecosystem-level assessments, then more diffuse stressors such as those arising from climate change may be ranked more highly. One such global ranking by Halpern et al. (2007⁴⁸) included an assessment of ecosystem vulnerability to each of 28 specific threats for a range of marine ecosystems, listing the following threats as the top six: 1) increasing sea temperature; 2) destructive demersal fishing; 3) organic, point-source pollution; 4) hypoxia; 5) increased sediment input; and 6) coastal development.

2.3.2 Multiple threats

While the ranking of threats should be useful in targeting management and resources towards the most insidious challenges and the most vulnerable ecosystems, ranking individual threats underplays the importance of multiple stressors acting simultaneously. This type of ranking potentially ignores the operational reality that management at the local level can achieve little unless at least some of the locally operating threats are removed.

Threats to biodiversity and ecosystem function can be focused in areas of high population density and economic activity; hence there are usually many overlapping threats acting in any

⁴⁷ Documents 272 and 289

⁴⁸ Document 419

one location (Crain et al. 2009; Grech et al. 2011⁴⁹). While research on multiple stressors requires increased attention, a recent review and meta-analysis of 171 studies suggests that synergistic and antagonistic effects between stressors are common and complex (Crain et al. 2008⁵⁰). However, in the majority of cases, multiple synergistic stressors will either add to worsen impacts, or they may interact to exaggerate impacts. In a smaller proportion of studies, stressors interact to ameliorate impacts. This makes the understanding of multiple stressors a priority, and it supports the use of spatial management to mitigate multiple stressors (Crain et al. 2008, 2009⁵¹). In the current management context, improved and more integrated management systems as proposed in this report would, with time, allow for a combination of spatial and specific objective-driven management approaches.

2.3.3 Threats to the NSW marine environment—scale and intensity

A Natural Resource Management Ministerial Council working group (Marine Biodiversity Decline Working Group 2008⁵²) has reviewed the threats to marine biodiversity under the following broad categories: climate change, resource use, marine pollution, land-based impacts and biosecurity. Here we briefly review the status of the NSW marine estate in relation to each of these threats (in the order presented in the 2008 report), and the degree to which the marine parks process is anticipated to address each significant threat.

2.3.3.1 Climate change

Climate change is a global threat to the marine estate of NSW. It is also probably the least-well understood in terms of impact and mitigation at the scale the Audit is examining. The uncertainty surrounding regionally specific predictions limits our ability to manage or plan for threats associated with changing temperature, sea level rise, storminess, precipitation and ocean acidification. The NSW coastline spans several marine bioregions and climate change is widely thought to be already affecting the intensity and extent of phenomena such as the East Australian Current (Suthers et al. 2011; Wernberg et al. 2011⁵³). Thus any future effects of climate change will not be evenly spread through NSW waters. OEH is working with climate change modellers and oceanographers to develop finer-scale regional and local climate change projections for NSW (Document 106). The ubiquity of possible climate change and climate variability suggests that impacts to NSW waters associated with that threat should be managed along the whole NSW marine estate.

Climate change threats to the marine environment are associated with sea level rise, coastal erosion (and engineering responses to this), changes to ocean currents, temperature, chemistry, storm events and freshwater input. DPI considers that climate change is already affecting Australian marine life, fisheries and aquaculture; and more significant changes are predicted to occur in the near future (Document 106). The implications of climate change for Australian aquaculture and fisheries are predicted to be most severe off the south-east coast

⁴⁹ Documents 289 and 270

⁵⁰ Document 272

⁵¹ Documents 272 and 289

⁵² Document 28

⁵³ Documents 281 and 321

(especially NSW) because of a much greater than average predicted increase in sea surface temperature in this region (Document 106). For example, species range extensions are predicted for northern species, and range constrictions are predicted for southern species as the East Australian Current strengthens and associated eddy systems move south (Document 106). Tidal wetlands, which are important nursery habitat, are predicted in some areas to become smaller as sea level rises and the possibility of expanding landward is restricted by development (known as 'coastal squeeze') (Document 106). Elsewhere, inundation would be expected to create new wetlands but at significant cost to society.

OEH is collecting data (e.g. on water levels, wave climate and rainfall time series) and investing in the down-scaling of climate models to make more regionally specific predictions (Document 106). However, it is also clear that the previous NSW Government was not prepared to wait for exact data before acting. In particular, there have been state government policies developed and guidance given to local councils regarding projected sea level rise (best indicate an increase in mean sea levels of 40 centimetres from 1990 to 2050 and 90 centimetres by 2100 (DECCW 2009, 2010a; Department of Planning 2010⁵⁴). This is prudent, since ongoing activities (e.g. coastal development) have the potential to dramatically reduce our ability to adapt to climate change (Hannah 2011⁵⁵) and because of the extreme natural variability of Australia's climate. Again, a broad framework of marine estate management would facilitate sensible adaptation and mitigation responses to climate change and buffer against climate variability.

2.3.3.2 Marine parks and climate change

In the face of climate change threats that are projected over such a broad scale and for which controls over their causal mechanisms are beyond the reach of a single state or nation, the protection of endangered species, biodiversity and ecosystem function is probably best carried out by the protection of essential habitat from localised threats (Dunlop & Brown 2008⁵⁶). The argument here is that marine parks will contribute to adaptation to climate change via enhanced resilience in areas that are managed so that they are relatively free from non-climatic stressors. Enhanced robustness of intact communities is considered to be likely from theoretical models (Case 1990⁵⁷), experimental studies showing increased resistance to invasions (e.g. Stachowicz et al. 1999, 2002; Byers 2002; Occhipinti-Ambrogi & Savini 2003; Clark & Johnston 2009, 2011; Piola & Johnston 2008⁵⁸), or observations that biota in marine reserves suffer less from diseases (Behrens & Lafferty 2004; Freeman & MacDiarmid 2009⁵⁹), invaders (Edgar et al. 2004⁶⁰) or trophic cascades (Pederson & Johnson 2006; Sweatman 2008; McCook et al. 2010⁶¹).

⁵⁴ Documents 236, 237 and 238

⁵⁵ Document 292

⁵⁶ Document 410

⁵⁷ Document 348

⁵⁸ Documents 345, 403, 346, 354, 341, 343 and 342

⁵⁹ Documents 347 and 351

⁶⁰ Document 350

⁶¹ Documents 355, 408 and 95

Essentially, this line of reasoning argues for some areas having as few impacts as possible upon them (e.g. via a high and consistent level of management and protection) to allow for the greatest accommodation of climate change in those places (McLeod et al. 2009⁶²). Further, the same authors argue that areas with no or less protection may be less able to adapt because of the existence of multiple stressors.

Marine parks may also assist with the mitigation of climate change via the natural storage and/or enhanced sequestration of carbon in natural habitat features like marine vegetation (e.g. seagrasses, macroalgae, mangroves, salt marshes), coral reefs, shellfish beds, calcareous sediments or plankton. This is becoming known as ‘blue carbon’, and its potential relates to the residence time of carbon in any of these potential sinks. Intact coastal vegetation can contribute to climate adaptation by reducing the damage caused by storms, floods, droughts and sea level rise (MacKinnon et al. 2011⁶³). Protecting habitat may be a relatively cost-effective and sustainable way to mitigate the effects of climate change and extreme climatic events; it could potentially complement more expensive technological strategies (MacKinnon et al. 2011⁶⁴).

The current arrangement in NSW, where marine parks are located within multiple bioregions separated along a latitudinal axis, is an appropriate precautionary planning response to the climate change threat especially if placed within the context of an approach to managing the entire NSW Marine Estate. Sanctuary areas that span multiple depth ranges may also be useful because they may encompass cooler, lower light intensity, deeper water refuges for some species. Extensive cooperation between marine and land-based managers is also required to ensure areas for landward extension of intertidal habitats so that their continued ecological functioning remains feasible (e.g. salt marsh, mangroves). This would require concurrence rights⁶⁵ for the administration responsible for the NSW Marine Estate (see section 2.8) on shoreline developments along with a statewide environmental management system.

Any static zoning arrangements can be rendered ineffective by climate change, such as shifts in temperature and rainfall ranges. However, there is currently only a weak argument for changing the locations of zones in the short term in responses to climate change. What are known as mobile protected areas with shifting boundaries are likely to make compliance difficult and inefficient. They may not even be feasible if there is a restricted occurrence of particular habitat types (e.g. rocky reefs). More importantly, the time taken for ecosystems to recover from anthropogenic threats is longer than the time taken to cause impacts. This is a result of the long life-cycle of many marine organisms and the relatively slow dynamics of recovery. A moving system of parks is thus likely to undo decades worth of ecosystem recovery. Placing marine protected areas in a latitudinal range and including within them a range of habitats determined by substrate and depth and in locations that are free of

⁶² Document 300

⁶³ Document 299

⁶⁴ Document 299

⁶⁵ Consultation or concurrence can be required before granting development consent. This allows impacts to be considered at the development assessment stage. It also allows for developments to be modified or refused, thus mitigating impacts (see Document 201)

significant human interference means that they should act as medium-term refuges from the effects of climate change, or extreme natural variations and human impacts. Such a system would be enhanced if the NSW Marine Estate had management regimes that include: sanctuaries where management protects them from the maximum possible number of all threats; buffer zones where threats are minimized; and areas between them that are protected and managed appropriately.

Finally, marine protected areas should assist with addressing broader problems such as climate change, sea level rises and human impacts on the environment if they are utilised as benchmarks or reference sites, and if comparisons between them and the wider marine estate are routinely made (e.g. Submissions 30, 74 and 78; Workshops 1b, 3, 5 and 6d).

The extension of protection to the entire NSW Marine Estate (section 2.8) and its appropriate management would further enhance management and provide both flexibility and adaptive management responses to the threats posed by climate change and climate variability.

2.3.3.3 Extractive resource use

Extractive resource use is a variable threat to biodiversity and ecosystem function in almost all areas of the coast that are open to recreational or commercial fishing, dredging, mining or other newer uses such as energy generation or desalination. Resource extraction is ranked the primary threat to endangered marine species (Crain et al. 2009⁶⁶).

It has been argued that well-managed fisheries are a minimal threat if conducted at an appropriate scale (Submission 11; Workshop 1c(i)). While all fishing methods may not necessarily pose a risk to the conservation values of marine parks, poorly managed fisheries and overfishing (see Box 2) in any context are a threat to biodiversity and ecosystem function. In general exploited species increase in size and abundance after the removal of fishing pressure even in well-managed fisheries (Fairweather et al. 2009; Babcock et al. 2010⁶⁷) with subsequent indirect effects on ecosystem function through non-target species (Edgar et al 2009; Babcock et al. 2010⁶⁸). A strong case can be made for sanctuary areas to achieve specific outcomes such as habitat refuges for vulnerable or threatened species or life-history stages, scientific reference sites, cultural sites and eco-tourism. Further consideration of fishing and the role of marine parks in addressing fishing is included in section 2.4 below.

⁶⁶ Document 289

⁶⁷ Documents 7 (Appendix) and 248

⁶⁸ Documents 379 and 248

Box 2: Overfishing

Overfishing occurs when fishing depletes a fish stock below a pre-determined *acceptable* level. In NSW these levels are determined as (Rowling et al. 2010⁶⁹):

- fishing mortality rates being more than double natural mortality rates
- estimates of biomass are less than 30 per cent of the estimated unfished stock
- catch rates are less than 30 per cent of the initial catch rates
- length and age distributions are unstable
- trends in length/age composition indicate excessive fishing mortality
- spawning potential ratio is less than 20 per cent.

A stock is overfished when the benefits of the resource cannot be maximised (in terms of yield or economic benefit).

In general the literature on overfishing is focused on target species and, to a lesser extent, by-catch species. Ecosystem effects of fishing are poorly understood and may well end up having very different acceptable levels than those described above.

The problem is complex and can affect both the stock and the environment (e.g. Babcock et al. 2010⁷⁰ and references therein). It can have both immediate and long-term effects, especially if the act of overfishing leads to a shift in the ecosystem from one ecological state to another. There are several forms of overfishing. It may relate solely to the target species itself, for example:

- Growth overfishing—fish are harvested at an average size that is smaller than the size that would produce the maximum yield per recruit. Growth overfishing is more common than recruitment overfishing, and is of less concern than recruitment overfishing because it does not pose such a serious threat to the continued existence of the resource.
- Recruit overfishing—the mature adult (spawning biomass) population is depleted to a level where it no longer has the reproductive capacity to replenish itself. Recruitment overfishing leads to the collapse of a fish stock.
- Genetic overfishing—the exploitation selectively removes a certain class of fish (e.g. fast growers), thus skewing the genetic make-up towards a different trait (e.g. slow-growth).

Alternatively it can encompass the broader, indirect effects of fishing, for example:

- Ecosystem overfishing—an indirect consequence of overfishing the target species, and a cascading impact on other components of the ecosystem (e.g. the formation of urchin barrens arising from the reduction of fish predation).

⁶⁹ Document 149

⁷⁰ Document 248

Threats from resource use activities are not restricted to fishing. There are substantial risks to the marine estate of NSW associated with the dredging and disposal of benthic sediments (Eggleton & Thomas 2004; Knott et al. 2009⁷¹). Dredging is necessary for safe navigation, to obtain supplies of useful particles such as sand, and to lay pipelines and cables. It therefore occurs regularly within estuaries, ports and harbours. Dredging activities can directly remove benthic habitat, including marine vegetation, and reduce water quality through increased turbidity and the re-suspension of contaminated sediments (Wilber & Clarke 2001; Simpson et al. 1998; Hedge et al. 2009⁷²). Dredge spoil dumping can have negative consequences through the smothering of benthic fauna and infauna⁷³. Substantial technological advances have enabled some minimisation of dredging-related impacts; however, the frequency of dredging activity, the great potential to destroy habitat, and the large-scale re-suspension of contaminated sediments are a substantial threat to biodiversity and to the ecosystem function of the NSW Marine Estate.

The threat associated with mineral, oil or gas exploration and extraction in the NSW marine estate is extremely limited due to the apparent absence of this activity within state waters. Should such activity take place in the future, the spatial and temporal extent of the threat will depend on the scale of the facility, the stage of the process and the choice of chemicals. The construction of artificial structures necessary for resource extraction will have scale-dependent impacts (see further details under 2.2.4) and the threat of waste streams also varies dramatically. For example, more 'produced water' is created as the oil extraction process proceeds, and the impacts from oil-based drilling fluids extend further than the impact of water-based drilling fluids. More substantial environmental impacts are observed when extraction facilities malfunction.

There are also threats from other forms of resource use, such as aquaculture, tourism and energy production, that are expected to increase in their spread and intensity during the next hundred years. Aquaculture can have a variety of impacts upon marine biodiversity from escapes of cultured or disease organisms, downstream nutrient impacts from excess feeding, the quality of any used water, and the loss of habitat to accommodate aquaculture facilities. Many of these are reasonably well understood and so can be monitored on a case-by-case basis, although the cumulative effects may be more difficult to assess and manage (hence the 'tyranny of small decisions' may lead to a 'death of a 1000 cuts' to biodiversity).

Tourism is an intended major user of marine parks in NSW (Document 113), and many of the relatively more passive activities (like swimming, snorkelling, photography) probably pose little risk at present, although the intensity of usage may increase greatly in the future and so bring with it any density-dependent effects. Issues to do with the provision of infrastructure for visitors, boating, vehicles on beaches or in saltmarshes, SCUBA diving, and wildlife watching (Document 113) are more problematic and will pose more specific and divergent risks to marine biodiversity as people become more affluent and demand for these activities increases.

⁷¹ Documents 383 and 359

⁷² Documents 385, 384 and 382

⁷³ Fauna that live in the sediment rather than on top of it

One feature of a lower-carbon economy for Australia is likely to be a push towards producing renewable energy from the sea, for example from the action of tides, waves or winds. It is difficult to determine in advance the likely impacts of such new technology, although there are lessons to be learnt from overseas, for example Europe, where several of these technologies are more advanced. Most of these require the installation of hard structures, some even covering the seabed, so habitat loss or transformation is very likely.

2.3.3.4 Marine parks and resource use

Marine park responses to the threats posed by fishing as a form of resource use are outlined in section 2.4.

Dredging activities within NSW are regulated through the various agencies that control the estuary bed or seafloor. For many NSW estuaries, the estuary bed is Unreserved Crown Land and dredging approvals occur through the Department of Lands, which also operates its own transportable cutter suction dredge (Minister Kelly 2011⁷⁴). Part 7 of the *Fisheries Management Act 1994* (NSW) also requires a permit for activities that might affect water quality or harm marine vegetation. For dredging activities over a certain volume of sediment (30,000 cubic metres), the *Protection of the Environment Operations Act 1997* (NSW) requires a Pollution Control License for any activity that may change the physical or chemical nature of state waters. Dredge disposal that takes place outside of state waters requires a permit from the Commonwealth Government (Environment Australia 2002⁷⁵). Within marine parks, planned developments trigger Section 19 of the *Marine Parks Act 1997* (NSW). This requires a consent or determining authority to consider the objects of the Act and objects of the zone within which the development or dredging activity is planned (Document 201). Threats to the biodiversity of marine parks may still occur if dredging or dredge spoil dumping takes place in close proximity to a park, and in these circumstances concurrence powers should be given to the Marine Parks Authority to allow the impacts on biodiversity and habitats to be considered at the development assessment stage. In some cases, dredging may not be allowed and in others, novel engineering solutions may be required to further reduce the threats to ecological processes posed by dredging and dumping operations.

It is unlawful to prospect or mine for minerals in a NSW marine park (Document 201).

The threats posed by aquaculture are well recognised by marine park managers (Document 107) and largely managed by the impact assessment provisions of the NSW planning legislation. Of particular interest are the 1311 hectares of oyster priority areas that currently lie within NSW marine parks, especially in the Port Stephens-Great Lakes Marine Park and Batemans Marine Park. Aquacultural (Document 107) and tourism (Document 113) impacts on NSW marine parks are all said to be considered by marine parks management. The way marine parks in NSW deal with these threats tends to be relatively straightforward (e.g. they do not allow aquaculture or energy production facilities in highly protected zones, and they put tight controls on tourism activities through a system of permits). The pressure for

⁷⁴ See media release at http://www.lpma.nsw.gov.au/data/assets/pdf_file/0019/149023/110314_Lands_NSW_Coastal_Dredge_purchase_WEB.pdf

⁷⁵ Document 395

expanding such activities, and pressures for new activities such as energy generation or desalination, shall pose challenges in the future for NSW Marine Park managers.

2.3.3.5 Land-based impacts

In general, the threat of land-based pollution to the marine and coastal environment of NSW is greatest in upper estuarine areas where contaminant loads are highest and flushing is lowest (e.g. Birch & Hutson 2009⁷⁶). The risks to the NSW Marine Estate are therefore more intense in estuarine environments, especially those that receive significant discharge from urban drainage or rivers with significant areas of agricultural development and human settlement in their basins (Lee et al. 2011; Scanes & Roach 1999⁷⁷; Document 103). While coastal waters and sediments are substantially free from land-based contamination (Birch 2000; Apte et al. 1998; Pritchard et al. 2003; Scanes & Roach 1999⁷⁸), contaminants (heavy metals and pesticides) are a problem in the upper reaches of estuaries close to Newcastle, Sydney and Wollongong where there is historical legacy of industrial contamination (Birch 2000; Knott et al. 2009⁷⁹; Document 103).

In addition, a major ongoing source of contamination is stormwater (Birch & Rochford 2010⁸⁰; Document 103). In response to the stormwater threat, most councils in highly urbanised areas have commenced stormwater management plans under the government's Urban Stormwater Program (Document 103). However, in places these contaminants still reach concentrations that breach ANZECC sediment quality guidelines and are likely to result in negative consequences for biodiversity (e.g. Birch & Hutson 2009; McKinley et al. 2011⁸¹).

The primary threat to much of the rest of the NSW Marine Estate from land-based impacts is considered to be from the addition of nutrients and sediments (Scanes et al. 2007⁸²). Increased sedimentation within estuaries often results from land-clearing and soil disturbance, and agriculturally enriched runoff and sewage are major sources of nutrients. Among other things, increased sedimentation and nutrients can lead to the loss of submerged aquatic vegetation, which is important biological habitat (e.g. Larkum & West 1990⁸³). It is acknowledged that, in some areas, other localised impact sources may exist, such as acid sulphate soils (MPA 2004⁸⁴; Submission 132). Acid sulphate soils, when disturbed, reduce the pH of waters, and through discharge either through drains or directly into the drainage system, can impact the biodiversity and ecosystem function of sections of some estuarine tributaries (Sammut et al. 1995, 1996⁸⁵).

The majority of NSW sewage is discharged directly into the ocean. Prior to 1992, treated sewage was discharged to the ocean off Sydney via shoreline outfalls at North Head, Bondi and Malabar, resulting in well-documented impacts on near-shore environments. Risk

⁷⁶ Document 361

⁷⁷ Documents 400 and 356

⁷⁸ Documents 369, 389, 364 and 356

⁷⁹ Documents 369 and 359

⁸⁰ Document 360

⁸¹ Documents 361 and 363

⁸² Document 212

⁸³ Document 368

⁸⁴ Document 103

⁸⁵ Documents 371 and 370

assessments of Sydney's large deepwater outfalls (that replaced the shoreline outfalls) did not detect major impacts on receiving environments (Otway 1995; Otway et al. 1996; Pritchard et al. 2003⁸⁶; Document 56). Studies of smaller ocean outfalls along the NSW coast tend also to be limited to the immediate surroundings of the outfall (e.g. Smith et al. 1999⁸⁷; Document 56). A relatively new potential point-source pollution threat to the marine estate derives from the newly constructed desalination plant which discharges hyper-saline brine offshore from the Kurnell Peninsula (not within a marine park). There is limited published literature investigating the impacts of desalination plants on marine environments (Roberts et al. 2010⁸⁸); however, a detailed impact monitoring program is underway to assess potential impacts from this point source.

Some land-based impacts are not pollution related but result from coastal developments and can also result in substantial habitat loss. Coastal developments represent a significant threat to intertidal and near-shore ecosystems. Habitat loss through coastal development occurs most often when shallow or intertidal areas are completely replaced by artificial structures (or marinas), and when land is reclaimed or wetlands drained. Habitat loss is considered one of the greatest threats to biodiversity and ecosystem function because it entirely removes the resident assemblage and the ecosystem services that the assemblage provided (Lotze et al. 2006⁸⁹). Habitat loss, either as a direct result of coastal development or as a result of water-quality deterioration, has been extensive within NSW, although statewide estimates are difficult to make due to the absence of historical baseline data. Some examples are the loss of natural shorelines within Sydney Harbour and Tom Thumb Lagoon (now known as Port Kembla Harbour) and the loss of seagrass within Botany Bay (Larkum & West 1990⁹⁰).

2.3.3.6 Marine parks and land-based impacts

The presence of marine parks in NSW may reduce the threat of habitat loss from land-based activities by controlling or preventing threatening activities such as the building of artificial structures, land reclamation and the placement of point-source pollutant discharges. Land-based impacts from point sources are primarily controlled through the *Protection of the Environment Operations Act 1997* (NSW), which provides authority for OEHS regulatory actions, including licenses (OEHS incorporates the Environment Protection Authority). The NSW Government has also developed Marine Water Quality Objectives to simplify and streamline the consideration of guideline levels for water quality when considering coastal development assessments (DEC 2005a, b, c, d⁹¹). These mechanisms influence land-based pollution of marine waters across the state. However, NSW marine parks can further reduce the potential threat from land-based pollution through direct management actions. Existing examples in NSW are the removal of old oyster leases, the creation of land buffers on logging activity, improved sewage treatment and relocation of ocean outfalls, and the mapping of marine parks as sensitive areas in the NSW Oil Spill Response Atlas. Marine parks do require

⁸⁶ Documents 373, 372 and 364

⁸⁷ Document 378

⁸⁸ Document 387

⁸⁹ Document 352

⁹⁰ Document 368

⁹¹ Documents 227–230

a greater ability to influence land-based activities that have the potential to cause long-distance, downstream impacts on marine biodiversity and function.

The current condition of estuaries in NSW is assessed through the *New South Wales Natural Resources Monitoring, Evaluation and Reporting Strategy 2010–2015* and focuses strongly on nutrients and sedimentation threats (DECCW 2010a⁹²). To date, data have been collected for approximately 120 estuaries (out of a total of 184). A third (60) of all 184 NSW estuaries are currently within marine parks, and slightly fewer than half of these (25) include some sanctuary zones (Document 193). The estuaries captured within marine parks have been assessed by the NSW Government as currently having low to moderate catchment pressure: a measure of threat from land-based activities (Document 193). This assessment is supported by the limited data available on the sediments of Batemans and Jervis Bay marine parks. In a recent assessment, most metal contaminant concentrations were below recommended sediment quality guidelines in these parks (Dafforn et al. 2012; ANZECC/ARMCANZ, 2000⁹³). Polycyclic aromatic hydrocarbon contaminants were generally below detection limits at all sites within marine parks (< 0.01 or 0.02 mg/kg), and when concentrations were detectable they did not exceed recommended sediment quality guidelines (Dafforn et al. 2012⁹⁴). The condition of some other estuaries, however, is poor due to previous activities within the region, for example within Cape Byron and Port Stephens-Great Lakes marine parks (Document 193). The issue of estuary health is significant.

Better management of the NSW Marine Estate requires improved management of all estuaries, which while not always protected in the marine park network, are important in terms of the state's total biodiversity. To this end, the further developments of ecological indicators of response are required such that the relevance of pressure variables may be better understood and the condition of the marine estate more accurately ascertained. Marine sanctuaries represent the best opportunity to establish baseline or reference conditions for such ecological monitoring.

Beyond the assessment of nutrient and sediment impacts in estuaries, there does not appear to be a recent substantial survey of water or sediment contamination within the NSW Marine Estate. Moreover, NSW's Marine Water Quality Objectives are not regulatory or mandatory: they are a tool for strategic planning and development assessment processes (DEC 2005a, b, c, d⁹⁵). This results in a regionally specific, and sometimes only industrially specific, understanding of land-pollution threats to marine systems. If properly resourced and managed in a whole-of-system context, the threat from land-based impacts on biodiversity and ecosystem function could be monitored by collecting data on contamination sources and concentrations within the various marine park zones. This would allow priority actions for reducing or ameliorating risk from contamination to be established. This would also assist local councils when considering possible water-quality impacts from coastal development assessments.

⁹² Document 150

⁹³ Documents 344 and 412

⁹⁴ Document 344

⁹⁵ Documents 227–230

2.3.3.7 Marine pollution

The threat of marine pollution⁹⁶ from spills or ship groundings is patchily distributed throughout the NSW marine estate and the extent of impacts is, in most cases, likely to be spatially and temporally more restricted than the other threats outlined above. The risks from vessel groundings include persistent contamination from spills, physical damage to seafloor assemblages, loss of structural complexity of habitat, the addition of artificial structures, and the introduction of toxic antifouling residues (Jewett et al. 1999; Ebersole 2001; Marshall et al. 2002; Negri et al. 2002⁹⁷). Clean-up operations can be logistically difficult and hugely expensive; moreover, some approaches to the clean up can cause further ecological impacts if not managed appropriately. Shipping densities and locations are used as an indicator of the degree of risk of ship groundings or spills along the NSW coast (Document 111). Australia's major shipping lane off the east coast runs parallel to the coast approximately 10 to 15 nautical miles offshore, and hence does not overlap with NSW state marine waters. However, the shipping lane is very active and much of the traffic is travelling to Newcastle or a Sydney port (including Botany Bay). As a result, ships regularly pass within three nautical miles of the shore, particularly at certain points along the coast such as Sugarloaf Point (Document 111). Ships are advised to anchor outside the three-nautical-mile limit and must be ready to move if weather conditions turn unfavourable. The Australian Maritime Safety Authority recently commissioned an assessment of the risk of pollution from marine oil spills in Australia as part of a 10-year review of its national plan, the report is expected to be completed in the next few months (AMSA 2012⁹⁸; Document 111).

Marine debris refers to all land-based or ship-sourced solid and largely non-biodegradable material that represents a threat to marine biodiversity. The threat is manifested through ingestion or entanglement by wildlife causing injury or fatality. Along the NSW coast, marine debris can include illegally dumped garbage (such as bags, bottles, ropes, fibreglass, piping, insulation, paints and adhesives), or abandoned or lost fishing gear from recreational and commercial fisheries (e.g. strapping bands, synthetic ropes, derelict fishing nets, floats, hooks, fishing line and wire trace) (DEWHA 2009⁹⁹).

2.3.3.8 Marine parks and marine pollution

Marine parks are designated as highly sensitive areas with regards to oil spills (Document 58; the NSW Oil Spill Response Atlas¹⁰⁰) and they should be considered highly sensitive to threats from *any* source of marine pollution. Marine parks can reduce the threat of marine pollution from ship groundings by reducing the frequency of vessel passage through their waters and establishing buffer zones around the most highly protected areas. NSW Maritime and the NSW Port Corporations manage the response to shipping incidents and emergencies (including oil and chemicals spills), which is outlined in the *NSW State Waters Marine Oil*

⁹⁶ This is differentiated from land-based impacts, which may also include pollution

⁹⁷ Documents 377, 375, 376 and 202

⁹⁸ Available at http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/

⁹⁹ Document 427

¹⁰⁰ Available at

http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Oil_Spill_Response_Atlas/

and *Chemical Spill Contingency Plan* (NSW Maritime 2008¹⁰¹) (part of the NSW Disaster Plan (DISPLAN)). Marine park personnel receive training so they can assist with the response to an oil spill that threatens a marine park area (Workshop 3).

Risks to the NSW Marine Estate from marine pollution other than chemical spills or ship groundings are reduced by existing regulations, such as prohibiting the disposal of plastics into the sea, and prohibiting disposal of other (non-plastic) garbage or sewage within 12 nautical miles of land. Marine parks offer the opportunity for these regulations to be strictly implemented through substantial public education campaigns and compliance monitoring. This is an ongoing feature of marine park management in NSW. Unfortunately, marine debris can arrive from outside of the NSW Marine Estate, but it can also be left unintentionally (for example, when fishing gear cannot be retrieved).

Recently, there has been documentation of such debris on subtidal reefs of northern NSW, and it should be considered a threat to biodiversity of these areas since it is known to be destructive to biogenic habitat such as soft-corals (Yoshikawa & Asoh 2004¹⁰²).

In a study of the Solitary Islands Marine Park by Smith (2010¹⁰³), fishing-related material (mostly monofilament line) comprised the majority of debris found on the reefs. Debris was even found within sanctuary zones, indicating non-compliance. The establishment and acceptance of restrictions on fishing in some areas is required for the protection of biodiversity from this localised threat.

2.3.3.9 Biosecurity

At a global level, biological invasions are widely recognised as one of the greatest threats to biodiversity and ecosystem function (Vitousek et al. 1997; Mack et al. 2000¹⁰⁴). Several submissions referred to the problem of introduced organisms in NSW or across Australia (Submissions 11, 172 and 175). From an ecological perspective, the impact of non-indigenous species on local communities can range from reduced biodiversity (Wilcove et al. 1998¹⁰⁵) to dramatic modifications to habitat and ecosystem function by ecosystem engineers (Crooks 2002¹⁰⁶).

The risks posed by the introduction of pest species or disease in NSW are likely to be greatest in areas of high vessel activity (ports and marinas), but the extent of current threats within NSW is relatively poorly defined. Statewide plans of management are contained in the *NSW Invasive Species Plan 2008–2015* (DPI 2008¹⁰⁷), which has four goals: (1) to prevent the establishment of new invasive species; (2) eliminate or prevent the spread of new invasive species; (3) reduce the impacts of widespread invasive species; and (4) ensure NSW has the ability and commitment to manage invasive species. The discovery of any new non-indigenous species that is listed on the Coordinating Committee for Introduced Marine Pest

¹⁰¹ Document 465

¹⁰² Document 380

¹⁰³ Document 325

¹⁰⁴ Documents 357 and 353

¹⁰⁵ Document 358

¹⁰⁶ Document 349

¹⁰⁷ Document 463

Emergencies Trigger List as a pest species would lead to an emergency response under new arrangements under the National System for the Prevention and Management of Marine Pest Incursions (Document 115). However, the system for detection of new incursions has major gaps and is seriously under-resourced. Major ports in NSW were surveyed for invasive species more than a decade ago and one survey has been conducted in some marine parks (Document 115). Previous port surveys identified many non-indigenous species in most ports, but the findings failed to trigger any management action. A risk assessment for marine pests was recently completed for the Sydney region (Glasby & Lobb 2008¹⁰⁸; Document 115), and it identified several high-risk vectors for a suite of new marine pests. However, funding has not been allocated for statewide surveillance programs for potential new invaders even in commercial ports (i.e. the most likely entry points for new pests). Current statewide monitoring for marine invasive species is limited to the green alga (*Caulerpa taxifolia*) and the European green crab (*Carcinus maenas*) (Workshop 4). Apart from this, there is only a serendipitous reporting system for detecting new incursions: there are arrangements under the *New South Wales Natural Resources Monitoring, Evaluation and Reporting Strategy 2010–2015* (DECCW 2010b¹⁰⁹), and the general public can also report (Document 115). It would appear that, while there is significant funding for terrestrial pest species research and management, there is relatively scant funding for marine pest species research and management. This disparity may reflect the economic value of agriculture versus fisheries, and it highlights the lack of proper ecosystem services valuation (Submission 158).

For the majority of non-indigenous species known to occur within NSW, there is insufficient information to ascertain whether they represent a significant threat to biodiversity or ecosystem function. The main invasive species currently being researched in NSW are the European green crab (*Carcinus maenas*) and the green alga (*Caulerpa taxifolia*). *Carcinus maenas* has been established in NSW for some time. International studies show that *C. maenas* can affect biodiversity when first introduced to a system, but that the threat diminishes over time. Catchment management authorities have eradication programs for marine pests including *C. maenas*, the Pacific oyster (*Crassostrea gigas*), and the European fanworm (*Sabella spallanzanii*). *Caulerpa taxifolia* opportunistically establishes in disturbed seagrass habitat, but *C. taxifolia* appears to co-exist with some native seagrasses in NSW (Document 115). Ecological impacts from *C. taxifolia* may occur through changes to sediment chemistry that negatively impact infauna (including clams) and sediments, suggesting it is a possible threat to soft sediment biodiversity in general (Byers et al. 2010¹¹⁰).

2.3.3.10 Marine parks and biosecurity

Highly protected zones within marine parks are themselves more protected from bioinvasion and this is a key aspect in which they protect biodiversity and ecosystem function. They do not, however, form a stand-alone strategy for the prevention of marine invasions across the

¹⁰⁸ Document 429

¹⁰⁹ Document 150

¹¹⁰ Document 425

entire marine estate. The prevention of invasions and reductions in the spread of invaders requires a state and Commonwealth level of coordination.

It is now well established that disturbance to ecosystems facilitates invasion (Stachowicz et al. 1999, 2002; Byers 2002; Occhipinti-Ambrogi & Savini 2003; Piola & Johnston 2008; Clark and Johnston 2009, 2011¹¹¹). Highly protected areas are therefore likely to be more resistant to threats that arise from disturbances such as fishing, pollution and coastal development (Piola & Johnston 2008¹¹²). Better approaches to damage mitigation in other areas could include fixed anchorages, tie-up protocols, codes of practice, which along with habitat protection zones, could contribute to mitigating threats. Another well-established driver of invasive success is exposure to non-indigenous propagules (Drake & Lodge 2006¹¹³). Marine parks protect against this threat by reducing exposure to invasive propagules through strict vector management. The parks can also directly regulate anthropogenic vectors for pests. In addition to the general powers to restrict ballast water exchange, the Marine Parks Authority has further powers to order the removal of boats with heavily fouled hulls from marine parks. The Marine Parks Authority could also, if necessary, use closure powers (under section 20A of the *Marine Parks Act 1997*) to support management of pest or disease outbreaks. Marine parks also restrict coastal developments such as artificial structures and marinas.

The Audit Panel believes that through public education and awareness programs, marine parks can encourage increased compliance and awareness of protocols and guidelines to minimise the risk of invasion (e.g. from biofouling and accidental transport on trailer boats). Monitoring of marine protected areas should assist with addressing broader problems such as early detection of non indigenous invaders (e.g. Submission 30). The main mechanism for this to occur is through the extra scrutiny that protected areas get in contrast with unprotected areas (e.g. because more people 'care' about the condition of them). This can provide increased surveillance for relevant invasive species and data on vectors that might allow invasive species to arrive in parks (Workshop 4).

2.3.3.11 Summary of threats and the role of marine protected areas.

In the NSW Marine Estate there are a range of threats to marine biodiversity and ecosystem function interacting at multiple spatial and temporal scales (Workshops 3, 5, 6b, 6e and 13). Climate change is a diffuse and global threat for which the impacts are yet to be fully understood. Resource extraction is a potential threat to much of the marine estate, and it increases under poorly managed commercial or recreational fishing activity. Land-based activities largely threaten near-shore habitat and upper estuarine areas, particularly near large population centres, while the threat from marine-sourced pollution (e.g. spills and debris) is more spatially and temporally restricted. Marine invasive species are at greatest threat in areas of high vessel activity, but the distribution and potential impacts of non-indigenous species are relatively poorly defined. As outlined in greater detail above, each threat acts through different mechanisms, and the interaction of threats is likely to result in additive or synergistic

¹¹¹ Documents 345, 403, 346, 354, 342, 341 and 343

¹¹² Document 342

¹¹³ Document 381

impacts. The NSW Government clearly recognises that there are multiple threats to marine biodiversity and ecosystem function and is managing these threats through multiple mechanisms. Marine parks form only one part of the NSW Government's response to simultaneously address multiple threats to the NSW marine estate. This includes legislation to regulate development and pollution that applies and is upheld within marine park zones. The Qualitative Ecological Risk Assessment of Marine Biodiversity in NSW project (see Documents 200 and 201) was initiated in June 2010 and the report on Phase I is due to be prepared around March 2012. This should shed more light on the intensity and scale of multiple threats across the NSW marine estate.

2.3.3.12 Better management of threats

In addition to the management of threats associated with marine parks, it is also desirable that threats be managed in the whole of coast and Marine Estate basis. This matter is considered under the latter terms of reference for this enquiry in section 2.8.

In the following section, a better approach to management and evaluation is proposed. Again this will be linked to a more comprehensive approach in section 2.8.

2.3.3.13 Monitoring and evaluation

The monitoring, evaluation and reporting (MER) system (DECCW 2010b¹¹⁴) that has been established as a part of the NSW catchment management process is starting to provide information that will be useful in managing the estuarine environment. It also has the potential to significantly improve the understanding of land-based threats to the coastal environment. This report proposes legislation that includes a mechanism for achieving this, which is to require the scientific committee to collaborate with the Natural Resources Commission in better coordinating such activities.

¹¹⁴ Document 150

Recommendations Relating to Terms of Reference 3, 4 and 9

(R5) From the information available to the Audit Panel, it would appear that there is a need to further extend the Monitoring, Evaluation and Reporting (MER) system to include a greater focus on marine, estuarine and inshore environments as a priority. This should include monitoring for invasive species in and around areas where boating or shipping activity is particularly intense.

Several further improvements to coastal management and protection should include the following:

1. Threats to marine parks should be assessed as part of a statewide risk assessment, including any indirect effects of activities such as tourism and fishing (for example, anchoring). This risk assessment should be used to guide a similar process that is done independently for each marine park. The park-specific process would interrogate the system at a much finer scale, both spatially and temporally. The risk assessments should be used to guide management actions commensurate with the park objectives.
2. Zoning and rezoning should also more explicitly and transparently consider the assessment of risks. In developing this framework, priority should also be given to determining how subsets of threats are being dealt with by the current configuration of the marine parks network as a (i) primary, or (ii) secondary, or (iii) subsidiary (i.e. much less assured and possibly only incidentally) goal for the network. Explicit detail on how current management practice addresses each potential threat can then be added to the framework and additional strategies developed where it is shown that marine parks are insufficient to address particular threats. Management actions should be in proportion to risk and must be cost-effective.
3. Greater clarity and attempts to communicate actions should be taken across the entire NSW Marine Estate to manage each threat type and the biological, social and economic justification for these actions.
4. Within the framework developed by the risk assessment and as a possible extension of the MER, the Audit recommends:
 - a. the development of an early detection pest-monitoring program that targets high-risk locations and pest species. Assessment of the ability of this program to deliver early detection of marine pests (e.g. estimates of detection probabilities) should be an integral part of this program. Existing pest-response strategies must integrate tightly with the monitoring program. Within the Marine Estate, marine parks should be considered as areas that warrant additional scrutiny with regards to biosecurity
 - b. that beyond the assessment of nutrient and sediment impacts in coastal waterways, a statewide survey of contaminant levels across NSW waters utilising both bio-monitor and sediment grab approaches would provide important

information as to where ANZECC/ARMCANZ sediment-quality guidelines are exceeded, or emerging contaminants of concern are identified. This should allow for the identification of current sources and the nomination of areas that should be targeted for remediation. This should be accompanied by a clear and consistent approach to understanding and managing the fate and effects of contaminants (including transport and remobilisation) for the NSW Marine Estate.

5. New legislation is required to implement Recommendation R15, which should include provision for a risk framework that allows the targeting of management resources towards high-risk vectors (e.g. boats that have come from areas with known pest species or large marinas) and a management regime for ballast-water exchange. The legislation should also provide for closure powers across the NSW Marine Estate to support management of pest or disease outbreaks. We have already recommended (Recommendation R4) that better understanding the risk to marine biodiversity posed by non-indigenous species (not just the currently named pest species) be considered a high-priority research area.
6. The management and licensing of dredging activities within the NSW Marine Estate be reviewed, consolidated and updated to require world's best practice.
7. A regulatory framework for better managing stormwater inputs of contamination should be provided.

2.4 What are the most significant issues with respect to the management of NSW fishing and the interaction of this with the management of NSW marine parks?

Term of Reference 3: Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat

Term of Reference 4: Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary

2.4.1 Managing fishing

DPI manages fisheries in NSW under the *Fisheries Management Act 1994* (NSW). The overarching object of the Act is to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. In particular, this includes:

- to conserve fish stocks and key fish habitats
- to conserve threatened species, populations and ecological communities of fish and marine vegetation

- to promote ecologically sustainable development, including the conservation of biological diversity.

Clearly there is a focus here on conservation-orientated sustainable use, and therefore, a significant overlap with the objects of the *Marine Parks Act 1997* (NSW), which are as follows:

- (a) to conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks,
- (b) to maintain ecological processes in marine parks,
- (c) where consistent with the preceding objects:
 - (i) to provide for ecologically sustainable use of fish (including commercial and recreational fishing) and marine vegetation in marine parks, and
 - (ii) to provide opportunities for public appreciation, understanding and enjoyment of marine parks.

There was a clear dichotomy in the submissions received by the Audit Panel. On one hand, proponents of no-take or sanctuary areas argued that fishing was a serious and sometimes irreversible threat in some areas, and therefore that no-take sanctuary areas were needed to address this threat (e.g. Submissions 106 and 150). Significant reference to the international published literature was made in support of this argument: that the world's oceans are overfished and that marine parks have been demonstrated to be an appropriate management response to this problem. On the other hand, others argued that fisheries in NSW were sustainable and that all fishing was not a threat in all circumstances (e.g. Submissions 11 and 46; Workshops 1c(i), 6e and 13). This difference of opinion has fuelled much of the public debate surrounding marine protected area zonation in NSW. The underlying principle of multiple-use marine parks is that there is continued access and opportunities for users of marine resources, provided that biodiversity and cultural values are conserved.

The Audit notes that the status of approximately 50 per cent of the species listed as commercially or recreationally fished have not been assessed due to lack of information. However, the most recent report on the status of 108 species important to the commercial and recreational fishing sectors in NSW showed that, while species considered to be overfished or recruitment overfished increased from three to six in the period between 2006–07 and 2008–09, all those are subject to specific recovery plans (Rowling et al. 2010¹¹⁵). They included jackass morwong (*Nemadactylus macropterus*) and eastern gemfish (*Rexea solandri*) (both Commonwealth managed), and eastern sea gar-fish (*Hyporhamphus australis*), mullet (*Argyrosomus japonicus*), blacklip abalone (*Haliotis rubra*) and grey morwong (*Nemadactylus douglasii*). Again, the Audit notes that stock assessments of target species are largely based on expert opinion and there is an acknowledged need for further fisheries-independent data on stocks, recreational fishing take, and information on more indirect ecological effects of fishing (Workshops 1a and 1c(i)).

¹¹⁵ Document 149

All major fisheries in NSW are required to have an environmental impact statement under NSW environmental legislation, and all export fisheries are required to be accredited under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) as being environmentally sustainable. NSW Fisheries has an extensive track record in the research and subsequent management of incidental impacts of fishing on biodiversity. The organisation is an acknowledged world leader in research on the impacts of by-catch, the development of by-catch reduction technology (e.g. for prawn trawling), and the management of the effects of hauling over sensitive habitats such as seagrasses (Submission 41). The Audit Panel concluded from the material available that much of the international concern over fisheries is directed at destructive fishing practices and overfishing (mainly recruitment overfishing) as key threatening processes in the marine environment. Clearly, this is not a significant issue for the majority of fisheries in NSW as there is clear evidence that most of the assessed fisheries are being well managed (Rowling et al. 2010¹¹⁶).

However, the Audit Panel also notes that contentions about fishing and no-take zones in marine parks in NSW are an unfortunate diversion from the very significant issues associated with the management of the NSW Marine Estate. While all members of the Audit Panel appreciate the value of rigorous professional debate, it is a diversion for this contention to become a focus for the management of the Marine Estate. Material presented in the submissions and workshops reflect this debate, and the Audit Panel has considered these in reaching its overall conclusions. The Audit Panel does not see its role as judging the debate; it does, however, believe that science in the Marine Estate would be better served if the debate was a scientific one rather than one that follows the increasingly distressing national and international trend of personalising what should be a courteous discourse between those with contending interpretations of data. In the opinion of the Audit Panel, the debate should be whether and to what degree no-take zones improve the conservation of biodiversity and provide marine ecosystems that are better buffered to withstand the threats they face from multiple sources (see section 2.3). The Audit Panel therefore believes that no-take zones are important in the context of biodiversity conservation where the aim is to preserve habitats free from extractive human impacts. In addition they provide reference sites that contribute to better science.

The Marine Parks Authority (MPA 2008b¹¹⁷) lists the benefits of marine protected areas to include:

- increases in the sizes and numbers of marine fish and invertebrates in sanctuary zones
- ‘spillover’ of fish from sanctuaries into areas open to fishing
- marine parks can lead to improvements in ecosystems and habitats.

The Audit Panel paid careful attention to the documentation provided in support of these putative benefits and here provides commentary on all three:

¹¹⁶ Document 149

¹¹⁷ Document 22

1. Increase in size and number. There is clear evidence in the international literature that in areas where habitats have been devastated by destructive fishing practices or grossly excessive or unmanaged fishing effort, any measure that addresses the primary cause is likely to result in change that is easily interpreted as being beneficial (Lester et al. 2009; Gaines et al. 2010¹¹⁸). More generally, a very significant body of research, both international and national, supports an increase in size and abundance of most marine species following the cessation of fishing (e.g. Halpern & Warner 2002; Micheli et al. 2004¹¹⁹). This has been demonstrated in both temperate and tropical situations, and some evidence is emerging from NSW in support of the observation. There are, however, several points to note:
 - the changes that occur are mostly to exploited species (e.g. Barrett et al. 2007; Tetreault & Ambrose 2007¹²⁰)
 - exceptions occur, notably in invertebrate species such as abalone, which trend downwards largely due to predator–prey interactions, i.e. protection benefits their predators as well (Babcock et al. 1999; Barrett et al. 2009¹²¹)
 - the magnitude of the effect is variable and depends to a large degree on the extent of depletion prior to closure and the life history of the species under consideration. The largest increases are observed where overfishing or destructive fishing has occurred and for resident species (Lester et al. 2009¹²²).
2. Spillover. Various theoretical studies have argued that well-managed fisheries will not benefit from the introduction of marine protected areas (e.g. Polacheck 1990; DeMartini 1993; Hilborn et al. 2006¹²³); however, it is frequently stated that fisheries will benefit from the spillover of ‘surplus’ adults from the protected areas adjacent to exploited sites (e.g. Bohnsack 1998, Ward et al. 2001; Halpern et al. 2010¹²⁴). There are few studies that have demonstrated conclusively that fisheries adjacent to sanctuaries benefit from spillover. Modelling of the spillover benefit has shown that a fisheries benefit should arise only if the resource has been overfished. This has been shown in several published studies, particularly in the Mediterranean (e.g. Goni et al. 2006¹²⁵), Africa (e.g. McClanahan & Mangi 2000¹²⁶) and the Asia-Pacific (e.g. Russ et al. 2003¹²⁷); all are instances where depletion of fisheries resources was significant. The Audit Panel concluded that where there is adequate fishery management, as is clearly the case for the majority of fisheries in NSW, it is misleading to espouse that there will be a large fisheries benefit from spillover.

¹¹⁸ Documents 401 and 396

¹¹⁹ Documents 398 and 404

¹²⁰ Documents 392 and 424

¹²¹ Documents 390 and 391

¹²² Document 401

¹²³ Documents 406, 393 and 399

¹²⁴ Documents 92, 409 and 5

¹²⁵ Document 397

¹²⁶ Document 402

¹²⁷ Document 407

3. Habitat and ecosystem improvement. Changes that occur in sanctuary areas are well documented and include those described above for target species. There is also mounting evidence from long-term monitoring that the recovery of target species such as lobsters and large predatory fish leads to indirect effects on non-targeted populations (e.g. Babcock et al. 1999; Pederson & Johnson 2006; Pederson et al. 2008; Barrett et al. 2009¹²⁸). Once again, the magnitude of the effect depends on the degree to which the area was depleted prior to the establishment of the sanctuary.

The indirect effects of some forms of fishing, such as demersal trawling, are singled out as being particularly destructive to benthic communities, and it is argued that marine sanctuaries will remove this threat and allow benthic communities to recover (MPA 2008b¹²⁹). The Audit Panel agreed that this was an important issue, noting the importance of habitat protection zones as a method of addressing specific concerns related to such fishing. It notes that all fishing methods (including trawling) are not a threat in all circumstances, just as none are necessarily always benign.

The material provided to the Audit Panel demonstrated a level of cooperation between OEH and the DPI, particularly in the area of research surrounding NSW marine parks. This level of investment has focused on science that serves the purpose of identifying a CAR system of marine parks in NSW. As stated elsewhere, this allocation of resources has probably been very useful; however, it has not been accompanied by building the relationship between marine park managers and a diversity of stakeholders that any major change in natural resource use requires if the pitfalls of public outrage are to be avoided. This is clearly demonstrated in information before the Audit both in a number of submissions and documents provided to the Audit (e.g. Submissions 34, 177 and 196; Workshops 6e, 13 and 17).

What was less evident was a high level of coordinated activity with respect to the management of the coastal zone and particularly with respect to the management of fisheries within the NSW Marine Estate and the general public. This disconnect was surprising given the significant overlap in the objectives of the *Fisheries Management Act 1994* (NSW) and the *Marine Park Act 1997* (NSW) and was probably a contributing factor to the difficulties that the Marine Parks Authority has been having in recent times in its dealing with recreational and professional fishers (e.g. Submissions 163, 177, 179 and 196; Workshops 6e and 13).

This approach is in contrast with a practice that has evolved since 1978 for the Great Barrier Reef Marine Park. The Great Barrier Reef Marine Park Authority has over the years developed relationships with all fishing sectors to the extent that it states in its most recent documentation (GBRMPA 2011¹³⁰) that:

The Great Barrier Reef Marine Park Authority recognises that fishing on the Great Barrier Reef is an important pastime and a source of income for both Queensland coastal communities and the Queensland seafood industry. Viable commercial and charter fishing

¹²⁸ Documents 390, 355, 405 and 391

¹²⁹ Document 22

¹³⁰ Available at <http://www.gbrmpa.gov.au/our-partners/commercial-fishing-industry>

industries depend on a healthy ecosystem just as Queenslanders rely on a healthy reef ecosystem for recreation and as a source of local seafood. Traditional Owners too are keen to ensure this culturally important resource remains healthy.

To this end the Great Barrier Reef Marine Park Authority works collaboratively with others including Fisheries Queensland, the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, and commercial and recreational fishers to continuously improve fishing gear and methods. While fisheries management continues to improve, a small number of risks remain which are being progressively addressed.

The combining of NSW Fisheries with marine parks under DPI and the recommendations of this report present opportunity for activities such as those referred to above to be given more emphasis in NSW.

2.4.2 Zoning

The zoning of multiple-use parks in NSW was a highly contentious issue, with a divergence of opinion about the need and value of sanctuary areas in which all fishing was prohibited. The Audit Panel noted that some submissions argued that current zoning had been proposed without a sufficient understanding of the specific threats to the biodiversity of the area (e.g. Submissions 92 and 129). Furthermore, zoning was based on habitat surrogacy measures rather than biodiversity data, and there was a perception that aspirational targets for sanctuary areas were accommodated rather than achieving well-defined but more specific objectives such as for habitat refuges, reference sites or recreational use. Others (e.g. Submissions 92, 102, 110 and 192) argued that sectional interests had been given undue weight in the determination of zoning outcomes.

Most marine-park planners, managers and scientists (especially those working in conservation biology) try to include some examples of each habitat in every zone in the system: such zones may include general use, habitat protection, sanctuaries (no take), and restricted access (no go) zones (not used in NSW). The reasoning is that zoning is a form of insurance against catastrophe (e.g. see arguments in Bohnsack et al. 2000; Allison et al. 2003; Fernandes et al. 2005; CBD 2006; The Scientific Peer Review Panel for NRSMPA 2006; The Ecology Centre, University of Queensland 2009¹³¹). This is however a subject of serious academic debate (Kearney et al. 2011¹³²), and is not favoured by many resource users, especially where the threats to biodiversity are not properly understood or where potential benefits are not well understood. The Audit recognises this contention and merely describes what has happened.

The situation in NSW seems to be that zoning, and particularly the determination of no-take sanctuary areas, has in some cases (such as ocean beaches) occurred where information was truly lacking. However, in other cases, zoning has been based on valid information. Problems have arisen because this information has not been effectively shared with or accepted by sectional interests. This creates a significant challenge for marine park managers. The Audit Panel acknowledged that, according to the international non-binding protocols under which

¹³¹ Documents 431, 430, 433, 432, 435 and 434

¹³² Document 262

these marine parks were established, there should be some representative habitat that is as far as possible fully protected from extractive anthropogenic impacts such as fishing. However, under these same conventions, any conservation action such as a ban on recreational fishing must be in proportion to the threat, and all management actions should be cost-effective.

The Audit Panel believed that more clarity was needed over the zoning of multiple-use parks in NSW and the intentions of each type of zone. For example, along with the creation of multiple-use marine parks in NSW, the buy-out of commercial fishing licenses has also created recreational fishing havens. Such havens are a valid consideration of recreational fishing interests, and given the apparent pleasure angling gives to so many people, their extension is probably desirable. On the other hand, there are also valid biological arguments for the extension of biodiversity havens (sanctuaries) to meet the conservation objectives of larger inter-breeding populations. Such trade-offs can only be achieved efficiently if the entire Marine Estate is under one management regime.

For such a strategy to be effective, the regulations applicable to each zone should be made more clear to the public of NSW as regards to what activities are being permitted (or not) in each zone, to overcome the current fixation upon fishing as 'the only thing affected'. The expected benefits for biodiversity conservation to result from use of a given zone in each place, in terms of the degree of protection it provides, should also be explained in clear and non-technical language.

In this context, the opportunity exists to take a more integrated approach to the management, zoning and operational planning of the NSW Marine Estate. This would lead to better conservation and resource use outcomes that incorporate biodiversity, recreational and commercial fishing, and community objectives.

The question posed in Term of Reference 5 of how zoning could be made more cost effective is discussed further in section 2.5 below. The following recommendations relate to Terms of Reference 5, 6 and 9 in terms of the matters discussed here.

Recommendations Relating to Terms of Reference 5, 6 and 9

(R6) Recognising the continuing improvement in fisheries management and resulting recovery and improvement in the status of several fish stocks, the Audit Panel sees the need for the following:

1. Better information is needed on the ecosystem effects of fishing and the integration of this information into the annual stock assessment of commercial and recreational fishing.
2. Recreational fishing (including distribution of effort, catch, discards of by-catch and ecosystem impacts) must be evaluated and the results of that incorporated into marine park management.
3. Approaches to zoning should be re-assessed to be based upon management objects that are specifically geared to ecological and biodiversity outcomes, rather than being merely surrogacy-based, and that utilise economic and social assessments in their implementation and evaluation. This will of necessity require:
 - a. clarifying the role and purpose of the various types of zones currently in use
 - b. reviewing the 1998 ANZECC approach to zoning in marine parks, which is currently based on principles of being comprehensive, adequate, and representative (CAR) and uses habitat as a surrogate for biodiversity *per se*
 - c. taking into account social and economic objectives and utilising appropriate tools
 - d. recognising that the needs of user groups should be included in any future zoning in the context of a much expanded NSW Marine Estate. This could extend to innovation such as havens for particular forms of fishing or other specific uses. This would be facilitated by the amendments to legislation and administration suggested in Recommendations R12 to R15.

These recommendations will require closer relationships between the agencies responsible for these areas and a whole-of-coast approach to marine environmental management, which must ultimately include better cost-benefit assessments of management actions and an integrated approach to spatial management be it for conservation purposes (e.g. sanctuaries) or resource sustainability (e.g. other closed areas).

2.5 How can NSW more effectively and efficiently achieve marine and estuarine biodiversity conservation?

Term of reference 5: recommend ways to increase the cost-effectiveness of Marine Park zoning arrangements

Term of Reference 6: recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Material provided to the Audit shows that knowledge about the biodiversity of NSW is increasing, and as it increases further, authorities will have a more sound basis for making an even finer-grained differentiation of what might be protected. This is not surprising and draws attention to a significant difference between terrestrial and marine conservation. Terrestrial conservation is conducted in an arena where landscape fragmentation has dramatically disrupted connectivity in the system. In the marine environment, this disrupted connectivity is not as severe because it occurs naturally, for example, with the outflows of major river mouths. However, these natural processes are now subject to anthropogenic interference. There are significant issues for marine connectivity associated with the artificial opening and closing of intermittently closed and open lakes and lagoons, harbour structures changing currents, and the armouring of the coastline. In addition, the fragmentation of littoral and marine vegetated habitats like coastal forests, dune fields, mangrove forests, salt marshes and seagrass beds is of significant concern.

The entire NSW Marine Estate should be seen as a continuum because of the connectivity between its various parts/areas/components. Connectivity is one of the strongest arguments for an approach to the management of the whole NSW Marine Estate that sees the entire area as a continuum. Some parts of this continuum will be managed under higher levels of protection, but all of the continuum should be managed.

The approach to management also needs to understand the dynamics of the system involved. This becomes a particular issue when making zoning decisions that affect all NSW marine parks. Marine parks all contain a number of marine habitat types that have different functional characteristics and different degrees of vulnerability to human use and threats. One of the issues that is in contention in the Audit is the user response to zoning systems that establish seek to strict protection areas associated with all habitat types in each marine park. This issue needs to be considered in relation to the CAR principles (see Box 1). In particular, does the decision to protect some areas of each habitat type as an insurance against unforeseen circumstances lead to management problems that could be resolved by a more extensive system of spatial planning and managing to meet explicit objectives?

While zoning is aimed at protecting a CAR system, it does not necessarily reflect the functional ecology of each area. Submissions to the Audit highlighted at least two highly contentious areas: namely the strict (no-take) protection of beaches and some rocky headlands (e.g. Submissions 11, 13 and 191). There is no doubt that there are activities that affect all areas of marine parks, but it may be possible to permit some activities on a rotational basis in

some areas without any severe disruption to the systems involved (Submissions 7, 51, 89 and 136). This might be the case with beaches (Defeo et al. 2009¹³³) and possibly some rocky headlands. The inclusion of better scientific, economic and social data into decision-making algorithms may see these areas zoned across wider areas, placed under different tenures or, in some cases, where the science supports it, managed on a rotational basis.

However, the current practice of restricting zoning to the marine park in question rather than the entirety of the coastal system will always lead to conflict. As mentioned above, if more scope for zoning management were provided by recognising that the entire NSW Marine Estate is worthy of protection, then better ways of managing the conflicts should be possible. Recommendations relating to these matters are made in section 2.8.

2.6 Assessing the social and economic benefits and costs of marine parks

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Material provided to the Audit demonstrated that social and economic benefits and costs could be better integrated into decision-making about NSW marine parks. The Audit identified two areas of particular concern: (1) the processes used to consider social and economic impacts when marine parks are established; and (2) the manner in which these impacts and benefits are balanced through marine park management practice.

2.6.1 Funding and quality of socio-economic research

Like the review of marine science two years ago (Fairweather et al. 2009¹³⁴), the Audit Panel is of the opinion that the socio-economic analysis part of the science relating to NSW marine parks has not received sufficient public resources.

This has meant the consequences of marine park decisions for the NSW community have been less well understood than they should have been—by decision-makers and the public alike. It is one of the reasons that the establishment and zoning decisions relating to marine parks have attracted such criticism. Many submissions to the Audit complained that the hard questions about what the impact of marine park decisions would be on individual interest groups and the community as a whole were not adequately addressed when the six marine parks were established (e.g. Submissions 92 and 122). The Audit Panel will repeat the finding of Fairweather et al. (2009¹³⁵) that resourcing of such work needs to be increased, notwithstanding the total funding cut projected for the marine parks in the *New South Wales Budget 2011–12*. The benefits to the NSW Government, the NSW community and to the NSW Marine Estate will be significantly better if better informed decisions were made and a better standard of public education and understanding about the issues and processes affecting marine parks was achieved.

¹³³ Document 247

¹³⁴ Document 7

¹³⁵ Document 7

NSW budgetary allocations to socio-economic projects have been surprisingly small as a proportion of total marine parks spending. During the past decade, the Marine Parks Authority has had an annual budget of about \$5 million. Of that total, the outlay on socio-economic research has amounted to less than \$200,000 a year. In addition, the environment agency have been allocating about four full-time staff equivalents a year to marine park matters, about one full-time equivalent of which has been allocated to socio-economic research (Document 132; Workshop 6b¹³⁶). The allocations to outside consultancies on socio-economic projects have been as in Table 4 below.

Table 4: Expenditure on socio-economic consultancies, 2004–2011

YEAR	EXPENDITURE
2004–05	\$95,600
2005–06	\$28,000
2006–07	\$52,000
2007–08	\$38,000
2008–09	\$28,000
2009–10	\$15,000
2010–11	\$85,200

Source: Document 128

The most recent advice received by the Audit Panel is that projected staffing for NSW Fisheries as a whole in 2011–12 is 343 full-time equivalents, with the marine parks portion being 40. The Scientific Services Group of OEHL includes some marine and coastal scientists who may be available for marine park work. The same may also be true of economists engaged in OEHL's Economic Services Section. However, the main source of economic advice on marine parks is expected to be the Strategic Policy area of the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS, or NSW Trade and Investment), within which DPI, including its fisheries area, administratively sits (Document 252¹³⁷).

As the new arrangements are established, the resources available for the economic analysis of marine park issues may increase during the next year or so, but on present indications not greatly. Certainly, the outlay on such work has been tiny in recent years in relation to the social values that, according to some estimates, are at stake with marine parks.

Further, there appear to be no social researchers principally employed in the marine parks area, and the priorities for social research are largely driven by economists, if they are considered at all. Currently there appear to be no plans to develop a capacity to comprehensively scope social research or social impact assessment.

Besides social and economic work having been devoted too few resources, the Audit Panel considers that, of what has been undertaken, too small a proportion has been in the nature of

¹³⁶ Workshop participants provided this information to the Audit Panel in Document 252 and follow-up e-mails and interviews on 12, 13 and 15 December 2011 with participant in Workshop 6b

¹³⁷ And follow-up email and interview communication on 21 and 23 January 2012 with participant in Workshop 6b

genuine social impacts assessment and cost–benefit analysis. Most work has been restricted to a simplistic estimation of the regional impacts of changes to a marine park on tourism and fishing. Among other analytical issues relating to the assumptions made about flow-on benefits, because gross rather than net impacts on local business have been reported, costs tend to have been exaggerated. None of the studies have included a monetary estimate of non-market benefits of proposed changes (such as the benefits of more secure biodiversity), whether regional or statewide; nor have there been any studies of the actual social impacts of zoning before or after zones have been changed. Finally, while a normal administrative review process has applied to the ‘socio-economic’ work, very little of the work has progressed to peer-reviewed publication, the main exception being sophisticated econometric research undertaken in collaboration with the Marine Parks Authority by a PhD student (Greenville & McAuley 2006, 2007; Greenville 2007¹³⁸). Indeed, not all the commissioned socio-economic reports have been made public, or at least they were not until the present Audit.

Most of these shortcomings, which are predominantly in the economic domain, were noted in a review by AgEconPlus Consulting & Gillespie Economics (2010¹³⁹) of previously commissioned socio-economic research for the Marine Parks Authority in the months following the review by Fairweather et al. (2009¹⁴⁰). Both reviews contained a recommendation that socio-economic research be better resourced. AgEconPlus Consulting & Gillespie Economics (2010¹⁴¹) is a high-quality report that should be compulsory reading for those interested in the question of how economic analysis might usefully contribute to NSW marine-park policy in the future. The report was made public during the course of the present Audit in November 2011.

2.6.1.1 Change of emphasis not yet in evidence

In the economic and social areas, it is not obvious that any changes in research strategy have yet been implemented since the Fairweather et al. (2009¹⁴²) and AgEconPlus Consulting & Gillespie Economics (2010¹⁴³).

The Marine Parks Authority’s forward-looking *Marine Parks Strategic Research Framework 2010–2015* contains two key research areas, D1 and D2, entitled ‘Economic research’ and ‘Social research’, respectively (MPA 2010d¹⁴⁴). Related to these are two key research areas called ‘E1 Aboriginal culture’ and ‘E2 Heritage’. The original version was a document written by the former Department of Environment, Climate Change and Water for the Marine Parks Authority in October 2010 (MPA 2010d). A revised version with current project details

¹³⁸ Documents 208, 209 and 231

¹³⁹ Document 140

¹⁴⁰ Document 7

¹⁴¹ Document 140

¹⁴² Document 8

¹⁴³ Document 140

¹⁴⁴ Document 8

and updated agency names was provided to the Audit Panel in December 2011 (MPA 2011¹⁴⁵).

The following extract from the updated strategic research document describes the priorities set by Marine Parks Authority in the economics and social areas for 2010–15 (MPA 2011, p. 15¹⁴⁶):

SOCIAL AND ECONOMIC INFLUENCES

D1 Economics research

Direct and indirect uses of marine parks generate a range of economic values for the whole community and associated economies. Research facilitates a greater understanding of these economic values and the impacts of marine parks, which better informs the community and government, and helps marine park planning and management. Economics research in marine parks involves the development of a comprehensive understanding of marine park values and quantification of these values where possible. It also involves developing an understanding of the interaction between a marine park and economic activity through:

- primary data collection through visitor and business surveys
- development of models of local economies around marine parks
- analysis of data to identify trends in economic activity that may be related to the presence of a marine park.

The Marine Parks Authority is planning a program of economic analysis over the next five years, particularly in the context of zoning plan reviews for Cape Byron, Port Stephens-Great Lakes and Batemans marine parks and is keen to build research collaborations with external researchers in this field.

Priority research area

- effects of marine parks on regional and local economies.

D2 Social research

Social research is an important component of the overall marine parks research program as it provides specific information on a range of issues such as governance; human use patterns; community attitudes; perceptions and behaviours; compliance effectiveness and evaluation of oral history.

Research outcomes assist in improving communication, consultation, education and compliance, managing conflicts and optimising benefits to the community by increasing knowledge and understanding about the marine environment, marine parks and coastal communities.

Priority research area

- use and non-use social values of marine parks.

Slightly more detail is provided in Tables 3 to 9 of the strategy document (MPA 2011¹⁴⁷).

Table 3 relates to statewide projects, and Tables 4 to 9 relate to specific projects in each of the six marine parks.

¹⁴⁵ Document 258

¹⁴⁶ Document 258

¹⁴⁷ Document 258

The Marine Parks Authority's stated intention in economic research from 2010 to 2015 is to focus on local impacts. The same impression is gained from the more detailed description of proposed work in the document's Tables 3 to 9. They all contain the same entry under the economics heading, 'Survey of local businesses providing services for marine park management and visitation'. The statewide table (Table 3) is the only one that includes a non-market services valuation project, and that is described merely as an 'anticipated' two year project on recreational fishing, which would be undertaken from 2011–12 to 2012–13. On the face of it, this emphasis seems ill-advised. It amounts to a repeat of past practice.

Previous social research has been narrowly defined as either visitor or business surveys, and even that has been poorly conceptualised and designed. There are no proposals to assess the social impacts of marine parks. Several marine parks are proposing to include some benchmark questions in the NSW Government statewide survey of community attitudes to the environment planned for later in 2012, which appear not yet to have been acted upon.

2.6.2 Incorporation of social impacts into marine park planning

Social impacts are integrated into decisions about marine parks (particularly their establishment and management) in a variety of ways across Australia. In NSW, there is broad recognition of the social and economic impacts on marine parks, and the social and economic impacts of marine parks on the community; however, the methods for managing these impacts is not as coherent as in other jurisdictions.

It is clear from reviewing international best practice that, for social and economic impacts to be meaningfully incorporated into decision-making, the goals of doing so need to be very clear. There is currently no such set of overarching, coherent goals in NSW marine park management across a broad spectrum of values and uses. Indeed, management criteria for marine parks have tended to have been modified in a 'patchwork' manner in order to reduce or manage the influence of vested interests and increase operational predictability.

NSW marine park management strategies do not always incorporate evidence-based knowledge of social and economic impacts. Instead, 'experience-based' information is often relied upon, but this has the potential to compromise outcomes and jeopardise the investment made in protected areas for conservation.

It was evident to the Audit Panel that social and economic research has lagged behind biophysical research. It is argued by many authors in the peer-reviewed literature that studies based on social science are equally important as biophysical studies because marine parks are about altering human behaviours, in particular that of fishers (e.g. Sale et al. 2005; Jones 2006, 2009; Charles and Wilson 2009; Thorpe et al. 2011; Voyer et al. 2012¹⁴⁸)

¹⁴⁸ Documents 470, 471, 472, 426, 473 and 105

In general, social assessment in marine protected area planning in NSW has taken two key forms:

1. socio-economic impact reporting
2. public participation or consultation exercises.

These are commonly followed by developing attitudinal surveys to gauge public opinion about the marine park following its establishment. The results of these surveys may then be used to counter the arguments of any remaining opponents within the community and to support future marine protected area declarations.

A salient point made by Voyer et al. (2012¹⁴⁹) is that too often the socio-economic assessments are under taken by economists, and they are heavily skewed by economic analytical tools. A good example is in the *Socio-economic Assessment of the Batemans Marine Park* (MPA 2006¹⁵⁰), which is heavily skewed toward devising a model for total economic value rather than providing a balanced assessment, including a quantitative and qualitative assessment of social and economic values.

This needs to be addressed in the future management of the NSW Marine Estate. There is a much wider range of tools available (Box 3; Appendix 6) for this purpose, and it is the view of the Audit Panel that greater attention needs to be given to understanding social impacts before decisions are made rather than simply using some of the tools to justify the decision after the event.

Under the new arrangements proposed by the Audit Panel, catchment management authorities could have an important role to play in assessing the social impacts on and by marine parks; however, the current statutory arrangements limit the capacity catchment management authorities have to do quality social impact assessments.

Case studies exist that highlight approaches that represent some dimensions of good practice in integrating social and economic impacts into decision-making about marine parks from other parts of Australia, for example the Great Barrier Reef and Ningaloo Reef.

Box 3: Some social science approaches

Social research

Social impact assessment

Economic impact assessment

Public participation

Communications

Education for sustainability

Appendix 6 contains further details of these approaches.

¹⁴⁹ Document 105

¹⁵⁰ Document 67

2.6.3 Social impact assessment

Socio-economic assessment seeks to incorporate social and economic considerations into marine-park management planning. In NSW, this assessment method commonly uses input–output methods to estimate the impacts of the marine park zoning on identified economic activities for the present-day and for a defined future period such as in five years time (MPA 2006¹⁵¹).

However, socio-economic reporting in this context differs from formal social impact assessment as the standard socio-economic assessment report considers social impacts only as far as they relate to shifts in local economic conditions, such as through loss of employment or income. In contrast a rigorous social impact assessment includes the:

... processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is the to bring about a more sustainable and equitable biophysical and human environment (Vanclay 2003, p. 2¹⁵²).

Voyer et al. (2012¹⁵³) singled out the Great Barrier Reef Marine Park Authority as the only marine protected area agency in Australia that has made a concerted effort to measure the potential social impacts of its marine park planning, concentrating on a group they identified as being particularly vulnerable to the proposed changes—commercial fishers and their families. In many other cases where social impacts have been studied and reported upon by economists, the focus has been primarily, or some cases exclusively, on economics.

Socio-economic reporting, which assumes that economic factors are the primary determinants of likely social impacts, can fail to appreciate the importance of culture, history, recreation, and the intrinsic value of nature, tradition and ‘sense of place’ in the lives of marine environment users and the wider community.

The Audit Panel has found that there is an *ad hoc* and generally poor approach to social assessment, if it is undertaken at all (e.g. Submissions 29, 71, 74, 88, 93, 109, 114, 126 and 137). A more strategic and rigorous approach to social benefit and cost assessment is required in marine estate and marine park planning.

Public participation in marine park planning processes has traditionally been used as a primary means of social assessment—making it an end in itself rather than the means. Rather, public participation is one tool that can be used to gain valuable information for a social impact assessment.

Using public participation as a substitute for social impact assessment can result in public participation being used to attempt to minimise the social impacts of a proposed marine park, but without any rigorous multidisciplinary attempt to accurately determine what those impacts might be or who might be most likely to feel them.

¹⁵¹ Document 67

¹⁵² Document 460

¹⁵³ Document 105

In contrast, social impact assessment processes that look beyond the simple ‘support versus opposition’ approach of public participation will allow for a deeper understanding of the importance of access and use of the marine environment to all user groups and allow for more meaningful discussions around potential trade-offs to achieve optimal environmental protection and community support for marine parks.

The process must include ongoing assessment of the social impacts and benefits and these should be reported as part of the overall reporting of marine-park effectiveness and impacts.

2.6.4 Stakeholder engagement and public participation

The success of marine parks, like any public policy, is partly dependent on community support, with some commentators arguing that community support is potentially more important than design modelling (Kareiva 2006 as cited in McPhee 2011¹⁵⁴). Recognising this, it is essential that stakeholders¹⁵⁵ are engaged and managed effectively (McPhee 2011¹⁵⁶).

Stakeholder engagement and public participation is said to be a central concern in the NSW marine park management–planning process. However, there is a view that the way this has been done has been inadequate and often undertaken with predetermined outcomes in mind (e.g. Workshops 6e, 13 and 17). Some submissions to the Audit claimed that stakeholders have been largely alienated from the Marine Parks Authority planning processes (e.g. Submissions 6, 11, 14, 53, 54, 74, 76 and 181). This alienation has been due to problems with the processes: ‘over-consulting’ without clear outcomes; public participation processes being used as a proxy for social research; lack of quality input from the science to enable educated and informed engagement; and a lack of transparency around why and how decisions have been made by not closing the feedback loop. This just fuels already existing suspicion around public participation and marine park management.

In the face of perceived and real problems, the principles for quality public participation adopted for management of NSW marine parks should ensure that:

- public participation is a process that does not drive a predetermined outcome
- there is a clear understanding of what the process can and cannot influence
- engagement of key stakeholders occurs early and regularly
- there is feedback regarding what inputs are considered and those that are not
- there is educated and expert informed engagement to ensure that those stakeholders who influence the processes are well informed
- there is particular attention given to expert and local indigenous knowledge as part of zoning and management processes

¹⁵⁴ Document 468

¹⁵⁵ Stakeholders are any individuals or groups that have a ‘stake’ in the outcome. Derived from the notion of ‘shareholder’ from the corporate world where the key objectives of corporations are to maximise profits for shareholders, the goals in public sector management cannot be so clearly defined. Public sector management can benefit from a stakeholder analysis that is a systematic process of assessing the capacity of key groups to influence policy or project outcomes against an analysis of their power and interest in an issue. This ensures that those with significant interests are given appropriate attention and resourcing and those that may be voluble but not necessarily as important do not distort the process. This is often referred to as ‘minority interest capture’

¹⁵⁶ Document 468

- there is full transparency in processes
- engagement is linked with, but separate to, communication and community education.

Key stakeholder groups should be engaged in a participatory way in all stages of the process to enhance their involvement in the management of biodiversity and reduce the need for compliance processes.

Separation of the public participation phases of the planning process from the development of socio-economic reports by external consultants has meant that important data relating to social variables have largely been lost to the impact assessment process (Voyer et al. 2012¹⁵⁷). Public participation is a means of informing and guiding social research and social impact assessment, but it should be independent of both.

The benefits of engaging commercial, recreational and indigenous fishers in the planning for marine parks and reserves are significant and include support for initiatives, access to valuable local knowledge, compliance with controls and mitigation of conflicts, and negative impacts on stakeholders (McPhee 2011¹⁵⁸).

In Australia, an example of a reasonably successful participatory process has been that undertaken in the Capricorn region of the Great Barrier Reef Marine Park, where Almany et al. (2010¹⁵⁹) identified that successful engagement was achieved by:

- engaging early in the process by collaborating with organisations to build trust
- ensuring scientific questions have direct relevance to the community
- providing appropriate incentives for participation
- clear and open communication.

Almany et al.'s (2010) account relates to what was the third rezoning of that part of the Great Barrier Reef Marine Park. The Audit Panel notes that the rezoning was backed by 30 years of public engagement and a concerted extension and education effort.

Supporting the view that NSW marine park planning has lacked clear goals and objectives (see section 2.6.1), information provided to the Audit claims that marine park zoning arrangements have been imbued with *stakeholder complexity* (Document 266). Under this thesis, the influence of disparate stakeholder interests has led to different management practices coexisting, such as seasonal spatial closures, gear-restricted spatial closures, and rounded zone boundaries. This could influence biodiversity adequacy in the future because of non-compliance due to misunderstanding and competing priorities.

¹⁵⁷ Document 105

¹⁵⁸ Document 468

¹⁵⁹ Document 394

A recurring theme of the Audit consultation was the frustration and concern around the political nature of marine parks planning in NSW. One submission stated (Submission 150, p. 15):

... much of the frustration with the marine park zoning process from all groups involved is the very highly political nature of the decisions. There seems to be a desire by all involved (anglers, conservationists, managers, tourism operators, scientists and commercial fisherman) for a scientifically driven process yet very often decisions are made behind closed doors with none of the stakeholders involved.

Accordingly, a strong recommendation put forward from various stakeholder groups was the importance of establishing a culture of transparent, scientifically justified decisions that begins with a very clear understanding, by all parties, of the motivation and justification for the parks in the first place.

The *Marine Parks Authority Communications Education Strategy 2009–2012* (MPA 2009¹⁶⁰) provides a useful foundation from which to build public support for aquatic conservation and to include the views of the community in marine park management. This strategy provides a framework for a statewide focus on communications that seeks to engage the community to take action towards conserving marine biodiversity. It would be of benefit if public participation were more clearly separated from communications, and the management of the public participation process were independent of marine park management. The Marine Parks Authority's vision is to establish a management system that encourages a culture of voluntary compliance, ensuring that regulatory requirements are understood and supported by the community (MPA 2008a¹⁶¹). However, this vision has yet to counter the public perception, in some sectors at least, that enforcement is given excessive emphasis.

There has been considerable work with key NSW marine park stakeholders to examine ways of maximising voluntary compliance (Read & West 2010¹⁶²). A case study in the Port Stephens–Great Lakes Marine Park found that the majority of zones are effectively meeting criteria to optimise voluntary compliance. There was considered to be potential, however, to improve both the design and management of some of the poorer performing zones, which would greatly improve current levels of compliance (Read & West 2010¹⁶³).

¹⁶⁰ Document 96

¹⁶¹ Document 256

¹⁶² Document 211

¹⁶³ Document 211

Recommendation for Term of Reference 6

(R7) Rigorous social impact assessments are to be made a central component of the methods used to establish and manage NSW marine parks. The social impact assessment framework needs to analyse, monitor and manage the intended and unintended social consequences (both positive and negative) of marine parks and any social change processes that are invoked. The ongoing evaluation of social impacts and benefits are to be reported in the same reporting cycle as environmental impacts.

In particular, marine park and NSW Marine Estate planning processes should be improved immediately to allow for a more strategic and cross-disciplinary approach to considering social impacts, which should include:

1. specific and targeted consideration of social impacts (incorporating qualitative research techniques) that is separate from (but informed by) consideration of economic impacts, with particular attention given to key groups within the community
2. integration of improved public participation exercises with social and economic impact assessment to add value to each of these processes, with each informing the other
3. the conduct of ongoing education for sustainability relevant to the marine park and wider Marine Estate
4. incorporation of social science expertise into planning and management processes to ensure social data are gathered and analysed in a meaningful and scientifically robust manner.

2.6.5 Assessing the economic benefits and costs of marine parks

It is important that those administering marine parks and the NSW Marine Estate be aware that a genuine and credible cost–benefit analysis of marine park or zoning proposals requires a significant effort to be made to quantify the changes in value of the non-market services that will accompany them. With marine parks in particular, the claimed social benefits predominantly lie in the non-market domain. Certainly, the estimated non-market benefits of proposed marine parks off south-western Australia have been found in two recent studies to be very large indeed, and incidentally, even with intrusive sanctuary zones, to outstrip the prospective deleterious effects on the fishing industry by a considerable margin (Allen Consulting Group 2009; Gillespie & Bennett 2011¹⁶⁴).

It is the Audit Panel's view that when the Marine Parks Authority intends to commission comprehensive economic research that embraces non-market services, the wording of the Marine Parks Authority's strategic research document should be changed. This would be

¹⁶⁴ Documents 131 and 86

facilitated by the new administrative arrangement the Audit Panel has recommended accordingly (section 2.8).

2.6.5.1 Expert views on demand estimation

At a workshop organised by the Audit Panel with past and present departmental economists (Workshop 8), some of the difficult issues relating to socio-economic research on marine park establishment and zoning were discussed. It was agreed that the valuation of community demand for non-market marine park services presents the greatest challenge. Conceptually the notion is straightforward, but collecting reliable survey information is not. International and Australian studies have attempted the task, including in crude form for NSW marine parks (Gillespie Economics 2007¹⁶⁵). Most studies of this kind are open to the criticism that ordinary respondents cannot be expected to be informed enough about the with- and without-park situations they are being asked to value to make coherent (or given the apparent room for opinion, even truthful) responses. Techniques known as choice modelling have been developed to address this by seeking generic demand information that can, if desired, be applied subsequently to expert assessments of the science. They are being continually tested and refined (Gillespie & Bennett 2011¹⁶⁶).

There is a view that the complex and ever-contentious non-market marine-park service valuation task is best avoided due to the potential for mistaken or mischievous calculations by insiders. This is not a view shared by the Audit Panel because that would then leave judgements about the value of key components entirely and arbitrarily to the political process. Decisions about the relative merit of marine parks proposals would then be made more subjectively than if there were professional work to comprehensively value them.

That said, in order to make the best of good analysis, it is necessary to nurture an accompanying culture that fosters its transparency and contestability. With economic analysis in particular, such a climate appears to have been absent for much of the NSW marine park era.

The Audit Panel will be offering a number of suggestions relating to accountability, and governance more generally, to strengthen the quality of advice and decision-making on marine park issues in section 2.8.

The Audit Panel considers it to be particularly important that future decisions be based on a proper construction of the problem at hand. Simply put, the central decision-making task in marine park management, as in all management areas, is that of making choices between competing demands. That is primarily a resource allocation issue of the kind economists deal with routinely.

¹⁶⁵ Document 166

¹⁶⁶ Document 86

The nature of the choices needed in regard to marine park no-take areas were neatly expressed, for example, in a recent University Sydney economics PhD thesis in the following terms (Greenville 2007, p. 77¹⁶⁷):

The use of marine protected areas as a management tool has resulted from a recognition that it is important to preserve biological habitats as well as stocks ... From a societal point of view, the use of protected areas should be evaluated in the context of changes in resource rent and improvements in welfare. As fishery resources are often owned by a common group, usually society, managers' objectives should be to maximise the return from use of the resources, whether for extractive or non-extractive purposes.

Given this decision criterion, protected areas can be evaluated in the sense of opportunity costs and benefits. Protected areas will influence the return from fishery resources through changes in access to fishing grounds, and thus harvest, effort and resource rent. Once a protected area is established, the flow of biomass from the protected area to the remaining fishing ground, may increase biomass, influence the effects of uncertainty and stochasticity, thus effecting mean harvests, effort and resource rent may increase. Changes in resource rent are dependent on other controls. Protected areas are a 'blunt' policy instrument, in the sense that they are not an instrument to capture resource rent or change the incentives of fishers.

2.6.5.2 Cost minimisation tools

Term of Reference 5 requires the Audit Panel to 'recommend ways to increase the cost-effectiveness of marine park zoning arrangements'. This is an economic question related to the issues raised on economic analysis above. It is approached here in that context, with particular reference to the material the Audit received in relation to cost minimisation models.

The Audit received several submissions that stressed the potential benefits of applying the best available quantitative techniques (e.g. Submissions 29, 84, 144 and 158).

Some submissions described models that can be used in zoning decisions. Others discussed particular matters relating both to the way marine park zoning was first done and how zoning plans were reviewed after the *Marine Parks Act 1997* (NSW) was amended to provide for it. In addition, the relevant government departments provided answers to a series of mainly procedural questions that had been asked by the Audit Panel (Document 319).

Given the societal tensions that could have been anticipated, the Audit Panel was somewhat surprised to learn how small were the budgetary outlays on the zoning plan reviews that began in 2008. Operational expenditure on the zoning plan review (Table 5) and development process for Jervis Bay, Lord Howe Island (review only) and Solitary Islands marine parks has been estimated at approximately \$534,000 over the financial years 2007–08 to 2010–11, as set out in the following table. Some operational expenditure was met by the Marine Parks Authority Secretariat on zoning plan reviews during this period, that expenditure is included in this estimate.

¹⁶⁷ Document 231

Table 5: Operational expenditure on zoning plans

MARINE PARK OR GROUP	EXPENDITURE
Solitary Islands	\$94,000
Jervis Bay	\$122,000
Lord Howe Island	\$119,000
Secretariat	\$199,000
Total	\$534,000

Source: Document 319

It is a matter of record that the rezoning of Jervis Bay and Solitary Islands Marine Parks proved difficult and were contested. They may not have been expensive, but they were not seen by many observers to be effective in either social or economic terms.

It is against that background that there needs to greater use of systematic analysis involving quantitative techniques. The Audit Panel considers that in future years, quantitative tools should be used a great deal more than they have been in zoning reviews to date, bringing increased objectivity. Credibility in such matter depends on transparent and contestable analysis: quantitative techniques can contribute.

The quantitative tools that submitting parties drew to the Audit's attention are cost-minimisation models. An Australian-developed example is the suite of tools known as 'Marxan', which grew out of a PhD thesis at the University of Adelaide (Ball & Possingham 2000¹⁶⁸). Marxan has since been maintained and developed at the University of Queensland¹⁶⁹. It is similar to one known as 'Spexan'¹⁷⁰ (from the United States of America, and indeed shares some of its algorithms for spatially explicit annealing), which is also used for spatial aspects of conservation planning. It is known that other models with the same main features, like 'C-Plan'¹⁷¹ (also a University of Queensland product, which can be run with Marxan) and 'Zonation'¹⁷² (a Finnish product) are in use elsewhere.

The practical use of such models for marine park planning remains in its infancy in NSW. The Audit Panel understands Marxan was used in the rezoning of the Great Barrier Reef Marine Park and in more than 100 other countries. The Audit Panel is not aware that the model has yet been used for planning purposes in NSW; however, the interest in its use is confirmed by the provision for experimental work using Marxan in the *Solitary Islands Marine Park Research Work Plan 2010–11* (MPA 2010¹⁷³).

Models of the Marxan type are not full-blown economic models because assumptions that have been made before the model is run determine the desired output, and the output types are generally expressed in physical terms such as a given surface area of park or zone-type, or representative percentages of certain geographical and biological features. Most importantly,

¹⁶⁸ Document 413

¹⁶⁹ See <http://www.uq.edu.au/marxan/>

¹⁷⁰ See <http://www.biogeog.ucsb.edu/projects/tnc/toolbox.html>

¹⁷¹ See <http://www.uq.edu.au/ecology/index.html?page=101951>

¹⁷² See <http://www.helsinki.fi/bioscience/consplan/software/Zonation/index.html>

¹⁷³ Document 481

the output levels are not derived from any optimisation procedure undertaken in the model itself.

Despite this limitation, models such as Marxan are a useful addition to the tool-kit available to marine park managers. In practical terms, managers will often find themselves working towards pre-determined (and sometimes inviolate) conservation targets, and in those situations the key question will be how to meet those targets in a cost-effective manner. In other situations, when surrounded by uncertainty about how much conservation would be worthwhile, Marxan applications could aid decision-making by assisting with the exploration of the cost implications of different levels or mixes of conservation. Besides bringing some mathematical strength to these matters, formal models can improve the standard of collecting and assembling relevant data.

The standard marine park application of Marxan has been in the search for a least-cost means of reaching a conservation target. The Marxan framework can also be configured using the same data to answer different questions. For example, Ban & Vincent (2009¹⁷⁴) published a Marxan-based zoning study for a British Columbia fishery in which the results were presented, not in terms of what additional no-take area needed to be declared, but rather in terms of how much unfished areas could be obtained from the intelligent planning of a small fishing quota cut. In the authors' words (p. E6258):

We found that small reductions in fisheries yields, if strategically allocated, could result in large unfished areas that are representative of biophysical regions and habitat types, and have the potential to achieve remarkable conservation gains.

There might be a presentational advantage in such an approach. Expressing familiar facts in an unconventional way, and in particular in a way that emphasises how large the conservation yield could be for a small fishing sacrifice, could assist with the wider appreciation of the implications of a park establishment or park zoning proposal.

Whether Ban & Vincent's (2009¹⁷⁵) Marxan paper has any greater importance is not obvious because there are grounds for thinking it is based on one (or perhaps two) questionable assumptions: (a) that the ecological services generated by British Columbia's marine environment are directly proportional to the area unfished; and even if not (b) that concentrating on the unfished area outcome of a small catch-quota cut would serve Canada well enough by helping it meet a Johannesburg Conference of Parties sustainability target¹⁷⁶. It is doubtful that either of these propositions is applicable to the NSW situation. Nonetheless, the Audit notes that Dr Ban and many others have expressed a broad scholastic interest in reconciling science and community-based approaches to marine conservation. This is a field of study that deserves to be taken seriously. As with other applications of Marxan and related models, presentations that shed light on the many different implications of zone proposals is a approach that should be encouraged.

¹⁷⁴ Document 157

¹⁷⁵ Document 157

¹⁷⁶ See the Johannesburg Declaration on Sustainable Development, available at <http://www.un-documents.net/jburgdec.htm>

2.6.5.3. Economists' work on zoning

Recent work by economists has sought to widen the scope of programming models to incorporate both supply and demand for marine park services, although it seems so far few real-world empirical studies have been attempted. One of the best known is the study relating to Atlantic cod (Grafton et al. 2005¹⁷⁷).

Greenville has also used mathematical models to explore the circumstances in which no-take zones might be sensibly used as fisheries management tools (Greenville & McAuley 2006, 2007; Greenville 2007, p. v¹⁷⁸). In his words:

A stochastic and deterministic model of a predator–prey meta-population fishery was developed to analyse the effects of protected area creation within a fishery. Such a model has not previously been used to analyse protected area creation. The model was analytically solved to find the optimal biomass of each species in an individual patch. This allowed for a comparison of protected areas under a range of management controls ranging from those which led to open access fishing to those which led to an optimal steady-state biomass.

Greenville developed a workable framework that captures some important detail of the economics of zoning decisions. For example, his model makes room for available information about both the nature and extent of the dispersal, or what marine scientists mainly term ‘spillover’ (see section 2.4), that is likely to occur from the protected area to the surrounding fishery. A small protected area might be all that was needed to get the benefits of any density dependent flows. By contrast, under sink–source flows, where differences in relative densities do not play much part in the movement of fish from the protected areas due to differences in patch population density, the level of dispersal will be more dependent on protected area size and perhaps be relatively insignificant.

His model was illustrated with a case study based on the Manning Bioregion, which stretches from just north of the Hunter River to Nambucca (see Figure 1), where he found the circumstances would likely allow no-take zones to be useful fisheries management tools (reported mainly in Greenville & MacAulay 2007¹⁷⁹). In view of the simplifications made in the case study it may have no immediate policy relevance but it does suggest a line of future research.

¹⁷⁷ Document 336

¹⁷⁸ Documents 208, 209 and 237

¹⁷⁹ Document 209

Recommendation on Term of Reference 5

(R8) In order to improve approaches to zoning, the Audit Panel recommends that:

1. The Marine Parks Authority and the NSW Department of Primary Industries allocate significant resources to research that are directed at operationalising the policy use of the available high-quality analytical tools for guiding the socially optimal zoning of marine park and NSW Marine Estate areas.
2. In order to ensure significant conceptual progress, the work should be focused for the next three years at least on one marine park, namely the Solitary Islands Marine Park, where in 2010–11 a project trialled, among other things, Marxan applications.
3. The research projects that are commissioned include a high quality social impact assessment process to provide a model that may be applied elsewhere and allow statewide benchmarking of community valuation of the NSW Marine Estate.
4. A further research project be commissioned as a high-quality economic-policy exercise that follows up on the 2002–07 Greenville work and that this work be under the control of the Department of Trade and Investment, Regional Infrastructure and Services' Chief Economist with expert oversight by economists qualified in the field.
5. Public participation and education for sustainability protocols be developed for marine parks along with sufficient resourcing for these processes to be undertaken effectively.

2.6.6 Land-use planning and the marine estate

A key insight emerging from the Audit is that marine park management in NSW is not well integrated with land-use planning. It is widely acknowledged that urban development along the NSW coast is one of the greatest threats to protection of biodiversity, particularly the threats posed by pollution, habitat loss and introduced species (see section 2.3).

Water quality management upstream of marine parks and coordination of councils and catchment management authorities is considered vital, as is the need for relevant bodies to work together. One way to better integrate marine park management and land-use planning would be for the Marine Parks Authority to be elevated to a 'referral agency' status with respect to development applications through the *Environmental Planning and Assessment Act 1979* (NSW) review and be a given concurrence role in local government planning applications.

Recommendations relating to Term of Reference 6

(R9) The proposed Coastal and Marine Management Authority (see Recommendations R12 to R15) should include in its legislation drafting brief the following:

1. NSW Marine Estate planning is required to incorporate properly constituted cost-benefit evaluations that cover all values into decision-making frameworks, and that these be in conjunction with appropriate social impact assessments.
2. In NSW Marine Estate planning, social and economic benefits and impacts are assessed as an integral part of zoning and management process.
3. Better integration of land-use planning regulations with NSW Marine Estate management protocol is to be mandatory. For instance, any land-based development or activity proposal that is within a prescribed distance upstream from a marine park ought to be automatically referred to the Coastal and Marine Management Authority for assessment of potential impacts under State Environmental Planning Policy No 71. In addition the Coastal Protection and Marine Management Authority should have a concurrence role in local government planning decisions.
4. Provide for the design and management protocols of the NSW Marine Estate to be overseen by the Independent Scientific Committee (Recommendation R3). Each of the five proposed sections of the NSW Marine Estate should have appointed, in collaboration with the relevant catchment management authority and the regional bodies proposed in this report, a local scientific committee for planning of sections of the Marine Estate (see Recommendations R3 and R12 to R15). The bodies would have expertise in both natural and social sciences.

2.6.7 Indigenous expertise

The Marine Parks Authority policy on Aboriginal Engagement and Cultural Use of Fisheries Resources in NSW marine parks (MPA 2010a¹⁸⁰) recognises that the Aboriginal people of NSW have a continuing custodial relationship with ‘Country’, the land, sea and their resources. This extends to maintaining spiritual links to and caring for Country.

The policy highlights that cultural use of fisheries resources is an integral part of the Aboriginal relationship with Country, and the Marine Parks Authority acknowledges that conservation-based fisheries and marine park laws place some restrictions on cultural resource use within NSW marine parks.

¹⁸⁰ Document 79

Cultural use of fisheries resources is supported in marine parks by:

- establishing special purpose zones
- developing cultural resource use agreements
- providing special permits for individuals or groups to hold events
- the appointment of Indigenous liaison officers.

While this policy is underpinned by appropriate principles, there is a lack of commitment and capacity to ensure that Indigenous knowledge and expertise of land and sea management is incorporated into marine protected area decision making at all levels.

This is highlighted by comments received in the Audit workshop process (Workshop 17, p. 1¹⁸¹), which stated:

Indigenous communities concerns and their values have rarely been appropriately factored into Marine Park design and management. Indigenous fishers are not acknowledged or mentioned in the *Marine Parks Act 1997* (NSW) objectives and this is a gross ... oversight ... Culturally inappropriate marine park management can criminalise cultural practices, potentially affecting Traditional Knowledge maintenance and transmission as well as disrupting social structures and economic opportunities in NSW.

These comments outlined the extent of inadequate consultation undertaken with Indigenous communities across all NSW marine parks. Across all six parks it has been felt that the Indigenous community's voices and the value of indigenous community concerns have been inadequately regarded. While the level of consultation across the marine parks varied greatly, even when Indigenous communities were given an opportunity to voice their concerns and felt as though they were given the appropriate level of time and input, their input generally fell on deaf ears (Workshop 17). Whether this has been the case or not, it is difficult to assess due to the lack of clarity and transparency in the consultation process.

A review of the current membership of the six marine park advisory committees revealed that only two of the six NSW marine parks (Cape Byron and Solitary Islands Marine Parks) had sitting members representing Aboriginal people.

In the case of Cape Byron Marine Park, there is a Memorandum of Understanding with the Bundjalung People of Byron Bay to establish the mechanism for their involvement in the management of the Cape Byron Marine Park and to establish the principles for communication between the Marine Parks Authority and the Bundjalung People of Byron Bay (MPA 2007¹⁸²). This provides a pathway for the development of a cultural resource-use agreement within the marine park. This management approach appears to have some merit.

All marine parks except for Lord Howe Island specify in their operational plans that marine park management needs to ensure that it is 'consistent with the cultural aspirations of Aboriginal people' (MPA 2010b, c, e, f, g¹⁸³). However, the operational plans contain little detail on how this objective is to be achieved.

¹⁸¹ Supplementary workshop material provided by Egan

¹⁸² Document 68

¹⁸³ Documents 97–99, 101 and 102

Recommendation Relating to Terms of Reference 5, 6, 7 and 9

(R10) Local Indigenous knowledge and expertise of land and sea management to be explicitly incorporated into the establishment and ongoing management of NSW marine parks and the NSW Marine Estate. To facilitate this, the Audit Panel recommends the employment of an Aboriginal Liaison Officer in each marine park, along with ongoing support of the Aboriginal Cadet Program in each marine park.

2.6.8 The value of nature

The Audit Panel agrees with the submissions that identified ‘nature’ as being of value in itself (e.g. Submissions 118 and 145). This provides a rationale for protecting biodiversity in NSW irrespective of what obligations might exist under international arrangements. This is in fact the stewardship ethic, which has been a theme through conservation politics and policy for well over a century. This ethic has become so ingrained that could be regarded as part of our cultural heritage and thus is itself of value.

This has implications for the way management planning is done for marine parks, the justification for protecting some components of these areas is simply their existence value. In addition, many may be difficult to measure but nonetheless important values have been identified for protected areas and these are provided in Appendix 7.

Recommendations Relating to Terms of Reference 7 and 9

(R11) The Audit Panel recommends that the NSW Government mandate better integration of land-use planning regulations with the NSW Marine Estate and marine park management as follows:

1. Overhaul and standardise the structure and process for stakeholder and public participation with clear principles that correspond with the objectives of the *Marine Parks Act 1997* (NSW) and relevant management strategies.
2. Acknowledge the biophysical realm as having intrinsic value in NSW Marine Estate planning.

2.7 Are the information gaps hindering robust, evidence-based decision-making on marine parks?

As indicated elsewhere in this report, there are significant information gaps with respect to the NSW Marine Estate. The proposals about the management of science and integration of management across the entire NSW Marine Estate are the most effective ways in which evidence-based decision-making can be applied, not just to areas as designated as marine parks, but also to the entire system as an integrated whole.

2.8 How might we achieve better management of the NSW marine and estuarine environment?

Terms of Reference 6, 7, 8 and 9 call for a new approach to managing the NSW Marine Estate:

Term of Reference 6: Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks

Term of Reference 7: Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks

Term of Reference 8: Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them

Term of Reference 9: Make other recommendations as appropriate, related to achieving better management of the NSW marine environment

2.8.1 Introduction

The current management of the NSW marine environment is in a state of flux and conflict, and it appears to the Audit Panel that there is significant confusion amongst stakeholders about roles and responsibilities of various government agencies and also the rights and responsibilities of citizens. In a number of the previous sections, this has been discussed in terms of the confused or divergent responses to the various issues canvassed.

In this section of the report the Audit Panel addresses the last Term of Reference (9), which asks it to set out a framework for the future management of the NSW Marine Estate. The section begins with by setting the context of the problem, which is essentially one of how to use policy in a common property setting.

2.8.2 The common property problem and the role of marine parks in addressing it

It is probably fair to say that, for two centuries at least, the search for solutions to the common property problem—the ‘tragedy of the commons’¹⁸⁴—has dominated economic policy literature on management of the marine environment. The problem is regarded as a textbook example of where, in the name of efficient resource use, governments need to step in to influence the ‘market’ signals that guide individual behaviour. Avoiding market failure is the generic target. The argument is that without special rules governing the use of marine resources, society will not be able to reap the greatest social value of output from them, or will not protect the long-term benefit in favour of short-term gain.

The proper management of common property fisheries is the marine resource management issue that has received the most attention from economic policy experts, but it is not the only one. For many years, establishing rules for the appropriate care of common-property marine

¹⁸⁴ For further information on the tragedy of the commons see Hardin 1968 (Document 461)

domains surrounding other marine resources such as oil fields, beautiful tourist areas, shorefronts and intertidal zones has also attracted interest. A feature of these domains is that they are not privately owned, and usually it is not practical for them to be so (say, for compliance reasons). During the past 50 years or so, the conservation or preservation of both fish and non-fish species and other natural life systems that occupy the marine environment has been a focus. That of course is the contextual issue with marine parks.

The approach to marine areas has changed¹⁸⁵, primarily as the abundance of marine resources has declined. But these changes in thinking have also been driven by advances in scientific and economic knowledge and by the shifts in public interest and perceptions of wise nurture that always occur as communities become materially better-off in other respects. The most obvious example is the increasing social concern for some attributes of marine environments (like ecological integrity) that were once regarded by most people as incidental. In this light, it comes as no surprise that the suggested recipes for centrally determined marine stewardship have been ever-changing.

In the field of economics, in view of indifferent experience with past regimes, scholars have started paying renewed attention to decentralised management approaches, which rely more on voluntary responses within broad frameworks that central authorities would set, as distinct from attempting to centrally design and enforce detailed regimes (e.g. Ostrom 1990¹⁸⁶, which bears consideration by common property managers everywhere).

Making rules for common property marine areas in order to ‘remedy’ their common property ‘defects’ is especially difficult because discouraging unwanted activities and defining the missing activities that should be encouraged is largely an exercise in imagination. The same generic problem faces officials charged with managing extractive or conservation activities in common property marine areas. Relative to standard practice, what type of fishing should be allowed? What does an ideal biodiverse environment look like? What actions are adequate to safeguard a particular ecosystem? What should be the interim regime until more is understood? Answers to such questions require a grasp of what a particular intervention might achieve compared with what can be seen at the time, and rarely is the answer either fully known, or perhaps even knowable¹⁸⁷.

Even in regard to the well-studied topic of fishing, there is a great deal of conjecture about exactly what central authorities’ intervention should be trying to achieve in order to overcome the absence of nurture and the carelessness of behaviour that is feared will be exhibited by

¹⁸⁵ A typical comment on the changes in thinking about fisheries management is that made by property rights experts Anderson and Libecap at a workshop:

In developed countries, the initial response to open-access generally has been prescriptive regulation to control entry and production. Both input and output controls are familiar regulations in fisheries and they include limitations on seasons, entry, vessel size and various harvest equipment and technique, as well as restrictions on the amount and type of fish harvested. In most cases these have not been successful and there has been a move toward rights-based management. (Anderson & Libecap 2010, p. 79)

¹⁸⁶ Document 122

¹⁸⁷ For example, no doubt for practical reasons, fisheries managers have resorted to proximate solutions such as crudely defined ‘effort’ restrictions, when a technically efficient regime might entail a different mix of activities including reef building, predator control, monitoring, protection of breeding stock. Equally, biodiversity objectives have needed to be pursued with a more limited depth of knowledge and a more limited range of tools than would be ideal if wisdom and money were no object

users who do not own the marine resource, and especially to do so in a way that is economic. Arguably, the task with less familiar biodiversity objectives is even more of a challenge.

The difficulty of knowing what to do is compounded because some legislatively endorsed marine policy objectives are expressed in evolving terms like biodiversity conservation where there is room for differences of interpretation. This extends to both the scientific requirements for biodiversity conservation and the institutional machinery needed for intervention.

Opinions vary in regard to the degree to which choices about the preservation or extractive use of biodiversity should be guided by popular opinion as distinct from expert opinion. These views may not be as distant as they seem – it is quite normal in democracies for complex policy issues to be delegated to officials within stated guidelines. But choosing the correct guidelines for officially appointed custodians and means of policing them are key issues. A democratic and economic principle is that, through some mechanism, they be accountable to the public.

Another source of disagreement about what decision-making machinery is appropriate for marine resource use lies in opinions about where the onus of proof lies—a debate often conducted in terms of the often quoted ‘precautionary principle’.

Some commentators have despaired that marine resource management and conservation is characterised by incompatible differences between groups, which at each extreme, consider their view should apply absolutely¹⁸⁸. In modern democracies, giving absolute status to any particular view is not operational. As a practical matter, achieving any given outcome will involve a commitment of administrative resources and the limitation of opportunities for some parties. All resources, including public funds, are limited. So there must be tradeoffs between competing demands. Fortunately the vast majority of people are content to accept decisions that emerge from a ‘political’ contest in which different parties have been free to fight for their preferred mode of resource use provided they perceive their own preferences have received due attention. Arguably that is a reasonable assumption to make about the situation in NSW and that is the basis on which the Audit Panel considers its response to the final terms of reference should proceed.

2.8.3 A new approach

All the material before the Audit, and the conclusions reached in the various sections of this report, support the need for some changes to the management of the NSW Marine Estate. As has been pointed out elsewhere in this report, the NSW Marine Estate is owned by all people and has to be managed for all people. It has also been emphasised that this is not a simple task

¹⁸⁸ Such incompatibilities can become a source of dysfunction in administrations. In a remark that brings to mind the problems that sometimes appear to have plagued marine management in NSW, the editor of an international environmental science journal has recently observed,

Beneath a layer of platitudes that all the agencies may share in their vision statements, differences in their core values and cultures lead these agencies to define shared objectives differently and to prefer different tools to address even challenges acknowledged as shared. For example, although marine protected areas are viewed by the International Union for Conservation of Nature as a preferred tool for protecting endangered marine species (IUCN-WCPA 2008), parties negotiating the Food and Agriculture Organization Guidelines for Management of by-catches and reduction of discards removed all references to marine protected areas from the guidelines (FAO 2010). Thus, agencies may end up working at cross purposes even when objectives purportedly are similar. (Rice 2011, Document 241, p. 1066)

with simple solutions. Instead, it is a classic ‘wicked problem’¹⁸⁹ (Rittel & Webber 1973; Australian Public Service Commission 2007¹⁹⁰).

The need for better systems of research management and a coordinated approach to coastal and marine management have already been recommended (Recommendations R3 and R4). Better research management will facilitate an integrated approach to the management of all threats to marine biodiversity—from long-term macro-scale threats such as climate change and climate variability, to short-term threats such as development and inappropriate catchment and estuarine management. In addition, more emphasis on and better use of research-based social and economic principles and practices in managing the NSW Marine Estate are likely to improved community acceptance and understanding of the role of marine parks in the context of managing all marine resources, including biodiversity.

The threat of Australia’s inherent extreme climate variability, the possible effects of anthropogenic climate change, the complex connectivity of NSW coastal waters and their interaction with adjacent coastal system and catchment systems calls for management responses on a scale that goes beyond that of a system of disjunct marine parks.

It is the finding of the Audit Panel that the best design for a system that can achieve the sustainable management of the NSW coast is one that is managed as a single and continuous system (Halpern et al. 2012¹⁹¹): namely, the NSW Marine Estate. This broad encompassing of all natural resources concerns for coastal and oceanic waters within a single regulatory framework is currently being implanted in the United States of America as a better way of co-ordinating many competing interests and fostering a stewardship ethic whilst managing for a plurality of legitimate concerns (Stokstad 2009; Lubchenco & Sutley 2010; Halpern et al. 2012¹⁹²).

This proposal has implications beyond NSW because Queensland now has a nearly continuous system of marine protection, and such a system in NSW would create synergies between both systems.

The recommendation of the Audit Panel is therefore that the management of the NSW Marine Estate be continuous from the Victorian border to the Queensland border. Further the Audit Panel is of the view that the NSW Government should explore the matching of the sections of the NSW Marine Estate with the five coastal catchment management authorities on the adjacent mainland. This would allow for the establishment of entities that are responsible for the day-to-day management of NSW Marine Estate (Figure 1) in conjunction with the existing catchment management arrangements.

The NSW Marine Estate would incorporate all current marine parks and other reserves under the *Fisheries Management Act 1994* (NSW) and other Acts. With time, the entire NSW Marine Estate would be zoned into a management regime that incorporates all IUCN

¹⁸⁹ Wicked problems have two distinguishing characteristics: there is more than one correct formulation of the problem, that is problem definition ‘is in the mind of the beholder’; and they involve groups of variables that may be unique in time and space

¹⁹⁰ Documents 474 and 475

¹⁹¹ Document 239

¹⁹² Documents 334, 335 and 239

categories from strict protection (Ia) to sustainable use (VI) (Table 1). In addition, there would be intermediate zones managed for specific purposes such as diving, fishing of various types, and commercial activities.

There are pragmatic considerations to this thinking. It is easier to manage multiple resource uses as scale increases and the ability to negotiate offsets, seasonal closures, effort management and strict protection is enhanced. It is also easier to manage threats on a catchment-to-marine basis. The alternative is to try to conduct ‘business as usual’, which as has been pointed out elsewhere in this report, is unlikely to resolve the conflicts that currently revolve around the NSW marine park system or the threats that face it.

In recommending radical change to the management to the NSW Marine Estate, the Audit Panel recognises that the NSW Government cannot achieve these recommendations immediately. It will take time to conduct a process that is considered and effective.

For instance, there is a substantial task in the need to audit all legislation currently in place with a view to its consolidation into either a single Act or via a consolidating Act. Another substantial task is designing the governance system for the NSW Marine Estate and how this should be integrated with the management existing arrangement for the coastal zone and coastal catchments.

The administrative arrangements for the proposed new Coastal and Marine Management Authority will also take time to be established. The Audit Panel is of the opinion that the Authority should consolidate many functions of existing components of various departments. The policy and coordination process should reside with a central authority, while the day-to-day management should be devolved to the five coastal catchment management authorities referred to above. In doing this, the expectation is that greater attention will be paid to social and economic issues while creating a system, which because of its flexibility, allows optimal biodiversity outcomes and integrates NSW into what could become an Australian approach.

As has been pointed out earlier, more attention needs to be paid to monitoring and evaluation; if this is done rigorously, then management that is truly adaptive can be achieved. To this end, the planning for implementation of what the Audit Panel recommends will require integration and expansion of existing approaches to management and evaluation through the existing MER system so that it extends more seamlessly into the NSW Marine Estate¹⁹³.

Another issue that would need to be addressed to make the Audit Panel's recommendations effective would be to harmonise the proposed administrative arrangements with the oversight provided by the NSW Natural Resources Commission. The Audit Panel sees the Commission as providing oversight over the management of all natural resources in NSW on behalf of all the people of NSW. This may mean that, in examining the need for legislative change, some harmonisation of the terms of reference of the Commission will be necessary.

¹⁹³ Currently, relevant targets under the MER Strategy (DECCW 2010, Document 150) include estuarine and coastal lakes, marine waters and ecosystems, rocky reef biota, algal blooms, the extent of marine protected areas and invasive species

Recommendations on Terms of Reference 6, 7, 8 and 9

- (R12)** The Audit Panel recommends the replacement of the Marine Parks Authority, the Coastal Management Panel, NSW Fisheries and any other relevant bodies with a Coastal and Marine Management Authority. This Authority should be supported by a rationalisation of the plethora of legislation that currently overlays the NSW Marine Estate. This new Authority, to be effective, must be given concurrent rights on land use developments that have the potential to affect the NSW Marine Estate.
- (R13)** The Audit Panel recommends that the NSW Marine Estate be managed by the Coastal and Marine Management Authority, with the estate being divided into five sections that correspond with the adjacent catchment management authorities. An issue that will have to be resolved in determining these boundaries is that of the marine bioregions that do not entirely correspond to terrestrial boundaries. This will clearly be a technical issue for resolution.
- (R14)** The Audit Panel recommends that new legislation consolidating all relevant Acts be drafted, and that this legislation give this authority real powers to coordinate with the activities of the Natural Resources Commission and work on a day-to-day basis with the catchment management authorities, terrestrial and marine park authorities, and local government (inasmuch as it relates to the coastal environment).
- (R15)** The Audit Panel recommends that there be a formal relationship between the Coastal and Marine Management Authority and the independent Scientific Committee (Recommendation R3). This would probably best achieved by the chair of the Scientific Committee being a member of the Coastal and Marine Management Authority.

2.8.4 Transitional arrangements

The Audit Panel recognises that proposals such as these will require a transitional plan. While a transition plan is being developed, the current management arrangements for NSW marine parks should remain in place.

2.8.5 Other specific issues**2.8.5.1 The culture of marine park management**

As has been referred to at various points above, it is clear that in some instances, a better relationship between marine parks staff and the general public is necessary. This extends to all stakeholders, not just those who may be sympathetic to the conservation ideals of park staff. This may require an adjustment in the culture that exists at the moment. The proposed new Coastal and Marine Management Authority (section 2.8.3) would have the opportunity to manage this process of cultural transition to one that is directed towards building acceptance of marine conservation and the better management of the NSW Marine Estate in general. One particular issue that came up several times in the Audit was the insufficient resourcing of

marine parks with regards to compliance, including the number of compliance officers. Another issue raised was the attitude of compliance officers to members of the general public. Although the poaching of seafood is clearly a threat to marine biodiversity and ecosystem function, it is the view of the Audit Panel that it is both dangerous and potentially counter-productive in Australia for rangers associated with protected areas to carry weapons of any sort.

Recommendation on Term of Reference 9

(R16) The Audit Panel recommends that compliance rangers be integrated with other ranger staff in the new authority and that no staff carry batons, handcuffs or any other such intimidating paraphernalia.

2.8.5.2 Should there be additional marine parks?

The recommendations made in this report do not in any way preclude the possibility of new marine protected areas being proposed in NSW. The existence of a protected area along the entire NSW coast would include areas that are zoned along the lines that are currently used. Which of these areas are designated as marine parks, sanctuary zones or any other zoning designation (see Table 3) would be determined by the requirement of managing the proposed area to achieve specific and explicit objectives; these will range from the conservation of biodiversity to the provision of improved fishing (or other usage) opportunities.

2.9 Lord Howe Island—a unique NSW marine park

This report has focused on the marine park system that is distributed along the NSW coast. Lord Howe Island is a special case. The marine park surrounding Lord Howe Island is contiguous with a Commonwealth marine park and adjoins an island that is World Heritage listed. In addition to this, the biological properties and ecological drivers for the area are distinctly different from those in all of the other marine parks. Lord Howe Island Marine Park contains biota that is more closely related to that of the southern Great Barrier Reef than to the distant NSW coastal systems.

There are some significant pressures on Lord Howe Island Marine Park, which include oceanic trash and coral bleaching. There are also some issues to do with fishing, although these seem to be comparatively minor in nature and are being managed at a local level.

The Audit Panel has determined that it should make no specific findings in relation to Lord Howe Island Marine Park other than that the park be incorporated under the new management arrangements that are proposed elsewhere in this report.

3. Conclusion

It is clear from the Audit Panel's terms of reference that the NSW Government understands the complexity of the issues that face the management of the NSW marine park system and the NSW Marine Estate in which it is embedded. This is reflected in the complexity of this report. The Audit Panel has grouped terms of reference and reviewed the issues associated with the grouping to arrive at recommendations that cover both the individual terms of reference and the interactions between them. In addition, several terms of reference appear under a number of headings.

The Audit Panel believes that it has, in its two principal recommendations, set out a framework that will improve the management of both marine parks and the NSW Marine Estate. The sixteen other recommendations deal with details that address either specific terms of reference or further aspects of the two principal recommendations.

It is the conclusion of the Audit Panel that NSW has an opportunity to establish a management framework for its Marine Estate that will future-proof it against public policy failure and natural catastrophe, while at the same time providing for a balanced and equitable system of managing of all the demands we place on the resources of the NSW Marine Estate and its marine parks.

Appendices

Appendix 1 Ministerial announcement

Appendix 2 Audit panel members

Appendix 3 Submissions to the audit

Appendix 4 Audit workshops and interviews

Appendix 5 Example of a workshop briefing paper

Appendix 6 Some social science approaches

Appendix 7 The intrinsic and non-market values of nature

Appendix 1: Ministerial announcement

The Hon Katrina Hodgkinson MP Minister for Primary Industries and Minister for Small Business

The Hon Robyn Parker MP Minister for the Environment and Minister for Heritage

MEDIA RELEASE

7 June 2011

ENVIRONMENTAL EXPERT TO LEAD AUDIT OF NSW MARINE PARKS

Minister for Primary Industries Katrina Hodgkinson and Minister for the Environment Robyn Parker today announced the appointment of Associate Professor Robert Beeton AM from the University of Queensland as Chair of the Independent Scientific Audit of Marine Parks in NSW.

Ms Hodgkinson described Professor Beeton as the ideal person to lead the independent scientific audit which will, among other things, determine the effectiveness of the existing marine park zoning arrangements in NSW.

“This audit was a commitment of the NSW Liberals & Nationals prior to the election,” Katrina Hodgkinson said.

“As Chair of the Independent Scientific Audit of Marine Parks in NSW, Professor Beeton will play a key role in ensuring we strike the right balance between sustainable fishing and conservation of marine biodiversity in our Marine Parks policy.

“From chairing the Australian State of the Environment Committee to being appointed a Member of the Order of Australia for his contribution to Environment and Resource Management, there is no doubt Professor Beeton has the experience and qualifications NSW needs.

“He has worked with governments of all political persuasions and we expect he will be a fiercely independent and non-partisan chair.

“The other members of the Independent Scientific Panel will be appointed next month and will be experts who are known for their achievements in fisheries science, marine biodiversity conservation, and social and economic evaluation,” Ms Hodgkinson said.

Robyn Parker said the audit will ensure that the scientific foundations of the NSW Government’s Marine Parks policy are rigorous, transparent and publicly available.

“The NSW Liberals & Nationals election commitment was to implement a Marine Parks Policy that is based on science, not on politics,” Ms Parker said.

“The independent scientific audit will provide a firm basis for consultation with communities and enable us to develop balanced policies that provide for protection of the marine environment as well as supporting a wide range of other uses including recreational activities.

“I welcome the appointment of Professor Bob Beeton to this important role.

“I know he will carry out his responsibilities with integrity and insight.”

Professor Beeton said the Marine Parks Independent Scientific Panel will review the effectiveness of marine parks in protecting different habitat types and provide recommendations of further action and, if appropriate, alternative management approaches.

“This independent scientific audit will follow a proven and transparent process that ensures the delivery of evidence-based outcomes,” Professor Beeton said.

“All parties will be able to review the evidence and reasoning behind the recommendations we make.”

Professor Beeton’s qualifications in this area have seen him hold many positions including Chair of the Australian State of the Environment 2006 Committee, member of the Environment Protection Council in Queensland and Chair of the Australian Threatened Species Scientific Committee for 10 years until March this year. In 2009, Professor Beeton was appointed a Member of the Order of Australia for his contribution to Environment and Resource Management.

Interested parties are invited to provide written submissions addressing one or more of the terms of reference. Submissions must be fully referenced, and will be published online, along with other papers considered by the Audit.

The terms of reference of the independent scientific audit are:

1. Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments, and the effectiveness of these actions;
2. Review the scientific data provided to the Panel by NSW Department of Primary Industries and the Office of Environment and Heritage;
3. Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The Panel will then consider the degree to which the marine parks process is anticipated to address each significant threat.
4. Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary;
5. Recommend ways to increase the cost-effectiveness of marine park zoning arrangements;
6. Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks;
7. Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks;
8. Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them; and

9. Make other recommendations as appropriate, related to achieving better management of the NSW marine environment.

The Independent Scientific Audit of Marine Parks is due to be completed by December 31, 2011.

Appendix 2: Audit Panel members

Chair

Associate Professor R.J.S. (Bob) Beeton AM FIEANZ

Associate Professor Bob Beeton is employed by the University of Queensland, where he teaches environmental problem solving. He was acting Head and Head of the Department of Management Studies from 1992 to 1997. From 1997 to 2002 he was foundation Head of the School of Natural and Rural Systems Management. He has held many university positions in addition to Australian and state government appointments.

Associate Professor Beeton has served on 26 government committees for Queensland, NSW and the Commonwealth, in seven cases as Chair. From 2000 to 2011 he chaired the Commonwealth Threatened Species Scientific Committee (TSSC). He chaired the Commonwealth 2006 State of the Environment Report, the 2000 Local Government Association of Queensland (LGAQ) Inquiry into National Park Management in Queensland, the 1999 NSW National Parks and Wildlife Service (NPWS) Visions Implementation Committee and, from 2000 to 2005, the Centre for Rural and Regional Innovation.

Associate Professor has also served on The Environment Protection Council (Queensland), Committee for Visions for the New Millennium (NSW NPWS), Agricultural Production Systems Research Unit Future Steering Committee, State of the Environment Advisory Committee 2001, Natural Heritage Trust Regional Assessment Panel – Western Queensland, Queensland Parks and Wildlife Service Master Planning Advisory Committee, Queensland Government Ministerial Regional Forum for South-east Queensland, Board of Agricultural Production Systems Research Unit, Board of Rural Extension Centre and the Greening Lockyer Working Group.

Associate Professor Beeton was a participating observer of the National Natural Heritage Trust (NHT) Advisory Council and the National Land and Water Audit Advisory Council. He was Deputy Chair of the Atherton Tablelands Sustainable Regions Advisory Committee, National Research Priorities Standing Committee, Marine and Tropical Sciences Research Facility Advisory Committee and the Commonwealth Environment Research Facilities (CERF) Advisory Committee.

Associate Professor Beeton is currently a member of the IUCN World Commission on Protected Areas, the IUCN Commission on Education and Communication and a member of the Lockyer Valley Regional Recovery Task Force Natural Environments Sub-Committee.

Professor Beeton has supervised 47 higher degrees. He and his students' current research interests are conservation, environmental problem solving, and sustainability issues associated with both natural and rural systems and communities in Australia and internationally. He has published 124 scholarly works and numerous reports to Government. He has conducted 36 short courses and 29 consultancies for industry and Government. His most recent consultancy was as Chair of the Expert Working Group Review of Biodiversity Decline on

Christmas Island. He also regularly works with local government and community groups in regional Australia.

Professor Beeton has received a 1988 Australian Bicentennial award, the 1994 University of Queensland Excellence in Teaching Award and the 2000 University of Queensland Affirmative Action Commendation. In 2000 he was elected a Fellow of the Environmental Institute of Australia and New Zealand, in 2009 was appointed a Member of the Order of Australia for his contribution to environmental and natural resource management, and in 2009 he was named one of 15 Lockyer Legends for his service to the environment and community.

<http://www.gpem.uq.edu.au/beeton>

Fisheries science and Marine Protected Area (MPA) research

Professor Colin Buxton (Director Fisheries, Aquaculture and Coasts Centre, Institute for Marine and Antarctic Science (IMAS), University of Tasmania, Hobart, Tasmania)

Professor Colin Buxton has held senior research director positions at the University of Tasmania since 1998 and currently is Director of the Fisheries, Aquaculture and Coasts Centre at IMAS.

Professor Buxton's expertise spans biology, ecology and fisheries of inshore reef associated fishes, particularly those that are important to recreational and commercial fisheries. This includes examining life-history changes in exploited populations using marine protected areas as a baseline for unexploited populations. Current research focus includes understanding marine protected areas' impacts on the coastal environment and assessing their efficacy as a fisheries management tool.

Professor Buxton's experience includes a PhD from Rhodes University and appointments at the Port Elizabeth Museum (Marine Biologist), Rhodes University (Associate Professor) and Australian Maritime College (Head of the Faculty of Fisheries and Marine Environment). He was the inaugural director of the Tasmanian Aquaculture and Fisheries Institute (TAFI) at the University of Tasmania, a post he has held since 1998.

He has had extensive experience on fishing and aquaculture industry advisory bodies and has consulted to governments in South Africa, Ciskei and Australia.

Professor Buxton has an extensive publication list and co-authored the former NSW Government's 2009 Independent Review of Marine Park Science in NSW, along with Professor Fairweather (see below).

<http://fcms.its.utas.edu.au/scieng/mrl/pagedetails.asp?lpersonId=2910>

Economic evaluation

Mr Greg Cutbush (ANU Enterprise Pty Ltd (ANUE), Australian National University, Canberra, ACT)

Greg Cutbush is a Visiting Economist at ANUE, where he assists with project selection and team building, but predominantly works as a freelance economics consultant. He has 15 years experience prior to this in the public sector and 20 years in the private sector. In consulting,

his history includes a term as Vice President in the economics consulting firm CRA International (2005–2007), which followed a lengthy consulting period with ACIL Tasman (1988–2005). His main consulting areas are: competition policy; international trade; infrastructure policy and cost-benefit analysis.

Greg's earlier positions have included Assistant Commissioner at the Industries Assistance Commission, where he worked almost continuously from 1975 to 1988. He worked from 1979 to 1981 with the Agricultural Policy Division of the Organisation for Economic Co-operation and Development (OECD) in Paris, and since 1983, he has worked with the World Bank and the Asian Development Bank on assignments in 10 developing countries. He has published widely – on trade policy, professional regulations, agricultural contracting, forestry, mining, airports, defence, health and aged care, spectrum allocation racing and biosecurity.

Greg Cutbush's domestic work has covered competition issues associated with all the key forms of infrastructure and expert witness statements for court cases on subjects as diverse as petrol retailing, diet-milk, pathology services, irrigation entitlements and fishing rights.

Greg has worked for the Commonwealth Department of Environment on airport and irrigation projects and his many assignments for the NSW Government over the past decade have included a National Competition Policy Review of The Lord Howe Island Act for the National Parks and Wildlife Service.

http://www.anuenterprise.com.au/images/stories/documents/greg_cutbush_cv_visiting_economist.pdf

Marine ecology and biodiversity protection

Professor Peter Fairweather (Flinders University, Adelaide, South Australia)

Professor Peter Fairweather has been Professor of Marine Biology at Flinders University, South Australia since 2001 and was also Director of the Lincoln Marine Science Centre there from 2001 to 2008.

Professor Fairweather's research interests include studies of food webs in a variety of coastal marine and estuarine ecosystems, the influences of groundwater upon nearshore coastal ecosystems, scaling issues and patchiness of biological community structure, human impacts as disturbances, and ecological monitoring via the use of bioindicators. He also has extensive experience with land based impacts, including serving on a deep ocean outfall steering committee

Professor Fairweather is currently seconded to work as a senior scientific advisor to the South Australian Department for Environment and Natural Resources (DENR), where he is also a member of the Scientific Working Group for Marine Parks and Marine Planning.

Professor Fairweather is a member of the editorial boards of the international journal *Marine and Freshwater Research* and the journal *Ecological Management & Restoration*. He was the President of the Ecological Society of Australia (ESA) from 2005 to 2007, the key professional body for Australia's scientific ecologists with a membership of more than 1400.

Professor Fairweather chaired the former Government's 2009 Independent Review of Marine Park Science in NSW, of which Professor Buxton was also a member (see above).

<http://www.flinders.edu.au/people/peter.fairweather>

Human impacts in the marine environment

Associate Professor Emma Johnston (University of New South Wales, Sydney, New South Wales)

Associate Professor Johnston has a BSc (Hons) and a PhD from the University of Melbourne. Since completing her PhD in 2002, she has worked as an academic at the University of New South Wales in the School of Biological, Earth and Environmental Sciences. She is currently Deputy Director of the Evolution and Ecology Research Centre (EERC), Associate Editor of Marine Ecotoxicology for the journal Ecotoxicology, and a member of the Editorial Board for the journal Environmental Toxicology and Chemistry. In 2007 she was a Visiting Researcher at the Marine Biological Association of the United Kingdom.

Associate Professor Johnston's research investigates human impacts in marine communities in a program that both progresses our understanding of fundamental ecology, and provides insights and recommendations for the management of marine systems. She has an extensive publication record, and her research has been continuously funded by the Australian Research Council since 2004. In 2010, Associate Professor Johnston was awarded an Australian Research Fellowship (ARF) to investigate 'Bioinvasions: the interactive effects of propagule pressure and pollution'.

Associate Professor Johnston's research is at the interface of fundamental and applied ecology and she frequently interacts with government and industry bodies. She has contributed expert opinion to: the Department of Environment, Water, Heritage and the Arts (Federal government), Biosecurity New Zealand (NZ government), the Department of Industry and Innovation (NSW), and the Office of Environment and Heritage (NSW). She is an invited member of Working Group 2 (Biology and Monitoring) for the Review of the Australia and New Zealand Environment and Conservation Council (ANZECC) Fresh and Marine Water Quality Guidelines. She consults with industry through the development and implementation of environmental monitoring programs.

<http://www.bees.unsw.edu.au/staff/emma-johnston>

Social policy and planning

Dr Roberta Ryan (Director Urbis Consulting, Sydney, New South Wales)

Dr Roberta Ryan is a leading social policy and planning analyst with over 25 years' experience in Australia and internationally. She has developed new approaches in the application of research to policy, social planning, evaluation, community engagement, stakeholder management, social sustainability, social and strategic planning, and land-use and development frameworks.

Dr Ryan has extensive experience in the design, development and facilitation of complex social and community planning processes for all levels of government and the private sector.

Sustainability initiatives have included mass media campaigns, local government and industry sustainability initiatives, stakeholder management, communications and facilitation to deliver large projects.

<http://www.urbis.com.au/our-people/roberta-ryan>

Appendix 3: Submissions to the Audit

Available at <http://www.marineparksaudit.nsw.gov.au/submissions/submissions-received/>.

Note some submission numbers are missing due to technical difficulties with the online submission form on the Audit website.

NO.	NAME AND ORGANISATION
1	Philip Wykeham
2	Aaron Briggs
3	Dr Matt Landos, Future Fisheries Veterinary Service
4	Anthony Humphreys
5	Katherine Christian
6	Dave Clark, Narooma Fishing Club
7	Philip Threlfall
8	Brian Coleman
9	Rob McMahon
10	Dan Bode, Byron Bay Services Deep Sea Fishing Club
11	Emeritus Professor Robert Kearney, The University of Canberra
12	Jennie Kun, Oceans and Coastal Care Initiative (OCCI)
13	Assoc Prof John Harris, La Trobe University, Harris Research
14	Chris Wallis, Hat Head Fishing Club
15	John Harrison, Professional Fishermen's Association
16	Keith Kneebone
17	Joan Dawes, Australasian Wader Studies Group
18	Phil Hilliard, Ballina Fishermens Co-operative Ltd
19	L Tregoning
20	C Russell, Manly Warringah Anglers
21	Peter Cole-Clarke
22	Bob Penfold
23	Cathy
24	Stafford Ray
26	Wendy
28	Stephen Smith
29	David Roser
30	Narelle Howard
31	Anne Dickson
32	Stephen Smith

NO.	NAME AND ORGANISATION
34	Carey McCray
35	Graham Harman, Apsley Pastoral Co
36	Paul Brun
37	Judy Cooney
38	Caroline Hoisington, Independent economic consultant
39	Marianne McMillan, ATA/EarthCare
40	Graham Hunt
41	Emil and Esmay Hropic
43	Jan Olley, Byron Bird Buddies
44	Chris Horton, Northern Beaches Resident's Association Inc
45	Sydney Fish Market Pty Ltd, Sydney Fish Market Pty Ltd
46	NSW Seafood Industry Council, NSW Seafood Industry Council
47	William Robertson
48	Keith de Haan, Boat Owners' Association of NSW
49	Emil and Esmay Hropic, Commercial fishing
50	Beth Hill
51	Emil Teleki
52	Graeme Greenup
53	Thomas Lantry and Arthur Beckmore, Maitland City Offshore Fishing Club
54	Manon Marcadet
55	Alexia Wellbelove, Humane Society International
56	John Darmody
57	Dr Samantha Capon, Griffith University
58	Paula Masselos
59	David Young
60	D Stuart, Narooma Charters
61	Nicolas
62	Ben Sterk
63	Stephen Allen
64	Iain Mckay, Northmead Anglers
65	Susanna Cheng
66	Ed
67	Catherine Walsh
68	Margo Goodwin

NO.	NAME AND ORGANISATION
69	Tegan Redinbaugh, Musica Viva
70	Mark McDermott, Fisherman
71	Jim Muldoon
72	Bryce Long
73	Clare Milledge, The University of Sydney
74	Ashley Love
75	Anne Gibbins
76	Phillip Hilliard, NSW Fishermens Co-operative Association Ltd
77	Toby Waters
78	Dailan Pugh
79	Attila Kaszo
80	Michael, Ecocern
81	Karen Pitt
82	Jimmy Malecki
83	Graham Cassidy
84	Susan Gould
85	George McKay
86	Ken
87	Colin Weir, The Billy Can
88	Sheila Monahan (President), The Coastwatchers Association Inc
89	Evan Jardine
90	Max Bedford
91	Keith Milton Harpley
92	Norman Ingersole, Narooma Charters
93	Gary Harpley
94	Jeffrey Leis
95	Mark Merritt
96	Peter Walz
97	Cate Faehrmann, The Greens NSW
98	Chris Cummins
99	Susan Newson, Crest Diving
100	Gwyn Austen, Red Rock Preservation Association
101	Keith Muir, The Colong Foundation for Wilderness Ltd
102	Annette McKinley

NO.	NAME AND ORGANISATION
103	Jillian Snell
104	Karen Pearn
105	John Edwards, Clarence Environment Centre Inc
106	John Jeayes, North Coast Environment Council
107	Rebecca Khair
108	Madison Stewart, Elements 5 Underwater Filmmaking
109	Mary Gardner
110	Avril Lockton, Community Environment Network
111	Gayle Russell
112	Ben Birt
113	Cathy Merchant, Secretary, Ryde Hunters Hill Flora and Fauna Preservation Society
114	Maria Zann, The University of Queensland
115	Megan Kessler
116	Mary Gardner
117	Michelle Linklater
118	Peter Simpson, Spot a Shark
119	Catherine Woolnough
120	Roman Suwald
121	Sandy van Veluwen
122	Craig Wilson, Australian Land Based Anglers Association Inc (ALBAA)
123	George Evatt
124	Barbara Stewart
125	Patrick W Medway AM, Wildlife Preservation Society of Australia Ltd
126	Michelle Voyer , University of Technology, Sydney
127	Dave Thomas, Eco Divers Inc
128	Mark Fleming
129	Matthew
130	Barbara Cameron
131	Mandy Swann
132	Jim Morrison
133	Kevin Taylor
134	Andy Davis , University of Wollongong
135	Kordes
136	Des Kerrigan

NO.	NAME AND ORGANISATION
137	Kate Kilgour (B.Mar Sci M.Env Educ), Marine Education Society of Australasia
138	Edwina Foulsham
139	Ian H Smith, Narooma Bowlo FC, Narooma Sport & Gamefishing Club, Australian National Sportfishing Association (ANSA)
140	Jennifer Kenna , National Parks Association of NSW
142	Fiona McCuaig , Australian Wildlife Activist
143	Marny Bonner & Gordon Fraser-Quick, Australian Seabird Rescue Inc
144	Steven Dalton , Southern Cross University
145	Will Jones, Marine Discovery Centre Bondi Beach Inc
146	Todd Minchinton
147	Rachel Fitzhardinge
148	Nicola Bowskill, The Wilderness Society Newcastle Inc
149	Raymond Cox
150	Peter D Steinberg, Sydney Institute of Marine Science
151	Lesley J Killen, Concerned citizen & supporter of Nature Conservation Council (NCC) of NSW
152	Will Figueira, Australian Marine Sciences Association, NSW Branch
154	Stephen D A Smith , Southern Cross University
155	Paul Crooks
156	Anne Reeves
157	Michael Ingram
158	Dr Bruce Pease, EcoNetwork Port Stephens Inc
159	Gary Williams
160	David Booth, University of Technology Sydney
161	Dr Pia Winberg, Shoalhaven Marine & Freshwater Centre, University of Wollongong
162	Barry Aish, Commercial Fishing
163	Les and Cathy Cheers
164	Alan Lloyd
165	Steve Clemesha
166	John Pandolfi, Australian Coral Reef Society
167	Rhett Smyth, Nambucca Heads Offshore Fishing Club
168	Greg Pullen, Shoalhaven City Council
169	Bruce Schumacher, NSW Advisory Council on Recreational Fishing
170	Peter Cameron
171	Rick Stuart-Smith, Reef Life Survey
172	Brian Lassig, Australian Museum

NO.	NAME AND ORGANISATION
173	Jenny Edwards, Nature Coast Marine Group Inc
174	Fiona Marshall, Hunter-Central Rivers Catchment Management Authority
175	Pam Green, Southern Rivers Catchment Management Authority
176	Geoff Parker, Coffs Harbour Deep Sea Fishing Club
177	Ken Thurlow, ECOfishers
178	Philip Creagh, Narooma Port Committee
179	John Miller, Abalone Fishery Management Advisory Committee
180	Jane Williamson, NSW Fisheries Scientific Committee
181	Pepe Clark, Darren Kindleysides & Kevin Evans, Nature Conservation Council of NSW, the Australian Marine Conservation Society and the National Parks Association of NSW
182	Jacqui Keats, Great Lakes Environment Association
183	Raymond Cox, Curl Curl Lagoon Friends Inc
184	Lief Lemke, Friends of the Solitary Islands Marine Park and the Bellingen Environment Centre
185	Graeme Macey
186	Les Buckley
187	Bouillard
188	Torsten Landwehr
189	A Woodbine
190	Wendall Weston
191	Malcolm Poole, Recreational Fishing Alliance of NSW
192	David Hempton, Bondi Mermaids
193	Mary Howard, Hawkesbury River Commercial Fishing Association
194	Stan Konstantaras, Australian National Sportfishing Association, NSW Branch
195	Nariman (Nari) Sahukar, Environmental Defender's Office (NSW)
196	Michael Featherstone
197	John Clemmett, Manufacturer
198	Roberta Dixon-Valk
199	Lindy Stacker, World League for the Protection of Animals
200	Response to S46 and S194 by Jervis Bay Marine Park, Jervis Bay Marine Park
201	Response to S10 by Cape Byron Marine Park, Cape Byron Marine Park
202	Response to S15 by Solitary Islands Marine Park, Solitary Islands Marine Park
203	Response to S196 by Solitary Islands Marine Park, Solitary Islands Marine Park

Appendix 4 Audit workshops and interviews

DECCW = former NSW Department of Environment, Climate Change and Water

DPC = NSW Department of Premier and Cabinet

DPI = NSW Department of Primary Industries (sits under DTIRIS)

DTIRIS = NSW Department of Trade and Investment, Regional Infrastructure and Services

OEH = NSW Office of Environment and Heritage (sits under DPC)

ToR = Terms of Reference for the Audit

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
1a	State government officials Fishing (threats, management and no-take zones)	Dr Bob Creese & Prof Steve Kennelly DPI
1b	Submissions from institutions ToR 1–9	S150 Sydney Institute of Marine Science (SIMS) Dr Melanie Bishop Prof Maria Byrne Assoc Prof Ross Coleman Dr Will Figueira Prof Iain Suthers S172 Australian Museum Dr Pat Hutchings Dr Lauren Hughes S166 Australian Coral Reef Society (ACRS) Ms Brigitte Sommer
1c	Submissions from academics ToR 1-9	(i): S11 Emeritus Prof Bob Kearney, University of Canberra (v): S154 Assoc Prof Stephen D A Smith, Southern Cross University
2	Did not proceed	
3	Pollution (point and diffuse) ToR 3, 8, 9	Dr John Chapman, Manager of the Ecotoxicology & Environmental Contaminants Section OEH Dr Klaus Koop OEH Mr Peter Marczan, Manager Technical Advisory Unit, Water OEH Mr Tim Pritchard, Manager, Waters and Coastal Science

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
		Section OEH Dr Peter Scanes, Head, Coastal Waters Unit OEH
4	Invasive species/disease ToR 3, 8, 9	Dr Bob Creese DPI Mr Tim Glasby, Senior Research Scientist DPI Dr Melinda Coleman, Research Scientist, Batemans Marine Park
5	Climate change ToR 3, 8, 9	Dr Klaus Koop OEH Dr Alan Jordan DPI
6a	Marine Parks Management ToR 1-9	Marine park managers Mr Matt Carr, Jervis Bay Marine Park Mr Max Haste, Port Stephens-Great Lakes Marine Park Ms Nicola Johnstone, Solitary Islands Marine Park Dr Brendan Kelaher, Batemans Marine Park Mr Ian Kerr, Lord Howe Island Marine Park Mr Andrew Page, Cape Byron Marine Park Marine park research scientists Dr Melinda Coleman, Batemans Marine Park Dr Nathan Knott, Jervis Bay Marine Park Mr David Harasti, Port Stephens-Great Lakes Marine Park Dr Hamish Malcolm, Solitary Islands Marine Park
6b	Marine Parks Management ToR 1–9	Marine park managers Mr Max Haste, Port Stephens-Great Lakes Marine Park Ms Nicola Johnstone, Solitary Islands Marine Park Dr Brendan Kelaher, Batemans Marine Park Mr Ian Kerr, Lord Howe Island Marine Park Mr Andrew Page, Cape Byron Marine Park Marine park research scientists Dr Melinda Coleman, Batemans Marine Park Dr Nathan Knott, Jervis Bay Marine Park Mr David Harasti, Port Stephens-Great Lakes Marine Park Dr Hamish Malcolm, Solitary Islands Marine Park Catchment management authorities Mr John Carse, General Manager, Sydney Metropolitan Catchment Management Authority Ms Lesley Diver, Sydney Metropolitan Catchment Management Authority Ms Pam Green, Chairperson, Southern Rivers Catchment

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
		Management Authority Mr Brian Hughes, Catchment Action Plan Implementation Officer (Coast and Marine), Hunter-Central Rivers Catchment Management Authority Mr Rod McKelvey, Deputy Chair, Northern Rivers Catchment Management Authority Mr Mark Robinson, Northern Rivers Catchment Management Authority Department of Primary Industries Dr Geoff Allan Mr Adrian Toovey Dr Rodney James Dr Alan Jordan Dr Steve Kennelly Dr Bob Creese Office of Environment and Heritage Mr Terry Bailey Mr Rob Quirk
6c	Marine Parks Management ToR 2, 3, 4, 5, 6, 9	Management Effectiveness Unit OEH Mr Peter Stathis Dr Andrew Growcock
6d	Marine Parks System ToR 1, 3, 4, 6, 7, 8, 9	Conservation groups S181 Nature Conservation Council of NSW Mr Pepe Clarke, Ms Paula Brown S181 National Parks Association of NSW Mr Kevin Evans S143 Australian Seabird Rescue Ms Marny Bonner, Mr Gordon Fraser-Quick S101 Colong Foundation for Wilderness Mr Keith Muir S158 EcoNetwork Port Stephens Dr Bruce Pease
6e	Marine Parks System ToR 3, 4, 6, 7, 8, 9	Recreational fishing groups S169 NSW Advisory Council on Recreational Fishing Mr Bruce Schumacher S191 Recreational Fishing Alliance of NSW Mr Malcolm Poole

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
		S194 Australian National Sportfishing Association, NSW Branch Mr John Burgess S122 Australian Land Based Anglers Association Mr Craig Wilson Mr Christian Gough S176 Coff's Harbour Deep Sea Fishing Club Mr Geoff Parker S177 Ecofishers Mr Ken Thurlow S10 Byron Bay Services Deep Sea Fishing Club Mr Dan Bode Underwater Skindivers and Fishermen's Association Mr Adrian Wayne Mr Peter Saunders Commercial Vessel Association of NSW Mr John Paton NSW Game Fishing Association Mr David Litchfield
7	Social benefits ToR 6, 9	Various workshop attendees particularly 6a, 6b, 6d, 6e, 8
8	Cost-benefit ToR 5, 6, 9	Dr Scott Davenport, Director and Chief Economist DTIRIS Mr Stewart Webster, Senior Manager Industry Policy DTIRIS Dr David Godden, formerly of DECCW Mr Robert Gillespie, Gillespie Economics Mr Nicolas Conner, Acting Manager Economics Services OEH
10a	Threatened species, Fisheries Scientific Committee ToR 3, 4, 9	S180 Dr Jane Williamson, Chair, NSW Fisheries Scientific Committee Dr Alan Millar, Deputy Chair Dr Sandra Diamond
10b	Threatened species, State government officials ToR 3, 4, 8, 9	Dr Bob Creese DPI Dr Bill Talbot DPI Mr Peter Gallagher DPI Mr Geoff Ross OEH

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
		Ms Clare Murphy OEH
11	Did not proceed	
12	Adequacy ToR 4	Dr Bob Creese DPI Dr Rodney James, Manager, Aquatic Protected Areas Unit Dr Alan Jordan, formerly seabed mapping OEH, now DPI Dr Brendan Kelaher, Marine Park Manager, Batemans Marine Park
13	Commercial fishing ToR 3, 5, 6, 9	S15 Professional Fishermen's Association Mr John Harrison (by phone) S18 Ballina Fishermens Co-operative Mr Phil Hilliard S193 Hawkesbury River Commercial Fishing Association Ms Mary Howard
14	NSW Environmental Defender's Office ToR 1, 3, 8, 9	Mr Nari Sahukar, Acting Policy and Law Reform Director Ms Megan Kessler, Science Director Mr Ian Ratcliff, Senior Solicitor
15	NSW Coastal Panel ToR 3, 8, 9	Mr Derek Rutherford, Panel member, Director Land, Coasts & Water OEH
16a	Marine Parks Authority, environment agency ToR 1-9	a(i): Ms Lisa Corbyn, Chief Executive OEH a(ii): Ms Sally Barnes, Deputy Chief Executive and Head of NSW National Parks and Wildlife Service OEH
16b	Marine Parks Authority, primary industries ToR 1-9	Dr Richard Sheldrake, Director General DPI
16c	Did not proceed	
16d	Marine Parks Authority, departmental officers working on MPA matters ToR 1-9	(i): Mr Michael Wright, formerly with National Parks and Wildlife DECCW (ii): Mr Ian Hunter, Acting Executive Director, Infrastructure, Environment and Economic Development Branch, Department of Premier and Cabinet
17	Indigenous interests	Aboriginal Fishing Advisory Council (AFAC) Mr Danny Chapman, Chairperson Mr Wally Stewart Assoc Prof Stephan Schnierer NSW Aboriginal Land Council Mr Peter Smith

NO.	TERM OF REFERENCE OR SUBJECT (OTHER ISSUES RAISED ALSO DISCUSSED)	SUBMISSION/DEPARTMENTAL PERSONNEL
		Ms Clare McHugh NSW Native Title Services Mr Warren Mundine Ms Danielle Bevins-Sundvall Ms Jennifer Brightling

Appendix 5: Example of a workshop briefing paper

Workshop 6e

Briefing package

2–3.30pm, Thursday 1 December 2011

Room 1254, Parliament House

6 Macquarie Street, Sydney

Proposed Attendees

Assoc Prof Bob Beeton, Chair

Prof Colin Buxton

Mr Greg Cutbush

Prof Peter Fairweather

Assoc Prof Emma Johnston

Dr Roberta Ryan

Ms Petrina Alcock, Secretariat Manager

Dr Fiona Powell, Secretariat

Mr John Burgess, Vice President, Australian National Sportfishing Association, NSW Branch

Mr Dan Bode, Byron Bay Services Deep Sea Fishing Club

Mr Christian Gough, President, Australian Land Based Anglers Association

Mr David Litchfield, President, NSW Game Fishing Association

Mr Geoff Parker, Fisheries and Environmental Spokesperson, Coffs Harbour Deep Sea Fishing Club

Mr John Paton, Vice President, Commercial Vessels Association

Mr Malcolm Poole, Chair/President, Recreational Fishing Alliance of NSW

Mr Peter Saunders, Underwater Skindivers and Fishermen's Association

Mr Bruce Schumacher, Chair, NSW Advisory Council on Recreational Fishing

Mr Ken Smith, President, Byron Bay Services Deep Sea Fishing Club

Mr Ken Thurlow, CEO, ECOfishers NSW

Mr Craig Wilson, Environmental Officer, Australian Land Based Anglers Association

TBC Mr John Millyard, Treasurer, Australian Fishing Trade Association

Apologies

Ms Ann Garard, Charter fishing representative on NSW Advisory Council on Recreational Fishing.

Purpose

The purpose of the workshop is to seek your response to the submissions and documentation with respect to the management of marine parks in New South Wales.

The purpose of this briefing package is to help you in preparing for this workshop. Included with this package are four attachments which are designed to assist you with the large number of documents and submissions which are on the Audit website. Specifically these attachments are:

- a schematic (Attachment A) in which Audit documents up to document 202 are mapped against the terms of reference
- the document database up to document 205 (Attachment B). This database is updated periodically and can be found on the Audit website
- a spreadsheet (Attachment C) indicating which terms of reference were addressed by each submission
- a list of issues and phrases grouped together from all submissions received (Attachment D), with submissions identified by number.

Please note all attachments are working documents and do not reflect any judgment by the Audit Panel about the depth of coverage or veracity of each document and submission.

Conduct of interview/workshop

Each interview/workshop is different and will cover different material. The material relevant to this interview/workshop is identified under 'Specific documents and submissions to note'.

Fourteen questions have been developed which reflect the terms of reference and a reading of all the documentation and submissions. The first 10 questions will not all apply to all interviews/workshops but are provided for the sake of completeness. Each interview/workshop will commence with a call for issues that you wish to raise that are not covered in the material we have prepared. It will then move on to the core questions which are relevant to the interview/workshop. These will provide a transition to specific questions about your submissions and other documents and submissions that may relate to it. Each interview/workshop will conclude with the four final questions.

Issues you wish to raise that are not covered below

The Panel would like to hear from you regarding any specific matters you wish to raise about the submissions provided on the Panel website. In formulating your questions please be able to reference submission numbers as listed on the Audit website.

Core Questions

These questions may not all be applicable to every interview/workshop, they are included here for the sake of completeness.

1. Do you have any comments on how NSW is contributing to Australia's international commitments to protect marine biodiversity?

2. Do you have any comments on how science is conducted and used by the Marine Parks Authority and the departments responsible for managing marine parks in NSW?
3. What are the most significant issues with respect to the management of NSW fishing and the interaction of this with the management of NSW marine parks?
4. What are the most significant threats to the maintenance of the biodiversity of marine parks and are these being appropriately managed?
5. Do you think the NSW marine park system as it is today is the best mechanism for managing the state's marine biodiversity?
OR if you prefer
How can NSW more effectively and efficiently achieve marine and estuarine biodiversity conservation?
6. Do you think that the social benefits and costs of marine parks are understood / assessed when marine parks are established? And do you have any suggestions for improvements?
7. Do you think that the social benefits and costs are understood and used when the zoning of existing parks is reviewed? And do you have any suggestions for improvements?
8. Do you think that the economic benefits and costs of marine parks are understood when marine parks are established? And do you have any suggestions for improvements?
9. Do you think that the economic benefits and costs of marine parks are understood and used when the zoning of existing parks is reviewed? And do you have any suggestions for improvements?
10. Can you comment on how consultations involving marine parks are conducted? And do you have any suggestions for improvements?

Specific documents and submissions for this interview/workshop

Documents : <http://www.marineparksaudit.nsw.gov.au/relevant-documentation/>

Document 7, Marine Park Science in NSW - An Independent Review

Document 8, Marine Parks Strategic Research Framework 2010-2015

Document 15, NSW Parliamentary Inquiry - Fisheries Management and Resource Allocation in New South Wales: Recommendations

Document 25, Keep Australia Fishing

Document 107, Background information on Fishing and Aquaculture

Document 149, Status of fisheries resources in NSW 2008-09 (Introduction and Executive Summary)

Document 155, Recreational fishing surveys in the Greater Sydney Region

Document 199, Response to R15 - proposed NSW recreational fishing survey

Submissions : <http://www.marineparksaudit.nsw.gov.au/submissions/submissions-received/>

S10 Byron Bay Services Deep Sea Fishing Club
S11 Kearney, University of Canberra
S15 Harrison (Professional Fishermen's Association)
S18 Hilliard (Ballina Fishermens Co-operative Ltd)
S46 NSW Seafood Industry Council
S57 Capon, Griffith University
S74 Love
S101 Muir, Colong Foundation for Wilderness
S122 Wilson, Australian Land Based Anglers Association
S134 Davis, University of Wollongong
S143 Bonner & Fraser-Quick, Australian Seabird Rescue
S146 Minchinton
s150 Steinberg, Sydney Institute of Marine Science
S154 Smith, Southern Cross University
S158 Pease, EcoNetwork Port Stephens
S169 Schumacher, NSW Advisory Council on Recreational Fishing
S176 Parker, Coff's Harbour Deep Sea Fishing Club
S177 Thurlow, Ecofishers
S181 Clark, Kindleysides and Evans, Nature Conservation Council of NSW, Australian Marine Conservation Society and National Parks Association of NSW
S191 Poole, Recreational Fishing Alliance of NSW
S194 Konstantaras, Australian National Sportfishing Association, NSW Branch

Final Questions

11. Considering the answers to date, are there any other significant information gaps hindering robust, evidence-based decision-making on marine parks?
12. Considering the answers to date about all current and potential threats to the marine environment, which bodies or agencies would be the most appropriate to address these threats?
13. Considering the answers to date, are there any additional mechanisms (legislative or administrative) that would achieve better management of the NSW marine and estuarine environment?
14. Do you have any other matters to raise with the Audit Panel?

Additional background information for participants

The Audit Panel would like to draw your attention to both the objects (primary and secondary) of the NSW *Marine Parks Act 1997*

<http://www.legislation.nsw.gov.au/viewtop/inforce/act+64+1997+FIRST+0+N> :

3 Objects of Act

The objects of this Act are as follows:

- (a) to conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks;
- (b) to maintain ecological processes in marine parks;
- (c) where consistent with the preceding objects:
 - (i) to provide for ecologically sustainable use of fish (including commercial and recreational fishing) and marine vegetation in marine parks; and
 - (ii) to provide opportunities for public appreciation, understanding and enjoyment of marine parks.

and the nine terms of reference for the Audit

<http://www.marineparksaudit.nsw.gov.au/about/audit-terms-of-reference/> :

Terms of reference for the Independent Scientific Audit of Marine Parks in NSW are:

1. Review the domestic and international commitments to conserving marine biodiversity, current actions for meeting these commitments and the effectiveness of these actions.
2. Review the scientific data provided to the panel by the nsw department of primary industries and the office of environment & heritage.
3. Review the degree to which all threats to the varying types of marine environments have been properly identified and prioritised. The panel will then consider the degree to which the marine parks process is anticipated to address each significant threat.
4. Review the specific science relating to the effectiveness of marine parks in protecting different habitat types and recommend further action and/or alternative management approaches if necessary.
5. Recommend ways to increase the cost-effectiveness of marine park zoning arrangements.
6. Recommend ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks.
7. Identify and recommend ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks.
8. Make recommendations on how all current potential threats to the marine environment could be effectively addressed and which bodies or agencies would be most appropriate to address them.

9. Make other recommendations as appropriate, related to achieving better management of the nsw marine environment.

The Panel considers that the objects of the Act represent the prime directives for marine park management in NSW at this time. The Panel's approach has been to consider the terms of reference as its principal reporting obligation. Under its terms of reference the Panel may make recommendations about improvements to management for better achieving the objectives of the Act or suggest changes. In both cases these must be in accord with the Panel's terms of reference. Your input is invited in this regard.

Please come prepared with any matters you may wish to raise with the Panel or any material you may wish to provide.

For more information please refer to Attachments A–D and visit the Audit website at <http://www.marineparksaudit.nsw.gov.au>

Should you have any queries please contact Ms Petrina Alcock, Secretariat Manager on 0408 420 836 or Dr Fiona Powell, Secretariat on 0407 94 77 23.

Yours Sincerely



Assoc Prof Robert (Bob) J S Beeton AM FEIANZ

Chair

NSW Marine Parks Independent Scientific Audit Panel

23 November 2011

Appendix 6: Some social science approaches

Social Research

What: systematic investigation, data collection and analysis to explore key issues and enhance understanding

Why: provide a robust and defensible evidence base for future policy development and decision-making

When: whenever there is limited available evidence; information is anecdotal, fragmented or untested; a theory or question requires testing/exploration

How: qualitative, quantitative and mixed methods. A quick definition of methods is below:

Quantitative designs approach social phenomena through quantifiable evidence, and often rely on statistical analysis of many cases (or across intentionally designed treatments in an experiment) to create valid and reliable general claims

Qualitative designs emphasise understanding of social phenomena through direct observation, communication with participants, or analysis of texts, and may stress contextual and subjective accuracy over generality

Social Impact Assessment

What:

- It is anticipatory—it is done before implementation and then the results are assessed after implementation
- Predicting and assessing the consequences of change on society
- A method of predicting and assessing the consequences of a proposed action or initiative before a decision is made on affected groups of people and on their way of life, life chances, health, culture and capacity to sustain these (Planning Institute of Australia, National Position Statement, June 2009).

Why: Social impact assessment includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions

- To provide an independent assessment, weigh relative impact, and recommend mitigation measures to minimise negative impacts and a monitoring and management plan
- To maximise benefits and minimise costs of developments, especially those costs borne by the community
- To examine implications of costs falling disproportionately on specific population groups or locations
- To ensure better decisions can be made about interventions, what these should be and how they should be implemented

- Because social impact assessment often assumes negative impacts, to also assess any positive impacts
- To recommend or develop mitigation measures and opportunities as part of the proposed development
- To move toward a more sustainable and equitable biophysical and human environment
- Principles of a social impact assessment:
 - Protection of fundamental human rights – good health, and quality of life to enable the development of human and social potential
 - Rights for people to be involved in decision-making about planned interventions that will affect their lives
- Local knowledge and experience can enhance planned interventions

When: Should be commenced at the detailed design and planning stage, when a proposal can be assessed in sufficient detail against the existing conditions and desired future state, but before it has been implemented. Then analysis needs to be done after implementation to assess the accuracy of the predictions and the success of the mitigation measures.

How: A highly structured process that considers existing conditions and community profile, potential issues and impacts, tested in detailed investigations including those likely to be affected by a proposal; then assesses relative impact and proposes mitigation and responses. Can involve desktop analysis, quantitative and qualitative assessment, usually based on primary research. Social Impact Assessments need to employ methods and techniques that can be replicated, independently assessed, test issues against a range of perspectives (particularly the values of different stakeholders) and data.

Economic Impact Assessment¹⁹⁴

What: Economic impact analysis examines the effect of a policy, program, project, activity or event on the economy of a given area, whether a region, a state or the nation. Economic impact is usually measured in terms of changes in economic value (gross output or value added) and associated changes in jobs (employment) and income (wages).

Why: The analysis typically measures or estimates the level of economic activity occurring at a given time *with the project or policy occurring*, and calculating the difference from what would otherwise be expected *if the project or policy did not occur* (which is referred to as the counterfactual case). This analysis can be done either before or after the fact (ex ante or ex post). The term economic impact may represent the change in contribution of a given activity or industry or set of industries or all industries or, most comprehensively, to the changes in total community welfare as represented by the sum of consumer and producer surplus with respect to both market and non-market goods and services. To permit consistent comparison with and without policy outcomes, a discount rate is applied to future costs and benefits.

When: Before or after the fact

How: Requires quantitative and monetised data, modelling and analysis.

¹⁹⁴ Not to be confused with the more common statutory term Environmental Impact Assessment (EIA)

Public Participation

What: An independent, voluntary, transparent, representative and accountable process offering a range of strategies to invite input, feedback and ideas on issues of interest. It is process focussed and does not assume an outcome. Good public participation ensures participants are clear about what can and cannot be influenced during the process. It is different from communications (and should not be managed by communications teams) and does not have an advocacy focus.

Why: To identify key issues, values and concerns; to inform planning, design and analysis; to strengthen outcomes that respond to stated needs and requirements

When: At all stages; however, early involvement in key decision making process is most effective

How: Activities depend on the purpose of engagement. These can include a combination of activities for breadth (communications, websites, newsletters, CIFS, community 'pop ups', telephone surveys, online panels, social media etc) and depth (focus groups, workshops, deliberative panels/citizens juries, stakeholder briefings, community reference groups and advisory groups etc.)

Communications

What: Strategies to disseminate information, key messages, profiling and publicity

Why: To communicate key messages and issues broadly, may have issues management/advocacy focus

When: At all stages

How: Fact sheets, letters, briefings, websites, media releases, media monitoring, good news stories, social media

Education for sustainability

What: Disseminate information, raise awareness, knowledge and understanding regarding key issues

Why: Promote desired behaviours and actions

When: At all stages

How: Depends on target groups and issue; strategies are often informed by social marketing research that examines communications preferences and tests for reach, relevance and recall. Online, paper-based, experiential, participatory, and electronic media.

Appendix 7: The intrinsic and non-market values of nature

Much of the worth individuals place on the marine environment has little or no economic basis, so attempts by economists to assign economic value to the environment and other non-market commodities (such as through ‘willingness to pay’ models) may be poor substitutes for the reality of loss of amenity, way of life, or access to and enjoyment of nature now and into the future.

The environmental benefits of protecting and providing nature in urban areas are readily quantifiable and widely proven. Although the social implications of natural areas are less tangible, a growing body of research demonstrates that there are significant benefits to the individual and broader community. While this research primarily relates to terrestrial settings, many of the benefits are also attributed to marine environments.

The benefits of interaction with nature, including direct contact with nature and simply seeing nature, are proved to be significant for not only individuals, but the broader community and environment as well. The following provides an overview of some of these benefits.

Benefits to the Individual

The physical and mental benefits received by individuals in interaction with nature include:

- improved fitness and reduced obesity (Corkery 2007; Maller et al. 2008; Kimbell et al. 2009¹⁹⁵)
- improved cardio-vascular and respiratory health (Townsend & Ebden 2009¹⁹⁶)
- increased rate of healing from illness, pain relief and reduced discomfort (Ulrich 1984; Parsons 1991; Diette et al. 2003¹⁹⁷)
- reduced irritability, inattention, impulsivity and proneness to mistakes (Herzog et al. 1997; Kuo & Sullivan 2001¹⁹⁸)
- reduced incidence of anger and anxiety (Maller et al. 2008¹⁹⁹)
- relief of stress and mental fatigue (Kaplan & Talbot 1983; Kaplan & Kaplan 1989; Ulrich et al. 1991; Lewis 1996; Kimbell et al. 2009²⁰⁰)
- increased productivity (Tennessen & Cimprich 1995; Kellert 2004²⁰¹)
- better moods (Maller et al. 2008²⁰²)
- improved motivation and self-esteem (Beatley 2009²⁰³).

For children in particular, interaction with nature results in:

- reduced incidence and severity of depression and attention disorders (Louv 2005, Kimbell et al. 2009²⁰⁴)

¹⁹⁵ Documents 438, 450 and 446

¹⁹⁶ Document 456

¹⁹⁷ Documents 458, 452 and 439

¹⁹⁸ Documents 440 and 447

¹⁹⁹ Document 450

²⁰⁰ Documents 443, 442, 459, 448 and 446

²⁰¹ Document 454 and 445

²⁰² Document 450

²⁰³ Document 436

- improved creativity, cognitive development and interpersonal skills (Louv 2005; Kimbell et al. 2009²⁰⁵)
- reduced incidence of obesity, diabetes and asthma (Corkery 2007²⁰⁶)
- increased attention span and improved academic achievement (Corkery 2007²⁰⁷).

Benefits to the broader community

The benefits of nature to the broader community are somewhat harder to define, simply due to the longer period over which benefits become apparent and the large populace in which changes occur. Natural settings are, however, theorised and in a smaller number of studies proven to benefit communities by:

- facilitating greater connection to and ownership of ‘place’ (Ryan 2006²⁰⁸)
- encouraging stewardship behaviour and resulting in greater support for conservation projects locally (Kals et al. 1999²⁰⁹) and generally (Miller 2006²¹⁰)
- providing a setting for community engagement (Maller et al. 2008²¹¹) and increasing interaction among neighbours (Chiesura 2004²¹²)
- promoting feelings of belonging (Turner et al. 2004; Kearney 2006; Townsend 2006²¹³)
- increasing neighbourhood satisfaction (Kearney 2006²¹⁴)
- improving perceptions of safety and reducing the number of ‘incivilities’ (Kuo & Sullivan 2006²¹⁵)
- reducing road rage and encouraging calmer driving experiences (Parsons et al. 1998²¹⁶).

²⁰⁴ Documents 449 and 446

²⁰⁵ Documents 449 and 446

²⁰⁶ Document 438

²⁰⁷ Document 438

²⁰⁸ Document 453

²⁰⁹ Document 441

²¹⁰ Document 451

²¹¹ Document 450

²¹² Document 437

²¹³ Documents 457, 444 and 455

²¹⁴ Document 444

²¹⁵ Document 447

²¹⁶ Document 464

References

- Agardy TS (1997) *Marine Protected Areas and Ocean Conservation*. Academic Press [Audit document 411]
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