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# Effectiveness of marine park management: a case study from New South Wales, Australia

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# EFFECTIVENESS OF MARINE PARK MANAGEMENT:

# A CASE STUDY FROM NEW SOUTH WALES, AUSTRALIA.

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## ABSTRACT

The effectiveness of marine park management in New South Wales (NSW), Australia, in achieving conservation and ecological sustainable use objectives was examined using three key determinants: 1) assessment of allowable activities put in practice to meet marine park and zoning objectives; 2) assessment of the effectiveness of marine park integration with fisheries management; and, 3) effectiveness of compliance to ensure that legislated plans and management strategies were enforced. The selection and planning of Marine Protected Areas (MPAs) in NSW was found to be consistent with international and national guidelines, and key commitments set at international, national and state levels of government had been fully or partially met. A quantitative gap analysis on ecosystem and habitat representation demonstrated that NSW was well advanced and in a strong position to achieve current 2020 Convention on Biological Diversity (CBD) MPA targets. A qualitative risk assessment of permitted activities in relation to zoning objectives indicated considerable variation between NSW MPAs, but more concerning was that multiple use zones might not be achieving their stated objectives, with several allowable activities being inconsistent with zoning objectives. Performance indicators to evaluate effectiveness of integration between MPA and fisheries management activities were developed and indicated that positive impacts had resulted from this partnership for the NSW case study. It was concluded that the partnership process could have been improved through formal arrangements being developed and with particular attention being given to community and stakeholder communication and engagement. Empirical evidence suggested that adopting manageability criteria for compliance during the design and planning of MPAs could lead to a marked increase in voluntary compliance. It was demonstrated that the majority of zones in the Port Stephens - Great Lakes Marine Park were relatively effective in optimizing voluntary compliance. Analyses of compliance data from 2007-2013 indicated encouraging trends in compliance in NSW marine parks, with the MPA offence rate declining over this period, with the exception of the Jervis Bay Marine Park. Despite evidence that offenders were deterred from repeating offending, general deterrence for first time offenders remained an issue in all NSW marine parks. The current level of non-compliance is concluded to not being conducive in achieving anticipated conservation objectives of the marine park system. Overall, this study has provided solid guidance for future improvements in marine park management, in particular providing recommendations for improved zoning design, more effective compliance and improving integration between MPA and fisheries management.

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## CERTIFICATION

I, Andrew David Read, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Law, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Andrew David Read

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## PUBLICATIONS FROM THIS THESIS

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## GLOSSARY OF TERMS AND ABBREVIATIONS

**Australia and New Zealand Environment and Conservation Council (ANZECC) -** Former Council of Ministers responsible for the Environment from each Australian jurisdiction and New Zealand.

**Biological diversity** - is the term given to the variety of life on Earth and the natural patterns it forms. Biodiversity is shaped by natural processes (i.e. the food web) and includes all genetic differences within each species to the variety of ecosystems where living creatures interact with one another and with the air, water and soil.

**China - Australia Migratory Bird Agreement (CAMBA) -** A treaty between Australia and China to minimise harm to the major areas used by migratory birds which migrate between the two countries.

**Collaborative Australian Protected Area Database (CAPAD)** - contains information on all protected areas in Australia, including their IUCN management categories.

**Commonwealth Waters** - the waters between the limits of the Australian States and of the Northern Territory, three nautical miles seaward of the territorial sea baselines and the outer limits of the Australian EEZ, 200 nautical miles from the Australian baseline boundary.

**Compliance** - is the state of conformity with the law.

**Comprehensiveness, Adequacy and Representative (CAR)** - *Comprehensiveness* refers to the degree to which the areas encompasses the full range of marine biological and biophysical diversity, and includes a full range of habitats within and across bioregions. *Adequacy* refers to the capability of the areas to maintain biodiversity and ecological patterns and processes, given both natural and human-induced disturbances. *Representativeness* refers to the extent to which the areas selected sample known biological/biophysical diversity and other values.

**Convention on Biological Diversity** (**CBD**) - is a multilateral treaty. The Convention has three main goals: conservation of biological diversity; sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources. Its objective is to develop national strategies for the conservation and sustainable use of biological diversity. The CBD was opened for signature at the

Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993.

**Ecologically Sustainable Use** - is using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased (also see sustainable development).

**Ecosystem-based Fisheries Management (EBFM)** - is a holistic approach to fisheries management, that relates the impacts of the fishery on the wider ecosystem, including bycatch species, communities and habitats, as well as recognising human goals including the social economic and cultural aspects

**Enforcement -** is the set of actions that the government takes to correct or halt behaviour that fails to conform to the law.

**Exclusive Economic Zone** (**EEZ**) - The sea zone prescribed by the United Nations Convention on the Law of the Sea, over which a state has special rights regarding the exploration and use of marine resources, including energy production from water and wind (nominally out to 200 nautical miles from state baseline boundaries).

**Food and Agriculture Organization of the United Nations** (**FAO**) - Formed in 1945, FAO is an agency of the United Nations that leads international efforts to defeat hunger. FAO acts as a neutral forum to negotiate agreements and international polices.

**Interim Marine and Coastal Regionalisation of Australia (IMCRA) -** The Australian nationally agreed regional framework for planning resource use and biodiversity conservation, including establishing the NRSMPA. The framework adopts an ecosystem-scale (100s -1000s kilometres) classification of the Australian continental shelf, with 60 identified meso-scale shelf bioregions in Australian waters.

**International Union for the Conservation of Nature (IUCN)** - Founded in 1948 as the world's first global environmental organization, the IUCN is the leading authority on the environment and sustainable development. The IUCN has over 1,000 member organizations in 140 countries, including more than 200 government and 800 non-government organizations.

**Japan Australia Migratory Bird Agreement** (**JAMBA**) – A treaty between Australia and Japan to minimise harm to the major areas used by birds, which migrate between the two countries.

**Marine Protected Area (MPA)** - A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. Marine parks, marine reserves and aquatic reserves are terms used by various pieces of legislation as names for MPAs.

**National Representative System of Marine Protected Areas (NRSMPA)** - The system of MPAs in Australia, aimed to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.

**New South Wales (NSW)** - An eastern State of Australia. The capital of NSW is Sydney.

**Ramsar Convention (RAMSAR)** - Named after the city of Ramsar in Iran where the International Convention was signed in 1971, the treaty provides for the conservation and sustainable utilization of wetlands recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.

**State waters** - The belt of coastal waters of Australia extending, at most, to three nautical miles from the baseline (usually the mean low-water mark) and including internal waters of that State.

**Sustainable development** - The pattern of resource use that aims to meet human needs while preserving the environment, ensuring that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

**United Nations, Educational, scientific and Cultural Organisation (UNESCO)** Established soon after WWII, UNESCO's mission is to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information.

**United Nations Environment Program (UNEP)** - Founded in 1972, UNEP is an agency of the United Nations that coordinates its environmental activities, assisting developing countries in implementing environmentally sound policies and practices.

**World Commission on Protected Areas** (WCPA) - One of six commissions of the IUCN. WCPA is the world's principle network of protected area expertise and is administered by the IUCN's Programme on Protected Areas.

**World Conservation Monitoring Centre** (**UNEP-WCMC**) - An executive agency of the United Nations Environment Programme. UNEP-WCMC has been part of UNEP since 2000.

**World Wildlife Fund (WWF)** - Founded on 29 April 1961, the WWF is an international non-governmental organization with over five million members WWF works on issues regarding the conservation, research and restoration of the environment.

# 1 INTRODUCTION

## 1.1 Research Context

Marine and coastal biodiversity is increasingly being threatened throughout the world by a large range of factors, including nutrient pollution, over-exploitation of living resources, destructive harvesting techniques, land-based development, dredging and reclamation, sedimentation, introduction of alien species, conflicting and competing uses and human induced climate change (WWF, 2008; Center for Ocean Solutions, 2009). Pressures on biodiversity and ecological sustainability are unrelenting as the world's population continues to grow and require resources to feed and support growing economies (Center for Ocean Solutions, 2009) In many regions of the world, there exists genuine political and community concern for marine biodiversity conservation aimed at reducing these environmental impacts and ensuring human use of marine resources is ecologically sustainable (Kelleher et al., 1995; Leadbitter et al., 1999).

Establishment of Marine Protected Areas (MPAs) is considered as the primary internationally agreed mechanism to achieve global marine biodiversity conservation and to provide lasting protection of critical areas and exploited species, and safeguarding against uncertain resource management outcomes (Wood et al., 2008). International efforts have been resolute in respect to establishing a global system of MPAs and target levels and timeframes have been agreed to progress national responses to marine biodiversity threats. Progress is considerably short of international goals[1], which has been compounded by changing political and community priorities, including responses to the 2007/8 Global Financial Crisis and the more recent conservation focus on climate change and greenhouse gas emission reduction.

As at July 2014, only about 2.2% of the world's oceans and 4.6% of Exclusive Economic Zones (approximately 3% of the global ocean) are protected in MPAs[2]

[1] Discussed in subsection 1.3 below.
[2] IUCN media release for IMPAC3 Conference, Marseille, France, 24 October 2013 states that the recent increase in coverage is due to the addition of large offshore MPAs, complementing smaller

(See Figure 1.1) (IUCN and UNEP-WCMC, 2012; United Nations, 2013). Of particular concern, however, is that it is considered that many MPAs might not be meeting conservation and sustainability objectives, due to poor governance, planning, management, compliance and integration within broader marine management systems (Baelde, 2005; Wood et al., 2008; Leverington et al., 2010)[3].

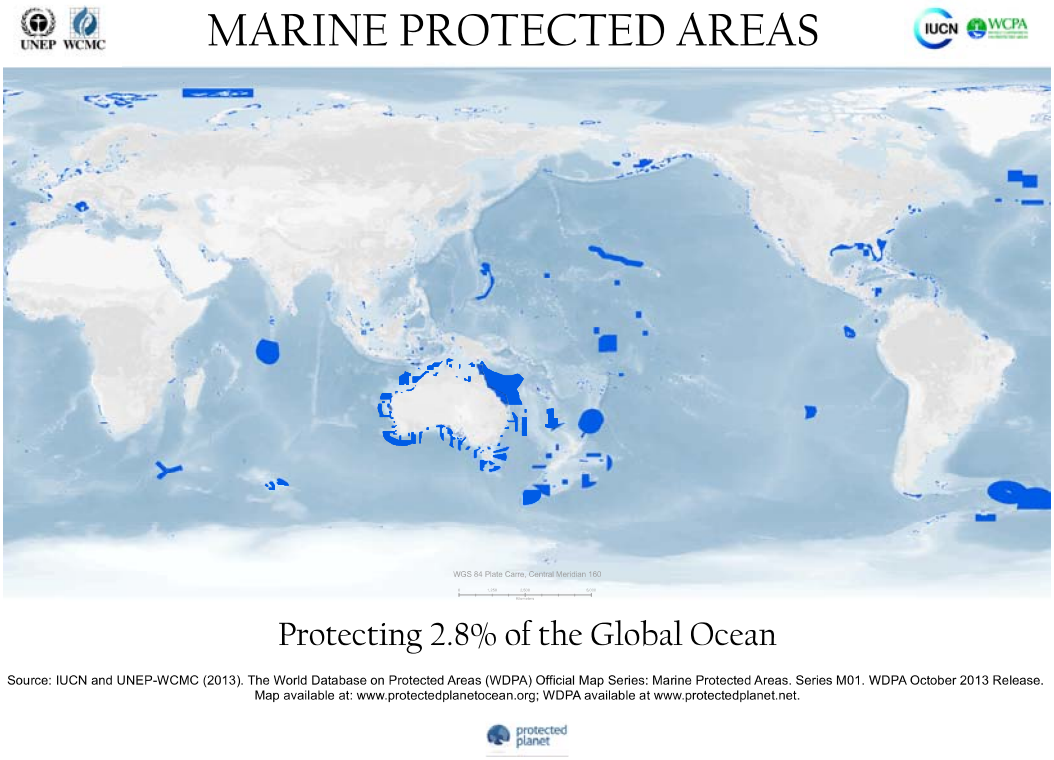


Figure 1.1 - Global MPA coverage as depicted by IUCN and UNEP-WCMC (2013), and the World Database on Protected Areas (WDPA) – (Note: figure is publicly available for replication and permission is not required for its use).

In this latter context, the research presented in this thesis has examined the effectiveness of the system of marine parks recently created in New South Wales (NSW), Australia, in meeting conservation and ecological sustainability objective. The current system of NSW marine parks was established to supplement and replace an out-dated system of fishing closures and MPAs that were not designed or

sites that exist in inshore waters of many countries. In particular, waters of Australia, France and West Africa. (See http://www.iucn.org/?13912/World-nearing-3-of-ocean-protection).

[3] Leverington et al. (2010) analysed approximately 8000 MPA assessments and concluded that 40% showed major deficiencies across many management effectiveness indicators.

managed for biodiversity conservation purposes (see Section 1.5, below). To assess the effectiveness of the current system of NSW marine parks, three key performance determinants have been examined throughout this research:

1) Assessment of allowable activities put in practice to meet marine park and zoning objectives;
2) Assessment of the effectiveness of marine park integration with fisheries management; and,
3) Effectiveness of compliance to ensure that legislated plans and management strategies were enforced.

The issues associated with comprehensive, adequacy and representativeness[4] of NSW MPAs were also broadly examined to provide the context of these requisites for effective management.

## 1.2 Types of Marine Protected Areas

The International Union for the Conservation of Nature (IUCN) definition of MPAs encompasses all protected areas types (terrestrial and marine), which are defined as:

*"A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values"(Day et al., 2012).*

The IUCN standard for categorising protected areas (which includes MPAs) includes six categories, which encompasses the full range of current protection regimes (see Table 1.1). These categories provide a global framework for classifying the variety of protected area types. The categories are explained in IUCN Guidelines for Protected Area Management Categories, first published in 1994, and updated in 2008. Within these six categories, Silva et al. (1986) identified over 90 variants, ranging from 'no-go' areas, which have very strict access rules, to areas with that are for general uses, with little restriction (Boersma and Parrish, 1999).

4 See p-25 for definitions of comprehensive, adequacy and representativeness.

Table 1.1 - IUCN Protected Area Categories (Dudley, 2008).

| IUCN Protected Area Category Type | | Main Purpose |
|---|---|---|
| **IA** | Strict Nature Reserve | Managed mainly for science. |
| **IB** | Wilderness Area | Managed mainly to protect wilderness qualities. |
| **II** | National Park | Managed mainly for ecosystem protection and recreation. |
| **III** | Natural Monument or Feature | Managed mainly for conservation of specific natural/cultural features. |
| **IV** | Habitat/Species Management Area | Managed mainly for conservation through management intervention. |
| **V** | Protected Landscape/ Seascape | Managed mainly for landscape/seascape conservation and recreation. |
| **VI** | Protected Area with sustainable use of natural resources | Managed mainly for the sustainable use of natural ecosystems. |

When considered in terms of objectives, however, it has been suggested that there are two basic types of MPAs that make up the majority of global MPAs (Kelleher, 1999): those with a broad strategic approach and those having a tactical site management approach. These two basic types are described below:

1) Broad Strategic MPAs. These are MPAs where a broad strategic approach to ecologically sustainable management and use has been adopted, which match the scale of regional ecosystems. These MPAs are generally large in scale and are zoned for 'multiple uses'. The United Nations, Educational, Scientific and Cultural Organisation (UNESCO) Biosphere Reserve Model[5] and The Great Barrier Reef Marine Park are iconic examples of this approach (Agardy, 1992); and,

2) Tactical MPAs. These MPAs have a tactical site management approach which addresses specific objectives for marine biodiversity preservation, research,

[5] The Man and Biosphere program was launched in 1971 with the aim of promoting interdisciplinary research, training, and communications in the field of ecosystem conservation and the rational use of natural resources through the establishment of biosphere reserves (UNESCO, 1984).

education and recreation, which are generally smaller in scale and have single conservation objectives (Kenchington and Agardy, 1990).

Kelleher and Kensington (1992) suggested that MPAs are established primarily as a result of two sectoral influences - either for fisheries management or for biodiversity conservation purposes. Globally, MPAs are routinely declared with the sole objective for a fisheries management outcome, such as: for the protection nursery areas, spawning sites and aggregation sites; protection of the biomass of targeted or key species (Gladstone, 2007); protection of habitat for species that are important to commercial or recreational fisheries and areas important for important temporal phases of targeted species' life cycles; protection of research and monitoring sites; and/or for fisheries resources allocation purposes (such as, Recreational Fishing Areas[6]). Conversely, MPAs declared for conservation goals aim to conserve biodiversity by protecting species (notably threatened and endangered species) and their habitats in a system of MPAs, often using habitat types as the framework (surrogates) for their identification (ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, 1997). In this way, the MPA system, or MPA network, can represent all species and their trophic interactions and ultimately help achieve the goal of biodiversity conservation (WCPA/IUCN, 2007). Often, MPAs with conservation objectives utilise preservation, and recreational concepts of terrestrial reserves into the marine environment (Kelleher and Recchia, 1998).

This thesis focuses on the broad strategic type of MPAs, often referred to as 'multiple use' MPAs[7]. In creating these MPAs, governments not only aim to provide for conservation, but also cater for a wide range of sustainable uses. It has been argued that, by balancing conservation and sustainable use in a broad strategic framework (with more options to maximise), that the multiple goals of biodiversity conservation and ecologically sustainable use can be realised (Kelleher and Kenchington, 1991). A common feature of multiple use MPAs is that they generally apply a zoning scheme, which provides the spatial and temporal plan for allowable

[6] For example, the NSW Government introduced Recreational Fishing Havens in 2001. This management initiative changed the allocation of fisheries resources in many waterways between the recreational and commercial sectors (Steffe et al., 2005).

[7] For the purpose of this thesis, multiple use MPAs may include both oceanic and estuarine waters, but not freshwater systems.

uses that are considered ecologically sustainable, whilst ensuring the protection of inherent marine biodiversity values (Laffoley, 1995). Some multiple use MPAs also utilise zoning as a means of solving use conflicts between incompatible sectors and within sectors. For example, zoning areas for scuba diving and fishing sectors[8], and recreational and commercial uses in order to physically separate conflicting uses and users (Day, 2002; Lynch et al., 2004).

The overall design of multiple use MPAs depends on their governing objectives and the objectives of the zone types deployed. The design also depends on the broader objectives of the system of MPAs. These objectives influence the location, size and shape, zoning types, and the permitted activities within each zone. Of note, there is no universal model for MPA design. It follows that, if MPA objectives are not well defined, it is extremely problematic to identify and quantify progress to measure the overall effectiveness of the MPA (Kay and Alder, 1999). The significance of clear and unambiguous objectives is highlighted throughout the research presented in this thesis.

Arguably the most well known international example of the multiple use model 'in practice' is that used for the establishment of Biosphere Reserves under UNESCO's Man and Biosphere program[9]. This program aims to present living examples of humanity and the environment in harmony, under the notion that humans must live as one with the biosphere and not in isolation (Kenchington and Agardy, 1990). Biosphere reserves aim to achieve ecologically sustainable use in which human activity is specifically provided for and integral to its management. Biosphere reserves incorporate three zones to help achieve these objectives: 1) a 'core zone' that is strictly protected from any forms of extraction, and providing protection to critical, sensitive areas important to threatened species. Human use in core zones is consequently limited to activities that do not adversely affect the functioning of the ecosystem; 2) a 'buffer zone' that completely surrounds the core zone. This zone is a controlled area that allows for sustainable, but limited extractive uses; and 3) a 'transition zone' that completely surrounds buffer zones. These

[8] During the planning of the Jervis Bay Marine Park, NSW, a sanctuary zone and no anchoring zone option was included in the zoning plan to formalize a partition between fishers and scuba divers, both to resolve conflict and maximize positive environmental outcomes. See Lynch et al. (2004) for further reading.

[9] In 2010 there were 562 biosphere reserves in 109 countries (UNESCO MAB Secretariat, 2010) - see p-1.

transition areas are often referred to as areas of co-operation or periphery zones (Vernhes, 1989). Although the inner boundary is defined by the intersection with the buffer zone, the outer boundary is not required to be defined, and can be amorphous. The outer zones allow for multiple uses with an aim of integration the functions of the biosphere reserve with human activities and the landscape. Of particular note is that the biosphere concept places equal importance on all three zones being functional in order to meet their intended objectives, which is conceptually at odds with the community views on zones in multiple use marine parks (Dasmann, 1988; Bohnsack et al., 2004).

Biosphere Reserves contain at least one sample of an ecosystem that is typical of a biographic unit, with the size being large enough to ensure the sustainability of viable populations of the species of the ecosystems (Kenchington and Agardy, 1990). 'Marine Biosphere Reserves' are in many ways very similar to large-scale multiple use marine parks. Kenchington and Agardy (1990) suggest that the main difference is that the scale of the core areas to meet the Biosphere Program objectives for a marine ecosystem would need to be very large, and in the order of hundreds of square kilometres. They acknowledge however, that similar conservation objectives can be achieved using a series of relative smaller core areas, which is the case with in the Great Barrier Reef Marine Park (GBRMP) in Australia. Other examples include the Marawah Marine Biosphere Reserve in the Arabian Gulf, and the Seaflower Biosphere Reserve in the south-western Caribbean.

Probably the most well known multiple use MPA in the world and one of the largest, is the GBRMP. Declared in 1979, the 344,000 $km^2$ marine park applies seven zone types (i.e. Preservation Zone, Marine National Park Zone, Scientific Research Zone, Buffer Zone, Conservation Park Zone, Habitat Protection Zone, and General Use Zone), all of which are defined by legislation that details their respective objectives and associated permitted activities (Great Barrier Reef Marine Park Authority, 2002). Today, many multiple use marine parks are modelled on the GBRMP, which has a reputation for international best practice (Marine Parks Authority, 2001a; Douvere and Badman, 2012). However, a longstanding debate continues with marine use sectors about the pros and cons of multiple use verses no-take MPAs, specifically in respect to their effectiveness in delivering biodiversity conservation goals (Bohnsack et al., 2004; Lester and Halpern, 2008). These views

are further elaborated in later chapters of this thesis and highlight the need more rigorous, scientific review to determine if multiple use MPAs are effective at meeting their objectives.

## 1.3 Global Agreement on Marine Protected Areas

Biodiversity conservation and sustainable development are the guiding principles against which the ultimate achievements of MPAs are benchmarked. Internationally, both concepts have been developed and progressed under the auspices of the IUCN World Conservation Strategy (1980) and the World Commission on Environment and Development (United Nations World Commission on Environment and Development, 1987). MPAs received their first major international attention during an IUCN workshop on marine conservation in Tokyo in 1975. (IUCN WCPA, 2008). However, it took 13 years to manifest international endorsement, which happened in 1988 at the 17th session of the World Conservation IUCN General Assembly when a policy statement on MPAs was passed which called on member countries to initiate cooperative action between the public and all levels of government for the development of national systems of MPAs:

> "*To provide for the protection, restoration, wise use, understanding and enjoyment of the marine heritage of the world in perpetuity through the creation of a global, representative system of marine protected areas and through the management in accordance with the principles of the World Conservation Strategy of human activities that use or affect the marine environment"* - Resolution 17.38-2a IUCN General Assembly 1988 (International Union for Conservation of Nature and Natural Resources, 1988).

In 1990, at the 18th General Assembly of the IUCN, Australia articulated its international commitment to investigate and work towards the establishment of a national representative system of marine protected areas that would protect representative areas of biodiversity, while allowing appropriate uses and promoting public education. The adoption of a program for global action in all areas of

sustainable development[10], and the signing the Convention on Biological Diversity (CBD) at the Earth Summit in Rio de Janeiro in 1992, have become the anchor stones of international conservation and natural resource management and were pivotal steps in progressing international MPA adoption. These agreements created an international mandate for an agreed framework for global sustainable development and biodiversity conservation and required that member parties prepared national plans, strategies or programs for conservation and sustainable use (United Nations, 1987). A governing body of the CBD was established under Agenda 23 of the Convention, known as the Conference of the Parties (CoP), and was given the mandate to review the implementation of the Convention and consider and adopt protocols, as required.

The flow-on effect of these agreements was that other international organisations developed mutually supporting policies, for example, the Food and Agricultural Organisation (FAO) developed a Code of Conduct for Responsible Fisheries (FAO, 1995). Member countries of the Convention were also required to prepare national strategies to address sustainable development and biodiversity conservation. Australia, like many other countries, responded with a range of policies, legislation and practices, the most notable being the National Strategy for Ecologically Sustainable Development[11] and the National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996). The main purpose of this latter strategy was to give effect to the Convention on Biological Diversity and to 'nationalise' government cooperative efforts and responsibility for protecting Australia's biodiversity. It also set the policy framework for establishing a national comprehensive, adequate and representative system of MPAs. In 2005, the Jakarta Mandate on Marine and Coastal Biological Diversity, a program of action for implementing the CBD in relation to marine and coastal biodiversity, was agreed to by member states (DecisionVII/30). This program of work included time constrained targets for the global establishment and maintenance

[10] The program for global action in all areas of sustainable development is commonly referred to 'Agenda 21'.

[11] The National Strategy for Ecologically Sustainable Development was adopted by all Australian governments in 1992 and provides broad strategic framework and directions for governments to direct policy and decision-making, and facilitates a coordinated and co-operative approach to ecologically sustainable development.

of MPAs by 2012. Program elements of this decision included five operational objectives:

1. Establish and strengthen national and regional systems of MPAs integrated into a global network and as a contribution to globally agreed goals.
2. Enhance the conservation and sustainable use of biological diversity in marine areas beyond the limits of national jurisdiction.
3. Achieve effective management of existing MPAs.
4. Provide support for and facilitate monitoring of national and regional systems of MPAs.
5. Facilitate research and monitoring activities that reflect identified global knowledge gaps and priority information needs of MPA management (Convention of Biological Diversity, 2004).

In 2010, at CoP 10, the CBD adopted a revised Strategic Plan for Biodiversity 2011-2020, which included 20 targets, arranged under five strategic goals, known as the Aichi Biodiversity Targets[12]. The Strategic Plan is being used widely as the framework for a number of the biodiversity-related conventions at national levels[13]. Target 11 of the Aichi Biodiversity Targets relates directly to protected areas and aims for an effective global conservation of at least 10% of coastal and marine areas by 2020, through an ecologically representative and well-connected system of protected areas (Conference of Parties 10, 2010). The Strategic Plan notes that all targets are "*aspirations for achievement at the global level and a flexible framework for the establishment of national or regional targets*". The Aichi Biodiversity Targets supersede the objective set out in the 2004 Program of Work on Protected Areas decision, but do not supersede the 2002 Johannesburg Plan of Implementation commitments. The goals and targets are aspirations, and are to be used as a flexible framework for co-operating countries to establish their own national or regional targets. Parties are invited to set their own targets within this flexible framework, taking into account national needs and priorities, while also bearing in mind national

[12] Decision X/2 of the tenth meeting of the Conference of the Parties was held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, -Aichi is the location of where the decision was entered into by members.
[13] Australia reported on progress made in implementing the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets in its fifth national report in March 2014.

contributions to the achievement of the global targets. Not all countries necessarily need to develop a national target for each and every global target. For some countries, the global threshold set through certain targets may already have been achieved. Other targets may not be relevant in the country context. Neither the Johannesburg Plan of Implementation nor CBD targets are to be interpreted as requiring all or a certain amount of MPAs to be no-take, and can be assigned and managed in accordance with six different IUCN Protected Area Management categories (see Table 1.1).

CoP 11, held in India in 2012, invited the Parties to the CBD (Decision XI/24) to integrate national action plans for the work programme and to undertake major efforts, with appropriate support to achieve all elements of Aichi Target 11 to improve MPAs in areas within their jurisdiction (Secretariat of the Convention on Biological Diversity, 2013). Notably, member states are to attain those goals of the programme of work on protected areas that are lagging behind; to improve inter-agency and inter-sectoral coordination, especially for mainstreaming protected areas and biodiversity and integrating protected areas into wider land and seascapes (special consideration of integration as an essential element for effective management has been discussed in Chapter Four of this thesis); and strengthen recognition of and support for community-based approaches to conservation and sustainable use of biodiversity.

## 1.4 Australian National Representative System of Marine Protected Areas

IUCN protected area categories have been reflected in Australian Government legislation in the *Environment Protection and Biodiversity Conservation Act 1999 (Cth.)* and Regulations. Under these laws the proclamation of Commonwealth marine reserves must assign the reserve to an IUCN category and may also assign an IUCN category to any zones. In Australia, MPA identification, selection and zoning arrangements for MPAs are subject to decisions by Australian governments, both national and state, with respect to their jurisdictions and legislative frameworks. In the context of the 1992 Conference on Environment and Development Australian Commonwealth, State and Territory governments established a National Strategy for Ecologically Sustainable Development. This Strategy provided a strategic policy

framework for Australian governments to cooperatively implement the Rio Declaration on Environment and Development and Agenda 21 (agreed at the Rio Earth Summit). Work to implement objective 10/2 of the National Strategy for Ecologically Sustainable Development commenced in 1992 with the development of the interim marine bio-regionalisation of Australia (Interim Marine and Coastal Regionalisation for Australia Technical Group, 1998; Commonwealth of Australia, 2006). This early work provided the initial framework for the development of a Nationally Representative System of Marine Protected Areas (NRSMPA)[14].

The 1996 National Strategy for the Conservation of Australia's Biological Diversity (revised 2010) provides the framework for the implementation of Australia's obligations under BCD. The main goals of the Strategy are to protect biological diversity and to maintain ecological processes and systems (Commonwealth of Australia, 1996). The NRSMPA has become the focus of the national approach to the conservation of marine ecosystems, habitats and species forming part of an integrated strategy for marine conservation and management (Marine Protected Areas Working Group, 2007). The goal of the NRSMPA is:

> "*... to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels*" (Australian New Zealand Environment and Conservation Council Task Force on Marine Protected Areas, 1999).

The NRSMPA commitment was subsequently recognised in the 1998 Australia's Oceans Policy[15], which identified the NRSMPA as the foundation for regional marine planning (Reichelt and McEwan, 1999; Wescott, 2000). A National Taskforce for Marine Protected Areas (NTFMPA) was convened in 1992 by the Australian and New Zealand Ministerial Environment Council[16] (ANZEC),

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[14] IMCRA was updated in 2006 to become the Integrated Marine Coastal Regionalisation of Australia (IMCRA version 4.0). This version includes both meso-scale bioregions of inshore waters and provincial bioregions off-shelf waters.

[15] In 2005 Australia's Oceans Policy was superseded by marine bioregional planning under the *Environment Protection and Biodiversity Conservation Act 1999*.

[16] ANZEC later become ANZECC, incorporating Conservation in its mandate and in 2001 was renamed as the Environment Protection and Heritage Council (EPHC), and was remitted in 2011 upon the establishment of the Standing Council on Environment and Water.

consisting members from both fisheries and conservation agencies of Commonwealth, State and Territory governments. Its role was: to coordinate the development of policy and planning related to the establishment of the NRSMPA; to prepare guidelines to assist agencies in developing the NRSMPA; and to support stakeholders understand the national MPA process. Subsequently, the Working Group prepared Guidelines for Establishing the NRSMPA (ANZECC Task Force on Marine Protected Areas, 1998), which specifically dealt with key aspects of the establishment of MPAs, including the functions of the NRSMPA and criteria for identifying and selecting MPAs, and a Strategic Plan of Action for the National Representative System of Marine Protected Areas[17].

The NRSMPA is founded on three principles: Comprehensive, Adequate, and Representative (CAR), where:

Comprehensiveness refers to:

> "the degree to which the areas encompasses the full range of marine biological and biophysical diversity, and includes a full range of habitats within and across bioregions. Comprehensiveness applies at bioregion, ecosystem and habitat levels. To be comprehensive, the full range of ecosystems across the marine environment needs to be represented in the MPA system" (ANZECC Task Force on Marine Protected Areas, 1999b).

Adequacy refers to:

> *"the capability of the areas to maintain biodiversity and ecological patterns and processes, given both natural and human-induced disturbances. The areas will have the required level of reservation to ensure the ecological viability and integrity of species and communities. The adequacy of the areas will depend on the level of management, size and shape of MPA, potential threats and replication"* (ANZECC Task Force on Marine Protected Areas, 1999b).

*Representativeness* refers to:

> *"the extent to which the areas selected sample known biological/biophysical diversity and other values. Marine and estuarine areas that are selected will reflect the diversity of the marine ecosystems from which they are derived. Representativeness applies to finer scales than comprehensiveness by including*

[17] Author's experience as the NSW departmental representative on NTFMPA (1998 - 2007).

*communities and species. To be fully representative, MPAs need to be typical of their biodiversity, but should also take into account rare and vulnerable species"* (ANZECC Task Force on Marine Protected Areas, 1999b)[18].

As at June 2014, the NRSMPA covered an area of approximately 3,237,800 $km^2$ representing about 36.2% of Australian waters, excluding Antarctic waters (see Table 1.2). Major additions to the system in the last five years include: the establishment of 19 marine parks by the South Australian Government, covering approximately 27,000 $km^2$; the establishment of four marine parks by the Western Australian Government, covering approximately 16,000 $km^2$; and the establishment of 40 Commonwealth marine reserves, covering approximately 2.1 million $km^2$.

Table 1.2 - Australian Marine Protected Area coverage (CAPAD, 2012 data).

| **Jurisdiction** | **Marine Area ($km^2$)** | **Marine Protected Area ($km^2$)** | **Marine Protected Area (%)** |
|---|---|---|---|
| Commonwealth | 8,528,215 | 3,094,800 | 36.3 |
| Queensland | 121,994 | 88,900 | 72.9 |
| Western Australia | 115,740 | 18,600 | 16.1 |
| Northern Territory | 71,839 | 2,200 | 3.1 |
| South Australia | 60,032 | 27,100 | 45.1 |
| Tasmania | 22,357 | 1,600 | 7.2 |
| Victoria | 10,213 | 1,100 | 10.8 |
| New South Wales | 8,802 | 3,500 | 39.8 |
| **Australian waters** | **8,939,192** | **3,237,800** | **36.2%** |

NOTE: Area of Commonwealth waters is based on the Australian Maritime Boundaries dataset (AMB v2.0) and based on using a Perth 97 adjusted EEZ limit. Calculations exclude waters adjacent to the Australian Antarctic Territory.

[18] See Breen (2004), Figures 1.1 to 1.5 for more detailed information on CAR components.

## 1.5 NSW Marine Parks

The New South Wales (NSW) system of MPAs, in particular marine parks, is the focus of research in this thesis. NSW is generally considered to have established the first known MPA in the world, with the marine component of the Royal National Park[19] being declared in 1879, for the purposes of recreational use and habitat protection (Davis 2001). Nearly one hundred years on, the NSW Government declared its first dedicated MPA in 1980 under the *Fisheries and Oyster Farms Act 1935* – 'the Long Reef Aquatic Reserve'[20], for the purpose marine scientific research (Pollard, 1980). Currently, NSW has six marine parks (see Figure 1.2), 12 aquatic reserves[21] and 52 marine components of terrestrial reserves[22], collectively covering an area of approximately 36% of state waters (Department of the Environment, 2012).

The *NSW Marine Parks Act 1997* provides for the establishment of marine parks for the primary purpose of conserving marine biological diversity, maintaining ecological processes and, where consistent with this purpose, providing for ecologically sustainable use, and for public enjoyment, appreciation and understanding of marine parks[23]. The Act establishes a Marine Parks Authority, which consists of Fisheries and National Parks department heads and the head of the Premier's department as the Chair. This governance model was especially crafted by Parliament and the agencies to deal with and manage emerging conflicts over the allocation of resources between conservation and fisheries uses (NSW Parliament, 1997; Grey and O'Gorman, 1998). The Act also provides for the establishment of consultative mechanisms at both state and regional levels to advise the Authority and

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[19] The Royal National Park, located south of Sydney, at the time of declaration included bans on dredging and the removal of sand, rocks, and vegetation, and later prohibitions on the use of explosives, net fishing, and the commercial exploitation of oysters.

[20] In 1979 the NSW Parliament amended the *Fisheries and Oyster Farms Act 1935* specifically to create new powers for the Minister for Fisheries to declare Aquatic Reserves. Up until this time only temporary fishing closures could be made.

[21] Aquatic reserves are declared under the *NSW Fisheries Management Act 1994* for aquatic conservation and fisheries management purposes. Marine Parks are declared under the *NSW Marine Parks Act 1997* for biodiversity conservation purposes.

[22] Marine components of NSW terrestrial reserves are declared under the *National Parks and Wildlife Act 1974* for the conservation of natural and cultural heritage and the management of wildlife. These reserves do not provide for the protection of fish species; however, are deemed to be MPAs, and are not mentioned further in this thesis.

[23] Section 3, "Objects of Act", *NSW Marine Parks Act 1997*.

Government on marine park establishment, policy and management, in particular on zoning plans, operational plans, and the ecologically sustainable use of marine parks[24].

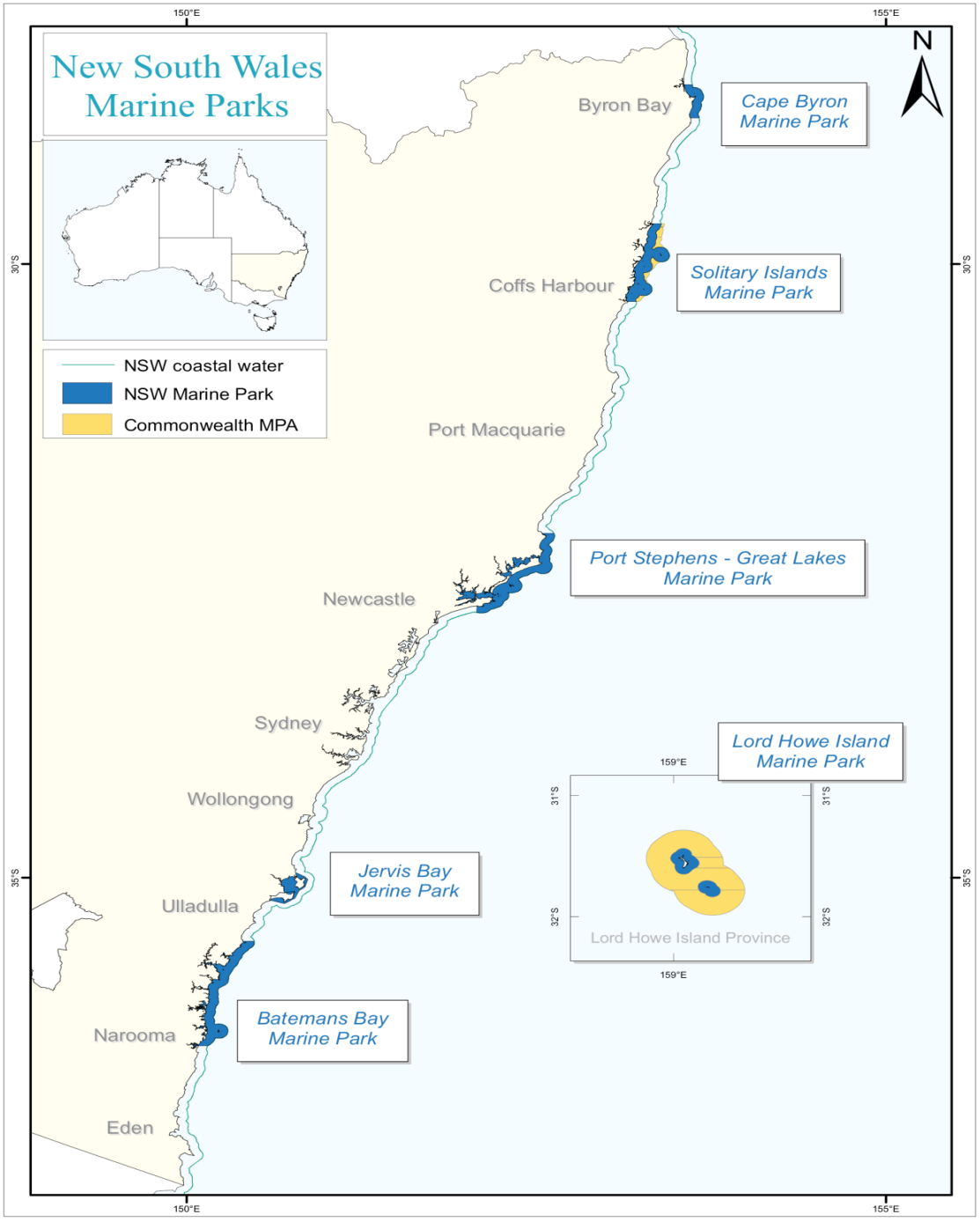


Figure 1.2 - Location of Marine Parks in NSW, Australia (source NSW Marine Parks Authority GIS database).

[24] The Marine Parks Advisory Council and marine park committees are established under Part 6, ss.32-33 of the *NSW Marine Parks Act 1997*.

Other provisions of the Act require the preparation of a zoning plan and an operational plan for each marine park. Zoning plans establish the types of activities that can be undertaken in different areas of a marine park. The NSW legislation was based on the *Great Barrier Reef Marine Parks Act 1975*, which at the time was considered to be one of the best governance arrangements in the world and a model for the establishment of multiple use marine parks (NSW Parliament, 1997; Day and Dobbs, 2013). The *NSW Marine Parks Act 1997* requires zoning and operational plans to be established for each marine park. A zoning plan is to have regard to the degree of potential impact that possible uses may have on differing species of plants, animals and habitats, as well as potential conflicts with other uses, and to provide for the spatial and temporal separation of these activities[25]. An operational plan is to identify and define the scheme of strategies, actions or activities that are proposed to be undertaken by the Authority (including arrangements with other agencies) to manage a marine park, consistent with the zoning plan for the marine park and the objects of the Act[26] (Marine Parks Authority, 2010b).

The Act provides for regulations to be made that may make provision for the management, protection and conservation of marine parks, and contains procedures for making, reviewing and amending zoning plans. The *Marine Parks Amendment Act 2008* established new provisions for the review and amendment of marine park zoning plans (with initial reviews to occur five years after zoning plan commencement and subsequent reviews to occur every ten years)[27]. The *Marine Parks Regulation 1999* provides for four zone types and lists activities that are permissible in these zones. It also provides for permitting provisions (including commercial and research activities). In 2009, the Regulation was separated into two instruments: the *Marine Parks Regulation 2009* and the *Marine Parks (Zoning Plans) Regulation 1999* to increase the duration of marine park zoning plans from five to ten years.

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[25] There are four zones under the *NSW Marine Parks Regulations 2000*: Sanctuary Zone, Habitat Protection Zone, General Use Zone and Special Purpose Zone. Sanctuary zones (or no take zones) prohibit all extractive activities. All zones are accessible for non-extractive use and transiting.

[26] Operational plans are only guiding instruments, to which marine park activities are strategically planned and delivered to meet the marine park's objectives.

[27] Almost immediately on commencement of the Act the Government declared the Solitary Islands Marine Park through repealing an aquatic reserve with the same boundaries; and declaration of Jervis Bay Marine Park, which had been earmarked as an aquatic reserve, with proposed boundaries exhibited for community consultation through this process.

The overall process of establishing a functional marine park in NSW can take many years. A marine park's outer boundary is declared first, but it involves no changes to existing uses until a zoning plan is established[28]. The zoning plan itself can take several years to complete, as it involves a series of statutory and non-statutory public consultation phases (Banks and Skilleter, 2010), including a public exhibition period of three months. The preparation of the operational plan follows the zoning plan and involves a similar lengthy process. Following a regulatory amendment in 2009, the development of the operational plan was assigned to local advisory committees[29]. The range of management actions included in recent operational plans (e.g. Batemans Marine Park) extend across the following strategies:

- Identification and adaptive management of threats to marine biodiversity and habitats;
- Protection of high conservation areas and threatened species;
- Assessing developments in and affecting the marine park to minimise impacts;
- Maximising voluntary compliance with the marine park zoning plan
- Ecologically sustainable management of commercial activities;
- Delivering an ecological, social and economic research and monitoring program;
- Promotion of sustainable tourism and recreational uses, as well as facilitation of a greater appreciation of marine biodiversity; and
- Ensuring management is consistent with the cultural aspirations of Aboriginal people (Marine Parks Authority, 2010a).

[28] This is in contrast to the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* where marine reserves are declared with both outer boundaries and zoning arrangements where activities are regulated upon declaration. Both models present pros and cons. For example, the capacity to comment on a marine park without zoning is problematic for fishers, whilst declaring a marine park before zoning is faster and less conflicting.

[29] The legislative process for preparing operational plans was initially laborious, as the process was based on the national park management planning process under the *NSW National Parks and Wildlife Act 1974*. The zoning plans were based on NSW Fisheries legislation. At the time of writing the legislation it is fair to say that the designers did not appreciate how the zoning plan and the operational plan worked together. It was much later understood that the operational plan acted more like a work plan and did not require regulatory rigor in the same manner as zoning, which actually regulated activities (personal experience).

## 1.6 Effectiveness of MPAs

In 2013, it was estimated that MPAs covered approximately 3% of the world's territorial seas, with few of the oceanic realms[30] having protection over 10% and only a small percentage of the 62 marine provinces having 10% or more coverage[31] (Spalding et al., 2007; Wood et al., 2008; IUCN and UNEP-WCMC, 2011). Despite renewed efforts by CoP 10 and CoP 11 to promote a global system of effectively managed MPAs, it has been estimated that it is likely to take many more decades to reach target commitments (Wood et al., 2008; Veitch et al., 2012). At CoP 11, the Australian Government reported that it had met and exceeded the Aichi 10% target, informing that 36% of waters were protected in MPAs (see Figure 1.3). At the provincial bioregion scale, all 41 marine provinces within Australian waters (with exception of Antarctic waters) are represented in MPAs, with coverage ranging from about two to 100% (mean 42%) (Department of the Environment, 2012). Despite Australia's MPA system being internationally ranked as the most significant in the world, a number of marine scientists and marine spatial analysts have expressed detailed and compelling arguments that Australian MPAs are not representative across its marine jurisdiction. In particular, they argue that the majority of the new Commonwealth marine reserves (declared in November 2012) are not fully representative, and that only a small proportion of the highest protection areas (IUCN I or II zones) occur in places where activities were potentially harmful to marine biodiversity (Barr and Possingham, 2013; Pressey et al., 2013). Putting aside this debate, there is also international concern that the number of MPAs and their zoning arrangements are not sufficient indicators for assessing effective marine conservation[32] (Agardy et al., 2003). There is also strong view that without effective management and assessment of effectiveness, MPA objectives will not be realised (Watson et al., 2003; Wood et al., 2008; Claudet and Guidetti, 2009; Joachim and Paolo, 2010; Leverington et al., 2010).

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[30] There are 12 oceanic realms, which represent the broad latitudinal divisions of polar, temperate, and tropical seas.

[31] Oceanic realms are sub-divided into marine provinces. There are 62 global scale marine provinces that are defined by the presence of distinct biota (fauna and flora of a region), which have at least some cohesion over evolutionary time frames. Marine provinces also hold some level of endemism, principally at the level of species, and include several marine ecosystems, which are areas of relatively homogeneous species composition and distinct from adjacent systems.

[32] Whether or not MPAs are meeting CAR principles in the context of MPA effectiveness in New South Wales, Australia, is discussed in detail in Chapter 2.

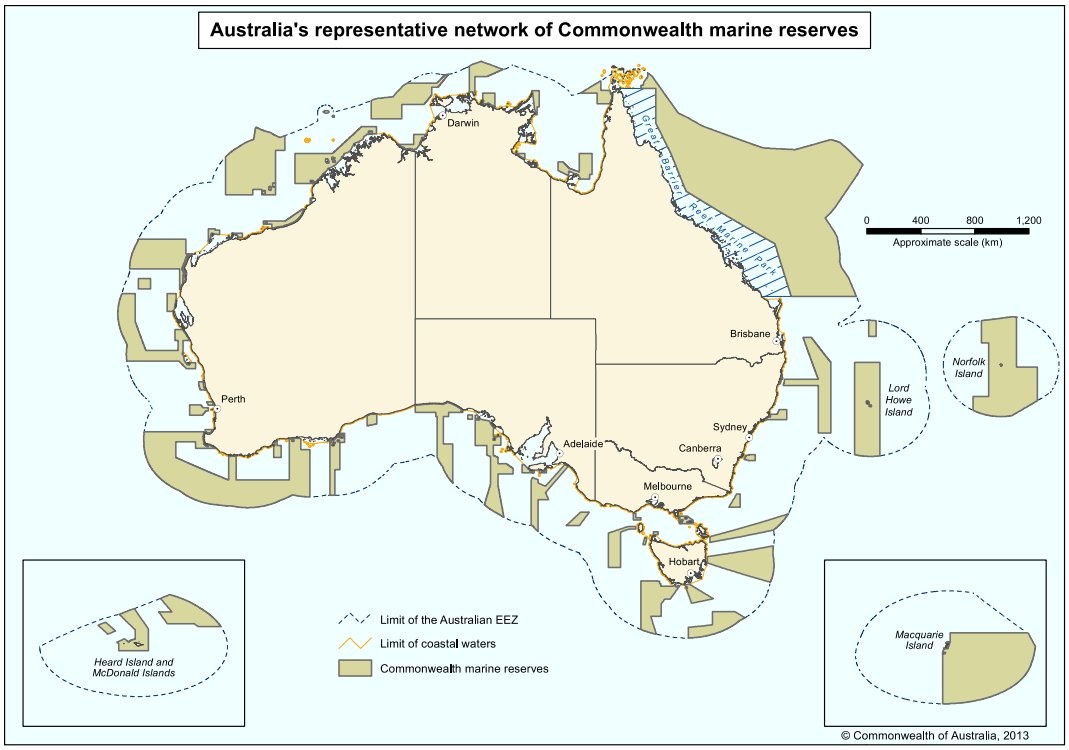


Figure 1.3 - Australia's Representative system of Commonwealth MPAs (Department of the Environment data, Dec 2014).

The ability of MPAs to achieve marine biodiversity conservation objectives is now more than ever before being challenged and questioned whether there better ways of achieving these objectives (Beeton et al., 2012).

In 2005 the WCPA commissioned a major initiative to promote evaluation of MPA management effectiveness, with an aim of designing a methodology for planning and conducting evaluations of MPA management effectiveness - to place a greater focus on management effectiveness (Watson et al., 2003; Pomeroy et al., 2005). Similarly, the World Bank developed a 'score card' to aid with assessing progress in achieving management effectiveness goals as a self-assessment tool for MPA agencies (Staub and Hatziolos, 2004). Also of note is that member nations have been actively encouraged by CoP resolutions to undertake their own assessments and develop appropriate guidelines to improve MPA effectiveness (Conference of Parties 10, 2010). A good example is the OSPAR Commission's guidelines for the assessment the effectiveness of management of MPAs in the northeast Atlantic (OSPAR Commission, 2003). Recently, the IUCN has sponsored a new framework for evaluating effectiveness of governance of protected areas (WWF International,

2007; Borrini-Feyerabend et al., 2013). These guidelines and associated criteria allow for the measurement the scientific, practical, socio-economic and legal performance of MPAs against their management objectives (Pomeroy et al., 2005; Himes, 2007b; Hockings and Giligan, 2009). The IUCN officially launched the "Green List of Well-Managed Protected Areas" at the IUCN World Parks Congress in Sydney, Australia in 2014. The Green List's objectives are to provide a benchmark for protected areas (both marine and terrestrial) progress towards effective and equitable management and rewarding innovation, excellence and enterprise. Protected areas on the IUCN Green List have to satisfy criteria thresholds (see text box below), including proving that: 1) objectives are being met; 2) boundaries are legally established, clear and secure (enforced); 3) management, policies and actions are fulfilling objectives; 4) governance, stakeholder relations and equity standards are being achieved; and 5) visitor management and tourism standards are met (IUCN, 2013). It has been suggested that some of the key advantages of inscription on the IUCN Green List will be an international standardisation of effectiveness evaluation and greater international recognition for the protected area, leading to increased political support, interest in quality tourism and stronger motivation among managers and other staff (Hardcastle, 2013).

Applied research on the effectiveness of MPAs has tended to apply fisheries effectiveness assessment techniques (such as harvest sustainability, economic and social benefits, and ecosystem function), with most MPA effectiveness research has tended to focus on no-take zones, with the aim of demonstrating the benefits of no-take controls in achieving biodiversity conservation objectives (Alder et al., 2002; Lester et al., 2009; Pajaro et al., 2010; Coleman et al., 2013). Consequently, there is a large body of research work on no-take zones, including optimal size requirements, taxa requirements, and optimal configuration and connectivity (Ballantine, 1995; Bohnsack et al., 2004; Weeks et al., 2009). Little attention, however, has been given to understanding the effectiveness of restricted or partially protected use zones, or managed use areas, which comprise the majority of multiple use MPAs (Read and West, 2010). Consequently, there are significant knowledge gaps for optimal selection and design of managed use areas, in particular around configuration of these zones in relation to distribution and structure of seafloor and pelagic habitats, and the activities types allowed in these zones to ensure protection of core areas, and

at the same time maximising use opportunities (Lester and Halpern, 2008; Rife et al., 2013).

**IUCN Green List Criteria**

1. Values stated, objectives declared and being met
   - Value and significance
   - Management planning
   - Conservation of nominated value

2. Protected area legally established, boundaries clear and secure
   - Protected area establishment
   - Enforcement of legislation and boundaries

3. Management capacity, policies and actions to achieve objectives
   - Management of resources and operations
   - Staffing
   - Information availability
   - Natural and cultural resource management

4. Governance, participation, equity and benefits fulfill standards
   - Governance
   - Stakeholder relations and communications
   - Community impacts and benefits

]5. Visitor management and communication meet standards
   - Visitor management and tourism

Determining the management effectiveness of a multiple use MPA (or a system of MPAs) in meeting their goals is a very complex task, and as explained, many indicators have been suggested and applied to aid this evaluation (Hockings et al., 2006; Ewers and Rodrigues, 2008; Edgar et al., 2014). The IUCN Green list has identified five key determinates, all of which are arguably critical for effective management. This study examines three of these determinants that are regularly considered as being fundamental to effective management[33] (Kelleher and

[33] Determinants of MPA outcome effectiveness also include size (100 $km^2$), age (>10 years), and isolation (buffer) of the reserve, but these are not necessarily management related (Edgar et al., 2014).

Kenchington, 1991; Kenchington et al., 2003; Jacobson et al., 2008; Muthiga, 2009; Leverington et al., 2010; Pajaro et al., 2010):

1) The establishment of MPAs and subsequent appropriateness of zoning must articulate and define their objectives of management and allow only those activities that are appropriate and consistent with those objectives (Sainsbury and Sumaila, 2001; Halpern and Warner, 2003; Stewart et al., 2007);
2) The establishment and management of MPA must be considered within the broader context of ecosystem-based management and be integrated in this process. In this regard, it is accepted that effective marine conservation can only be achieved by the creation of an integrated marine management, which considers all human activities and their impacts (Kelleher, 1999; Cicin-Sain and Belfiore, 2005); and
3) The establishment and management of MPAs must be supported by effective compliance[34]. It is universally recognised that effective compliance (education and enforcement) is fundamental in achieving MPA goals, and that poor compliance undermines potential biodiversity gains that may accrue through MPA establishment (Alder, 1996; Wood, 2004; Bergseth et al., 2013; Pierpaolo et al., 2013). Effective compliance requires robust legislation, governance, and resources, as well as, management planning provision for surveillance and monitoring to determine the extent to which users are adhering to the provisions of management (Sweeting et al., 2006; Miller et al., 2013).

## 1.7 Research Questions

The primary goal of this research was to explore the effectiveness of marine park management and, in particular, present a case study, which assessed the extent to

[34] Only recently has compliance featured in popular journals, and it is arguable that it is the least researched with respect to MPA management effectiveness (Bergseth et al., 2013). Recent studies have also demonstrated that levels of enforcement and ecological effectiveness of MPAs are often linked, with a positive relationship found between abundance and density of fish and invertebrates and the numbers of enforcement actions (Guidetti et al., 2008).

which the system of NSW Marine Parks met its objectives. As discussed above, measuring management performance of MPAs in meeting their stated goals is very complex. To measure this performance, my research has focussed on the three leading determinants: 1) the assessment of permitted activities and sustainability controls put in practice to meet marine park and multiple use zoning objectives; 2) assessment of the effectiveness of MPA integration within broader marine management, including inter- and intra-sectoral integration; and 3) analysis of the effectiveness of compliance strategies to ensure that legislated plans and management strategies are enforced. It follows that this thesis is structured to answer the following questions:

1) Is the system of NSW Marine Parks meeting international and national MPA establishment and management criteria and goals?
2) Are permitted activities in the system of NSW Marine Parks consistent with their zoning objectives and ecologically sustainability requirements?
3) Is the system of NSW Marine Parks integrated with broader marine management strategies?
4) Are the legislation, regulations and rules governing the use of NSW Marine Parks adequately and efficiently enforced?

These research questions have been addressed through a combination of qualitative and quantitative research methods, supported by the practical experience and knowledge of managers and researchers involved in the development and management of the NSW Marine Parks system.

## 1.8 Structure

Each chapter of this thesis addresses a component question of the research through case study examples and separate literature reviews. Chapter 2 provides the context of NSW Marine Parks in relation to international and national MPA agendas, and examines what is being done and if there are any gaps in the NSW MPA system to achieve current international and national expectations. The management effectiveness of a MPA is inextricably linked to its location and zoning arrangements. Specifically, this chapter examines the expectations relating to

meeting international and national establishment and 'management effectiveness' targets and discusses these commitments. Chapter 2 plays critical role in providing the broader picture for the case studies presented thereafter. For instance, where and how NSW Marine Parks are located and zoned is a determining factor in the achievement of voluntary compliance, which is discussed further in Chapter 5.

Chapters 3, 4, 5 and 6 collectively indicate whether or not NSW marine parks are achieving their stated conservation and ecological sustainability goals. Chapter Three studies key management aspects of permitted activities and their ecological sustainability in managed use zones. This chapter discusses whether permitted activities in NSW marine parks meet zoning and marine park objectives. The first consideration here is to determine what activities should be permitted in the various zone types. A published case study by the author (Read and West, 2010) is presented discussing permitted activities in NSW marine parks that uses risk assessment techniques to determine if permitted activities are appropriate in relation to zoning objectives. After determining that a permitted activity is appropriate within a zone type the next consideration is to determine if that activity is managed sustainably and what controls are in place to ensure such management. It follows that allowable capacity requirements and how these are implemented in NSW Marine Parks is examined in the context of potential effectiveness in meeting ecological sustainability objectives.

Chapter 4 explores the notion that for MPAs to be effective in achieving ecologically sustainability they need to be integrated with the management of neighbouring jurisdictions, in particular fisheries and coastal and land use management. This chapter presents research by the author (Read and West, 2014) that provides a method to assess the effectiveness of intersectoral integration between MPA and fisheries management agencies, and discusses what needs to be done to improve potential ecological sustainable outcomes through better integration of marine parks with fisheries.

Chapter 5 demonstrates that compliance planning during the zoning process is critically important in achieving optimal compliance. This research is based on information about the Port Stephens - Great Lakes Marine Park (PSGLMP), which is part of the NSW Marine Park system and, subsequently, published by the author (Read et al., 2011) A comprehensive list of compliance planning criteria for MPAs is

compiled and multi-criteria analysis is used to compare the perception of recreational fishers and compliance officers to manageability and voluntary compliance in the PSGLMP. Empirical evidence presented in this chapter shows the relationship between zoning and compliance.

Chapter 6 continues the discussion regarding compliance operations and requirements and outcomes of compliance delivery, in particular the checks and balances in achieving voluntary compliance on the ground.

Chapter 7 synthesises and concludes the thesis by connecting the outcomes of each chapter. This chapter provides an overview of the performance and adequacy of NSW marine parks in meeting their conservation and ecologically sustainability objectives. This is considered in respect to the assessment of allowable activities and multiple use zoning; the assessment of MPAs integration with fisheries management; and effective of compliance. This chapter also makes final recommendations that aim improve the management capability of meeting these MPA goals. This final chapter presents implications for evaluating the effectiveness of MPA management more generally, particularly in regard to establishing and managing multiple use MPA systems, and identifies future research directions arising from research in this thesis.

## 1.9 Scope

The underlying theme of this thesis is about the management effectiveness of multiple use marine parks in achieving their stated goals in NSW. The contribution of managed use zones, which are generally established for the primarily purpose for ecological sustainable use, is central to the discussion. Managed use zones aim to provide for existing uses, including fishing, provided that they are ecologically sustainable.

Although the location of reserves and zones is considered critical to the success of MPAs and is reviewed in Chapter 2, an analysis of the placement of zones or zone types to meet CAR objectives is outside the scope of this thesis[35]. A potential

[35] PhD work by H. Malcom illustrated the level of evaluation needed to assess representativeness at MPA level. H. Malcom found the location of the Solitary Islands Marine Park, NSW, was consistent with regionalization, but recommended that areas of deeper habitat should be included in IUCN

disadvantage of multiple use planning is that a zoning scheme may be ineffectively designed to achieve CAR objectives. The reasons for this are often the result of limitations in available biophysical knowledge. In Australia, it is more likely that the design is out-weighted by social and economic considerations, which ultimately results in political compromises being adopted (Wescott, 2006; Northcote and Macbeth, 2008; Banks and Skilleter, 2010; Barr and Possingham, 2013; Pressey et al., 2013). Although IUCN Category II zones (i.e. sanctuary zones and no-take zones) are mentioned throughout this thesis, they are not a particular focus. No consideration is given to the appropriateness or otherwise of percentage targets. Consistent with views expressed by UNESCO with Biosphere reserves (Vernhes, 1989), no attempt has been made in this thesis to weight these zones differently from partially protected zones, or to compare efficacies between zone types.

This study does not enter into discussion regarding the adequacy or effectiveness of community engagement (including Indigenous community) in the planning process or on-going management. It is recognised, however, that this is viewed as being critical for the success of MPAs and MPA networks worldwide[36] (see Criteria 4 and 5 of the IUCN Green list). MPA integration is examined in Chapter 4, but specifically in relation to fisheries management. It is recognised that integration across sectors is important. Of particular mention is academia and relevant government agencies in research and monitoring of MPAs. Broader discussion of building MPA networks and ensuring ecosystem connectivity with other MPAs is outside the scope of this thesis (IUCN-WCPA., 2008). There is little argument from the author's perspective that ecosystem connectivity is paramount for a system of MPAs to achieve its biodiversity conservation objectives; however, it is understood that the overall understanding of connectivity and how MPAs should be networked is data poor at local levels (Harrison et al., 2012). In regard to the NSW MPA network, a fruitful discussion on the effectiveness of their biological connectivity would be limited at best, and warrants separate dedicated research (Gladstone et al., 2003; Banks and Skilleter, 2010). NSW MPA integration with Catchment Management is not examined. However, it is referred to and a summary

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Category II zones (Malcolm et al., 2010).

[36] Recent PhD research by M.Voyer compared the social impact of the creation of MPAs in NSW, and is of interest in regard to the effectiveness of community engagement in MPA management (Voyer et al., 2012).

paper has been appended to the thesis (prepared by the author) for completeness and interest only (see Appendix 1).

The thesis includes limited discussion of legal governance, including general recommendations concerning legislative provisions and penalties (Chapter 3, 6 and 7). The legal framework supporting MPA establishment, planning, and stakeholder engagement is recognised as a universal prerequisite for MPAs. From a global perspective legal governance is arguably the number one MPA issue limiting effective management (Leverington et al., 2010). In the Australian context, however, it is the author's view that the legal framework, is relatively well advanced and is not a 'risk' factor affecting the effectiveness of MPA management.

# 2 STATUS OF NSW MARINE PARKS IN RELATION TO NATIONAL AND REGIONAL COMMITMENTS.

## 2.1 Introduction

Marine Protected Areas (MPAs) are widely recognised as being an essential part of the overall equation to protect marine biodiversity (Lester et al., 2009; Nursey-Bray, 2011; Harrison et al., 2012). Recently, significant progress has been made in establishing new MPAs and moving towards a global representative system of MPAs[37]. Over the last decade the coverage of MPAs has increased five-fold[38] (Jay et al., 2013; Spalding et al., 2013). In Australia, despite escalating cynicism about the utility of MPAs, by fishers and by some fisheries scientists[39], national polling figures indicate the vast majority (70%) of the Australian community support MPAs[40]. Bipartisan political support is also evident, with the major federal political parties supporting the establishment and maintenance of a National Representative System of MPAs (NRSMPA). Australia's maritime jurisdiction is divided into Commonwealth Waters (administered by the Australian Government) and State Waters (administered by state and territory governments). The establishment of MPAs has progressed largely separately, with each level of government having their own legislation, policies and strategies, but adopting similar principles based on Comprehensiveness, Adequacy and Representativeness (CAR), and therefore contributing towards the NRSMPA common goals (Marine Protected Areas Working Group, 2007; Department of the Environment, 2012).

With the introduction of the *NSW Marine Parks Act* in 1997 (see Chapter 1), the NSW Government made clear its intention "*to conserve marine biological diversity and marine habitats by declaring and providing for the management of a*

[37] Chapter 1 of this thesis includes specific reference to global and Australian coverage of MPAs.
[38] Spalding et al. (Spalding et al., 2013)(2013) notes that only a relatively small number of MPAs (20 out of 10,000) cover 60% of the global coverage, but also acknowledge MPA coverage is expanding across the globe and most jurisdictions (see p-229).
[39] A growing number of fisheries scientists suggest that there are better ways to protect the marine environment rather than establishing MPAs, and have raised concerns that MPAs are not dealing with the key risks of pollution and catchment impacts (Kearney et al., 2012).
[40] Reported in the Herald-Sun Newspaper, Sydney, on 2 August 2012.

*comprehensive system of marine parks*"[41]. In 2001, the NSW Government released its 'blueprint' for establishing a system of MPAs, consistent with the NRSMPA goals. The guiding principle of this strategy was to establish a representative system of MPAs that included the full range of marine biodiversity found at the ecosystem, habitat, and species levels within each bioregion in NSW estuarine and marine waters (Marine Parks Authority, 2001a). The strategy highlighted that appropriately located and designed marine parks were fundamental in meeting MPA objectives (Breen, 2007). Following the introduction of the strategy, three marine parks were declared, bringing the total number of marine parks to six, covering 36% of state waters (see Table 2.1).

This chapter presents quantitative and qualitative analyses of the NSW Government's progress towards establishing a representative system of MPAs that meet CAR principles (at ecosystem and habitat levels), and critically examines the extent to which the NSW Government has achieved its international and national MPA commitments and expectations. Understanding this context is essential in order to comprehend and appreciate the potential effectiveness of marine parks, which is considered in following chapters (Kelleher, 1999; Pressey et al., 2013; Rodolphe et al., 2014). After a brief history of the development of NSW MPAs (Section 2.2), the methodology and results of the analyses have been presented.

## 2.2 Evolution of NSW Marine Parks

### 2.2.1 Selection and declaration of marine parks in NSW

The NSW Government's 2001 Framework for a NSW Representative System of MPAs was underpinned by national planning principles and commitments, in particular the national Guidelines for Establishing the National Representative System of Marine Protected Areas, and CAR principles for identifying MPAs and zoning (Marine Parks Authority, 2001a). The Interim Marine and Coastal Regionalisation for Australia (IMCRA) was also adopted as the planning framework

[41] Object of the *NSW Marine Parks Act 1997* (s.3).

for determining MPA site identification within each bioregion[42]. Between 2001 and 2006 bioregional 'broad-scale' biodiversity assessments were conducted for all NSW coastal waters (except Lord Howe Island). These assessments included the Tweed-Moreton Bioregion (Avery, 2001), Manning Shelf Marine Bioregion (Breen et al., 2004), Hawkesbury Shelf Marine Bioregion (Breen et al., 2005) and Batemans Shelf and Twofold Shelf bioregions (Breen et al., 2006). The objective of these assessments was to map ecosystems and habitat types, as surrogates for biodiversity, to aid in MPA site identification. Five major estuary ecosystems and four ocean ecosystems (classified by depth) were mapped, along with nine habitat types. Habitat mapping involved plotting mangrove, seagrass, saltmarsh, sub-tidal sediment, beach, intertidal rocky shore, sub-tidal reef and islands at high resolution. Assessments were also supplemented with finer scale species data where available, such as kelp and coral locations (see Table 2.2). Breen (2004) applied irreplaceability analysis using C-Plan reserve selection software[43] and multiple criteria decision analysis[44] to identify candidate options for large multiple use marine parks, as well as other MPA types with important conservation values that might be included in the NSW system of MPAs.

[42] In respect to NSW state waters, the IMCRA report identifies five coastal bioregions and one marine province, namely; Tweed-Moreton, Manning Shelf, Hawkesbury Shelf, Batemans Shelf, Twofold Shelf bioregions; and the Lord Howe province (See Chapter 1).

[43] C-Plan software is a decision support tool that links with GIS to map options for achieving conservation targets (Pressey et al., 1997).

[44] Chapter 5 of this thesis applies multi-criteria analysis and provides a literature review on this methodology.

Table 2.1 - NSW marine park declaration, size and zoning plan commencement information.

| Marine Park | Bioregion | Date Declared | Date of Zoning Plan | Size (ha) | Sanctuary Zones (%) |
|---|---|---|---|---|---|
| Solitary Islands | Tweed Moreton | 1998 | 1/8/2002 | 71,500 | 12.5 |
| Jervis Bay | Batemans Shelf | 1998 | 1/10/2002 | 21,500 | 20 |
| Lord Howe Island | Lord Howe Province | 1999 | 1/12/2004 | 46,500 | 27.5 |
| Cape Byron | Tweed Moreton | 2002 | 1/5/2006 | 22,200 | 27.5 |
| Port Stephens - Great Lakes | Manning Shelf | 2005 | 21/4/2007 | 98,400 | 20 |
| Batemans | Batemans Shelf | 2006 | 30/6/2007 | 85,000 | 20 |

Table 2.2 - Classification for broad-scale mapping of biodiversity types (Marine Parks Authority, 2001a, 2008a, b).

| Ecosystem Types | Habitat Types | Community and Species Types |
|---|---|---|
| Brackish barrier lakes | Mangrove | Mud, sand, gravel, rock |
| Intermittent lagoons and creeks | Seagrass | Mangrove, seagrass and saltmarsh associations |
| Wave dominated barrier estuaries | Saltmarsh | Mud sand, gravel, rock |
| Tide dominated drowned valleys | Sub-tidal sediments (unconsolidated) | Mud, sand, and coarse sediments (gravel, rock) |
| Coastal embayments | Beach | Intermediate, reflective and dissipative beaches |
| Coastal 0 – 25m depth | Intertidal and Inshore reef | Rock platforms, boulders, cobbles, pools and crevices |
| Offshore 25 – 60m depth | Mid shelf reef | Barrens, kelp, coral |
| Shelf 60 – 200m depth | Offshore reef | Specific communities and species |
| Oceanic > 200m depth | | Specific communities and species |

Solitary Islands and Jervis Bay Marine Parks were declared under the *Marine Parks Act 1997* prior to bioregional assessments being undertaken. The representative values (ecosystem and habitats) of these marine parks and other MPA types were included in the bioregional assessment to identify MPA representation gaps. The declaration and zoning of Lord Howe Island Marine Park did not involve a bioregional assessment, as it was based on a previous aquatic reserve proposal under the *Fisheries Management Act 1994*, which had been withdrawn because of irreconcilable community concerns at the time. Nevertheless some priority mapping of Lord Howe Island was undertaken to support zoning selection as part of the management planning process. The Cape Byron Marine Park was declared following a dedicated site assessment of the Cape Bryon area (Avery, 2001). This assessment found that a number of ecosystems (e.g. estuaries) were under-represented within MPAs in the Tweed-Moreton Bioregion, and concluded that a marine park in the Cape Byron region would contribute to their comprehensive reservation[45]. The Cape Byron area was also known to support a relatively high population of spanner crabs, not observed elsewhere in NSW waters, and was considered significant from a fisheries management perspective. The Port Stephens - Great Lakes Marine Park[46] and Batemans Marine Park were the most recent marine parks to be declared, and are the only marine parks objectively identified using a broad-scale bioregional assessment as the basis for their selection (Breen et al., 2004; Breen et al., 2006). A summary of NSW marine park declaration information is provided in Table 2.1. The locations and extent of marine parks (and aquatic reserves) in each bioregion, from north to south, are shown in Figures 2.1 to 2.4 below.

### 2.2.2 Marine park zoning and review

In a similar way to the marine park selection process described above, planning zone boundaries also used habitat types as the main surrogate to represent biodiversity. Together with other biological, social and economic information, zoning is designed to meet zoning principles and criteria (Marine Parks Authority,

[45] The driver for the Cape Bryon assessment was a commitment by the Government during the tabling of the Marine Parks Bill 1997 to gain the NSW Greens Party support for the *Marine Parks Bill 1997* (NSW Parliament, 1997).

[46] The Port Stephens-Great Lakes Marine Park is the focus of attention in Chapter 5 of this thesis, where its planning history and management are explained in detail.

2001b). These zoning guidelines were prepared by the Authority and endorsed by the Marine Parks Advisory Council[47] and were adopted for all Marine Parks. Of particular note, these guidelines aim for each habitat type to be represented in sanctuary zones, but do not specify any target levels for these zones or priority for their location. These considerations are informed by CAR principles and community consultation. During the planning for the Port Stephens - Great Lakes Marine Park and Batemans Marine Park zoning plans the government decided to set targets of at least 20% for sanctuary zones, in a bid to be transparent and to progress a more focussed debate around the government's expectations (Marine Parks Authority, 2001c; Read, 2003).

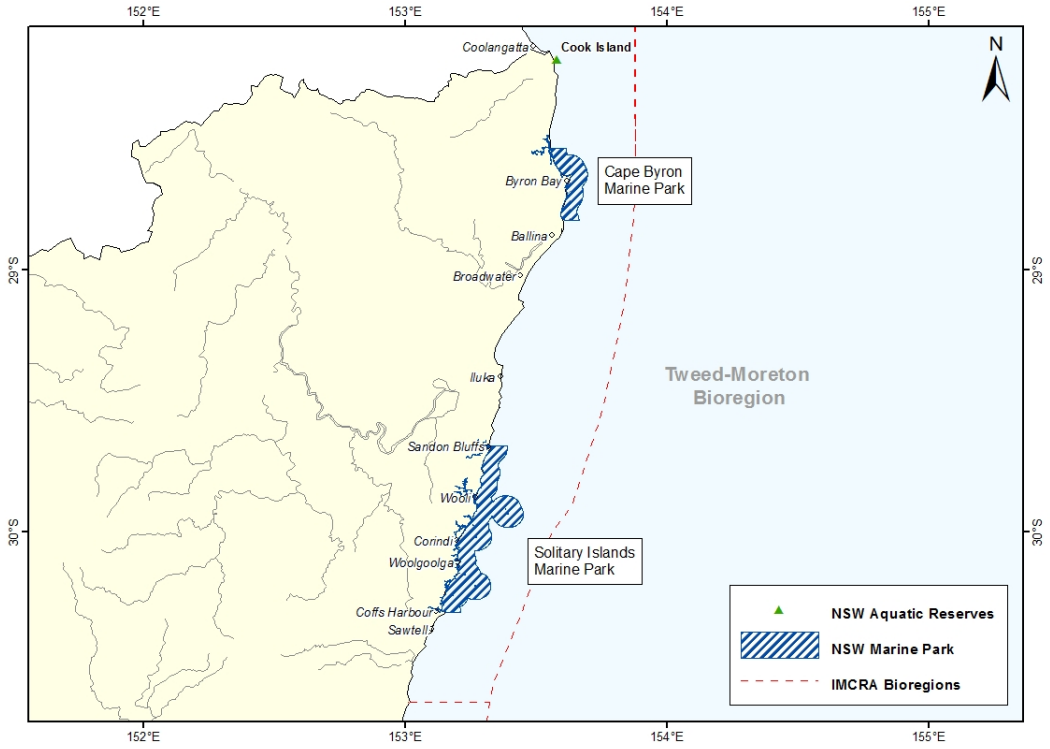


Figure 2.1 - Location of MPAs in NSW, Tweed-Moreton bioregion (Figures 2.1–2.4 are sourced from the NSW Marine Parks Authority GIS database, and drafted by Mr Phil Rofe for the purpose of this thesis)

[47] The Marine Parks Advisory Council is established under s.32 of the *NSW Marine Parks Act 1997* and consists of the Director-General of the Department of Primary Industries, the Director-General of the Department of Environment one member to represent the Commonwealth Government, and members representing the interests of marine conservation, marine science, Aboriginal people, tourism industry, commercial fishers, recreational fishers, and scuba divers. The Advisory Council can advise on any of the following matters from a state- wide perspective: proposals for marine parks, the conservation of marine biological diversity within marine parks, the ecologically sustainable use of marine parks, and the public use and enjoyment of marine parks. Currently, it appears that the Council is no longer operating and that the legislative provisions for its establishment and role are to be repealed.

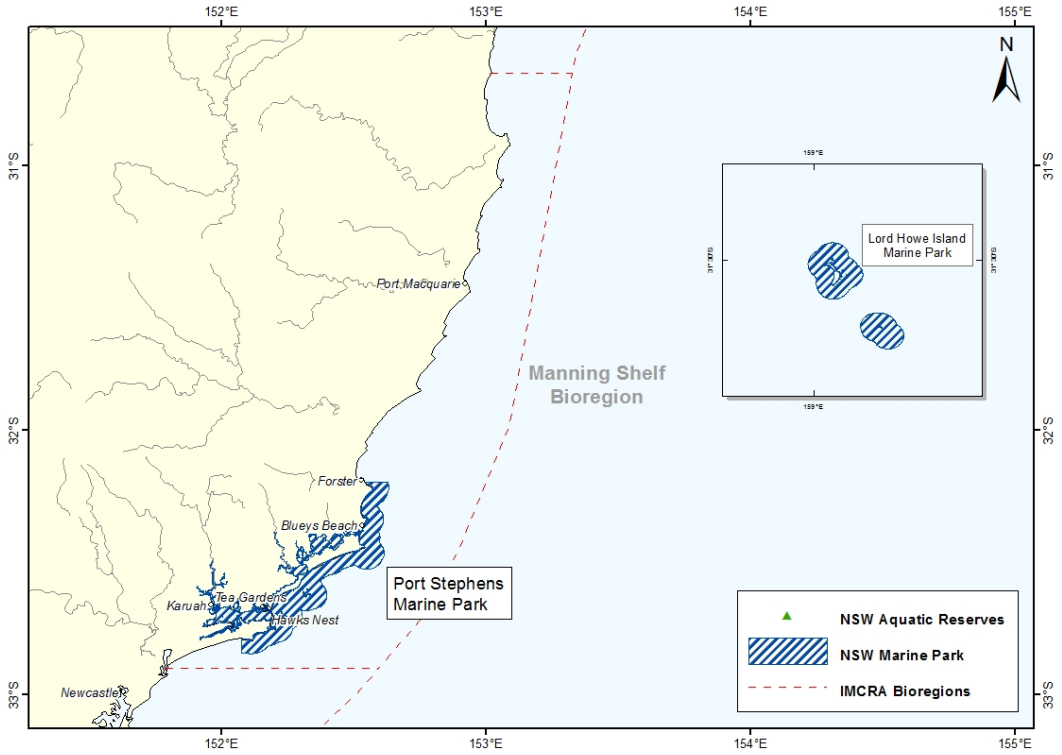


Figure 2.2 - Location of MPAs in NSW, Manning Shelf bioregion.

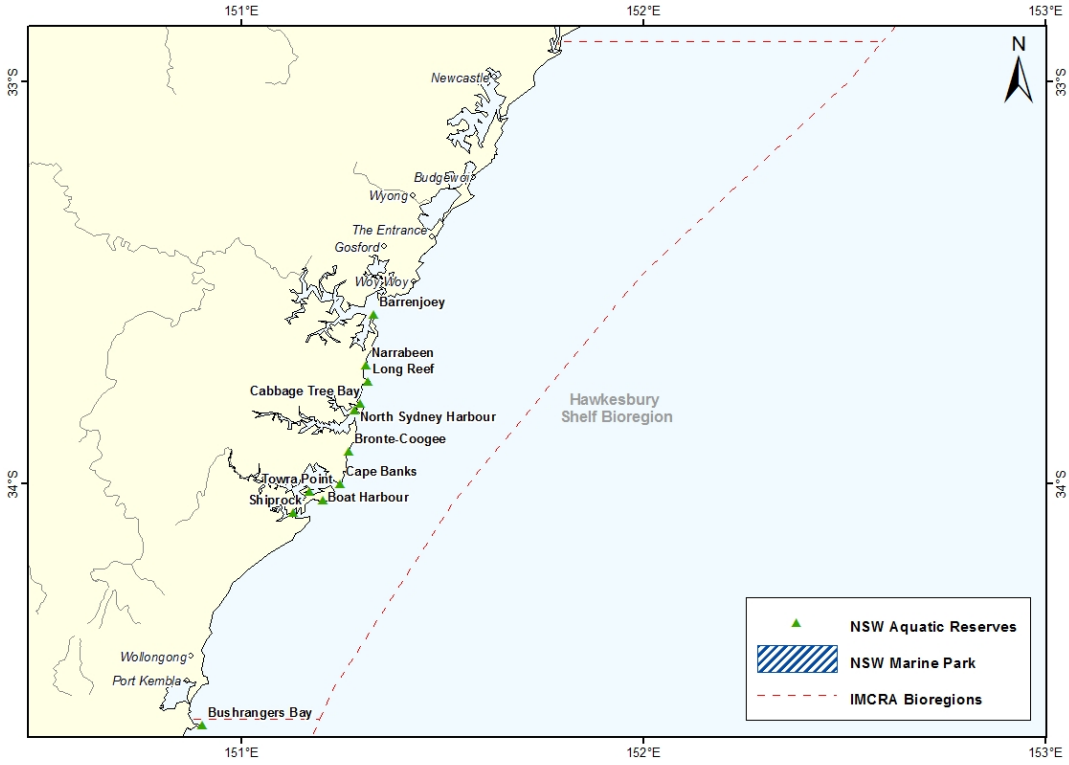


Figure 2.3 - Location of MPAs in NSW, Hawkesbury bioregion.

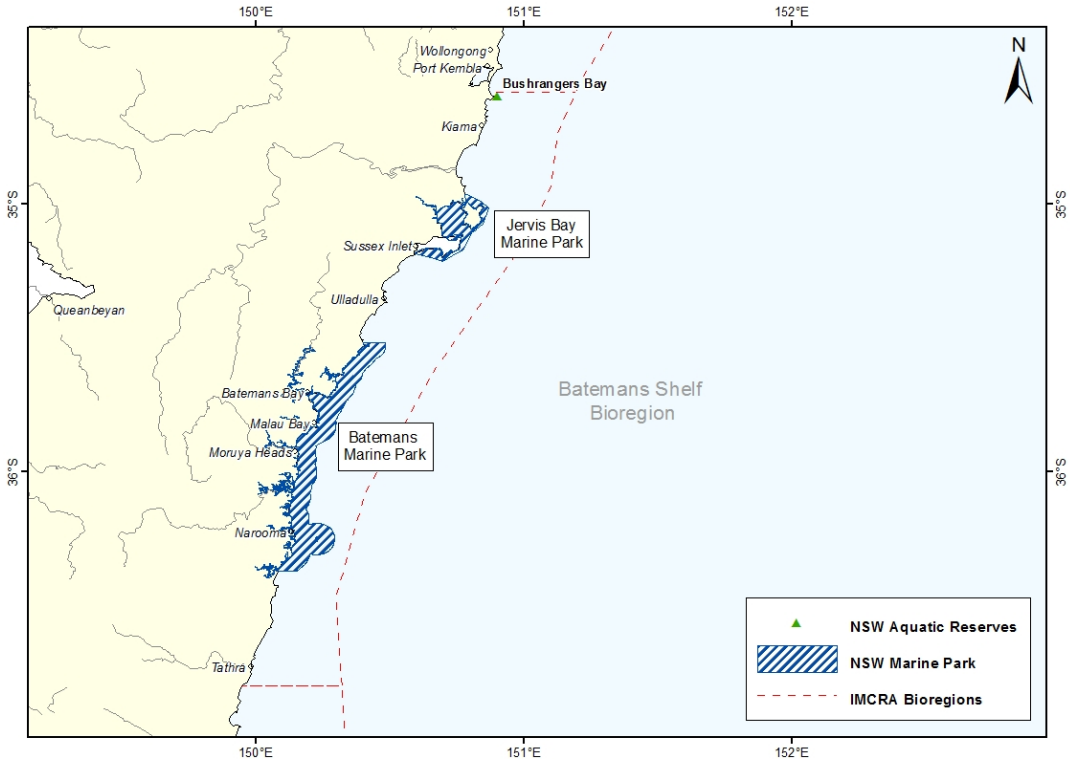


Figure 2.4 - Location of MPAs in NSW, Batemans Shelf bioregion.

During the zoning process, the classification of estuarine and ocean environments is used to represent finer-scales of physical and biological variation for marine park zoning purposes (Malcolm et al., 2012). Irreversibility analysis involving C-planning and Marxan software[48] was applied on one occasion only, as requested by the Cape Byron Marine Park Advisory Committee[49] in planning the Cape Byron Marine Park. No other NSW marine park planning process used these tools. Of interest, is the finding that the lack of early systematic planning using these type of planning tools has since been shown to lead to increased costs of meeting conservation targets and, in hindsight, perhaps should have been applied to other NSW marine parks to assist in zoning decisions (Malcolm et al., 2012). As part of the planning process for zoning within the Port Stephens-Great Lakes Marine Park, maps and overlays of potential sanctuary zones and other restrictive zones were used

[48] Marxan is the marine version of Spexan and developed under contract to the Great Barrier Reef Marine Park Authority and was a product of Ian R. Ball's PhD thesis. MARXAN is an acronym, fusing MARine, and SPEXAN, (i.e. SPatially EXplicit and Annealing).

[49] Advisory committees consist of local marine park stakeholders and are established for each marine park under s.35 the *NSW Marine Parks Act 1997*. They include the spectrum of key interest groups and community representatives, and advise on matters of local management relevance, in particular zoning planning and its implementation.

by stakeholders to meet the 20% target. The final product included advisory committee input and reflected a series of negotiated zones to meet both biodiversity and socio-economic objectives. A number of stakeholders considered this 'hands-on' approach to be more acceptable than the Cape Byron process, primarily because their socio-economic considerations were better integrated and factored into the decision-process[50]. There were, however, several prominent objectors who strongly criticized this process, and were opposed to a target approach for which they viewed had no scientific basis (Voyer et al., 2013b). This situation reflects a global MPA planning impasse, with the appropriateness of using MPA targets still being debated amongst marine sector groups (Agardy et al., 2003; Ainsworth et al., 2012; De Santo, 2013b).

As required under the *Marine Parks Act 1997*, statutory zoning reviews for the Solitary Islands and Jervis Bay Marine Parks were undertaken ten years after they were first implemented, in 2008 to 2009 (NSW Marine Parks Authority, 2009c, a). Revised zoning criteria were developed for these reviews, but were heavily based on the zoning guidelines initially used by the Authority. The public consultation process for the Solitary Islands Marine Park review found that that 87% of marine park users supported the marine park and 80% supported sanctuary zones (NSW Marine Parks Authority, 2009c). The review concluded that the zoning plan was generally appropriate for meeting the objects of the *Marine Parks Act 1997*, but made recommendations to improve the effectiveness of the zoning plan. These recommendations also included: delineating zoning boundaries for compliance purposes; and the creation of more sanctuary zones to represent offshore intermediate reef and deep soft sediment habitats[51]. Environmental monitoring since the commencement of the zoning plan had also revealed patterns of biodiversity and ecological processes within the marine park with cross-shelf linkages, suggesting that zoning integration would be beneficial for some sections of the marine park (Malcolm et al., 2010). The review of the Jervis Bay Marine Park zoning plan presented a similar situation to that of the Solitary Islands Marine Park, in that the zoning plan was generally appropriate for meeting the objects of the *Marine Parks*

[50] Personal communication between the author and commercial and recreational fishers during the Port-Stephens - Great Lakes Marine Park zone planning process.

[51] New information from seabed mapping since 2002 provided evidence that most marine and estuarine habitats in the marine park were represented in sanctuary zones; however, only 1.5% of the total mapped area of offshore intermediate reefs (25 to 60 m), 0% of deep reefs (deeper than 60 m) and 0% of deep soft-sediment habitats (deeper than 60 m) (NSW Marine Parks Authority, 2009c).

*Act 1997*, and that most habitats and ecosystems were represented in sanctuary zones. Of particular note, was the finding that research in the marine park leading up to the review had indicated an increase in abundance and diversity of species in shallow rocky reef sanctuary zones and recommended that the distribution of sanctuary zones in the marine park be maintained (NSW Marine Parks Authority, 2009a). Following acceptance of the review, new zoning plans were approved on 1 March 2011[52].

### 2.2.3 Recent developments

In May 2011 the new marine park plans were abolished by the newly elected Government, which had been extensively lobbied by fishing groups. Recreational fisher concerns were not specifically about these review processes, but more about the negative impacts marine parks had, in general, on regional economies and their recreational values (ABC News, 2011). The *Marine Parks Act 1997* was subsequently amended by a the *NSW Marine Park (Amendment) Moratorium Act 2011* to provide for a five-year moratorium on zoning plan reviews, zoning plan regulations and the establishment of new marine parks, in order to allow for an independent audit process to be undertaken and findings to be considered.

The NSW Government commissioned the Independent Scientific Audit of Marine Parks (the Audit) later in 2011. An Audit Panel (Panel) was assembled and given terms of reference that were broad and encompassing. Key elements of the Audit included: a review of the domestic and international commitments to conserving marine biodiversity; a review of the degree to which all threats to the varying types of marine environments have been properly identified and prioritised; a review of the specific science relating to the effectiveness of marine parks in protecting different habitat types. Recommendations from the Audit were requested

[52] Consistent with s.17C of the *Marine Parks Act 1997*, the relevant Ministers are to consider any submissions and any comments from the advisory committee for the marine park. Within three months after the date the zoning plan is referred the relevant Ministers are to submit a regulation to the Governor setting out the zoning plan for the marine park with such modifications, if any, as the relevant Ministers think fit, or refer the draft zoning plan back to the Authority for further consideration.

on any further action or alternative management approaches, if necessary; ways to increase the cost-effectiveness of marine park zoning arrangements; ways to improve inclusion of social and economic impacts into decision-making on marine parks, in particular the design and management of marine parks; ways to address the most significant information gaps hindering robust, evidence-based decision-making on marine parks; and how all current potential threats to the marine environment could be effectively addressed, and which bodies would be most appropriate to address them (Beeton et al., 2012). In respect to domestic and international commitments affecting NSW decisions towards conserving marine biodiversity, the Panel concluded in their report that:

> *"The objectives of the Convention on Biological Diversity were not internationally binding, being open to the policy settings of both national and state governments."* and "C*BD obligations did not prescribe implementation mechanisms, or metrics to measure the degree to which objectives were achieved, and that MPA targets were set in non-binding documents and declarations from the Conference of Parties and other international meetings, such as the IUCN World Parks Congress*"[53].

The Panel also concluded that NSW was obliged to do only what it agreed to do with the Australian Government, which is the Party to the international conventions and agreements covered by the *Environment Protection and Biodiversity Conservation Act 1999*" (Beeton et al., 2012). In this regard, their advice to the NSW Government was that NSW MPA arrangements posed "*no risk to the NSW Government that it would be found in breach of International conventions in regard to its management of marine parks*" (Beeton et al., 2012). With respect to national commitments, the Audit acknowledged the various national commitments associated with the protection of marine biodiversity and, in so doing, concluded that the present system of MPAs was contributing to Australia's commitment to the

[53] The International Union for Conservation of Nature (IUCN) World Parks Congress (WPC), is a global forum held every ten years, and sets the global agenda for protected areas. Since 1962 there has been five World Park Congresses. The WPC is organized on behalf of IUCN by the IUCN Global Protected Areas Programme and the IUCN's World Commission on Protected Areas (WCPA). The most recent WPC (WPC6) was held in Sydney, Australia, on 12-17 November. Over 6000 participants from over 170 countries met at the Congress.

establishment of an NRSMPA, and went "*a long way*" to meeting the ANZECC CAR system of MPAs. The Panel made the observation that the management of marine biodiversity and threats could be improved through "*whole of marine planning*"; however, also advised that the current system of MPAs be maintained, and mechanisms be found to enhance the protection of biodiversity gaps within the Hawkesbury and Twofold Shelf marine bioregions (Beeton et al., 2012). The Panel also noted an earlier independent review by Fairweather et al. (2009) concerning the NSW research strategy for marine parks, and that a similar conclusion had been made supporting the view that the system of MPAs generally represented the marine biodiversity of NSW. Of note, neither the audit nor the Fairweather review, reviewed whether the NSW MPA system was meeting CAR principles. This issue has been explored in the remainder of this Chapter. Another important observation in the Audit is that its deliberations did not refer or mention in the report the significant work by the NSW Marine Parks Authority in assessing the five mainland bioregions, or the Authority's policy documents for establishing the NSW system of marine parks and zoning marine parks. The absence of consideration by the Panel of these references is a significant oversight, as these documents provide the baselines for gauging NSW progress and commitments made by the NSW Government towards the NRSMPA goal. The review of NSW commitments below takes these important documents into account.

Most recently, the moratorium on NSW marine parks was partially lifted by the *NSW Marine Park (Amendment) Moratorium Act 2013,* which removed some of the restrictions put in place during the 2011 moratorium. These included lifting restrictions on the review of zoning plans for marine parks and the preparation of review reports; and the making of regulations under section 17B of the *NSW Marine Parks Act 1997*, which allows for new zoning plans to be prepared. The moratorium on the declaration of new marine parks was not removed; however, and will remain in place until further advice is received from the Marine Estate Management Authority[54] and Marine Estate Expert Knowledge Panel[55] (NSW Government, 2013).

[54] In 2013 the Marine Estate Management Authority (MEMA) replaced the Marine Parks Authority in response to Principal Recommendation A of the Report of the Independent Scientific Audit of Marine Parks in NSW. MEMA oversees the management of the entire NSW marine estate and is responsible to the Ministers for Fisheries and the Environment for setting out the strategic direction and priorities. MEMA has an independent chairperson and comprises the Chief Executive Officers for agencies,

## 2.3 Methods

### 2.3.1 Assessment of NSW MPA commitments and targets

Several analyses are necessary to determine and evaluate the progress made by the NSW Government in meeting international, national and its own commitments to establish a CAR system of MPAs. A review of relevant literature was undertaken to compile a comprehensive list of commitments by jurisdiction associated with MPA establishment. Principle information reviewed included: World Summit on Sustainable Development (WSSD) and Convention on Biological Diversity (CBD) and Conference of Parties (CoP) decisions, as well as the associated Program of Works; Australian national policies and strategies; and NSW MPA policies. The set of international, national and state commitments were collated and then assessed against NSW MPA delivery and outcomes, and evaluated as being 'achieved', 'partially completed' or 'not commenced'.

### 2.3.2 MPA gap analysis

A comparison of Australian state MPA coverage and relevant statistics was undertaken using the Collaborative Australian Protected Area Database[56] (CAPAD). This comparison is important to put the NSW position in perspective with respect to its progress against national commitments and other state positions. A systematic and quantitative gap analysis of progress of NSW MPAs in meeting CAR principles was undertaken using ecosystem and habitat coverage data. These surrogates for species biodiversity were quantified as a percentage or proportion of area of that type, from within the system of MPAs for each identified bioregion. This methodology is based on that applied by Breen et al. (2004; 2005; 2006; 2007) for the bioregional assessment reports for NSW. The results from this analysis are compared with the

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which have responsibility over the marine environment, including Trade and Investment, Regional Infrastructure and Services, Environment and Heritage, Planning and Infrastructure, Transport and the chairperson of the Marine Estate Expert Knowledge Panel.

[55] The Marine Estate Expert Knowledge Panel was established in response to Principal Recommendation B of the Report of the Independent Scientific Audit of Marine Parks in NSW in 2013. The Panel provides independent expert advice on economic, social and ecological sciences to the Marine Estate Management Authority.

[56] Every two years, the Australian Government collects information on protected areas from state and territory Governments, which is published in the Collaborative Australian Protected Area Database (CAPAD).

conclusions made by the NSW Independent Scientific Audit of Marine Parks (2012), which included a review of the domestic and international commitments to conserving marine biodiversity in NSW. In this regard, the Audit panel considered the current actions of the government for meeting these commitments, and the effectiveness of these actions (Beeton et al., 2012).

## 2.4 Results

### 2.4.1 Assessment of NSW MPA commitments

Ten international commitments were identified that specifically related to the establishment of MPAs and MPA networks in NSW. The majority of international commitments are associated with CBD and CoP decisions, and included in the CBD Programme of Works. A review of national commitments identified eight national level commitments specifically associated with MPA establishment and management. The assessment of relevant MPA commitments against targets indicates that NSW has achieved or has partially completed all international and national MPA commitments (Table 2.3). The NSW Government has articulated these national commitments principally through legislation and associated strategies. For example, the NSW *Marine Parks Act 1997* has a primary objective to conserve marine biological diversity and marine habitats "*by declaring and providing for the management of a comprehensive system of marine parks*"[57]. Policy commitments have also been expressed by the NSW Government in its "Framework for Establishing a System of MPAs", which articulates both guiding principles and several commitments to establish MPAs in NSW (Marine Parks Authority, 2001a). Over the past two decades, the NSW governments have steadily increased the area of state waters in MPAs. The current level of 39.5% of State waters within MPAs at 'face value' exceeds the CBD goals. In comparison with other Australian states and territories, NSW is ranked third in terms of per cent of water area included in MPAs (see Table 2.4).

[57] See *Marine Parks Act 1997* - Objects Part 1, s.3.

Table 2.3 - Assessment of Comprehensiveness, Adequacy and Representativeness (CAR) commitments relevant to NSW MPAs.

| Jurisdiction level | Commitment | Source | Target date | Nature of Commitment to NSW | NSW Outcome |
|---|---|---|---|---|---|
| International | Establish a system of protected areas where special measures need to be taken to conserve biological diversity. | CBD article 8(a). | N/A | Legally binding to Australia and its governments. | Achieved. NSW has established a system of MPAs, consistent with the CBD Article 8(a). |
| International | Establish time-bound and measurable (e.g. numerical) national/regional MPA targets and indicators (A1.1). | CBD Program of Work. | 2006 | Subject to national policy (date superseded). | Achieved. Australian governments agreed to establish a NRSMPA by 2012. |
| International | Carry out national and regional gap analyses to identify new MPAs needed to complete an ecologically - representative MPA system (A1.1.5). | CBD Program of Work. | 2006 | Subject to national policy (date superseded). | Achieved. NSW completed five bioregional analyses from 2001-2006, supported by National funding. |
| International | Take action to protect the most urgent sites; including large intact or irreplaceable natural areas, areas under high threat, centres for endangered species and marine and freshwater ecosystems (A1.1.2 &1.1.3). | CBD Program of Work. | 2006 | Subject to national policy (date superseded). | Achieved. NSW declared aquatic reserves or provided zoning critical habitat for Grey nurse shark and critical habitat for other sensitive species, inkling coral communities (in early 2000). |
| International | Designate MPAs identified in the gap analysis. | CBD Program of Work. | 2009 | Subject state approach (date superseded). | Partially completed. Habitat (representation) gaps in two bioregions exist, with some minor (adequacy) gaps remaining in one other bioregion. |
| International | Evaluate options for new governance systems and integration of MPAs into broader seascapes and implement practical steps to increase integration such as ecological corridors, buffer | CBD Program of Work. | 2008 | Subject state approach (date superseded). | Partially completed. NSW reviewed its governance arrangements in 1997 to bring together fisheries and national |

| | | | | | |
|---|---|---|---|---|---|
| | zones and restoration by 2008 (A1.1.4 & 1.2.1 to 1.2.5). | | | | park agencies. In 2013 it announced the establishment of the Marine Estate. Management Authority, which integrates maritime planning and transport agencies (NSW Marine Estate Management Authority, 2013). |
| International | Complete establishment of MPAs (A1.1.6). | CBD Program of Work. | 2012 | Subject to national and state policy (date superseded). | Achieved. NSW has established a system of MPAs, consistent with the CBD Article 8(a), however some habitat gaps in representation or adequacy remain. |
| International | At least 10% of each of the world's ecological regions effectively conserved. | BCD CoP VII decision. | 2012 | Subject to national policy (Superseded with new date 2020). | Achieved, NSW has 39.5% of state waters represented by MPAs (including 7.5% in IUCN Cat. II protected zones). |
| International | Areas of particular importance to biodiversity protected. | BCD CoP VII decision. | 2012 | Subject to national and state policy (Superseded with new date 2020). | Achieved. NSW declared aquatic reserves or provided zoning critical habitat for Grey nurse shark and critical habitat for other sensitive species, inkling coral communities (in early 2000). |
| International | Protected areas and protected area systems integrated into the wider seascape, and relevant sectors, by applying the ecosystem approach and taking into account ecological connectivity and the concept, where appropriate, of ecological networks. | CBD Program of Work | 2015 | Subject to national and state policy (Superseded with new date 2020). | Partially completed. |
| National | Establish across the nation a comprehensive system of protected areas, which includes representative samples of all major ecosystems, both terrestrial and marine; manage the overall | NSESD 1992, NBCS 2010-2020, IGAE. | N/A | Highest level Federal and State policy commitment. | Achieved. NSW has established a system of MPAs, consistent with these strategies. Major ecosystems |

| | | | | | |
|---|---|---|---|---|---|
| | impacts of human use on protected areas; and restore habitats and ameliorate existing impacts such that nature conservation values are maintained and enhanced. | | | | at the state level are represented by MPAs; however, some habitat gaps in representation low level of adequacy remain. |
| National | Nationally increase of 600,000 $km^2$ of native habitat managed primarily for biodiversity conservation across terrestrial, aquatic and marine environments. | NBCS 2010-20. | 2015 | The National Biodiversity Conservation Strategy (NBCS) 2010-2020 is a high-level policy commitment agreed to by Council of Australian Governments. | Not commenced. This indicates that across the nation there will be measurable increases in MPA coverage at state level. |
| National | 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider seascapes[58]. | NBCS 2011-2020 | 2020 | High-level policy commitment agreed to by Council of Australian Governments. | Partially completed. NSW has 39.5% of state waters represented by MPAs (including 7.5% in Cat II protected zones). Further MPA establishment is required to fill gaps in the system and to understand MPA connectivity. |
| National | Establish and manage a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels. | National Guidelines for Establishing the National Representative System of Marine Protected Areas, 1998. | N/A | Policy. Agreed to by ANZECC Ministers. | Achieved. NSW has established a system of MPAs, consistent with the CBD Article 8(a), however some habitat gaps in representation or adequacy remain. |

[58] Convention on Biological Diversity targets are not to be interpreted as requiring all or a certain amount of MPAs to be no-take zones (Coad et al., 2008).

| | | | | | |
|---|---|---|---|---|---|
| National | The NRSMPA will include the full range of ecosystems recognised at an appropriate scale within and across each bioregion. | National Guidelines for Establishing the National Representative System of Marine Protected Areas, 1998. | N/A | Policy. Agreed to by ANZECC Ministers. | Partially completed. Further MPA establishment is required to fill gaps. |
| National | The NRSMPA will have the required level of reservation to ensure the ecological viability and integrity of populations, species and communities. | National Guidelines for Establishing the National Representative System of Marine Protected Areas, 1998. | N/A | Policy. Agreed to by ANZECC Ministers. | Partially completed. Further MPA establishment is required to fill gaps and address adequacy of existing representation. |
| National | MPAs should reasonably reflect the biotic diversity of the marine ecosystems from which they derive. | National Guidelines for Establishing the National Representative System of Marine Protected Areas, 1998. | N/A | Agreed to by ANZECC Ministers. | Achieved. This principal has been adopted for the majority of new MPAs. |
| National | The NRSMPA will aim to include some highly protected areas (IUCN Categories I and II) in each bioregion. | National Guidelines for Establishing the National Representative System of Marine Protected Areas, 1998. | N/A | Policy Agreed to by ANZECC Ministers. | Achieved. This principal has been adopted for the majority of new MPAs and is included in zoning principles. |
| State | To declare and provide for the management of a comprehensive system of marine parks. | *NSW Marine Parks Act 1997.* | N/A | Statute Law | Partially completed. NSW has established a system of MPAs, however, it is not comprehensive and some ecosystem and habitat gaps remain. |
| State | Commitment to international strategies and conventions, to contribute to the establishment of the NRSMPA. | Framework for Establishing a Representative System of MPAs in NSW. | N/A | State government policy (through MPA public process). | Achieved. This commitment has been achieved for the majority of MPAs and is included in zoning principles. There are some inconsistencies with uses in zone types, including recent decision to allow recreational fishing IUCN Cat II zones. |

| | | | | | |
|---|---|---|---|---|---|
| State | National 'Guidelines for Establishing the National Representative System of Marine Protected Areas, and national definitions of CAR), used as principles for identifying MPAs and zoning. | Framework for Establishing a Representative System of MPAs in NSW. | N/A | State government policy (through MPA public process). | Achieved. In declaring MPAs NSW has placed a high focus on National guidelines for the selection and declaration of MPAs. |
| State | Adoption of the IMCRA as general planning framework and basis for determining representativeness within each bioregion. | Framework for Establishing a Representative System of MPAs in NSW. | N/A | State government policy (through MPA public process). | Achieved. NSW completed five bioregional analyses from 2001-2006 and subsequently declared and zoned several marine parks. |
| State | Use of surrogate indicators for reporting representativeness at a national level and appropriate indicators for monitoring of MPAs. | Framework for Establishing a Representative System of MPAs in NSW. | N/A | State government policy (through MPA public process). | Achieved. NSW provides national data on marine parks, and has invested in habitat mapping in all marine parks for representativeness review. Recent work has expanded surrogate knowledge in SIMP (Malcolm et al., 2010). |
| State | Represent each bioregion with at least one large marine park, declared under the Marine Parks Act 1997, that are representative of ecosystems and habitats found in the bioregion, and a target to achieve this by 2010. | Framework for Establishing a Representative System of MPAs in NSW. | 2010 | State government policy (through MPA public process). | Partially completed. Hawkesbury and Two-fold bioregions are not represented by a marine park declaration. |
| State | Represent the full range of ecosystems and habitats that occur in the marine park in sanctuary zones. | NSW MPA Zoning Guidelines. | N/A | MPA planning Guideline (Supported by Marine Parks Advisory Council). | Achieved. On average marine parks in NSW include 20% sanctuary zoning, representing all surrogates habitat types. SIMP review indicated a gap in depth water habitat representation, however (NSW Marine Parks Authority, 2009c). |
| State | Ensure that sanctuary zones have the capability to maintain biodiversity and ecological patterns and processes over time. | NSW MPA Zoning Guidelines. | N/A | MPA planning Guideline (Supported by | Partially completed. Several sanctuaries do not have the capacity to maintain |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Marine Parks Advisory Council). | biodiversity and ecological patterns and processes over time (Read et al., 2011). Note: Zoning plan reviews of the Solitary Island Marine Park and the Jervis Bay Marine Park indicated that overall achievement (NSW Marine Parks Authority, 2009a). |
| State | Include protective zoning for areas of international, national, regional or local significance, or that are otherwise of high conservation value for marine biota and habitat conservation. | NSW MPA Zoning Guidelines. | N/A | MPA planning Guideline (Supported by Marine Parks Advisory Council). | Partially completed. Review of marine park plans to date indicates that international, national, regional or local significance, or that are otherwise of high conservation value are protected by appropriated zoning. Local and regionally important saltmarsh communities are generally poorly represented and protected in MPAs. |
| State | Include protective zoning for potentially threatened species that occur within the marine park. | NSW MPA Zoning Guidelines. | | MPA planning Guideline (Supported by Marine Parks Advisory Council). | Achieved. Protective zoning has been provided for grey nurse shark, and critical habitat for other sensitive species including black cod nursery areas, giant clam and clown fish coral habitat. |

Table 2.4 - Comparison of Australian State and Territory MPA coverage (Extracted from the Collaborative Australian Protected Area Database (CAPAD 12).

| State | Area of MPAs (ha) | IUCN Cat. II zones in state waters% | Total State waters% |
|---|---|---|---|
| Queensland | 6352194 | 13.6% | 52.1% |
| South Australia | 2713338 | 1.4% | 45.2% |
| New South Wales | 347785 | 7.5% | 39.5% |
| Western Australia | 2745023 | 7.6% | 15.0% |
| Victoria | 118031 | 4.9% | 11.6% |
| Northern Territory | 300390 | 3.1% | 4.2% |
| TAS | 64387 | 1.4% | 2.9% |

### 2.4.2 MPA gap analysis

As explained previously, there two ecosystem types and eight habitat classes used as surrogates for biodiversity for MPA and zoning identification in NSW (see Table 2.2) (Malcolm et al., 2010). Ecosystem surrogates include ocean ecosystems that are sub-classified into four depth ranges; and estuarine ecosystems that have been are sub-classified into five embayment types. The habitat classes include: mangrove, saltmarsh, seagrass, subtidal sediment, beach, intertidal rocky shore, subtidal reef and islands (see Table 2.2). Tables 2.4–2.6 quantify ecosystem and habitat surrogates, as a percentage of area of that type within the current system of MPAs for each identified bioregion.

There are about 150 recognised estuarine areas in NSW, with over one-third (52) of these estuaries included within MPAs (see Table 2.5). At the bioregional level however, seven estuary types are assessed as being not comprehensively represented, that is, either not represented in any MPA within the bioregion or poorly represented. From Table 2.5 it is apparent that gaps in the representation of estuary types are predominately in the Twofold Shelf and Hawkesbury bioregions. Ocean ecosystems, identified in three depth ranges categories (see Table 2.5), appear to be well represented (greater than 26%) in the three bioregions that have marine parks (i.e. Tweed-Moreton, Manning and Batemans bioregions). However, ocean ecosystems are either not represented or poorly represented within MPAs in the Twofold shelf and Hawkesbury bioregions (Table 2.6). Table 2.6 presents the coverage of macrophyte (i.e. mangrove, saltmarsh and seagrass) habitats in MPAs in

each bioregion. Mangroves are well represented in MPAs, ranging from 5.0–24.4% coverage, in all bioregions except in the Twofold Shelf bioregion.

Saltmarsh habitat and associated communities are well represented in the Batemans Shelf bioregion (10.6%); however, this habitat type is comparatively poorly represented in all other bioregions (coverage ranging 0–3.5%), and is not represented at all in the Twofold Shelf bioregion. Seagrass habitat is well represented in all bioregions (coverage ranging 7.7–50.5%), but again is not represented in the Twofold Shelf bioregion. Beach habitat is well represented in the Tweed-Moreton, Manning and Batemans Shelf bioregions; however, there is less than 4.8% coverage in the Hawkesbury bioregion and no representation in the Twofold shelf bioregion[59]. Rocky shores are generally well represented in all bioregions (coverage ranging 6.0–66%), except for the Twofold Shelf bioregion where it is not represented. Emergent rock islands and nearshore reefs are also well represented in the Tweed-Moreton, Manning and Batemans Shelf bioregions; however, they are poorly represented in the Hawkesbury bioregion (coverage of 3.5%) and are not represented in the Twofold Shelf bioregion (Table 2.7).

[59]In 2013, the NSW Government decided to have an amnesty for fishing in opened beach and ocean frontage rocky shores habitats included in sanctuary zones to recreational line fishing. Consequently, full protection of these habitat types does not exist within the NSW Marine Parks system. On 13/1/2014 over 220 marine scientists from across Australia and internationally signed a joint statement raising concerns to the NSW Government for allowing recreational fishing in sanctuary zones (Sydney Morning Herald newspaper, 14, January 2014). A decision is still pending on the continuation of the amnesty, and whether or not fishing will be allowed in sanctuary zones in NSW MPAs.

Table 2.4 - Assessment of MPA coverage of estuaries by bioregion in NSW

| Bioregion | Estuarine Ecosystem | Aquatic Reserve | Marine Park | Not Protected | Total |
|---|---|---|---|---|---|
| Tweed-Moreton | Brackish lake | 0 | 0 | 2 | 2 |
| | Intermittent estuary | 0 | 8 | 6 | 14 |
| | Tide dominated estuary | 0 | 0 | 0 | 0 |
| | Wave dominated estuary | 0 | 6 | 9 | 15 |
| | Ocean embayment | 0 | 0 | 0 | 0 |
| Tweed-Moreton Total | | 0 | 14 | 17 | 31 |
| Manning Shelf | Brackish lake | 0 | 1 | 0 | 1 |
| | Intermittent estuary | 0 | 1 | 5 | 6 |
| | Tide dominated estuary | 0 | 2 | 0 | 2 |
| | Wave dominated estuary | 0 | 1 | 7 | 8 |
| | Ocean embayment | 0 | 0 | 0 | 0 |
| Manning Shelf Total | | 0 | 5 | 12 | 17 |
| Hawkesbury Shelf | Brackish lake | 0 | 0 | 0 | 0 |
| | Intermittent estuary | 0 | 0 | 10 | 10 |
| | Tide dominated estuary | 2 | 0 | 3 | 5 |
| | Wave dominated estuary | 0 | 0 | 7 | 7 |
| | Ocean embayment | 1 | 0 | 1 | 2 |
| Hawkesbury Shelf Total | | 3 | 0 | 21 | 24 |
| Batemans Shelf | Brackish lake | 0 | 0 | 0 | 0 |
| | Intermittent estuary | 0 | 18 | 17 | 35 |
| | Tide dominated estuary | 0 | 1 | 0 | 1 |
| | Wave dominated estuary | 0 | 9 | 13 | 22 |
| | Ocean embayment | 0 | 2 | 1 | 3 |
| Batemans Shelf Total | | 0 | 30 | 31 | 61 |
| Twofold Shelf | Brackish lake | 0 | 0 | 0 | 0 |
| | Intermittent estuary | 0 | 0 | 12 | 12 |
| | Tide dominated estuary | 0 | 0 | 0 | 0 |
| | Wave dominated estuary | 0 | 0 | 4 | 4 |
| | Ocean embayment | 0 | 0 | 1 | 1 |
| Twofold Shelf Total | | 0 | 0 | 17 | 17 |
| Grand Total | | 3 | 49 | 98 | 150 |

(Grey shading indicates ecosystems not comprehensively represented in NSW MPAs).

Table 2.5 - Assessment of MPA coverage of ocean and estuarine ecosystems (by depth) for each bioregion in NSW.

| NSW Marine Bioregion | Ocean ecosystem (Depth range - metres) | MPA Coverage (%) | | |
|---|---|---|---|---|
| | | Aquatic Reserve | Marine Park | Not protected |
| Tweed-Moreton (NSW portion) | 0-20 | 0.1 | 26.3 | 73.6 |
| | 20-60 | 0 | 41.2 | 58.8 |
| | 60-200 | 0 | 97.5 | 2.5 |
| Manning Shelf | 0-20 | 0 | 37.6 | 62.4 |
| | 20-60 | 0 | 31.5 | 68.5 |
| | 60-200 | 0 | 68.6 | 31.4 |
| Hawkesbury Shelf | 0-20 | 1.9 | 0 | 98.2 |
| | 20-60 | <0.1 | 0 | >99.9 |
| | 60-200 | 0 | 0 | 100 |
| Batemans Shelf | 0-20 | 0 | 53.6 | 46.4 |
| | 20-60 | 0 | 45.1 | 54.9 |
| | 60-200 | 0 | 42.7 | 57.3 |
| Twofold Shelf (NSW portion) | 0-20 | 0 | 0 | 100 |
| | 20-60 | 0 | 0 | 100 |
| | 60-200 | 0 | 0 | 100 |

(Grey shading indicates ecosystems not comprehensively represented in NSW MPAs).

Table 2.6 - Assessment of estuarine macrophytes, shore type and near shore reef habitat representation in MPAs for each bioregion in NSW.

| Marine Bioregion | Reserve | Estuarine Macrophytes (% area) | | | Shore type (% length) | | Near Shore Reef (% area) | |
|---|---|---|---|---|---|---|---|---|
| | | Mangrove | Saltmarsh | Seagrass | Beach | Rocky shore | Emergent rock and islands | Reef |
| Tweed-Moreton | Aquatic Reserve | 0 | 0 | 0 | 0 | 1.1 | 2.3 | 0.3 |
| | Marine Park | 5.1 | 3.5 | 10.1 | 34.6 | 58.5 | 49.7 | 38.4 |
| | Not Protected | 94.9 | 96.5 | 89.9 | 65.4 | 40.4 | 48.0 | 61.3 |
| Manning Shelf | Aquatic Reserve | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Marine Park | 11.8 | 2.6 | 29.0 | 27.6 | 66.4 | 22.3 | 52.5 |
| | Not Protected | 88.2 | 97.4 | 71.0 | 72.4 | 33.6 | 77.7 | 47.5 |
| Hawkesbury Shelf | Aquatic Reserve | 7.6 | 0.9 | 7.7 | 4.8 | 6.0 | 0.2 | 3.5 |
| | Marine Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Protected | 92.4 | 99.1 | 92.3 | 95.2 | 94.1 | 99.8 | 96.5 |
| Batemans Shelf | Aquatic Reserve | 0 | 0 | 0 | 0.1 | 0.2 | 0 | <0.1 |
| | Marine Park | 24.4 | 10.6 | 50.5 | 56.8 | 61.6 | 18.3 | 53.2 |
| | Not Protected | 75.6 | 89.4 | 49.5 | 43.1 | 38.2 | 81.7 | 46.8 |
| Twofold Shelf | Aquatic Reserve | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Marine Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Not Protected | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

(Grey shading indicates ecosystems not comprehensively represented in NSW MPAs).

## 2.5 Discussion

### 2.5.1 NSW legal obligations for establishing MPAs.

The Convention for Biological Diversity (CBD) is viewed as the most important global convention in support of MPAs (Maes, 2008). The goal of the Convention is that the global protected area network will contain examples of all world ecosystems and all species, in a spatial scale and population size that is large enough to be viable and for natural processes to continue functioning over time (Dudley et al., 2005). This concept of ecological representation (viz. Comprehensiveness, Adequacy and Representativeness) is the fundamental principal underpinning the establishment and management of protected areas for all biodiversity (ANZECC Task Force on Marine Protected Areas, 1999b; Dudley et al., 2005).

It is generally acknowledged that the CBD is legally binding to its signatories (Kimball, 2001; Maes, 2008). This includes establishing "*a system of protected areas or areas where special measures need to be taken to conserve biological diversity*" (Article 8). Also, these obligations apply to all Australian government jurisdictions. Though the Australian government recognises the legality of the Convention, it has taken a view that CBD obligations concerning the implementation of the Program of Works and Aichi Biodiversity Targets are subject to a nation's capacity to do so (pers. comm. Mr. T. Bover, 8 October 2013[60]). In this regard, the Aichi Biodiversity targets might be regarded as 'soft laws', which act more like guidelines (Coad et al., 2008). Having said this, the Australian Government views the CBD targets very seriously and reported to both CoP11 and CoP12 its progress towards meeting the 2012 MPA target of establishing a comprehensive system of MPAs[61] (Commonwealth of Australia, 2014). Whether or not NSW is legally bound to declare a system of MPAs is a moot discussion, as the NSW Government could effectively argue it has met its commitments at the level prescribed by the Convention. This view is also supported in the conclusion reached by the NSW

[60] Mr T. Bover, (Department of Environment), confirmed by email on 8 October 2013.
[61] In 2013, the Commonwealth marine reserves system increased the number of marine reserves in Commonwealth waters from 27 to 60 (including the Great Barrier Reef Marine Park), expanding the national Commonwealth marine reserves estate to cover a total of 3.1 million square kilometres (over 33% of Commonwealth waters).

Independent Audit of MPAs, that the NSW MPA system had gone a long way to establishing the NSW component of the NRSMPA and associated commitments (Beeton et al., 2012).

Currently, there is a national commitment to increasing native habitat managed primarily for biodiversity conservation across terrestrial, aquatic and marine environments by 600,000 $km^2$ by 2020, but this does not commit NSW to any regional target, except through the adoption of regional planning to address this national target (Natural Resource Management Ministerial Council, 2010b). The Australian government has also stated that no specific MPA or zoning targets exist in establishing the Commonwealth system of MPAs[62] (Commonwealth of Australia, 2003). The Australian government has reflected this understanding in the *Environmental Protection and Biodiversity Conservation Act 1999*, which allows the Commonwealth to assign and manage MPAs in accordance with any of the six different IUCN Protected Area Management Categories. With respect to MPA zoning (including zoning types and IUCN categories) in state waters, the Australian Government acknowledges that these decisions are solely that of the states and not a decision of the Australian government, or decisions made by the IUCN[63] (Beeton et al., 2012).

### 2.5.2 Progress towards meeting national commitments.

The IUCN CBD "Programme of Works" is the primary guidance for member states to progress biodiversity protection and MPA establishment[64]. A primary binding commitment of the CBD and the Programme of Works on Australia and

[62] The 10% target for MPAs has been misinterpreted by some interest groups as being an IUCN international target for no-take zones (Wood et al., 2008; Kearney et al., 2012; Caveen et al., 2013). For example, the South Australian Wilderness Society has quoted, the IUCN World Parks Congress recommendation that all nations establish networks of no-take marine sanctuaries covering at least 20 to 30% of each habitat type across the globe as the official target (The Wilderness Society (South Australia) Inc, 2009)

[63] The IUCN Reserve Management Principles applying to the designation and management of Australian Government protected areas are set out under the Environment Protection and Biodiversity Conservation Regulations, but not as determined by decisions of the IUCN over time.

[64] For further explanation of the CBD and the CoP role is provided in Chapter 1, Section 1.3 of this thesis.

state governments is to establish a system of MPAs[65]. The international policy goal of participating nations to the CBD is to establish by the year 2020:

> *"at least…10 per cent of coastal and marine areas especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures"* (Coad et al., 2008).

In 1992, the Australian federal, state and territory governments agreed to a National Strategy for Ecologically Sustainable Development (Commonwealth of Australia, 1992b). This Strategy provides a strategic policy framework for Australian governments to cooperatively implement the Rio Declaration on Environment and Development and Agenda 21 as agreed at the Rio Earth Summit (Commonwealth of Australia, 1992b). This commitment was recognised by the Commonwealth, states and territories under the Intergovernmental Agreement on the Environment[66] (Commonwealth of Australia, 1992a; Coad et al., 2008); and were the drivers for the development of the 1996 National Strategy for the Conservation of Australia's Biological Diversity[67] (Commonwealth of Australia, 1992b). This later strategy was specifically developed to guide the implementation of CBD obligations and in 2010 was revised and up dated by Australian governments to include the CoP 10 MPA 2020 target. Importantly, the strategic plan explains that the targets are "*aspirations for achievement at the global level and is a flexible framework for the establishment of national or regional targets*" (Natural Resource Management Ministerial Council, 2010a).

Similar to other Australian state and territory governments, the NSW Government adopted national policies and principles for MPA selection, including the and the Interim Marine and Coastal Regionalisation of Australia (IMCRA), as a

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[65] Article 8(a) of the CBD, establishes an international legal obligation on parties "to establish a system of protected areas where special measures need to be taken to conserve biological diversity"(Dudley et al., 2005).

[66] In October 1990 the Heads of Government of the Commonwealth, States and Territories of Australia, and representatives of Local Government in Australia, meeting at a Special Premiers' Conference held in Brisbane, agreed to develop and conclude an Intergovernmental Agreement on the Environment to provide a mechanism by which to facilitate a cooperative national approach to the environment

[67] The National Strategic Plan for Biodiversity 2011-2020 was prepared by the Natural Resource Management Ministerial Council, October 2010.

basis for MPA planning and identification. Of particular note, NSW Government adopted the international target in its blueprint for establishing a system of MPAs a commitment to establish a marine park in each of the NSW marine bioregions by 2012 (Marine Parks Authority, 2001a). This commitment, however, was effectively overridden in 2011 before the target date, when the newly elected NSW Government enacted the *Marine Parks Amendment (Moratorium) Act 2011*, to prevent the establishment of future marine parks and establish an independent review to inform Government's future actions in this area.

### 2.5.3 NSW commitment to establish a System of MPA

Achievement of the National Representative System of Marine Protected Areas (NRSMPA) is based upon the classification of the Australian marine environment into marine bioregions and provinces, and the utilisation of ecosystem types and habitat classes as surrogates for biodiversity (ANZECC Task Force on Marine Protected Areas, 1998; Australian New Zealand Environment and Conservation Council Task Force on Marine Protected Areas, 1999). In regard to NSW, the NRSMPA goal translates to representing ecosystem types and habitat classes in five marine bioregions and one marine province within MPAs (i.e. the Tweed-Moreton Shelf bioregion; the Lord Howe Island bioregional province; the Manning Shelf bioregion; the Hawkesbury Shelf bioregion; the Batemans Shelf bioregion; and, the Twofold Shelf bioregion - see Table 2.1 and Figures 2.1 - 2.4). The Tweed-Moreton Shelf bioregion extends into Queensland State waters to the north, and the Twofold Shelf bioregion extends into Victorian State waters to the south. The bioregional boundary overlap across state jurisdictions is an important consideration when assessing the level of representation of ecosystem types and habitat classes, as IMCRA planning guidelines apply to the bioregional boundaries and not jurisdictional boundaries (Marine Parks Authority, 2001a).

Consistent with its framework for the establishing MPAs, the NSW Government has declared and established six multiple use marine parks representing 36% of state waters (including 100% of the Lord Howe Province). At the national level it is the third ranked State in MPA coverage. NSW has also met, or has made

good progress towards meeting, all national MPA goals by 2020 (Table 2.2). The following dot points provide further details of this progress.

1. The gap analysis (see Section 2.4.2) clearly shows that are there are no MPAs in the NSW section of the Twofold Shelf bioregion (Tables 2.3–2.5). When considered in conjunction with adjacent Victorian state waters, which contains six MPAs in the same bioregion, the only ecosystem and habitats types that are under-represented in the bioregion are those associated with estuarine ecosystems (Breen et al., 2006). As NSW has good examples of estuarine habitat in the Twofold Shelf bioregion and Victoria has already declared six MPAs in the bioregion, it is arguable on both scientific and socio-economic grounds that it should take the lead and include their representation to complete the NRSMPA.

2. Ten small MPAs (aquatic reserves) have been declared in the Hawkesbury bioregion, however they represent less than 1% of the bioregion. Most (7) of these MPAs are located in coastal areas and represent 6% of the rocky intertidal and sub-tidal habitats of the bioregion. Sub-tidal sediment, beach, sub-tidal reef and island habitats are under-represented in the bioregion. Additionally, not all ocean and estuarine ecosystem types are represented. It is clear then that not all habitat types are represented in the Hawkesbury bioregion and a number are under represented within the existing suite of MPAs.

3. The Manning Shelf bioregion is represented by the Port Stephens - Great Lakes Marine Park in the south of the bioregion. Within this relatively large MPA, ecosystems and habitats are well represented, exceeding 20% for most surrogates within this bioregion. It is debateable, however, whether spatial representation within the bioregion has been achieved. Of note, barrier estuary ecosystems appear to be under represented in MPAs in the bioregion.

4. Ecosystems types and associated habitats found in Tweed-Moreton and Batemans bioregions, and within the Lord Howe Island Marine Province are comprehensively represented by MPAs, with the exception of saltmarsh communities, which are poorly representation across all bioregions except the Batemans bioregion. Saltmarsh communities are regarded as significant ecological communities, and provide an important habitat for many fish and bird species and an essential buffer zone for wetlands. In NSW, saltmarsh

communities are listed as threatened communities and are contracting, with area losses ranging 12–97% in places since European settlement (Wilton, 2002). There is, however, an explanation for this lack of representation. Declaration of marine parks cannot be made in respect of an area of Crown lands above mean high water mark (MHWM) without the consent of the Minister administering the *Crown Lands Act 1989*, and in respect of any area of land above MHWM, without the consent of the owner of the land[68]. Consequently, extending the boundary to include saltmarsh areas is problematic, being time consuming and potentially very costly if compensation was required. As a consequence the inclusion of saltmarsh habitat in marine parks has generally been deferred for a later time[69]. Unfortunately at this stage, the inclusion of saltmarsh communities in existing MPAs in existing MPAs is unlikely to occur, and is a considerable gap in the habitats protected in NSW MPAs.

In regard to MPA and zoning establishment in NSW, it is evident from the bioregional assessments and zoning review analyses that MPA selection and planning processes have been undertaken consistent with national selection and establishment guidelines. NSW legislative processes have also supported accountable and equitable management solutions, with trade-off decisions and fisheries compensation arrangements geared to ensure ecological sustainable use and biodiversity objectives outcomes. This conclusion is in contrast to a growing number of scientists who are concerned about the 'poor placement' of MPAs, both internationally and within Australia (Pressey et al., 2013). Ensuring MPAs are effective and that they are not seen as 'residual' or 'paper parks' is rapidly becoming one of the most pressing priorities for MPA managers, in order to maintain community confidence and support for these conservation tools (Veitch et al., 2012; Barr and Possingham, 2013; De Santo, 2013b; Pressey et al., 2013).

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[68] A Marine Park proclamation cannot be made in respect of an area of Crown lands above mean high water mark without the consent of the Minister administering the *Crown Lands Act 1989*; and in respect of any area of land above mean high water mark (whether or not Crown lands) without the consent of the owner of the land (see Part 2 s.6, 'Declaration of Marine Parks', *Marine Parks Act 1997*).

[69] Author's experience during the declaration of MPAs in NSW.

The quantitative gap analysis presented in this chapter indicates that a large-scale MPA in each bioregion is not required to complete the NSW component of the NRSMPA, on the basis that several existing MPAs already provide a substantial degree of representation of some ecosystem and habitat types in these bioregions. A recommended alternative approach is to build on these existing MPAs and declare smaller aquatic reserves[70] (IUCN Category II and IV zone types only) to represent estuaries and oceanic ecosystems. In order to complete the representative system of MPAs, only ten new aquatic reserves would need to be declared (see Table 2.7). There are many options available to complete the system of MPAs in NSW, however the suggested option by the author includes: two in the Manning Bioregion, to represent barrier and intermittent estuary areas; six in the Hawkesbury Bioregion, to represent estuary types and ocean depths, and; two in the Two-fold Bioregion, to represent estuary types. The options also include the extension and amalgamation of existing reserves at Long Reef and Narrabeen, to include Dee Why and Narrabeen Lagoons, and the joining of the North Harbour Aquatic Reserve and Cabbage Tree Aquatic Reserves to increase representation and improve there capacity for protection.

The NSW Independent Audit identified that the Hawkesbury and Twofold bioregions presented gaps in the NSW system of MPAs. The Audit also reported that investigations to progress the establishment of a representative system of MPAs should be undertaken, but did not suggest how this might be progressed. At this time, the future direction for the system of MPAs in NSW is yet to be determined by the NSW Government. It is understood, however, that a new strategic plan for MPAs will be prepared by 2015. Recent moves by the NSW Government to link agencies responsible for planning and transport to strategically manage the whole marine estate is consistent with the current thinking of the IUCN, which is focussing efforts towards better integration and effective management. There also appears to be some maturing of the concept of ecosystem based management (EBM) into practice in NSW, with principles published by the new Marine Estate Management Authority supporting a holistic approach to marine management (NSW Marine Estate Management Authority, 2013). The revised objective and target for MPA

[70] There has been some uncertainty of the value of small MPAs, however, recent studies of the effectiveness of zones in large MPAs indicates that effective representation can be achieved with relatively small reserves (NSW Marine Parks Authority, 2009c; Curley et al., 2013).

establishment under the CBD Program of Works (CoP11) aim to ensure MPAs are well connected, effectively and equitably managed, and ecologically representative. Meeting this commitment will require a high degree of integration and partnership between agencies responsible for marine management in NSW. The effectiveness of intersectoral integration in NSW is discussed in detail in Chapter 4 of this thesis.

Table 2.7 - Aquatic Reserve options to complete the NSW Representative System of MPAs.

| Bioregion | Location | Ecosystem types | Habitat types | Supporting comments |
|---|---|---|---|---|
| Manning | Limeburners Creek and Saltwater Lake, Hastings River* | Wave dominated barrier estuary | Subtidal sediments, seagrass, mangrove and saltmarsh. | Adjacent to and within national park Adjacent wetlands listed in Directory of Important Wetlands.<br>Saltwater Lake identified as one of the most natural saltwater lakes in NSW and rated "near pristine by Healthy Rivers Commission. Recognised as important for migratory bird species identified within CAMBA and JAMBA agreements. |
| | Khappinghat Creek* | Intermittent estuary | Subtidal sediments, seagrass, mangrove and saltmarsh. | Largest intermittent creek in the bioregion.<br>Wetlands protected under SEPP 14.<br>Adjacent littoral rainforest protected under SEPP 26.<br>Completely surrounded by NR.<br>Mean river and catchment disturbance indices are lowest in the bioregion. |
| Hawkesbury | Wamberal lagoon* | Intermittent coastal estuary | Subtidal sediments, seagrass and saltmarsh. | Arguably the most diverse and abundant fish assemblages in lagoons in bioregional area north of Hawkesbury River.<br>Important habitat for JAMBA and CAMBA listed avian species.<br>Diverse estuarine wetland habitats |
| | Kooragang Island Nature Reserve, Creeks 1–5* | Wave dominated estuary | Subtidal sediments, seagrass, saltmarsh and mangrove. | Creeks completely within national park. Kooragang Island Nature Reserve and nearby locations incorporates the largest areas of mangrove and saltmarsh habitat in the bioregion.<br>Kooragang Island is recognised as a RAMSAR wetland of international significance and is recognised as important for migratory bird species identified within CAMBA and JAMBA agreements. |
| | Dee Why Lagoon to Narrabeen Headland (including coastal frontage)* | Intermittent coastal estuaries<br>Ocean (0-20m) | Subtidal sediments, reef and shoal, beach, rocky intertidal, seagrass and saltmarsh. | Dee Why Lagoon includes diverse remnant saltmarsh habitat and has one of the most diverse community of fish of any lagoon type in the bioregion. |
| | Bouddi National Park marine extension.* | Ocean (0–60m) | Subtidal sediments, beach, rocky intertidal, reef and shoal. | Completely within national park boundaries and under long-term fishing closure. |

| | | | | |
|---|---|---|---|---|
| | Expansion of the North Harbour Aquatic Reserve and Cabbage Aquatic Reserve. | Drowned river valley and estuarine habitats and rock platforms. | Seagrass, algal habitats. | Common boundary with the Sydney Harbour National Park and integrated management with the aquatic reserve will result in improved protection and management. The amalgamation of aquatic reserves and adjacent lagoons would in increase representation of subtidal mud/sand, intertidal beach, shallow subtidal reef, rocky shore and mud flat. |
| | South-western embayment, Port Hacking | Tide dominated river valley estuary | Subtidal sediments, seagrass and mangroves. | Surrounded by national park. The river and catchment disturbance indices within Port Hacking are lowest in the bioregion. Port Hacking contains significant areas of seagrass. |
| | Wamberal lagoon.* | Intermittent coastal estuary | Subtidal sediments, Seagrass and saltmarsh. | Most diverse and abundant fish assemblages in lagoons in bioregional area north of Hawkesbury River. Important habitat for JAMBA and CAMBA listed avian species. Diverse estuarine wetland habitats. |
| Twofold | Nadgee River to Nadgee Lake (including coastal frontage).* | Intermittent coastal estuary and Ocean (0-20m) | Subtidal sediments, beach, rocky intertidal, reef and shoal, seagrass and mangrove. | Within national park boundaries. Identified as having high conservation value within the 2002 Healthy Rivers Commission Inquiry (Healthy Rivers Commission of New South Wales, 2002). |
| | Merimbula Lake, southern embayment.* | Wave dominated barrier estuary. | Subtidal sediments, saltmarsh and mangrove. | Adjacent to a national park. Large-scale representation at bioregional level of seagrass, mangrove and saltmarsh habitats. Southern limit of River mangrove distribution. Important habitat for JAMBA and CAMBA listed species. Listed in the Directory of Important wetlands. |

*Detailed information on locations is described in the NSW Bioregional assessments for the Manning, Hawkesbury and Twofold bioregions assessments - see (Breen et al., 2004; Breen et al., 2005; Breen et al., 2006).

## 2.6 Conclusion

The NSW Government is internationally and nationally obliged to establish a representative system of MPAs. Currently, the NSW system of MPAs is well advanced, with marine parks being established over 36% of state waters, and with a high level of ecosystem and habitat representation in four of the six bioregions and the Lord Howe Province. A gap analysis of representation in MPAs clearly shows that are there are no MPAs in the NSW section of the Twofold Shelf bioregion. Although ten aquatic reserves have been declared in the Hawkesbury bioregion, they represent less than 1% of the bioregion and it is clear then that not all habitat types are represented in the Hawkesbury bioregion and a number are under represented within the existing suite of MPAs. The Manning Shelf bioregion is well represented however, barrier estuary ecosystems appear to be under represented bioregion. Ecosystems types and associated habitats found in Tweed-Moreton and Batemans bioregions, and within the Lord Howe Island Marine Province are comprehensively represented by MPAs, with the exception of saltmarsh communities, which are poorly representation across all bioregions except the Batemans bioregion.

Since the introduction of the NSW *Marine Parks Act 1997* the identification, selection and planning of MPAs in NSW have been consistent with international and national guidelines and principles for establishing MPAs. This includes ensuring CAR principles being applied in these processes, and appropriately placing marine parks in to each of the State's bioregions to represent key ecosystems, habitat and species found in these areas. The NSW Government has also met or has partially completed key international and national commitments associated with MPA establishment. Comprehensive representation of all key ecosystems and habitats in the state's bioregions, however, has yet to be achieved. In particular, representation of ecosystem and habitat types in MPAs has not been achieved in the Hawkesbury and Twofold bioregions. It is concluded that NSW is in a strong position to achieve the 2020 CBD MPA targets. Key to fulfilling these targets will be ensuring ecological representativeness, connectivity with other MPAs, evidence of effectively managed MPAs and their integration with the broader seascape and marine management regimes. It is understood that the NSW Government is currently

reviewing all aspects of MPAs in NSW and the outcomes of these internal reviews will be critical in the future for the system of NSW MPAs.

# 3 QUALITATIVE RISK ASSESSMENT OF MULTIPLE USE MARINE PARK EFFECTIVENESS - A CASE STUDY FROM NSW, AUSTRALIA.

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## 3.1 Introduction

Although universally supported as one of the most important tools for the conservation of marine biodiversity, the effectiveness of marine protected areas (MPAs) in achieving conservation biodiversity objectives continues to be debated at all levels (Alder, 1996; Agardy et al., 2003; Bohnsack et al., 2004). One of the most prominent issues is the effectiveness of multiple use areas within marine parks compared to the effectiveness of no-take areas in achieving conservation objectives (Barton, 2002). For the many governments that have adopted multiple use marine park models (i.e. allows for resource extraction in a proportion of the area), the debate is often focussed on percentage targets of no-take zones, both at the system level and in the design of individual multiple use marine parks (Committee on the evaluation design and monitoring of marine reserves and protected areas et al., 2000; Agardy et al., 2003). Multiple use marine parks often apply a zoning scheme to manage uses within prescribed spatially defined areas, with an overall aim to provide for biodiversity protection, but also to provide for ecologically sustainable uses, including fishing (Kelleher, 1999). Most often the primary objective of managed-use zones (often referred to as partially protected zones, buffer zones, and transition and periphery zones) is to support multiple uses and reduce overall ecological impacts within a biodiversity conservation framework (Kelleher and Kenchington, 1991). Zoning arrangements are also used to manage conflict between incompatible uses (Davos et al., 2007). They generally have a particular aim that allows for extractive use, provided they are 'ecologically sustainable', and compatible with the objectives of the zone itself. Activities within zone types are managed by specifying what is permitted or not permitted. A common model for zoning types includes three types of zones: a core zone, sometimes referred to as a 'no take' zone; a restricted zone, which restricts certain forms of fishing and other activities in order to protect habitats and species; and, a peripheral zone, often referred to as general-use zones or

transition zones which permit most forms of fishing and other marine activities (Dasmann, 1988; Francour et al., 2001; Merino et al., 2009). Collectively, and for the purpose of this paper, restricted and peripheral zones are referred to as ‘ managed-use zones’. In many cases MPA agencies utilise more than three zones in order to have greater spatial control over the permitted activities, to help achieve multiple use objectives (Villa et al., 2002). For example, the Great Barrier Reef utilises six types of managed-use zones types, the key ones being: conservation zones; habitat protection zones; general-use zones; and, special purpose zones (Great Barrier Reef Marine Park Authority, 2005).

The list of benefits of multiple use MPAs and their managed-use zones have been documented and discussed in a number of publications (Sainsbury and Sumaila, 2001; Kenchington et al., 2003). Two fundamental benefits of large scale multiple use MPAs are: their ability to address the full suite of threats to marine ecology in a holistic manner, demonstrating integration with coastal watershed management; and, their inherent capacity to overcome management obstacles that come with large scale and complex marine planning (Agardy, 2005). It has also been noted by Kelleher and Recchia (1998) that the integration of managed-use zones within a planning regime that is specifically designed to ensure ecological sustainability is critical for broader scale biodiversity outcomes and that the significance of effective integrated management cannot be underestimated in respect to achieving MPA goals. Probably the most important benefit of managed-use zoning for biodiversity conservation reasons is the utility of the buffer zone. Shafer (1995) concludes that the greatest problems facing reserves now lie on their boundaries and that buffer zoning to protect and connect core areas is critical. In this regard, biospheres reserves, under the UNESCO Man and Biosphere Program, have entrenched the concept of core and buffer areas by introducing a world-wide reserve system that placed equally as much importance on the success of the buffer zones as the core areas (Dasmann, 1988; Kenchington and Agardy, 1990; Li et al., 1999). The benefits and effectiveness of managed-use zones and less restricted MPAs for aspects of biodiversity other than the harvest of exploited species have not been well studied (Lester and Halpern, 2008). For example, planning criteria for managed-use zone selection, design and size are not well developed, and there are many gaps in our knowledge of buffer zoning requirements, such as, optimal size and configuration in relation to habitats;

and, in particular, what activities should be permitted in these zones to ensure their effectiveness at protecting core areas, but at the same time maximising use opportunities (Lester and Halpern, 2008). One reason for the lack of study on these zones is that multiple use MPA types vary so greatly and it has been suggested that it is impractical to generalise about their benefits or effectiveness. Also, the cost of research to evaluate the biodiversity value of such intermediate forms of protection is notably higher than for a relatively simple fished/unfished comparisons (Kenchington et al., 2003; Lester and Halpern, 2008). However, the 'effectiveness' of managed-use zones (i.e., the measurement of 'actual performance' towards the stated goal (Hovi et al., 2003), in achieving biodiversity conservation and ecological sustainability and their respective contribution to the overall objectives of the multiple use marine parks is an emerging issue generating much discussion (Salomon et al., 2002). It is a poignant question whether or not managed-use zones are in fact delivering their benefits and meeting their stated objectives.

To assess if managed-use zones are adequately meeting their ecological objectives the first and fundamental test is to ascertain whether or not allowable activities in these zones are applicable against legislated objectives, in particular maintenance of ecological processes (Pomeroy et al., 2005). The aim of the current investigation was to use Ecological Risk Assessment (ERA) techniques to assess the risks of all permitted activities in all zone types to determine if they are appropriate in meeting zoning and park objectives. A case study of six multiple use marine parks in New South Wales, Australia was selected to assess the range of permitted activities in the various zones and to determine if these activities were consistent with the stated zoning objectives and application across the MPA system. Specifically, the objectives of the case study were to identify inconsistencies in the permitted activities within the zones in the system of NSW marine parks and to assess the risks of all activities in all zone types against zoning and park objectives.

## 3.2 Method

### 3.2.1 Location and background to NSW marine parks

The case study involved six Marine Parks established within NSW, Australia, between Cape Byron Marine Park in the north and Batemans Marine Park in the south (see Figure 1.2, Chapter 1). Multiple use marine parks in Australia have been established to support the national representative system of MPAs. Common key principles of the national system of MPAs are that the establishment and planning of MPAs needs to be 'comprehensive' (i.e. include the full range of ecosystems); 'adequate' (i.e. ensure ecological viability); and 'representative' (i.e. represent the biotic diversity of marine ecosystems) (Australian and New Zealand Environment and Conservation Council Task Force on Marine Protected Areas, 1999). While there are variations between zone names and types in across Australian states, the multiple use MPA frameworks are all similar in concept in that they include several zone types (IUCN categories I, II, IV and V1) to provide for the management of extractive uses (Marine Protected Areas Working Group, 2007). The primary legislative objectives of NSW marine parks are to conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks; and to maintain the ecological processes within these marine parks (*NSW Marine Park Act 1997*). Where consistent, marine park objectives also aim to provide for ecologically sustainable use of fish and marine vegetation (the legislation specifically includes commercial and recreational fishing as objectives), and to provide opportunities for public appreciation, understanding and enjoyment of marine parks. To help achieve these objectives the Marine Park regulation describes four zone types: Sanctuary Zone (SZ), Habitat Protection Zone (HPZ), General Purpose Zone (GUZ) and Special Purpose Zone (SPZ). Each zone type has defined objectives that provide for biodiversity protection and sustainable uses.

Over the last decade six marine parks have been established and zoned, representing four of the State's six defined bioregions and provinces (Creese and Breen, 2003). As establishment and zoning of marine parks has progressed, the NSW marine park zoning process has also evolved and adapted as improved information is applied to zoning design. Initial decisions on marine park boundaries were based on ensuring inclusion of a range of defined ecosystems and habitat types, with options modelled using C-plan (a GIS based conservation reserve design tool) (Creese and

Breen, 2003). As further information becomes available, for example information on the distribution, and structure of habitats, the objective of ensuring that the full range of biodiversity is protected can be improved considerably, and zoning criteria can be applied more effectively. While no specific targets are defined for SZ coverage, collectively the NSW marine parks system currently covers approximately 34% of State waters, and includes 104 no-take zones, which make up around 20% of the total MPA coverage (Department for Environment and Heritage and the Arts, 2006). In each zone type, activities are permitted by regulation. Sanctuary Zones allow only non-extractive use types (extraction for scientific and Aboriginal cultural use is an exception). In Habitat Protection Zones, limited commercial and most recreational fishing activities are permitted. In most NSW marine parks, permitted activities in GUZs include all commercial fishing methods allowed by the State's fisheries agency, such as trawling and mesh netting (gillnetting). To assist in the preparation of zoning plans, guidelines have been developed by the NSW Marine Parks Authority that mainly focus on the identification and selection of SZs (Marine Parks Authority, 2001a). These guidelines include specific criteria: 1) conservation of natural and cultural resources; 2) sustainable resource use; and, 3) manageability of zones. The development of zoning plans follow a strict legislative process, requiring a draft plan to be developed and a local advisory committee to be established. Draft plans are placed on public exhibition for three months to allow comments and feedback from stakeholders and the local community. To minimise adverse impacts from the transfer of fishing effort resulting from loss of fishing grounds from zoning, the NSW Government introduced a voluntary commercial fishing licence buy-back scheme. This program identifies potential effort displacement for affected commercial fisheries and allocates buy-back funds to achieve effort reduction targets (Marine Protected Areas Working Group, 2007).

Following the selection of SZs, multiple use zones (HPZs and GUZs) are then selected, which generally correspond closely to existing use patterns. For example, trawling grounds become general-use zones and non-trawling grounds become habitat protection zones. Permitted activities in HPZs are also determined more by the significance of existing uses rather than for ecological reasons. For example, if important beach hauling grounds are present, then the plan will generally allow this activity to continue. The draft zoning plan is finally derived using 'ground-truthed'

use information and trade off arrangements to balance stakeholder preferences and biodiversity conservation objectives, with an overall aim to achieve ‘a best compromise’ that provides for representation of habitat types within SZs and allowable extractive uses to continue.

### 3.2.2 Ecological Risk Assessment Method

Ecological Risk Assessment (ERA) management frameworks are well documented, providing procedural guidance for systematic, qualitative or quantitative analysis of risk (see Figure 3.1) (U.S. Environmental Protection Authority, 1998; Standards Association of Australia, 1999). ERA is also gaining momentum as a key tool to assist fisheries ecosystem based management decision-making (Sarti, 2002; Carey et al., 2005; McPhee et al., 2007). Although there are no published examples of ERA being used to help assign permitted uses against zoning objectives as proposed in this case study, there are good examples to draw on, in particular, Fletcher (2005) and Astles et al. (2006; Astles et al., 2009) who documented similar themes in order to prioritise risks related to fisheries activities on the marine environment. As recommended in Fletcher (Fletcher, 2005), an expert panel was first established to agree on the a risk analysis approach and to collate activity information to describe concerns, consequences and uncertainties that would be included in calculations of risk analysis.

The established Panel consisted of departmental staff from research, policy, planning, assessment, and management and enforcement disciplines. Given the complexity of the decision problem and lack of quantifiable data, the panel made its first decision to address the risk management problem using a qualitative ERA process. For the purpose of this study, the Panel defined ‘risk’ as ‘the likelihood of an adverse event occurring as the result of an activity on an environmental value (physical or ecological) in relation to a particular zone type’. Three risk values where defined: Low, Medium and High (Table 3.1). Separate risk tables were prepared for each zone type by comparing permitted activities to the objective of the zone. For example, recreational line fishing was assessed by the Panel as having a low-risk value over ocean unconsolidated habitat as the chance of an adverse event occurring, on the biological feature or related ecological process was low and not inconsistent

with the general use zoning objectives. Estuary fish trapping scored a high-risk value in respect to biological values, as this activity was assessed has having potentially adverse impacts on target and non-target species values and related ecological process, which is inconsistent with the 'habitat protection' zoning objectives.

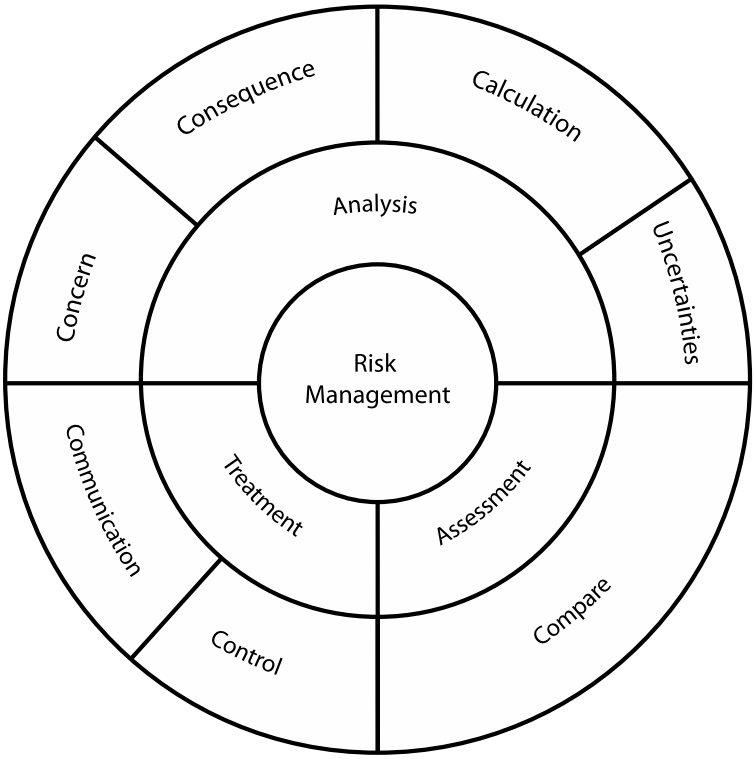


Figure 3.1 - Ecological Risk Management Framework: Outcome of the Australian Academy of Science Fenner Conference on the Environment 1995.

As part of the risk analysis, MPA permitted activities were firstly grouped into extractive and non-extractive types and then categorised as either commercial or non-commercial. In total, 76 different activity types were identified for the NSW marine parks (not including swimming, sailing and beach walking). Of these, 45 activity types were related to commercial fishing methods (from 8 distinct fisheries); 11 involved recreational fishing (including fishing competitions and charter fishing); and, 21 were non-extractive uses, such as boating, scuba diving, education and research activities. Profiles were prepared for each activity to describe current use patterns, method (including temporal and spatial elements), management and its interactions (consequence) with marine environmental values (habitat and ecological

attributes). Particular attention was given to detailing fishing gear and deployment methods in order to better understand their potential impacts on marine habitats and species. Determining the likely interactions with environmental values required a sound understanding of potential impacts from each activity type. For example, impacts of trawling in NSW were collated to develop the trawling activity profile, in order to understand the risks associated with this activity in relation to marine park objectives (NSW Department of Primary Industries, 2007).

Table 3.1 - Risk values and descriptions adopted for this case study.

| RISK VALUE | DESCRIPTION |
|---|---|
| **Low risk** | Regardless of the chance of an adverse event occurring, any adverse event in itself would be insignificant, having little or no impact on the biological feature or related ecological process, and was not inconsistent with the zoning objectives. |
| **Medium risk** | The interaction of the activity with the environmental value (including influence of pollution, noise, light, and gear loss, contact, capture) was probable, but the number of individuals impacted and/or the spatial extent of habitat or species distribution effected and/or the frequency of interactions was determined to be small enough to have little or no impact on the biological feature or related ecological process, and was not inconsistent with the zoning objectives. |
| **High risk** | The interaction of the activity with the environmental value (including influence of pollution, noise, light, and gear loss, contact, capture) was probable, and that the number of individuals impacted and/or the spatial extent of habitat or species distribution effected and/or the frequency of interactions was potentially measurable, with adverse impact on the biological feature or related ecological process, and was inconsistent with the zoning objectives. |

Environmental values considered at risk were biodiversity and ecologically sustainable use. Similar to Fletcher (Fletcher, 2005), these values were assessed using: 'Habitat attributes'; and 'Ecological attributes'. In this case study, the 'habitat' set consisted of the eight habitat types considered by NSW Marine Parks Authority in the selection of marine parks. These were: macrophytes (seagrasses, mangroves, saltmarsh), estuarine mud and sand, ocean unconsolidated, beach, intertidal rocky shore and sub-tidal reef (Breen et al., 2004). 'Ecological' attributes included target

species, non-target species and threatened species (including mammals, reptiles and birds). Weightings were not applied to any of these environmental values. Consequently, if an activity was defined as 'high risk' against any a single environmental value, it was deemed by the Panel as being an inappropriate use for the zone type. An activity that received more than three medium risk scores was further assessed by the Panel to consider whether the accumulated risks warranted classification as a high-risk activity. The Panel deliberately included social values in the risk analysis, as it become clear from the profiles that 'social acceptability' was a major and sometimes determining factor in planning marine parks (Fletcher, 2005). For example, the Panel was aware that spearfishing had a greater social impact in the Lord Howe Island Marine Park than its ecological risk. Any activity assessed to have high social risks together with a medium ecological risk score was deemed to be a potential high-risk status and, as such, required further consideration to evaluate its risk analysis.

### 3.3 Results

Comparison of permitted activities across the five mainland marine parks indicated that 13 (29%) of the commercial fishing methods currently permitted in HPZs were inconsistently regulated, with different rules applying across the parks. This increased to 24 methods if Lord Howe Island Marine Park was included in the analysis. Of the ten recreational fishing activity types permitted in HPZs, five activities were identified to be inconsistent across marine parks, with the major differences being spear fishing, recreational prawn hauling and collection of seaweed. One third (7) of non-extractive uses also varied across HPZs, but most of these were relatively minor, such as variations in boating speeds and designated areas. Major differences were observed in regard to permitted aquaculture activities (Table 3.2). In respect to activities allowed in GUZs, 16 (36%) commercial fishing activities were inconsistently applied across the marine parks, of which 11 were considered to be major variations between parks. Only one recreational fishing difference between GUZs was identified, and this was related to differences in the spear fishing restrictions between parks. Seven inconsistencies were recorded for

non-extractive uses in the GUZ, with only extensive aquaculture identified as a major difference between the marine parks (Table 3.3).

Activities assessed by the ERA process as high risk to environmental and social values in HPZs are listed in Table 3.4. Twenty (20) commercial fishing activities were considered high risk to HPZ values, of which ten were already consistently prohibited in HPZs. Notable differences in permitted activities in HPZs between different NSW marine parks were commercial fish trapping, hauling and push net collecting, recreational prawn haul netting, prawn push nets, and aquarium collection. Non-extractive uses identified by the ERA process for possible prohibition or restriction in HPZs included: aquaculture (both intensive and extensive); any infrastructure which impacted on habitat; artificial reefs; fish attracting devices; fish feeding; anchoring; and, vehicle use (by permit only). Although the Expert Panel considered that anchoring and mooring could be accommodated in designated areas within HPZs, its preferred recommendation was that anchoring and mooring should be accommodated by different zoning options, such as general-use or special purpose areas. With exceptions of hauling and dredge trawling, there was little consistency across mainland GUZs for high-risk activity types (Table 3.5). The ERA process identified 10 of the 45 commercial fishing activities to be high risk, suggesting these activities should be either prohibited or restricted in GUZs. ERA results that were inconsistent with current allowable activities in GUZs were trawling, set lining drift lining, mesh netting and purse seining.

Table 3.2 - Summary of the inconsistencies in activities permitted in Habitat Protection Zones (HPZs) across NSW marine parks as determined by the Expert Panel.

| Activity Category | Total Number | Number Consistent | Number Inconsistent | Number of minor inconsistencies | Number of major inconsistencies | Inconsistency due to LHIMP | Major activity differences |
|---|---|---|---|---|---|---|---|
| Com. fishing | 45 | 21 | 24 | 14 | 10 | 11 | Hand held prawn net; Garfish hauling net; Garfish bullringing net; Prawn set pocket net; Prawn haul net; Prawn running net; Prawn seine net; Set lining; Drift netting; Purse seine net |
| Charter fishing | 1 | 1 | 0 | 0 | 0 | 0 | |
| Rec. fishing | 10 | 5 | 5 | 2 | 3 | 3 | Spearfishing; Prawn haul net; Seaweed collecting |
| Non extractive | 21 | 14 | 7 | 5 | 2 | 2 | Intensive aquaculture; Extensive aquaculture |

Table 3.3 - Summary of the inconsistencies in activities permitted in General Use Zones (GUZs) across NSW marine parks as determined by Expert Panel.

| Activity Category | Total Number | Number consistent | Number inconsistent | Number of minor inconsistencies | Number of major inconsistencies | Major activity differences |
|---|---|---|---|---|---|---|
| Commercial fishing | 45 | 31 | 16 | 5 | 11 | Flathead net; Mesh net (extended); Mesh net (splash); Prawn seine; Estuary prawn trawl; Set lining; Trot line; Purse seine; Prawn otter trawl; Fish otter trawl; Aquarium collecting |
| Charter fishing | 1 | 1 | 0 | 0 | 0 | |
| Recreation fishing | 10 | 9 | 1 | 1 | 0 | |
| Non extractive uses | 21 | 14 | 7 | 6 | 1 | Intensive aquaculture |

Table 3.4 - Summary of activities identified by the ERA process as high risk in Habitat Protection Zones (HPZs) and suggested to be prohibited or restricted.

| **High Risk Activity Type** | **ERA Outcome** | **Current Zoning Arrangements** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **CBMP** | **LHIMP** | **SIMP** | **PSGLMP** | **JBMP** | **BMP** |
| Estuary Fish Trap | X | √ | n/a | √R | √ | √ | √ |
| Flathead Net | X | X | n/a | X | X | X | X |
| Hand Hauled Prawn Net | X | √ | n/a | √ | √R | X | √R |
| Hand Gathering | X | √R | n/a | √ | √R | √ | √ |
| Push or Scissor Net | X | √ | n/a | √ | √ | √ | √ |
| General Purpose Haul | X | √R | X | √R | √R | √R | √R |
| Mesh Net - extended set | X | X | X | X | X | X | X |
| Mesh Net - splashing | X | X | X | X | X | X | X |
| Garfish Net (Hauling) | X | √ | X | X | X | √R | X |
| Prawn Set Pocket Net | X | X | X | X | √R | X | X |
| Prawn Haul Net | X | X | X | X | √R | X | X |
| Trumpeter Whiting Net | X | X | X | X | X | X | X |
| Estuary Prawn Trawl | X | X | X | X | X | X | X |
| Set Lining | X | X | √R | X | X | X | X |
| Fish Trap | X | √ | X | √R | √ | √ | √ |
| Drift Line | X | √ | X | X | X | X | X |
| Trotlines | X | X | X | X | X | X | X |
| Fish Trawl | X | X | X | X | X | X | X |
| Prawn Trawl | X | X | X | X | X | X | X |
| Dredge Trawl | X | X | X | X | X | X | X |
| Aquarium Commercial | X | X | X | X | √R | X | X |
| Aquarium Non commercial | √P | √P | √P | √P | √P | √P | √P |
| Recreational Collecting | X | √R | √R | √R | √R | √R | √R |
| Recreational Prawn push net | X | √ | n/a | √ | √ | √ | √ |
| Recreational Prawn Haul Net | X | X | X | X | √ | X | √ |
| Airplanes | √R | √ | √ | √ | √P | √ | √P |
| Anchoring | X | √R | √R | √ | √ | √ | √ |
| Aquaculture Extensive (no added food) | X | √R | X | X | √R | √R | √R |
| Aquaculture Intensive (added food) | X | X | X | X | √R | X | X |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Infrastructure public | √R | √P | √P | √P | √P | √P | √P |
| Infrastructure (private) | X | √P | √P | √P | √P | √P | √P |
| Artificial Reefs | X | √P | √P | √P | √P | √P | √P |
| Fish Attracting Devices (FADs) | X | √P | √P | √P | √P | √P | √P |
| Fish Feeding | X | √R | √R | √R | √R | √R | √R |
| Vehicles | √P | √R | √R | √R | √R | √R | √R |

(Note: R – currently restricted; P – currently undertaken with permit; n/a – not applicable).

Table 3.5 - Summary of activities identified by the ERA process as high risk in General Use Zones (GUZs) and suggested to be prohibited or restricted.

| **High Risk Activity Type** | **ERA Outcome** | **Current Zoning Arrangements** | | | | |
|---|---|---|---|---|---|---|
| | | **CBMP** | **SIMP** | **PSGLMP** | **JBMP** | **BMP** |
| General Purpose Haul | √R | √ | √ | √ | √ | √ |
| Mesh Net (extended set) | X | X | X | √ | X | √ |
| Mesh Net (splashing technique) | X | X | X | √ | X | √ |
| Prawn Trawl | X | √ | √ | √ | √ | X |
| Fish trawl | X | √ | √ | √ | √ | X |
| Dredge trawl | X | X | X | X | X | X |
| Set lining | X | X | X | X | X | √R |
| Drift line | X | √ | X | X | X | √ |
| Purse seine net | X | X | X | √ | √ | √ |
| Aquaculture (intensive) | X | X | √ | √ | √ | √ |
| Vehicles | √R | √R | √R | √R | √R | √R |

(Note: R – currently restricted; P – currently undertaken with permit; n/a – not applicable).

## 3.4 Discussion

As stated previously, this study adopted a similar ERA process to that applied by Fletcher (2005), but rather than assessing a single fishery against fishing sustainability objectives, our study assessed both extractive and non-extractive activities, against zoning and marine park objectives. Given that risks relate to the impact of an activity on objectives, which in our case study were the legislative zone

objectives, it meant that a very clear understanding of the objectives was required to properly assign and analyse risk. However, because these objectives were too broadly defined by the NSW legislation, it was a difficult task for the expert panel to achieve consensus. For example, when the ERA was undertaken, the objective of the HPZ allowed for activities that "did not significantly impact on fish populations within the zone and had a negligible impact on other animals and habitat" (Marine Park Regulation 1999). Clearly, this objective is open to interpretation about what activities should be permitted. It also unintentionally brings 'zone size' into the equation, as a larger HPZ might conceivably accommodate larger populations of fish at any one time 'within the zone', in turn, allowing certain fishing activities to occur without 'significantly impacting on the fish population'. Smaller HPZs might never accommodate a large population of the same fish type at any one time, and consequently would prohibit by definition the same fishing activity, which was permitted to operating in the larger zone.71 There is little question that the ERA applied in this case study would have been more definitive, if the zoning objectives were unambiguous.

In analysing risk associated with fishing activities in MPAs the expert panel identified a difference between the risk conclusions for fishing activities when assessed against marine park zoning objectives, compared with fishing activities assessed against ecosystem based fisheries management objectives (Ward and Hegerl, 2003; Pitcher et al., 2009). The reason for this difference can be explained by the subtle differences in their respective objectives. The primary objectives of marine parks and their zones are focussed on biodiversity conservation and maintenance of ecological processes, rather than on fisheries management and sustainability of fish populations. Related to this is the scale of use compared with the two management boundaries. For example, NSW Department of Industry and Investment (NSW Department of Primary Industries, 2007) concluded that the management controls for the trawl fishery, when considered across the entirety of state waters, allowed for an appropriate allocation of the resource and addressed the principles of ecologically sustainable development. However, the scale of a standard sized multiple-use MPA in NSW (80,000 ha) is much smaller than the ecosystem scales considered by

[71] In 2009, a review of the NSW regulations resulted in an amendment to the Habitat Protection Zone definition to resolve this ambiguity, largely due to this case study.

fisheries managers for the entire State. When considered against the size of the marine park and potential impact on habitat, trawling was deemed to be a high-risk activity and inconsistent with the objectives. This conclusion is consistent with independent impact assessments against similar objectives and management scales (Hutchings, 1990; Pitcher et al., 2007; Ellis et al., 2008; Rodríguez-Cabello et al., 2008).

### 3.4.1 Consistency in zoning

As MPAs have expanded worldwide the necessity for some level of consistency in the naming of specific marine park zone types and associated permitted activities has been recognised (Suter, 1983). In Australia, it was also recognised by managers and recommended that zone names should reflect a clear relationship to the activities permitted within their boundaries (Australian Committee for the IUCN and Natural Resources (ACIUCN), 1986). For instance, if a zone is named habitat protection then it should not permit activities that impact on habitat. Such basic associations have been used by the IUCN to develop guidelines for MPA management jurisdictions to ensure a reasonable degree of consistency is applied in all aspects of MPA planning and management (Day et al., 2012). Inconsistencies with the application of MPA rules over time are not uncommon and are by no means isolated to NSW. For example, a key objective of the Great Barrier Reef Marine Parks Representative Areas Program was to ensure more consistent zoning provisions across the Marine Park (Great Barrier Reef Marine Park Authority, 2002). In our case study the analysis of activities permitted in zone types revealed considerable variation amongst the NSW system of marine parks. Twenty-four inconsistencies out of 76 activities were identified in HPZs alone, of which ten were determined to be notable variations. Although, it might be expected that some minor inconsistencies might emerge from localised planning processes, in the main there is little reason for inconsistency, particularly as the management (e.g. input controls) of activity is standardised and major habitat categories are universally applied for planning purposes in NSW marine parks (Malcolm et al., 2010). Secondly, the distances between the marine parks are relatively small (ranging from 39 km to 263 km to the nearest adjacent marine park boundary - NSW Marine Park GIS database),

consequently marine environments are not so drastically different to justify different rules for activity types within zones. Probably the main reason for the observed inconsistency is that planning and mapping information have improved as each park has been declared and planned, resulting in deviations in allowable activities over the 10 years roll out of marine parks. Lord Howe Island Marine Park is a stand out example in that this MPA did not include a general-use zone in its design, because there was no commercial fishing or trawling in the waters prior to its establishment. The most recent planned MPA, the Batemans Marine Park, is another good example in that its zoning plan has prohibited trawling in the GUZ, principally as a consequence of local views on habitat impacts and available funding for commercial licence buy-out (NSW Marine Parks Authority, 2007). Examining the overall pattern of uses within NSW mainland marine parks against optimal ERA outcomes, it is encouraging to see the most recent marine park planned in NSW, the Batemans Marine Park, is the 'best fit' with the respect to risk reduction (Table 3.4 and 3.5). This is an indication that the planning and creation of NSW marine parks is improving in terms of meeting sustainability objectives.

### 3.4.2 Utility of managed use zones.

Historically, there may have been good reasons to include general-use areas in multiple use marine parks, the primary reason being that fisheries agencies did not have a good track record of incorporating ecosystem considerations in their management of fisheries (Lauck et al., 1998). However, there is clear evidence that this trend is changing rapidly and in many countries there is solid progress and reform towards Ecosystem Based Fisheries Management (EBFM) (Pitcher et al., 2009). International agreements and targets now require the introduction of EBFM and for MPA systems to be established by 2012 (Pitcher et al., 2009). Thus, in the not too distant future, it is reasonable to suggest that in some developed countries, management arrangements for areas outside marine parks may become similar to current GUZ management. This would mean that unrestricted managed-use zones, in particular peripheral zones or GUZs, might not have a role under well-implemented EBFM. Comparing current multiple use MPA zoning schemes around the world, it is apparent that in many cases peripheral zones allow for most uses found outside MPA

boundaries, such as commercial long line, gillnetting, trawling, aquarium collecting, spearfishing and infrastructure development (Great Barrier Reef Marine Park Authority, 2002; Department of Conservation and Land Management, 2005; Fraschetti et al., 2005). A recent review by Gaudin and De Young (2007) showed that in Mediterranean MPAs, commercial fishing was allowed in all peripheral zones, and that in 50% of these cases, there was 'open' access to these resources. Similarly, in the NSW case study, almost every fishery type and method was found to be permitted in GUZs. This reality adds weight to the discussion of whether GUZs have any significant utility with respect to achieving MPA sustainability objectives. The question needs to be asked is how closer to MPA goals are we with a multiple use structure that allows for unrestricted or high risk uses against that of the no regime 'counterfactual' state: a question considered by some scholars to be paramount in determining how effective an institutional system is in delivering what it was established to achieve (Hovi et al., 2003; Mitchell, 2006). Another point worth noting is that the optimal 'or effective' number of zones for multiple use marine parks has also been questioned in the past (Kelleher, 1999; Francour et al., 2001; Loos, 2006). Too many zone types contribute to confusion and difficulties with compliance, which in turn lead to greater costs for management (Francour et al., 2001; Erdmann and Merrill, 2002). It could be argued that a tangible benefit resulting from the removal of GUZs would be more simplified and cost effective multiple use MPA implementation.

### 3.4.3 Implementation

It is important to be aware that ERA is not in itself a decision and, in our case study, there was no expectation that the process would rationalise all the social, economic and political factors that would be expected in the planning of multiple use MPAs. The results of the case study, however, indicated that permitted activities need to be more restricted in both HPZs and GUZs, as well as, consistently applied across MPAs in NSW. High-risk activities currently permitted in GUZs, such as trawling and meshing, would not be permitted if the ERA suggestions were adopted. This would have immediate affects of depicting a clear gradient of activities permitted within and outside MPA boundaries. With changes to GUZ arrangements,

HPZ changes would be needed to again establish a gradient of permitted activities. Consequently, adaptive management processes would need to be adopted in order to implement these new scenarios. As the ERA outcomes represent significant changes to HPZs and GUZs, the appropriate time to introduce change is during a formal review of existing management plans. Although it would be a challenge to implement the ERA zoning outcomes, it is not an intractable task. Probably the biggest task would be changing the mindset of the users and broadcasting the benefits of such changes to the community. In regard to dealing with commercial fishing impacts, it would be possible to re-zone a marine park with only few impacts to existing uses. For example, current locations where hauling and fish trapping occur in HPZs could become GUZ, without any shift of use or impact on these fishers. In respect to implementing restrictions in GUZs this could be achieved by a number of ways, for example: through modification of marine park boundaries to remove important commercial fishing grounds (Rayns et al., 2006); buy-back of licences or other forms of compensation to the fishery; or, phase-out arrangements of fishing practices over a given time and space to allow for impacts of changes to be absorbed. In the interim, introduction of low impact gear technology (e.g. by-catch reduction devices), vessel monitoring systems, and capping effort would be prudent to minimise risks of these activities on marine park objectives. It is important to acknowledge that little would be gained by implementing any of these changes if funding was not available to adjust fishing effort to ensure that displaced fishing effort did not result in unsustainable fishing outside the marine park.

## 3.5 Conclusions

Determining the 'effectiveness' of managed-use zones in achieving ecological sustainability, and their respective contribution to overall objectives of multiple use marine parks is critical in reviewing their utility. Systematic assessment of activities that are permitted in managed-use zones, ensuring that they are consistent with their objectives, is the first test step to determine if managed-use zones are adequately meeting their ecological objectives. The ERA process proved to be an effective tool in ratifying what activities are appropriate within managed-use zone types to meet

their respective zoning objectives. ERA also highlighted variations of management approaches and provided useful feedback for adaptive management, planning and policy development. Although challenging, implementing ERA outcomes in order to standardise zoning activities and improve their potential at meeting marine park ecologically sustainability objectives is necessary in the medium term, as MPA arrangements that are put in place now will only be more difficult to change over time. The NSW case study illustrates that achieving multiple use MPA objectives may not be realised if high-risk activities that are inconsistent with zoning objectives are permitted in managed-use zones. With implementation of EBFM and MPA targets over the next decade, the utility of GUZ or unrestricted managed-use zones is debatable.

# 4 THE EFFECTIVENESS OF SECTORAL INTEGRATION BETWEEN MARINE PROTECTED AREA AND FISHERIES AGENCIES.

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## 4.1 Introduction

Ensuring the effective management of Marine Protected Areas (MPAs) is equally, if not more important to their establishment. Internationally, there is acceptance of the fact that without effective management (for example, adequate compliance, size and regulations), MPA objectives will not be achieved and the high order goal of global marine biodiversity conservation and maintenance of ecological processes will not be realised (Agardy et al., 2003; Edgar et al., 2014). In order to manage MPAs effectively, it is also recognised that cooperation, coordination and collaboration between institutions with mandates over activities in the ocean are essential. Such partnerships are not only for consistency, but also to ensure the comprehensive protection of the marine environment as part of sustainable development (FAO Fishery Development Planing Service, 1996; Kjell, 2003; Roff, 2005; International Seabed Authority, 2012). Central to the success of MPAs is that they are not managed in isolation, but implemented within the larger framework of ecosystem-based management (EBM), and integrated with fisheries management[72] (Allison et al., 1998; White et al., 2014). However, MPAs around the globe have been, and continue to be, implemented without the level of integration[73] that is required to meet their conservation and ecological sustainability goals, particularly in terms of fisheries management (Kelleher and Recchia, 1998; Ehler, 2003; Hockings and Giligan, 2009; Yates et al., 2013; Van Trung Ho et al., 2014). It has even been suggested that the long-term failure of conservation and fisheries institutions to integrate their efforts to address the governance of preservation, conservation and

[72] It is recognised that catchment integration with MPA agencies is also critical for MPA success, and particularly so for coastal MPAs. Although integration with catchment is not within the scope of this thesis, for completeness purposes Appendix A of this thesis includes an extract for the NSW Marine Parks Advisory Council on NSW marine park integration with catchment management, prepared by the author during the thesis preparation.

[73] For the purposes of this paper, integration is defined as the cooperation, coordination and collaboration of government institutions (Keast, 2007; Ehler, 2005).

sustainable management of the marine environment remains as one of the key barriers to EBM and MPA objectives being realised (Kelleher, 1999; Ehler, 2005) Fisheries management agencies have a tendency not to give adequate regard to MPA management needs, and the same is true for MPA (or nature conservation) agencies in regard to fisheries management interests (Baelde, 2005). It is arguable that this non-alignment is derived from their legislative objectives. Generally, MPA agencies have an overriding objective of protecting all components of marine biodiversity and ecosystems (especially threatened species) with their spatial design based on ecosystem representation. Fisheries agencies on the other hand, though responsible for aspects of biodiversity conservation, have a clear focus on developing fisheries and achieving optimal and sustainable utilization of fish as a harvestable resource (Fletcher et al., 2010; Food and Agriculture Organisation of the United Nations, 2011). In many regions of the world, and also historically, this core difference in legislative objectives has led to considerable public and stakeholder confusion, particularly when fishery agencies establish "fishing closures or fish refuges" (and sometimes also called MPAs), but which usually have management objectives that differ significantly from MPAs that are established by a nature conservation agency (Ward et al., 2001). As a consequence, their respective management principles, performance criteria, and their optimal designs are different. For example, the effectiveness of a fishing closure would be dependent on their benefit to a fishery by improving sustainability and harvest rates, and its overall integration with other fishery management tools (Baelde, 2005). If the criterion for conserving an area, however, was based on broader biodiversity conservation objectives and/or threatened species, the measure of effectiveness would be quite different from that of a fisheries management measurement. This may seem obvious, yet it is an on-going issue that is often incorrectly perceived by both the public and management authorities (including politicians), with ecological, social and political consequences. Despite these differences being a barrier to integration, addressing the confusion between fisheries and MPA objectives is a very desirable outcome of an integrated approach (Guidetti et al., 2008).

Integration efforts between fisheries agencies and MPA agencies, however, are blemished with poorly designed and/or poorly implemented partnership arrangements, which is the focus of this paper. Successful integration between MPA

and fisheries agencies, in particular the success of their partnerships and outcomes of these arrangements, are critically important to ensure improvement in the integration of their sectoral services over time and delivery of ecosystem based fisheries management and MPA outcomes (Food and Agriculture Organisation of the United Nations, 2011). This paper revisits the reasons why fisheries and MPA agency partnerships are beneficial and necessary, and the complex barriers against achieving successful integration. It also discusses International and Australian examples of formal partnership agreements between these institutions, and provides an assessment framework and suggested criteria for evaluating partnerships specific to these agencies, which in turn have application use in other economically developed countries, with similar institutional situations, such as experienced in Ireland, the United Kingdom and Canada (Heck et al., 2012; Salomon and Dross, 2013; Yates et al., 2013). The framework may also be of assistance for developing countries with MPA and fisheries institutional cooperation issues, such as those experienced in the Philippines and South-east Asia, to improve integration and the quality of institutional relationships (Horigue et al., 2012; Bennett and Dearden, 2014; Van Trung Ho et al., 2014). As a test of the assessment framework, a case study is presented that discusses the effectiveness of the partnership in place between fisheries and MPA agencies in New South Wales (NSW), Australia.

### 4.1.1 Need, benefits and the barriers of fisheries and MPA management integration

The need for, and benefits of, integration between MPAs and fisheries management has been well documented (Rowley, 1992b; Kelleher and Recchia, 1998; Cicin-Sain and Belfiore, 2005; Jentoft et al., 2007; Rauschmayer et al., 2008). The *World Summit for Sustainable Development* (WSSD) held in Johannesburg in 2002 promoted MPAs as a key part of the solution to marine conservation, but recognised that MPAs cannot be effective in isolation, and must be incorporated within the broader framework of integrated management (Spalding et al., 2013). The conservation of marine biodiversity and future ecosystem service benefits is dependent not only on the effectiveness of MPA management, but also on the management of their surrounding environments. As a result, the successful

integration of MPAs into the wider seascape hinges on collaboration with fisheries and other marine management agencies.

The poor levels of integration being documented in current literature all illustrate that the need to integrate fisheries and MPA management is of global significance. For example, Salomon and Dross (2013) concluded that the agreed European Natura 2000 network of MPAs (by European Commission) would not be achieved until disparate sectoral responsibilities and objectives were resolved. Analysis of MPA management in British Columbia by Heck et al. (2012) concluded that there was a great need for improved intergovernmental collaboration, with the management of fisheries being associated MPA performance in 15% of those MPAs assessed. Complex governance structure and lack of interdepartmental co-operation are considered by Yates et al. (2013) to be severely hindering Northern Ireland's ability to meet Ecosystem Based Management (EBM) commitments. They argue that fisheries management needs to incorporate wider ecological considerations and that cooperation between relevant government departments is required. Tension between approaches to nature conservation and fisheries management also exist in other parts of Europe (De Santo, 2013a). This tension is highlighted when addressing the conservation of habitats and species, which are under threat from fishing activities. De Santo (2013a) believes that the "bifurcation" between fisheries management and nature conservation poses a "significant challenge" for European Union (EU) States to effectively govern their offshore marine environment. Likewise, in South Brazil conflicts in fisheries management is listed in the top three threats for the Baleia Franca Environmental Protection Area; and institutional partnerships to deal with these conflicts are considered to be very important to cope with the limitations of the environmental agency (Macedo et al., 2013). Jones (2013) has also argued that improving cross-sectoral integration is needed for MPA resilience, referring to the major challenge of cross-sectoral and cross-jurisdictional integration in the US, as illustrated by the management of the National Marine Sanctuary System. Examples of fisheries-conservation agency tensions exist worldwide, and include: the Bahamas where regional issues have highlighted the tenuous linkages between fisheries and conservation agencies (Wise, 2014); Hawaii, where the slow pace of agency's bureaucracy is viewed to be a serious hurdle for responding quickly to marine resource issues (Rossiter and Levine, 2014); Japan, where MPAs managed by the

Ministry of the Environment need an increased coordination effort from fisheries agencies to increase the network of the MPAs (Yagi et al., 2010); and, in Canada, where a recent internal review of the Department of Fisheries and Oceans found that a persistent disconnect existed between the fisheries and oceans mandates (Fisheries and Oceans Canada, 2012 ).

Ward (2002) has listed over 50 attributes of MPAs that could provide beneficial outcomes for fisheries. Of particular significance, MPAs have the potential to act as baselines to measure harvesting effects and support EBM (Jamieson and Levings, 2001). They also: reduce risk of overfishing; encourage adult export and larval spill (Harrison et al., 2012); support management of population structure (Food and Agriculture Organisation of the United Nations, 2011); maintain representatives of habitat and species structure (Cote and Finney, 2006); act as a buffer against recruitment failure; and, have the potential enhance local fishing (Rowley, 1992a). Integration also delivers additional benefits to MPA management over what a MPA agency in its own right might achieve, including: improved vessel monitoring and compliance (Claridge Natural Environment Consulting, 1997); access to resource management information and cost savings (Kozuch and Kozuch, 2010); improved access and engagement with fisheries stakeholders; more effective and sustainable resource use (Pressey et al., 2013); reduced impact on users; and potentially better located and designed MPAs (Ward, 2002) These benefits derive as a consequence of several factors, such as: clearer delineation of objectives; access to better information and expertise; more productive engagement and support from stakeholders; and environmental monitoring capability (Hastings and Botsford, 2003; National Fisheries Conservation Center, 2004; Barr and Possingham, 2013). One poignant observation is that MPAs in their own right serve as instruments for integration; providing a focus for broader seascape integration (Salomon and Dross, 2013). From a central government and political viewpoint, a successful partnership between fisheries and MPA agencies has the potential to result in improved local and regional economies, cost savings and community support, and greater sense of community and community cohesion (Claridge Natural Environment Consulting, 1997). At the agency level, the benefit of an effective partnership brings with it a partnership benefit in its own right, or ‘collaborative advantage’ to the agency, which includes tangible efficiencies, new products, and access to broader skill base. Such

advantages cannot be realised except through a successful partnership (Kozuch and Kozuch, 2010).

With evidenced-based benefits and international calls for integration between MPA and fisheries agencies, many authors have asked the question why it is that integration between these agencies remains so illusive (Ehler, 2005; Jentoft and Chuenpagdee, 2009). One reason is that the barriers between these agencies are often very complex, with agency cultures, individual preferences, stakeholder perceptions and political drivers all playing roles that thwart integration. Hudson et al. (1999) have categorised these barriers into five main areas, all of which are relevant to the fisheries and MPA agency integration problem. These categories are: 1) Structural differences (fragmentation of service responsibilities both across and within agency boundaries); 2) Procedural differences (planning and budgetary horizons, cycles and procedures); 3) Financial differences (funding mechanisms and bases and flows of resources); 4) Professional differences (values, self-interest, threats to job security, and conflicting views about user interests and roles; and, 5) Status and legitimacy (self-interests, concern for threats to autonomy and domain, and differences in legitimacy between the agencies). It is well recognised that government agency conflicts are often caused by ministerial and executive directions (i.e., category 4 and 5) and their respective legislative obligations and associated incongruent processes, (i.e., categories 1, 2 and 3 above) (Bess and Rallapudi, 2007). Differing approaches to stakeholder engagement, and impact assessment of the negative impacts of MPAs on commercial fishing (category 2 and 4) have also been identified as being barriers to integration, particularly from fisheries perspective (Baelde, 2005). Over time sectoral directions and singular processes have shaped organisational cultures that are inherently competing and often parochial, which is routinely depicted by fisheries and MPA agency relationships, where 'turf' issues exist over allocation (use rights), power and authority over access to marine resources and users (Cicin-Sain, 2002; Bess and Rallapudi, 2007; Kozuch and Kozuch, 2010).

Partnership agreements between fisheries and MPA agencies, sectors and jurisdictions have been applied in a number of economically developed countries, at both national and state level jurisdictions, for example, formal agreements between fisheries and MPA agencies are in place, or planned in New Zealand, Australia, OSPAR states, USA and Canada (see Table 4.1). Recently, the Western Australian

Government (WA) developed principles and guidelines for Collaborative Operational Plans (COPs) between the WA Department of Conservation and WA Department of Fisheries for each MPA, which recognise that both agencies have significant responsibilities and resources committed to the protection and sustainability of WA's marine resources, and essential that they work together in a collaborative way (Department of Environment and Conservation and Department of Fisheries, 2006). WA principles require the COPs to articulate the roles of the agencies, and require recognition of respect, cooperation, teamwork, communication and on-going involvement with MPAs. The agencies are required to prepare joint annual reports for both departments, including performance against targets, outputs and outcomes and efficiencies achieved (Department of Environment and Conservation and Department of Fisheries, 2006). Common to these formal agreements is that they define roles and responsibilities of each agency in the context of MPAs and aim to define a process for communication between the parties. The utility of formal agreements with respect to evaluating partnerships is discussed later in this paper.

Table 4.1 - Examples of fisheries and conservation agency agreements in place or planned involving MPAs.

| MPA and Fisheries Agencies, Organizations and Jurisdictions | Objectives of agreements | Content of agreement | | | | | | Service funding | Dispute system | Performance and reporting |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MPA design and planning | MPA policy development | Data sharing and research | Stakeholder engagement and communication | Vessel monitoring/ surveillance/ joint patrols | Asset sharing, cross-authorization, legal support | | | |
| North-east Atlantic Fisheries Commission (NEAFC) and the OSPAR Commission. | To promote mutual cooperation towards the conservation and sustainable use of marine biological diversity including protection of marine ecosystems in the North-East Atlantic. | ✓ | ✓ | ✓✓ | *x* | *x* | *x* | *x* | *x* | *x* |
| Channel Islands National Park, California and the Department of Fish and Game. | To coordinate enforcement training, patrols, intelligence, planning, communications and case prosecutions. A local cooperative agreement under the MOA provides funding for DFG to assist in patrolling MPAs. | *x* | *x* | ✓ | ✓ | ✓✓ | ✓✓ | ✓ | *x* | *x* |
| Fisheries and Oceans Canada and Environment Canada. | Planned agreement for interdepartmental cooperation and enhanced collaboration for management and monitoring of MPAs, including site-specific collaboration to develop management plans that link MPA objectives and other conservation objectives (e.g. species at risk, fisheries, biodiversity, unique ecosystems). | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | *x* | *x* | *x* |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand Dept. of Conservation and N.Z. Ministry of Fisheries. | To assist with interactions between agencies to progress applications for MPAs. | √ | √ | √√ | √√ | *x* | √ | *x* | √√ | *x* |
| Parks Australia and Australian Fisheries Management Authority. | Sharing of compliance information, compliance monitoring, delegation of enforcement functions, development of complementary and consistent compliance policies and systems, including legislative provisions, case and legal support, specialist investigative services, and communication material. | *x* | *x* | √√ | *x* | √√ | √√ | √√ | √√ | √ |
| Great Barrier Reef Inter-government Agreement between the Commonwealth of Australia and State of Queensland. | Long term protection of the GBR; establish forum; maintain complementarily management arrangements; joint program of field management. | *x* | √ | √ | √ | √√ | √√ | √√ | *x* | √ |
| Western Australian Environment and Conservation and WA Dept. Fisheries. | To deliver more effective and efficient management of MPAs through greater cooperation and integration between agencies where there is an overlap of responsibility. | *x* | *x* | √√ | √√ | √ | √√ | *x* | √√ | √√ |

(*x* = not included in the agreement; √ = included in the agreement; **√√** = comprehensively addressed in the agreement).

### 4.1.2 Evaluating partnerships between fisheries and MPA agencies.

There are no standard guidelines for the specific purpose of evaluating partnerships between fisheries and MPA agencies (Horigue et al., 2012); however, much work has been done in the areas of MEA evaluation and intersectoral partnership governance more generally. Notably, Underhal (1992) Helm and Sprinz (2000) and Hovi (2003) have analysed and made recommendations to measure the effectiveness of environmental agreements, using methodologies that compare the counterfactual against actual performance (impact). These methodologies are appealing, but are complex when multiple outcomes and variants of integration (individual and organizational) are being assessed, as is the case for fisheries and MPA agency agreements (Bernauer and Siegfried, 2008). Considerable work has been invested by the USAID Bureau for Policy and Program Coordination, and the UK Building Partners for Development and Department of Public Administration with the George Washington University in developing frameworks for assessing the impact of intersectoral partnering, (Charles and McNulty, 1999; Brinkerhoff, 2002; Caplan et al., 2007; United Nations Global Compact Office, 2007). USAID Policy and Coordination Program's partnership assessment framework consists of three domains, which are then evaluated: 1) Values and capacity of the partnership; 2) Process of partnering; and 3) Impact of the partnership (Charles and McNulty, 1999). The inclusion of these domains support the notion that performance of partnerships involves not only the an assessment of the results of the collaboration, but assessment of how the partners work together, i.e. taking into account the partnership factors that may influence intended outcomes (Brinkerhoff, 2002). These domains are segregated into sub-components or dimensions and into specific categories that focus evaluation, using indicators and measures that are identified on a case-by-case basis, subject to the partnership's characteristics.

Performance indicators for fisheries and MPA integration have been proposed by a number of authors, but there is no common set that addresses the range of issues associated the performance of partnerships between these agencies (Ehler et al., 1997; Food and Agriculture Organisation of the United Nations, 2011). Furthermore, these indicators tend to be part of a broader set of management indicators and, consequently, are either too broad or simplistic to be of value to comprehensively evaluate the performance of agency partnerships. For example indicators that have

been used in a number of MPA performance assessments, such as: “Are agencies integrated”; “Is an agreement in place”; “Is there a sound governance system in place”; or “Do the agencies engage in systematic meetings” are not sufficient to evaluate the performance of the partnership (OSPAR Commission, 2007; Bernauer and Siegfried, 2008; Hockings and Giligan, 2009). The IUCN guidelines for assessing the management of protected areas is widely used for rapid assessment of effectiveness of MPAs (OSPAR Commission, 2003; Hockings et al., 2006; Hockings and Giligan, 2009) The guidelines focus on the evaluation of management indicators across the entirety of the management decision cycle, using six categories, i.e. context, planning, process, input, output and outcomes (Pomeroy et al., 1997). These guidelines support a very large suite of indicators for MPA performance, but only a few indicators are applicable to evaluating fisheries and MPA partnerships. Integrated Coastal Management (ICM) performance indicators, which include biophysical, socioeconomic and governance outcomes at global, national and local levels are also generic in nature and not pitched at a level that assists assessing fisheries and MPA agency partnership performance, albeit integration between these agencies is highlighted as an essential prerequisite for Integrated Coastal Management (Food and Agriculture Organisation of the United Nations, 1999; Belfiore et al., 2003; Belfiore et al., 2004; Christie et al., 2005; Powell et al., 2009).

## 4.2 Case Study - MPA and fisheries agency partnership in New South Wales, Australia.

The State of New South Wales is located on the south-eastern coast of Australia. In 1997 the State government proclaimed the *NSW Marine Parks Act 1997* to conserve marine biological diversity and marine habitats by declaring and providing for the management of a comprehensive system of marine parks; and to maintain the ecological processes within these marine parks (Read and West, 2010). Prior to this Act, marine reserves were declared under fisheries legislation and managed solely by the fisheries agency. This arrangement raised internal agency problems associated with marine conservation versus development and use of fish resources, and, prior to the new Act, less than 1% of the coastal and estuarine marine resources were in any form of conservation protection. This situation fell

considerably short of constituting a Comprehensive, Adequate and Representative (CAR) Reserve system, which was being discussed and endorsed at the Australian national level (Grey and O'Gorman, 1998; ANZECC Task Force on Marine Protected Areas, 1999a).

The *NSW Marine Parks Act 1997* was proclaimed to change this order, and established a bipartisan Marine Parks Authority. A public strategy was jointly developed by the agencies to guide the establishment and planning of NSW MPAs. Embedded in this strategy were some high-level policies directions, notably guidance on CAR principles and a target to establish at least one large marine park in each bioregion within NSW. The strategy also recognised that joint management, liaison and cooperation between the fisheries and conservation agencies were essential to achieve the goals of the MPA system, and a joint agency agreement for their respective roles in administering marine parks was developed (Marine Parks Authority, 2001a). Despite the disparate views of the agencies over MPA locations, design, zoning targets (e.g. in respect to implementing IUCN Cat II zoning), under the helm of the jointly managed Marine Parks Authority, six new marine parks where operational with statutory zoning plans in place by 2007. The comparatively rapid development of MPAs in NSW waters and the associated increase in marine conservation areas during this period, with zones closed to fishing, resulted in a period of intense public debate, particularly among recreational and commercial fishers (Voyer et al., 2013a). Consequently, when a change of government occurred in 2011, all administrative responsibilities of MPAs were returned to the fisheries management agency. An independent scientific audit with the goal of considering the future of MPAs in the state concluded that there existed little evidence of coordinated activity with respect to the management of fisheries within the NSW marine estate and the general public (Beeton et al., 2012). The audit also concluded that although there existed a level of cooperation between the agencies in the area of research and compliance surrounding MPAs, this effort was not accompanied in building relationships between marine park managers and the diversity of stakeholders (Beeton et al., 2012).

### 4.2.1 Method - NSW MPA and fisheries partnership evaluation

A list of 46 performance indicators has been compiled that are specific to fisheries and MPA partnerships (Table 4.2). These indicators were developed after a review of the assessment frameworks proposed by Charles and McNulty (1999) and Brinkeroff (2002); the IUCN MPA effectiveness framework and indicators by Hockings et al. (2000) and Hocking and Giligan (2009); and, those used the W.A. Department of Environment (Department of Environment and Conservation and Department of Fisheries, 2006). These performance indicators were grouped into the three domains of partnership performance as proposed by Charles and McNulty (1999), namely: 1) Values and capacity of the partnership; 2) Process of partnering; and, 3) Impact of the partnership. Weighting/ranking was not applied to the indicators; however, the methodology does not preclude this stage in the evaluation process.

Table 4.2 - Indicators for assessing the effectiveness of fisheries and MPA management agency partnerships (framework adapted from Charles and McNulty 1999, and indicators selected from Brinkerhoff, 2002 and Hockings and Giligan, 2009)

| Domain | Dimension | Indicators |
|---|---|---|
| VALUES AND CAPACITY (Context, planning and input that supports the Partnership) | ORGANISATIONAL CAPACITY<br><br>- Planning capacity<br><br>- Administrative Capacity<br><br>- Resource Capacity | VC1 - Relevant staff understand Fisheries and MPA management processes.<br><br>VC2 - Overlaps between fisheries and MPA governance are identified in the partnership.<br><br>VC3 - Information needs are identified, analysed and shared between the agencies.<br><br>VC4 - Appropriate funding and balanced resource exchange is available to implement fisheries and MPA partnership activities.<br><br>VC5 - Existence of partnership champions.<br><br>VC6 - A program to support training and skill development is developed and implemented to enhance partnership understanding. |
| | ORGANISATIONAL CULTURE<br><br>- Vision<br><br>- Common Issue<br><br>- Commitment to partnership | VC7 - A common vision of partnership goals is articulated by the agencies.<br><br>VC8 - Partnership objectives are clearly stated and give support to all aspects of MPA management, including: MPA identification and selection, management planning, stakeholder engagement and operations. |

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| | | VC9 - Objectives are clearly stated and support relevant aspects of fisheries management, including social and economic aims, gear risk assessment, and sustainable fishing practices.<br><br>VC10 - MPA and fisheries targets are identified, prioritised, agreed to by the agencies.<br><br>VC11 - Individuals involved in the partnership planning are well supported both internally and externally by the agencies.<br><br>VC12 - There is joint recognition of the agencies limitations and context, including legislative and political constraints. |
| | EXTERNAL ENVIRONMENT<br><br>- Capacity of individual Sectors<br><br>- Mechanisms for sectors to work together | VC13 - Roles and responsibilities between agencies are defined and understood internally and externally.<br><br>VC14 - There is mutual respect of each partner and shared understanding of partner drivers.<br><br>VC15 - An agreed decision-making process is understood, both internally and externally. Decisions are equitable and consistent.<br><br>VC16 - A joint public awareness and stakeholder engagement strategy is adopted.<br><br>VC17 - Agreed tasks are delivered by an agreement, which includes performance indicators. |
| PROCESS (Processes supporting the Partnership) | INTERNAL COMMUNCATION AND COLLABORATION<br><br>- Democratic practices<br><br>- Attitudes and behaviours | P1 - The partnership/agreement is explained and understood by relevant staff.<br><br>P2 - Inter-agency and intra -agency steering groups are established to ensure MPA and fisheries tasks and targets are achieved.<br><br>P3 - Regular formal and informal meetings are scheduled and held by the steering groups and any associated working groups.<br><br>P4 - An agreed partnership work plan has been developed that specifies tasks (that are manageable and achievable) and implemented.<br><br>P5 - Information is effectively and appropriately organized, managed and disseminated though partner agencies and at all levels.<br><br>P6 - Financial arrangements associated with the partnership are agreed to and contributions are coordinated.<br><br>P7 - An independent conflict resolution mechanism is agreed and defined.<br><br>P8 - A process for monitoring and periodic review of the partnership/agreement is in place. |

| | | |
|---|---|---|
| | | P9 - A self-regulation process is put in place by each agency to facilitate partnership and compliance with agreement/s.<br><br>P10 - Partnership drivers for the agencies and key individuals are identified, in particular: incentives that encourage proactive support and engagement in the partnership; and disincentives that discourage non-compliance where an agreement is in place. |
| | EXTERNAL COMMUNCATION AND COLLABORATION<br><br>- Mechanisms for relating to other entities | P11 - An agreed joint public awareness and stakeholder engagement strategy is developed and implemented, with risks identified and treated. |
| IMPACT (Outputs and Outcomes generated from the Agreement) | IMPACT OF THE PARTNERSHIP ON MPA DECLARATION AND FISHERIES MANAGEMENT<br><br>- Resolution of issues | IM1 - MPA selection and design are supported by the partners.<br><br>IM2 - An economic and social impact assessment process for the fisheries sector (including commercial and recreational users) is endorsed and undertaken for each MPA.<br><br>IM3 - There is a fishery adjustment program, which defines agreed objectives and processes, and funding and timing agreed to.<br><br>IM4 - A fisheries gear risk assessment process is developed, with agreed fishing methods in MPA zones.<br><br>IM5 - Fisheries sustainability and population modelling adequately takes into account MPAs and fishery adjustments.<br><br>IM6 - A permitting and assessment process for fishing and related businesses in MPAs is agreed, developed and implemented.<br><br>IM7 - An enhanced surveillance and monitoring program is developed, implemented.<br><br>IM8 - Enforcement arrangements include cross authorization, joint patrols, effective use of assets, and legal support between the agencies.<br><br>IM9 - A joint research and ecological monitoring program is developed, implemented. |

| | | |
|---|---|---|
| | IMPACT OF THE PARTNERSHIP ON AGENCIES<br><br>- Sustainability of partnership<br><br>- Effect on partners | IM10 - There is improved advocacy of MPAs and fisheries management within the agencies.<br><br>IM11 - Agency culture is empowered and respected.<br><br>IM12 - Fisheries and MPA objectives are realized.<br><br>IM13 - Agency staffing skills are expanded and improved.<br><br>IM14 - Emerging issues and conflicts between agencies are identified early and quickly resolved. |
| | IMPACT OF THE PARTNERSHIP ON SOCIETY<br><br>- Social capital<br><br>- Enabling environment | IM15 -There is public and stakeholder awareness and support of the partnership arrangement.<br><br>IM16 - User conflicts over marine use are understood by partners, managed and reduced.<br><br>IM17 - There is transparent and justifiable decision-making.<br><br>IM18 - Marine users understand and comply with rules for MPAs and fisheries management. |

A qualitative assessment methodology similar to that developed for the Great Barrier Reef Marine Park Authority (GBRMPA) assessment of management effectiveness (Hockings and Giligan, 2009) is proposed for scoring each performance indicator using an expert group. Indicator scores are aggregated in each domain to assess the effectiveness of each component of the partnership. Members of the expert group are individually surveyed using the list of indicators and guided by standard questions that aid in scoring each indicator. Scoring by individual experts relates to their personal experiences and observations from their respective disciplines, perspectives and involvement in the partnership. Group members are not made aware of the identities of other members; this is designed so that individual views were not corrupted or compromised by group influences (i.e. sometimes referred to as 'bandwagon bias'), which is recognised as one of the biases of using human judgment (Hubbard, 2010). This approach also allowed anonymity and unfettered views to be expressed. Unlike the GBRMPA approach, consensus opinions are not sought. This allows for the range of scores, and divergences of opinions to be recorded. It is recognised that the use of expert groups has limitations and errors that need to be understood, particularly in respect to their analysis and

interpretation of qualitative data (i.e. ordinal scores compared to real quantities) (Hockings et al., 2006; Hubbard, 2010). Expert judgment is a practical option, however, for evaluation purposes when time, budget or data limitations preclude the development of analytical models (Ewing and Bartholomew, 2009). For comparison purposes, similar methodology used by Hockings and Giligan (2009) is applied to indicator scoring and evaluation. Indicators are scored from 1 to 4, whereby a score of 1 equates to 0–20% of the optimum; score of 2 equates to 21–50% of the optimum; score of 3 equates to 51–80% of the optimum; and a score of 4 equates to 81–100% of the optimum (Hockings et al., 2006). Individual scores are summed for each indicator. The minimum total score is the product of a score of 1 times the number of expert group members, and the maximum is the product of a score of 4 times the number of expert group members. Percentages are also calculated for each partnership component i.e. domain and dimension, which are subject to the number of indicators in each of these areas. A grading system is then applied to contrast and compare performance across the partnership components. For example, GBRMPA applied a generic grading system similar to that used for scholastic grading to indicator scores, which were scaled out of 40 (i.e. the maximum score for ten indicators). With total scores between 35 and 40 (>87.5%) graded as 'very good' performance; a score between 27 and 34 (>67.5%) = adequate or good performance; a score between 16–26 (>40%) = poor performance; and a score from 0–15 (<37.5%) = very poor performance (*Note* all grading systems are subjective and are subject to assessment errors, e.g. range compression errors, and accordingly interpretation of results must to be cognisant of such errors (Cox, 2008).

For the purpose of this case study, an expert group made up of past and present NSW MPA and fisheries agency personnel was selected, comprising 12 individuals with high-level understanding (average years of experience was approximately 8 years) and a comprehensive range of experiences associated with MPA and fisheries administration, including: MPA and fisheries policy; MPA and fisheries management planning; MPA and fisheries research; and, MPA and fisheries compliance. The experts were asked to score the 46 performance indicators developed previously, between 1 and 4. The 12 scores were summed and percentages calculated for each partnership domain and dimension, and then graded using a grading system similar to the GBRMPA approach (Hockings and Giligan, 2009). Indicator scores between

42–48 were graded as achieving ‘very good performance’; a score between 32–41 = good performance; a score between 19–31 = poor performance; and, a score from 12–18 = very poor.

When scoring indicators, participants found it easier (and more consistent) to make judgments by considering the frequency that an indicator was met by the partnership. For example, a score of 1 equates to the indicator being met rarely or on few occasions (i.e. up to 20% of the time), and a score of 4 equates to the indicator being met regularly and more than 80% of the time. Unlike the GBRMPA review process, external marine users (i.e. those individuals and groups that may be affected by the partnership) were not canvassed in the study; however, their inclusion would have likely improved the assessment, particularly to gauge external impacts of the partnership. Validity of the assessment would have also be improved if more that one data capture method was used, for example, external surveys and questionnaires and focus groups (Caplan et al., 2007). While this is acknowledged as a preferred approach for a more detailed and comprehensive evaluation, the resources required for such an analysis are often unavailable.

### 4.2.2 Results - MPA and fisheries partnership performance

The performance indicators aim to track progress success with regard to the nature of the partnership, the mechanisms and processes used by the partnership, and the impact of the partnership on government and society, both in terms of the objectives and activities. These three aspects of partnering, when performing well, provide the framework for achieving long term and sustainable outcomes for all partners (Charles and McNulty, 1999). Table 4.3 summarizes performance results at the domain and dimension levels for the partnership between fisheries and MPA agencies in NSW, as evaluated by the expert group. In respect to the values and capacity domain, both organisational capacity (i.e. the ability of the organizations to carry out the stated objectives) and organisational culture (i.e. organisational characteristics that hold the partnership together) had an average score of much the same (i.e. 53% and 57%), with indicators being met approximately only 50% of the time. Fisheries and MPA management processes appeared to be adequately understood by both agencies (*VC1* = 33). There was also an adequate degree of a

common vision for the partnership by the agencies (*VC7* = 31), and adequate understanding of the limitations of the agencies in the partnership (*VC12* = 31). Poor performance was scored for information needs being identified, analysed and shared (*VC3* = 19), and similarly for MPA and fisheries targets being identified, prioritized, agreed and transparent (*VC10* = 22), equating to indicators being meet around one-fifth of the time. With respect to values and capacity associated with the external environment (i.e. the political, social, legal and economic enabling context), performance indicators ranged from 19 to 26, with notably poor performance with regard to joint public awareness and stakeholder engagement (*VC16* = 19). Overall, the values and capacity domain indicated poor performance at 53%.

Table 4.3 - Summary of Domain, Dimension and Indicator scores for fisheries and conservation agency partnership performance in NSW, Australia.

| **Partnership Domains and Dimensions** | **Performance Indicator** | **Indicator Score** (Note: min =12, max = 48) | **%** | **Grading** |
|---|---|---|---|---|
| VALUES AND CAPACITY | | | 53 | P |
| Organisation Capacity | | | 53 | P |
| | VC1 - Relevant staff understand Fisheries and MPA management processes. | 33 | | G |
| | VC2 - Overlaps between fisheries and MPA governance are identified in the partnership. | 27 | | P |
| | VC3 - Information needs are identified, analysed and shared between the agencies. | 19 | | P |
| | VC4 - Appropriate funding and balanced resource exchange is available to implement fisheries and MPA partnership activities. | 24 | | P |
| | VC5 – Existence of partnership champions. | 28 | | P |
| | VC6 - A program to support training and skill development is developed and implemented to enhance partnership understanding. | 22 | | P |
| Organisational Culture | | | 57 | P |
| | VC7 - A common vision of partnership goals is articulated by the agencies. | 31 | | P-G |
| | VC8 – Partnership objectives are clearly stated and give support to all | 27 | | P |

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| | aspects of MPA management, including: MPA identification and selection, management planning, stakeholder engagement and operations. | | | |
| | VC9 - Objectives are clearly stated and support relevant aspects of fisheries management, including social and economic aims, gear risk assessment, and sustainable fishing practices. | 27 | | P |
| | VC10 – MPA and fisheries targets are identified, prioritised, agreed to by the agencies. | 22 | | P |
| | VC11 - Individuals involved in the partnership planning are well supported both internally and externally by the agencies. | 27 | | P |
| | VC12 - There is joint recognition of the agencies limitations and context, including legislative and political constraints. | 31 | | P-G |
| External Environment | | | 45 | P |
| | VC13 - Roles and responsibilities between agencies are defined and understood internally and externally. | 24 | | P |
| | VC14 – There is mutual respect of each partner with shared understanding of partner drivers. | 26 | | P |
| | VC15 -An agreed decision-making process is understood, both internally and externally. Decisions are equitable and consistent. | 20 | | P |
| | VC16 – A joint public awareness and stakeholder engagement strategy is adopted. | 19 | | P |
| | VC17 - Agreed tasks are delivered through a formal agreement, which includes performance indicators. | 20 | | P |
| PROCESS | | | 46 | P |
| Internal communications and collaboration | | | 48 | P |
| | P1 - The partnership/agreement is explained and understood by relevant staff. | 31 | | P-G |
| | P2 - Inter-agency and intra -agency steering groups are established to ensure MPA and fisheries tasks and targets are achieved. | 29 | | P |
| | P3 - Regular formal and informal meetings are scheduled and held by the steering groups and any associated working groups. | 32 | | G |
| | P4 – An agreed partnership work plan has been developed that specifies tasks (that are manageable and achievable) and implemented. | 21 | | P |

| | | | | |
|---|---|---|---|---|
| | P5 - Information is effectively and appropriately organized, managed and disseminated though partner agencies and at all levels. | 20 | | P |
| | P6 – Financial arrangements associated with the partnership are agreed to and contributions are coordinated. | 24 | | P |
| | P7 - An independent conflict resolution mechanism is agreed and defined. | 17 | | VP-P |
| | P8 - A process for monitoring and periodic review of the partnership/agreement is in place. | 17 | | VP-P |
| | P9 - A self-regulation process is put in place by each agency to facilitate partnership and compliance with the agreement/s. | 17 | | VP-P |
| | P10 – Partnership drivers for the agencies and key individuals are identified, in particular: incentives that encourage proactive support and engagement in the partnership; and disincentives that discourage non-compliance where an agreement is in place. | 24 | | P |
| External communications and collaboration | | | 25 | VP |
| | P11- An agreed joint public awareness and stakeholder engagement strategy is developed and implemented, with risks identified and treated. | 12 | | VP |
| IMPACT OF THE PARTNERSHIP | | | 62 | P |
| Impact on MPAs and fisheries management | | | 71 | G |
| | IM1 - MPA selection and zoning are supported by partners. | 29 | | P |
| | IM2 - An economic and social impact assessment process for the fisheries sector (including commercial and recreational users) is endorsed and undertaken for each MPA. | 26 | | P |
| | IM3 - There is a fishery adjustment program, which defines agreed objectives and processes, and funding and timing agreed to. | 44 | | VG |
| | IM4 - A fisheries gear risk assessment process is developed, with agreed fishing methods in MPA zones. | 31 | | P-G |
| | IM5 - Fisheries sustainability and population modelling adequately takes into account MPAs and fishery adjustments. | 34 | | G |
| | IM6 - A permitting and assessment process for fishing and related businesses in MPAs is agreed, developed and implemented. | 38 | | G |

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|---|---|---|---|---|
| | IM7 - An enhanced surveillance and monitoring program is developed, implemented. | 33 | | G |
| | IM8 - Enforcement arrangements include cross-authorization, joint patrols, effective use of assets, legal support and reporting between the agencies. | 43 | | VG |
| | IM9 - A joint research and ecological monitoring program is developed, implemented. | 27 | | P |
| Impact on the Agencies | | | 52 | P |
| | IM10- There is improved advocacy of MPAs and fisheries management within the agencies. | 24 | | P |
| | IM11 - Agency culture is empowered and respected. | 24 | | P |
| | IM12 - Fisheries and MPA objectives are realized. | 36 | | G |
| | IM13 – Agency staffing skills are expanded and improved. | 26 | | P |
| | IM14 -Emerging issues, risks and conflicts between agencies are identified early and quickly resolved. | 15 | | VP |
| Impact on Society | | | 54 | P |
| | IM15 -There is public and stakeholder awareness and support of the partnership arrangement. | 23 | | P |
| | IM16 – User conflicts over marine use are understood by partners, managed and reduced. | 23 | | P |
| | IM17 -There is transparent and justifiable decision-making. | 21 | | P |
| | IM18 - Marine users understand and comply with rules for MPAs and fisheries management. | 36 | | G |

(Scores for each indicator are evaluated between 1–4, where: 1 equates to 0–20% of the optimum; 2 equates to 21–50% of the optimum; 3 equates to 51–80% of the optimum; and 4 equates to 81-100% of the optimum. The 12 individual scores are summed (with a minimum score =12 and maximum = 48). Domain and dimension level totals are expressed as a percentage of their total scores for the number of indicators. Total scores ranging from 42–48 = Very Good (VG); 32–41 = Good (G); 19–31 = Poor (P); and 0–18 = Very Poor (VP).

Partnership process includes both internal mechanisms for communication and collaboration within the partnership, as well as, external mechanisms for communication and collaboration outside of the partnership. Overall the scores associated with this domain where also low (46%), with internal communications scoring poorly in eight out of the ten indicators, including three indicators rarely being met (*P7*, *P8* and *P9*; see Table 4.3). For example, information dissemination, financial arrangements, conflict resolution and performance monitoring indicators scored poorly. Some indicators scored adequately, for example, the partnership

arrangements seem to be well understood by relevant staff (*P1* = 31*)*. In this regard, participants identified that a formal agreement was in place for compliance cooperation, which was viewed by all participants as a good example where those involved in the agreement were very aware of the obligations of the agreement. Partnership external communications scored relatively poorly, primarily because there was no agreed joint public and stakeholder strategy and that joint engagement was not or rarely undertaken (Table 4.3).

The impact of the partnership includes the impact of the partner activities (MPA and fisheries management) and on the common issues of the partnership, the impact on the partner agencies themselves, and the impact of the partnership on society (Table 4.3). Overall, this domain was graded well (62%) compared with the other domains. Indicators associated with the impact of the partnership on their common objectives, i.e. the partnership's affect on MPA establishment and fisheries management, where scored higher than any other aspect of the partnership, with participants scoring good performance for most indicators (i.e. at least 50–80% of optimum). Noteworthy, is the indicator score for the impact on common issues, with two indicators being graded with near maximum scores (*IM3* and *IM8*; see Table 4.3). Beneficial impacts cited by the participants included marine park selection (location); marine park establishment, in particular a significant increase in the percentage of MPAs to one-third of State waters; fisheries adjustment (a fisheries adjustment program was funded through the MPA program to off set the impact of new MPAs on fishing grounds), allowable fishing methods in zones (in partnership, allowable activities in each zone type where negotiated and agreed to at the initial stage of the making regulations); permitting process (fisheries permitting processes and jointly prepared policies were adopted); and enforcement arrangements (undertaken under a formal contractual agreement) were recognised as being outcomes that significantly benefited from the agency integration, and significantly more than what might have been achieved if there was no partnership (the counterfactual). The partnership's impact on the agencies themselves, however, was scored relatively low (52%). Identifying emerging issues, risks and potential conflicts between the agencies was poorly rated, with no strategy in place to be proactive in this area, and with conflicts not quickly identified and often left unresolved (*IM14* = 15; see Table 4.3). Participants were also of the view that the

partnership's impact on society was not often realized, particularly in regard to public awareness and support of the partnership, decision-making transparency, and public understanding of marine use management scoring quite low (i.e. *IM15* = 23, *IM16* = 23 and *IM17* = 21). A good result was recorded, however, for marine users understanding and complying with rules (*IM18* =35). Implications of these results, as well as general observations raised by questionnaire respondents are discussed below.

## 4.3 Discussion

### 4.3.1 Partnership Performance Indicators

The benefits achieved from integrated MPA establishment and the effectiveness of institutional collaborations between fisheries and MPA agencies are still largely untapped around the globe (Horigue et al., 2012; Jennings and Le Quesne, 2012; Yates et al., 2013). Yet integration of MPAs into seascape management is well recognised, and notably is included in the 2020 Convention for Biological Diversity goal statement (Yates et al., 2013). Currently, there is no universal way of measuring if effective integration is being achieved between these institutions, and where partnership evaluation has been measured it has been done so in very cursory way (Coad et al., 2008). The more we focus our attention on bridging these institutions together, and building partnerships to both design MPA networks and support integrated fisheries management, the more likely we will realize their collaborative benefits. Monitoring and evaluating the performance of their partnerships has this objective in mind. It is a constructive process, designed to highlight and acknowledge areas where things are going well, and identify where and how things can be improved. The large number of performance indicators (i.e. in this case 46) illustrates both the complexity and importance of issues to be considered in evaluating agency partnership performance. For example, it is paramount that a partnership has agreed common objectives and agreed performance indicators to evaluate the partnership's performance (Charles and McNulty, 1999). Mechanisms and processes that are put in place to encourage partners to work towards these agreed objectives are also essential to the partnership's success, in order to facilitate collaboration within the partnership, and with external stakeholders. Indicators that

reflect and support the monitoring of performance of these mechanisms are important, and of particular note, are the processes that govern relations among stakeholders, particularly recreational and commercial fishing sectors that might affect the partnership's performance. External communication and collaboration may be the most important requisites for partnership resilience and sustainability (Scholz et al., 2004; Muthiga, 2009; Vasconcelos et al., 2013). Charles and McNulty (1999) consider that parties should be able to communicate with stakeholders through both informal and formal means, ensuring respectful communication and coordination practices between both partners. The Western Australian MPA and fisheries agency partnership is a working example that places considerable emphasis on respect between and the agencies and coordinated stakeholder communication, which is prominent at all levels (Department of Environment and Conservation and Department of Fisheries, 2006).

Included on the list of partnership performance indicators used in this case study was an indicator that identifies the presence and adequacy of 'partnership drivers', as identified by Belfiore et al. (2003) and Caplan et al. (2007). Incentives that encourage a partnership to succeed, and disincentives that discourage non-compliance are essential safeguards for partnership sustainability (Caplan et al., 2007; Powell et al., 2009). Both partner agencies need to prosper from their relationship and receive a 'collaborative advantage' from the arrangement for a partnership to be sustainable (Caplan and Jones, 2002; Kozuch and Kozuch, 2010). For example, fees for service arrangements, such as the Channel Islands National Park, California and the Department of Fish and Game arrangements (Table 4.1), and the MPA and fisheries compliance arrangements in NSW identified in this case study, have used MOUs and fee for service contracts resulting in both agencies benefiting with returns from the partnership. Such tangible outcomes are powerful drivers, which serve to maintain the partnership. Partnership drivers, in whatever shape and form, need be robust enough to see the partnership through time to achieve the common objectives. The drivers for the W.A. fisheries and environment agencies partnership are potent, with agencies having to annually report on the effectiveness of the integration with one another under a MOU, and to demonstrate efficiencies achieved for each MPA (Department of Environment and Conservation and Department of Fisheries, 2006).

### 4.3.2 New South Wales MPA and fisheries partnership evaluation

The rapid assessment of partnership effectiveness between fisheries and MPA agencies in NSW illustrates the complexity of issues to be evaluated to better understand the partnership performance. The case study has indicated that the partnership values and process indicators generally scored low and that improvements in this area of the partnership are desirable particularly for dealing with internal communications (*P7–P9*), and external communications e.g. public stakeholder awareness, and risk management (*P11*). Despite this, several very positive and significant impacts have been generated by the partnership over time. The case study has indicated that the impact of the partnership on MPA and fisheries management (*IM1–IM9*) has been significantly beneficial. In particular, establishing a representative system of MPAs, effective structural adjustment of impacted fishing grounds were identified as benefiting from the integration. Integration between the agencies was suggested by participants to be at best with compliance, which was also recognised in the NSW MPA audit report as an example of successful integration (Beeton et al., 2012).

Poorly performing partnership values/capacity and processes make it a struggle for any partnership to manage with emerging internal and external issues and sustain performance over time (Charles and McNulty, 1999). Although early benefits might result from of the initial phase of a partnership, sustainable achievement over time is problematic when mechanisms for managing the partnership itself are not in place or maintained. All partnership domains need to be effective to ensure sustainable and long term beneficial impacts of the partnership (Caplan et al., 2007). Many of concerns of overlapping functions and interests of MPA and fisheries agencies around the globe, could be addressed by focusing partnership development in the areas of values/capacity and processes, to delineate and define roles in progressing an integrated approach to marine management (Jones et al., 2013; Salomon and Dross, 2013; Bennett and Dearden, 2014). Effective partnership processes between MPA and fisheries agencies to support and manage stakeholder engagement are recognised as essential to progress an integrated approach to MPAs and fisheries management, particularly in South-east Asia and other economically developing areas (Muthiga, 2009; Horigue et al., 2012; Van Trung Ho et al., 2014). In this regard, the NSW fisheries and MPA partnership is not that different. The recent

independent audit of NSW MPAs identified that administrative governance between the agencies required improvement to facilitate public service delivery (Beeton et al., 2012). The general view of participants involved in the NSW case study was that an integrated approach to communication and engagement with marine users rarely occurred between the agencies, and that there were no arrangements in place to identify and manage emerging external stakeholder issues and risks. Awareness of these process issues is a significant outcome of the case study, and helps guide priorities for management in the short term. Public understanding and engagement and the management of associated risks and public expectations in the context of the long term benefits of MPAs are seen as some of greatest risks to developing and sustaining systems of MPA (Voyer et al., 2012; Jones et al., 2013) In relation to the building of public unrest concerning MPA management in NSW, it is not unreasonable to suggest that the partnership process flaws identified in this study have been a contributing factor (Beeton et al., 2012; Voyer et al., 2013a; Patty, 2014). Fundamental to a successful partnership is effective processes information sharing and exchange (Caplan et al., 2007). This includes transparency and justifiable decision-making. Information sharing was considered to be lacking between the NSW agencies, indicating that new approaches might be needed to improve performance in this important partnership feature. One option to provide for effective sharing of information is to establish a formal agreement between the partners (Rauschmayer et al., 2008).

### 4.3.3 Utility of agreements to improve partnership performance.

The adoption of a partnership agreement (including MOU or contractual arrangement) has been identified as an indicator for performance both in the values/capacity and process domain areas (*VC17, P1* and *P8*). A discussion of formal agreements being a performance indicator is worthy in that formal agreements provide a framework for partnership expectations to be explained; communication processes to be articulated; negotiated outputs to be defined; performance indicators to be 'visible' and reported against; and resource commitments detailed. Importantly, agreements can facilitate a commitment by the partners to cooperate in policy development towards achieving common goals and supporting effective delivery of

social processes (Rehbinder, 1997). Most of the 46 performance indicators listed in Table 4.2 are relevant to formal agreements between MPA and fisheries institutions in one way or another (Department of Environment and Conservation and Department of Fisheries, 2006; OPSAR and NEAFC., 2008). For example, it would be expected that a partnership agreement would aim to: clearly state the objectives of partnership (*VC8*); identify any overlaps in governance (*VC2*); identify information needs, and outline sharing arrangements (*VC3*); outline funding arrangements (*VC4*); include targets and performance measures and conflict arrangements; and include a statement of the agencies limitations and context (*VI2*). In this regard, the partnership performance indicators in Table 4.2 could be used, albeit with some modification, to evaluate the performance of agreement (cw. partnership). Case study participants noted that only one agreement was in place, which provided for compliance arrangements only between the agencies, and that this agreement was well understood by relevant staff (*P1*), and agreed tasks (including fees for services) where identified and delivered according to the agreement (*VC17*). It was also highlighted that this agreement resulted in significant benefits with improved surveillance and enforcement in MPAs.

It is recognised that formal arrangements are important when funding or a contract is set up for the provision of service (Seixas et al., 2010), but there appears to be few examples of agreements that have in place arrangements for integrated MPA and fisheries management at the policy development stage (e.g. see Table 4.1). Operational agreements, such as the NSW MPA and fisheries compliance agreement, are more routine, supporting cross authorization of officers and joint asset use, and have been reported to be effective (Davis and Morett, 2005). It is arguable if governments are to succeed in introducing integrated marine management that partnership agreements need to focus on developing policies and strategies that progress both fisheries and MPA objectives (Murawski, 2007). By way of example, fisheries and MPA agencies need to work together in identifying closed areas and habitat protection areas that benefit both biodiversity and fisheries outcomes, not only to reduce stakeholder confusion and reduce the number of 'lines' on the water, but also to benefit from the efficiencies associated with such collaboration (Rayns et al., 2006; Food and Agriculture Organisation of the United Nations, 2011; Salomon and Dross, 2013). Strategically, spatial objectives need to be resolved sooner than

later to achieve international expectations for marine conservation (Gilliland and Laffoley, 2008; Foley et al., 2010). Having a formal agreement in place is not a panacea, or an end to a means for effective and resilient partnerships. Even high profile organizations, such as the North East Atlantic Fisheries Commission (NEAFC), and the Great Barrier Reef Marine Parks Authority (GBRMPA) have reported poor performances associated with MPA and fisheries integration, despite having binding agreements in place (Arbuckle et al., 2006; Hockings and Giligan, 2009; Jones et al., 2013). Caplan and Jones (2002; 2007) and other experts in this field consider to be successful, formal agreements also need to be associated with incentives to comply, and executive and agency governance drivers (Brinkerhoff, 2002; Rose and Kurukulasuriya, 2006; Roux et al., 2008).

In the circumstances where MPA and fisheries management are carried out from within the same agency, as is now the case with MPA and fisheries in NSW, there are few examples of formal agreements (e.g. Canada's Department of Fisheries and Oceans) (Pilgrim, 2005). The lack of formal agreements within a single agency is not surprising, as agency governance is seen to be able to deal with internal conflicting objectives. However, integration between fisheries and MPA management can be even more illusive and challenging under the spectre of the 'poacher and gamekeeper' and resultant highly competing priorities of establishing and managing MPAs (Grey and O'Gorman, 1998). Recently, the newly established NSW Marine Estate Management Authority (MEMA) developed principles for underpinning the NSW marine estate, including a common vision for NSW. The vision and associated goals to be achieved, "biologically diverse and resilient ecosystems and maximum social, economic and environmental benefits", is intended to provide the basis for developing performance measures against which progress towards the vision can be assessed (NSW Marine Estate Management Authority, 2013). The new principles reflect the issues identified in the independent audit and correspond to many of the issues raised in this case study, including: effective community engagement to identify and prioritise benefits and threats; management decisions will be transparent and adjust in response to new information; and management performance will be measured, monitored and reported and information pursued to fill critical knowledge gaps. MEMA has proposed a high level approach of putting these principles into practice; however, as considered in this case study,

the use of formal agreements supporting MPA and fisheries management integration objectives, is perhaps what is required to address the potential problems associated with single agency administration. Revisiting a formal partnership agreement that identifies collaborative benefits and goals is an option that should be investigated. The WA collaborative arrangement for the management of marine reserves is a good starting point for a partnership agreement, which has paid close attention to the performance of the partnership itself and the processes supporting their common goals (Department of Environment and Conservation and Department of Fisheries, 2006).

## 4.4 Conclusion and recommendations

With repeated calls for nations to coordinate efforts towards ecosystem-based management, it is now more than ever critical for MPA and fisheries institutions to integrate their efforts to address the governance of marine conservation and sustainable resource management. The benefits of this integration are universally documented and there should be every reason to build stronger and more effective partnerships between these bodies. Measuring the performance of the integration between MPA and fisheries agencies, in particular the success of their partnerships and outcomes of these arrangements, is critically important to ensure on going improvement in the integration of their sectoral services over time. The performance indicators for partnership effectiveness proposed in this paper, represent a collective of the issues that might be considered in reviewing the impact of a partnership or an agreement. The inclusion of indicators that allow for partnership objectives and targets and agreed indicators of success or failure against these objectives is paramount (Roux et al., 2008).

The nature of and the processes used by the MPA and fisheries agency partnership need to be considered, along with the benefits the partnership brings over time, including the partnership's impact on society. The NSW case study involving a rapid qualitative assessment of the fisheries and MPA management in NSW, illustrates the complexities in evaluating partnership performance, but has also highlighted those areas of the partnership where more deliberate consideration might be given. Notably, partnership context, capacity and processes and internal and

external communication warrant attention. Key recommendations arising from the case study results for MPA and fisheries partnership activities for NSW include: 1) Identify and prioritise targets and indicators to evaluate the effectiveness of MPAs and the network; and prepare a partnership work plan; 2) Implement a risk management approach to MPA and fisheries objectives, including identification and treatment of risks associated with project delivery; 3) Develop and implement a common public education and awareness strategy and program, to increase public awareness, understanding and participation in MPA management; 4) Develop common MPA and fisheries communications outreach tools to increase awareness of marine conservation and sustainability issues; 5) Review current partnership information management and sharing arrangements; 6) Implement a staff training program to enhance understanding between the agencies, in particular their management and planning approaches; and 7) Introduce a process to monitor and review the performance of the partnership, including the introduction of incentive arrangements that require effective partnership delivery and performance. Establishing a formal partnership agreement between MPA and fisheries divisions of the agency, which includes functional and reportable arrangements is suggested as a practical way forward to integrate functions and deliver the benefits of this important collaboration.

# 5 OPTIMIZING VOLUNTARY COMPLIANCE IN MARINE PROTECTED AREAS: A COMPARISON OF RECREATIONAL FISHER AND ENFORCEMENT OFFICER PERSPECTIVES USING MULTI-CRITERIA ANALYSIS.

(Published in Read, A.D., West R.J., Haste. M., and Jordan. A., 2011 Optimizing voluntary compliance in Marine Protected Areas: a comparison of recreational fisher and enforcement officer perspectives using multi-criteria analysis, Journal of Environmental Management 92, 2558-2567).

## 5.1 Introduction

There is global awareness that good governance is essential for sustainable development and marine biodiversity conservation, but despite this, non-compliance continues to be a universal major problem for Marine Protected Areas (MPAs) (Wood, 2004). Some recent studies have demonstrated that levels of enforcement and ecological effectiveness of MPAs are often linked, with a positive relationship found between abundance and density of fish and invertebrates and the numbers of enforcement actions (Kritzer, 2004; Micheli et al., 2005; Guidetti et al., 2008; McCook et al., 2010). Compliance issues are thought to arise as a consequence of many contributing and compounding factors, including: the economic gains of breaking the rules against the risk of being detected; the severity of sanctions; and the design of the management system (Smith and Anderson, 2004). There are also other equally important social reasons that contribute to non-compliance. These include legitimacy (fairness, justification and necessity) of regulations, stakeholder consultation and involvement in MPA planning, and the degree of individual moral development (Viteri and Chávez, 2007; Hauck, 2008). In many regions, the majority of the community seek to comply with MPA regulations, and most people actually support the establishment of marine parks (Kay and Alder, 1999). High public support for a MPA increases the potential for greater voluntary compliance, which can both improve the effectiveness of the MPA and reduce costs of enforcement (Davis and Morett, 2005). Individual 'motivation' has also been recognised as a key element in understanding compliance problems (McClanahan, 1999). This underlying motivation can range from an 'unintentional' action (an individual is unaware of the rules), to an 'uninformed' action (an individual is not aware of the

consequences of the non-compliance), to 'wilfulness' not to comply (an individual makes a judgment to commit an offence). Both planning and operational responses are needed to deal with these motivations in order to improve voluntary compliance. Planning responses include those implemented before and during the planning or review of an MPA; while operational responses include those actions that are carried out following reserve establishment, such as building up an enforcement capacity and carrying out risk based surveillance. Social reasons contributing to the acceptability of a MPA, such as adequacy of stakeholder engagement, legitimacy of decisions, impact on valued and habitual fishing grounds, and the complexity of rules, need to be addressed in the planning stage (Davis and Morett, 2005; Thomassin et al., 2010). MPA planning guidelines and criteria aim to address the above suite of manageability issues. However, despite these manageability criteria being intuitively known to planners, ecological criteria (such as, ensuring representation of all habitat types) are generally weighted considerably higher, with manageability criteria applied for the purpose of optimizing voluntary compliance considered as an after thought (with a few exceptions e.g. Airame et al. (2003).

This paper aims to examine the importance of manageability criteria in designing an MPA zoning plan, with an overall goal to improving voluntary compliance within the recreational fishing sector. It also aims to demonstrate how recreational fishers and compliance officers can be more constructively engaged in this planning process. In our case study a comprehensive list of planning criteria for MPAs was compiled and used to compare the perception of recreational fishers and compliance officers to manageability and voluntary compliance in the Port Stephens - Great Lakes Marine Park (PSGLMP), located in South-east Australia.

## 5.2 Methods

### 5.2.1 Study Area

The Port Stephens - Great Lakes Marine Park (PSGLMP) is located on the central coast of New South Wales (NSW), in SE Australia, and was declared in December 2005. It covers an area over 98,000 ha (Figure 5.1) and extends from the tidal limit of estuarine waters to ~3 NM offshore (i.e. NSW state-managed waters). After declaration, an extensive public consultation process assisted in the

development of a multiple-use zoning plan. In total, the planning process involved seven months of formal community consultation, 137 stakeholder and public meetings and 4399 written submissions. The process also established a local stakeholder advisory committee that consisted of 21 members, representing 10 major stakeholder sectors. In order to identify places of community importance within the marine park, and to minimise impacts of the zoning plan on these social and economic values, a public survey with a scaled map of the MPA was widely distributed within the community (50,000 forms distributed and 4.4% returned). Information was sought on the range, location and frequency of existing recreational activities, which were subsequently mapped using GIS and later 'ground-truthed' by stakeholder focus groups to verify the level of accuracy of the information (Read and West, 2010).

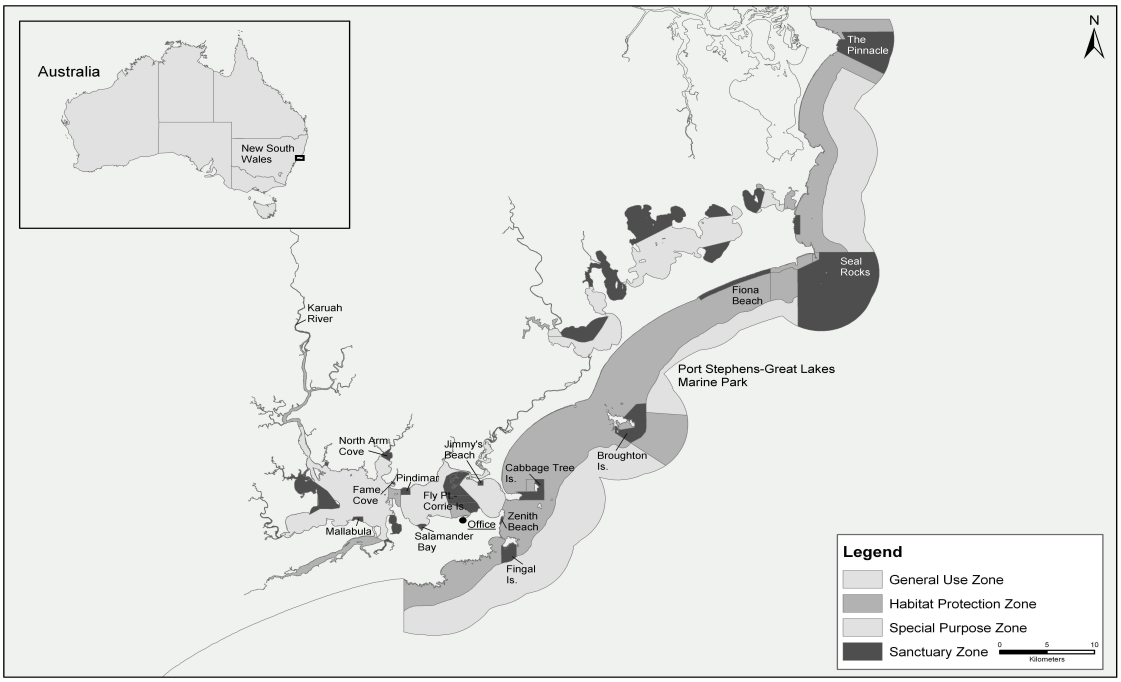


Figure 5.1 - Location of the Port Stephens - Great Lakes Marine Park, NSW, Australia. Current distribution of management zones within the MPA are also shown.

Using these data, together with a detailed map of the distribution of known seabed habitats, marine park planning experts applied zoning criteria to develop zoning options for discussion and negotiation with stakeholder groups. These criteria

provided a set of principles that were aimed to ensure that the objectives of the legislation were systematically considered during the zoning process (Marine Parks Authority, 2001c). These guidelines identified a broad range of criteria relevant to the conservation of natural and cultural resources, sustainable resource use and manageability. The final adopted zoning plan included 81 separate zones (Figure 5.1), which consisted of 29 sanctuary (no-take) zones (totalling 17.5% of the marine park area, and ranging from 23ha to 6580 ha); and, 52 'managed-use' zones, of which 38% by area were habitat protection zones (fishing restricted to selected methods) and 44% were general use zones (fishing essentially unrestricted).

Enforcement within the PSGLMP is strategically undertaken, consistent with a local risk-based compliance plan. This plan requires that all enforcement actions and offence details be spatially recorded. From June 2009 to June 2010, there were 701 combined enforcement actions (*cf*. 804 in 2008/9), comprising 453 marine park legislative enforcement actions and 248 fisheries enforcement actions. More than 95% of offenders were male recreational fishers 20–50 years old, and the majority of these offences were associated with illegal fishing activities.

### 5.2.2 Multi Criteria Analysis (MCA)

In this study, MCA was applied to the PSGLMP zoning plan to evaluate how individual no-take (conservation) zones met manageability criteria (sometimes also referred to as compliance feasibility criteria). To date, MCA methods have been widely reviewed and adopted in the environmental decision making process, including for natural resources management and marine park planning purposes (Kiker et al., 2005; Andalecio, 2010). For example, MCA has been used to assist with MPA decision making in respect to: selection of candidate sites (Breen et al., 2004); identification of preferred MPA manageability criteria (Garoufalia, 2007); comparison of stakeholder views on MPA success (Himes, 2007c) ; and in design of conservation zones (Li et al., 1999; Geneletti and van Duren, 2008). MCA techniques have also been demonstrated as an effective tool for engaging stakeholders in decision-making, which is regarded as a critical in increasing voluntary compliance (Dyer and Forman, 1992).

The MCA decision framework used in our study involved the following key steps: 1) goal development and identification of options; 2) criteria identification, weighting and scaling; 3) prioritizing and determining uncertainty; and 4) analysis of results and sensitivity testing (Haerer, 2000). Criterium Decision Plus MCA software was used, which incorporates two very well known decision analysis methods to rate alternatives against criteria, Analytical Hierarchy Process (AHP) and Simple Multi-Attribute Rating Technique (SMART) (Figueira et al., 2005). Both methods require the user to rate each alternative (in this case, no-take zones) against each criterion to a defined score. This score is normalized to allow direct comparison of criteria and the ranking of alternatives (Dyer and Forman, 1992). Both techniques also involve structured discussion, with each criterion relevant to the decision being addressed in turn. The formula for SMART computation is detailed in Hwang and Yoon (1981). Previous studies comparing the application of MCA methods indicate that either AHP or SMART can be applied without notable differences being observed with the rankings (Hobbs et al., 1992).

### 5.2.3 Working Groups

Two working groups were established to assist in MCA scoring and ranking of PSGLMP zones against manageability, thus allowing for a comparison of the perspectives of recreational fishers and compliance officers. The recreational fishers working group (RFWG) was made up of seven locally diverse recreational fishing leaders who were very familiar with fishing locations and practices in PSGLMP. This group also had a good understanding of MPA planning processes and local compliance issues from a recreational fishing sector perspective, particularly as many were involved in the initial planning process of the marine park.

The second working group consisted of six marine park compliance officers (COWG) that collectively had many years of experience with enforcing zoning regulations, and were very cognisant of issues related to non-compliance. Both working groups were assigned the same tasks, with outcomes achieved by way of consensus by group members. Brainstorming methods, which are well documented, were used to facilitate the first task, which was to develop a list of manageability criteria related to the goal of optimizing voluntary compliance (Dyer and Forman,

1992; Rickards, 1999). Criteria with common themes were grouped into higher order categories i.e. main criteria (see Figure 5.2). In this regard, the COWG used the same manageability criteria that were developed by the RFWG. The next task involved assigning weightings to each criterion (0–100) and scoring the 29 no-take zones in PSGLMP against each criterion. In order to facilitate scoring of no-take zones against the weighted criteria, detailed attribute information was gathered for each no-take zone (e.g. area of the zone, alignment of boundaries, distance from patrol base, presence of marker buoys and signs, number of enforcement actions by zone, and significance of fishing grounds). Sub-criteria were scored against each zone in succession. In this way, each zone could be compared to another. The alternative method of scoring a zone against all criteria and then moving to score the next zone was considered to be less powerful in terms of ranking individual zones against each other. Again, how well a zone met each criterion was determined by group consensus. As a scoring rule it was decided that when a criteria was not relevant to a particular zone, the zone would be awarded a full score against that criterion (i.e. meaning that the criterion had been met). For example, zones on the continental shelf that could not possibly benefit from marker buoy installation were rated as if they met this criterion.

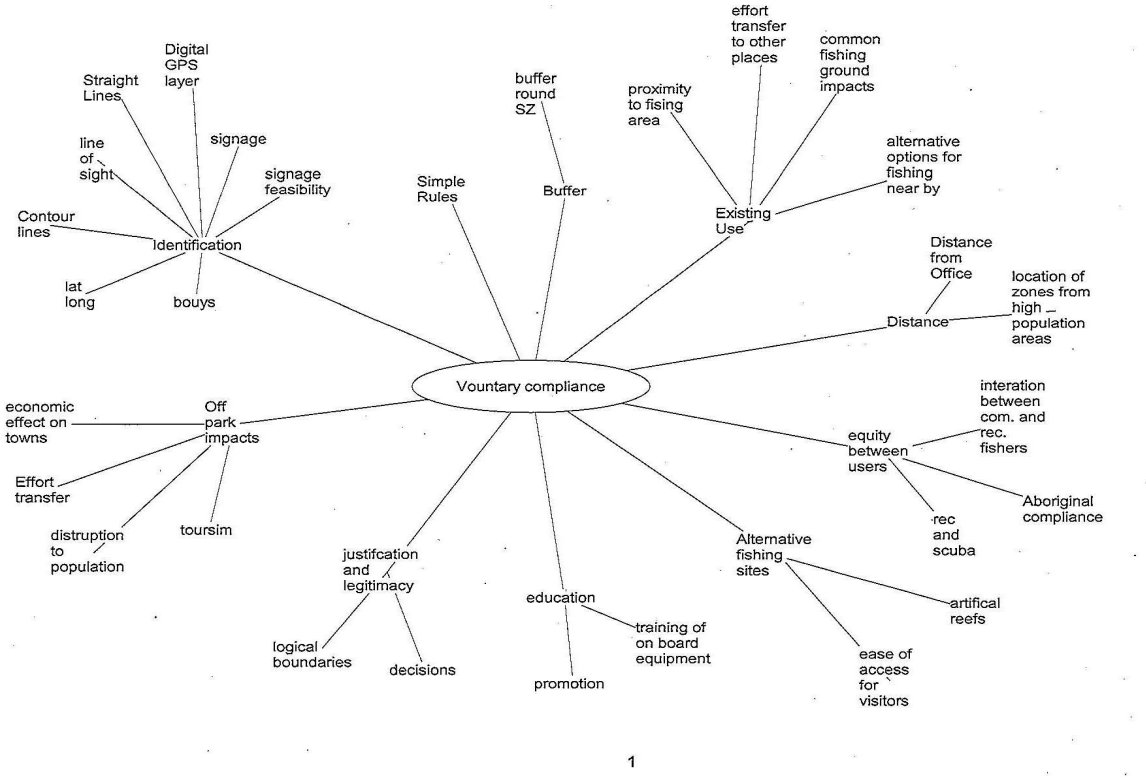


Figure 5.2 - Hierarchy model of manageability criteria for compliance developed by recreational fishers working group using CDP Software.

### 5.2.4 Scoring, Ranking and Sensitivity Analyses

The CDP software was used to calculate the scores and rank the zones. A MCA score below 0.6 was set as the trigger point to require closer consideration of the zone (this was arbitrarily set to ensure that all marginal values (0.5) were included. Each working group applied their own weightings to the criteria. The COWG also applied a hierarchical model of criteria that had been reviewed by the authors (see Table 5.1). As changing any value weighting on a first order or second order criterion has an affect of changing the decision scores of the zones, sensitivity testing was carried out to assess the general stability of rankings. Critical changes in weightings or scoring are suggested to occur when a cross over in the rankings result

from small changes (<5%) in these values (Infoharvest Inc, 2001). In such circumstances the model was considered sensitive to these weightings and, as a consequence, further review of the decision values were made by the working groups.

## 5.3 Results

The RFWG identified ten main (first order) criteria groups incorporating 25 sub-criteria (*cf*. 35 identified from the literature). These were sorted into two broad categories, criteria associated with whole of the park establishment, and those associated with individual zone selection and management. Four criteria were applicable to both categories (Table 5.2). The heaviest weighted first order criteria by RFWG were: 1) zone identification; 2) compliance education and capacity building, in particular, skipper training in the use of GPS equipment; 3) zoning impacts on important fishing grounds; and 4) legitimacy (or justification) of a zone. The COWG placed similar weightings on identification, education, and legitimacy, but otherwise there was little similarity. For example, minimising impact on existing use, off park impacts, provision of alternative fishing sites and no-take zone buffers were of low importance to the COWG. Although considered by both working groups to be critically important in establishing new marine protected areas, 'whole park' criteria were not included in the MCA model, as they apply to all zones equally, and do not assist in ranking or comparing how individual zones meet planning criteria. RFWG scores ranged from 0.312 to 0.885 and COWG scores using the same criteria ranged from 0.393 to 0.924. COWG scores using reviewed criteria ranged from 0.421 to 0.773 (see Table 5.3). Taking the results from both working groups, 8 out of 29 sanctuary zones (28%) had scores less than 0.6, prompting closer review of the zone to improve its respective compliance performance. Spearman's Rank Order Correlation indicated a strong correlation between the zone rankings from the two working groups ($r_s = 0.64$, $P<0.01$). Also of significance, the comparison of the zone rankings generated from the two criteria sets (RFWG and literature reviewed set) also indicated strong correlation ($r_s = 0.575$, $P<0.01$).

It was further hypothesized that, if these planning criteria were realistic and ranking of manageability of conservation zones accurate, then this should be

reflected in a negative correlation between the MCA scores and the actual number of recorded enforcement actions (see Figures 5.3–5.6). That is, the higher a zone scored in terms of manageability criteria (towards a score of 1.0), the lower the number of enforcement actions would be required in that zone. To test this hypothesis, total numbers of enforcement actions, together with effort (individual officer hours in zone's sector) were collated for each zone over a twelve-month period (June 2009 to June 2010). MCA scores were correlated against: total enforcement actions, enforcement actions/effort, and enforcement actions/effort/area of individual zones. The size of the zone (ha) was included in this computation as there were large differences in zone size within the PSGLMP and this could impact on coverage of effort. In all comparisons the hypothesis is supported and with a negative correlation between MCA and enforcement actions being apparent (see Figures 5.3–5.5). Of particular note was the strong correlation between RFWG scores with the number of enforcement actions in a zone (ranging between -0.30 and -0.40, $P < 0.05$, n=29).

A Spearman's test was also applied to determine if a correlation existed between the numbers of enforcement actions in the zone and the distance of a zone from the office, where distance was measured from patrol origin to the centre of zone (see Kuperan and Sutinen, (1998). It was hypothesized that there would be more enforcement actions/effort further away from the office (on the basis that a user would rationalize that the risk of being detected was lower in remote areas). Results did not support this hypothesis, however, but instead suggested a negative correlation ($r = -0.275$). This result might be explained due to lower usage of zones in more remote areas.

The most sensitive criterion for the COWG weighted model was 'legitimacy maximization', with only a 2% change in the weighting resulting in a cross over of the zone rankings. The most sensitive criteria using the RFWG data was 'impact on existing use', with a 4.6% change in the weighting resulting in a ranking cross over. The most sensitive criteria weighting for the RFWG using the reviewed criteria list model was 'maximization of the distance of no take reserves from high use areas', with a 2.4% change in the weighting resulting in a zone ranking change. This model was also sensitive to 'minimising impact on use', with a 3.1% change resulting in a ranking change. Despite these critical sensitivities, however, the ten lowest ranked zones, from both working groups were not sensitive to any criteria weight changes of

less than 5%, indicating that the models had some degree of stability in lower order ranking.

Table 5.1 - Manageability Criteria for Optimizing Voluntary Compliance in Marine Protected Areas

| CRITERIA CATEGORY | SUB - CRITERIA | REASON |
|---|---|---|
| Simple Shape | Zone shape to be made up of straight line boundaries * (Federal Geographic Data Committee's (FGDC) Marine Boundary Working Group, 2006; Department of Environment Water Heritage and the Arts, 2010). | Irregular shaped boundaries reduce compliance. Straight boundaries are generally easier to enforce and to understand than curved boundaries. |
| | Minimise the number of boundaries(Kritzer, 2004; IUCN-WCPA., 2008). | Zones that are compact with a minimum number of boundaries are best for enforcement and compliance. Most desirable shapes are squares or rectangles. |
| Simple Rules | Simplify zone rules* (IUCN-WCPA., 2008). | Simple zone rules improve compliance. Clear and easily understood, enforceable zone regulations have been positively correlated with MPA performance (Davis and Morett, 2005; Monteiro et al., 2010). |
| | Minimise number of zoning categories (Davis and Morett, 2005). | Applies to the whole park<br>Fewer the number of zoning categories reduce complexity and improves likelihood of compliance. |
| | Reduce complex zoning patterns over small areas * (Marine Parks Authority, 2001c). | Simple zoning will help the community comply with zoning regulations. |
| Easy Identification | Simplify identification by alignment of boundaries to north and east compass bearings * (Davis and Morett, 2005; California Department of Fish and Game, 2008; Department of Environment Water Heritage and the Arts, 2010). | Boundaries that align with north/south or east/west are more easily recognized by marine users and enforcement is simplified.<br>Complex identification, using depth contours and boundaries from uncertain base markers affect compliance feasibility (Federal Geographic Data Committee's (FGDC) Marine Boundary Working Group, 2006; IUCN-WCPA., 2008). |
| | Provide for identification signage, where appropriate *(Marine Parks Authority, 2001c; Mascia, 2003). | Well-marked zones with adequate signage improve compliance. (Note that signage does not apply to large offshore zones) |

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| | Provide for marker buoys, where appropriate (Marine Parks Authority, 2001c; IUCN-WCPA., 2008). | Well-marked boundaries improve compliance. (Note that for offshore zones that are extensive in size marker buoys are not appropriate – marker buoys are most important for small areas close to shore). |
| | Align boundaries with permanent terrestrial features * (e.g. headland to headland). | Line of sight identification can be simple to use and, in turn, helps voluntary compliance (note that line of sight, if complicated, can be difficult to explain and illustrate to users) (Marine Parks Authority, 2001c) |
| Size of zones | Maximise the area of zone (Gribble and Robertson, 1998; Kritzer, 2004; Davis and Morett, 2005; Stefansson and Rosenberg, 2006; IUCN-WCPA., 2008; Monteiro et al., 2010). | Compliance is related to MPA size. Illegal fishing within MPAs will most likely occur near the periphery, as a result of accidental straying across the boundary, the magnitude of boundary effects will be lessened in larger no take zones as a result of a lower ratio of perimeter to area. |
| Compliance capacity | Minimise the distance to respond and patrol zones * (Kuperan and Sutinen, 1998; IUCN-WCPA., 2008) . | The closer the zone is to the patrol base greater potential for compliance Offshore or inaccessible sites increase challenges for enforcement. |
| | Reduce number of high protection zones in location, (Kritzer, 2004; California Department of Fish and Game, 2008). | Modelling of violations of spatial closures shifted relative success from the several small to single larger zoning model. Individual patrols may not able to reach all areas where several small no-take zones exist. |
| | Minimise the distance of no-take zones from the public eye (Crawford et al., 2004; Davis and Morett, 2005; California Department of Fish and Game, 2008). | The risk of detection increases when distance to public is minimized. Close proximity to the coast, and the presence of other activities improves surveillance and compliance inshore than elsewhere(Davis et al., 2004). |
| | Align no-take zones with terrestrial reserves (Marine Parks Authority, 2001c; California Department of Fish and Game, 2008). | Can assist enforcement and probability of surveillance. |
| | Minimize the number of public access points, where applicable (California Department of Fish and Game, 2008). | The fewer the number of access points the less monitoring is required. (Note: this sub-criterion relates to shoreline zones only). |
| | Locate no-take zones adjacent to shoreline (California Department of Fish and Game, 2008). | Protected areas adjacent to shoreline allows for enforcement using smaller vessels or vehicle patrol. |
| | Maximize shoreline length of a zone (California Department of Fish and Game, 2008). | Larger shoreline provides a buffer against unintentional boundary infractions. (Note: relates to shoreline zones only). |

| | | |
|---|---|---|
| | | |
| | Reduce distance between high protection zones (California Department of Fish and Game, 2008). | Criterion applies to the whole park. Individual patrols may not be able to enforce large expanses of multiple zones. |
| Location | Minimise impact on existing human uses, including recognised fishing grounds * (Roberts, 2000; Davis and Morett, 2005; Campbell et al., 2007). | Zones placed in areas where they have community and stakeholder support will be much more effective than those imposed on the community and users. |
| | Minimise impact on all weather fishing grounds * (Davis et al., 2004; Davis and Morett, 2005). | Fishing pressure is likely to be much greater in sheltered areas. |
| | Minimise impact on local community access to nearby fishing grounds *(Albers, 2010). | Fishing pressure is likely to be greater around townships. Visitors and locals will seek to fish grounds closer to these areas, in particular piers and boat ramps. |
| Age of marine protected area or zone | Age of marine protected area or zone. | Criterion applies to the whole park. Established zones and reserves receive more awareness and acceptance resulting in improved compliance over time (McClanahan et al., 2005). |
| Penalties | Apply clear and appropriate penalties. | Criterion applies to the whole park. High penalties have are proven to discourage non-compliance (Viteri and Chávez, 2007). |
| Access to information | Maximise access to mapping and referencing for charts * (IUCN-WCPA., 2008). | Criterion applies to the whole park. Zoning boundaries displayed on official navigational charts, with associated regulations improves compliance feasibility. |
| | Provide zoning information in digital form for GPS plotter use * (Marine Parks Authority, 2001c). | Criterion applies to the whole park. Boundary information available in digital form should be available as soon as possible. Global positioning systems (GPS) allow vessels to know precisely where they are in reference to zones (Davis and Morett, 2005; Norse, 2005; Monteiro et al., 2010) |
| Education | Introduce comprehensive education during planning. * | Criterion applies to the whole park. Compliance behaviour improves with increased levels of targeted education. |
| | Improve user relationship with officials (Davis and Morett, 2005) | Criterion applies to the whole park. Improved relationship with fishers increases respect and improves compliance. |
| | Promotion and awareness and understanding * (Monteiro et al., 2010). | Criterion applies to the whole park. Better understanding leads to better acceptance and voluntary compliance. |

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| | Provide for capacity training. * | Criterion applies to the whole park. Capacity building, such as active support for skipper training for the use of vessel plotting and GPS equipment will develop skills that are needed to support voluntary compliance. |
| Legitimacy | Provide for adequate public participation in zoning * (Nielsen, 2003; Lundquist and Granek, 2005; Viteri and Chávez, 2007; IUCN-WCPA., 2008; Monteiro et al., 2010). | Criterion applies to the whole park. Increased and adequate community involvement results in improved compliance. |
| | Ensure scientific justification and rationale of marine park or zone location and purpose * (Nielsen, 2003; Méndez-Contreras et al., 2008). | Criterion applies to the whole park, as well as individual zones. Scientific justification of a zoning decision will improve community and user understanding and support for zoning laws. |
| | Ensure policy alignment with other government agencies (The Ecology Centre University of Queensland, 2009). | Criterion applies to the whole park. Marine park users are more likely to learn the zone locations if they are similar to surrounding areas. |
| | Provide for fisheries buy-back (IUCN-WCPA., 2008). | Criterion applies to the whole park. Compensation reduces potential for vindictive or deliberate noncompliance by displaced fishers. |
| | Provide for access equity between user groups.* | Ensuring that access rules are equitable between users improves acceptance and improved voluntary compliance(Suuronen et al., 2010). |
| Integrated Management | Ensure jurisdictional alignment (The Ecology Centre University of Queensland, 2009; Department of Environment Water Heritage and the Arts, 2010). | Criterion applies to the whole park. National and state jurisdictional alignment increases likelihood of compliance and helps aid in understanding of zoning rules and mapping(Marine Parks Authority, 2001c). |

(* Indicates those criteria also identified by Port Stephens recreational fishing working group) Note: the criteria and sub-criteria list includes planning related criteria only. The list does not include post-planning operational criteria, such as: number of enforcement officers, number of boats, budget, compliance strategies and plans, or on-going extension/education activities.

Table 5.2 - Weighted manageability criteria for optimizing compliance in MPAs identified by Recreational Fisher Working Group (RFWG).

| First Order Criteria Group | Weighting Score | | Second Order Criteria | Weighting Score | | Application |
|---|---|---|---|---|---|---|
| | RFWG | COWG | | RFWG | COWG | |
| **Zoning Identification** | 100 | 100 | Align boundaries north and south/east west. | 100 | 100 | Zone |
| | | | Seaward boundaries to have straight lines. | 100 | 100 | Zone |
| | | | Provision of GPS plotter layer of zoning plan. | 100 | N/A | Whole Park |
| | | | Boundaries with a line of sight to terrestrial feature. | 100 | 85 | Zone |
| | | | Provision of marker buoys, (where appropriate). | 75 | 85 | Zone |
| | | | Signage feasibility. | 50 | 75 | Zone |
| | | | Provision of identification signage, where appropriate. | 50 | 50 | Zone |
| | | | Align with contour lines. | 25 | 15 | Zone |
| **Education** | 100 | 80 | Promotion and awareness of marine park. | 100 | 80 | Whole Park |
| | | | Provision of training of vessel plotting and GPS equipment. | 75 | 40 | Whole Park |
| **Impact on Existing Use** | 80 | 20 | Minimise impact on common fishing grounds. | 100 | 25 | Zone/whole Park |
| | | | Minimise proximity to fishing areas. | 100 | 25 | Zone |
| | | | Alternative options for fishing. | 100 | N/A | Whole Park |
| | | | Minimise effort transfer to other places. | 80 | N/A | Whole Park |
| **Legitimacy** | 40 | 30 | Ensure justification of zone location and that boundaries are logical. | 100 | 80 | Zone/whole park |
| **Distance from high use areas** | 60 | 65 | Maximise distance of zones away from highly populated areas. | 75 | 10 | Zone |
| | | | Minimise distance from Marine Park Office. | 25 | 80 | Zone |
| **Off park impacts** | 100 | N/A | Minimise economic impact on towns. | 100 | N/A | Zone/whole Park |
| | | | Minimise disruption to local community. | 100 | N/A | Zone/whole park |
| | | | Minimise impact on tourism. | 100 | N/A | Whole park |
| **Equity** | 60 | 0 | Minimise conflict | 75 | 15 | Zone |

| | | | | | | |
|---|---|---|---|---|---|---|
| **between users** | | | between com and rec. fishers, scuba and cultural use. | | | |
| **Alternative fishing sites** | 70 | N/A | Maximise fishing access for visitors | 75 | N/A | Whole Park |
| | | | Provide for artificial reefs to compensate loss of fishing grounds | 50 | N/A | Whole Park |
| **Simple Rules** | 80 | 95 | Apply simple rules and fewer numbers of zones adjacent to no take zones. | 100 | 100 | Zone |
| **Buffer no take zones** | 40 | 0 | Provide for buffers around no take zones. | 100 | 0 | Zone |

Table 5.3 - Recreational fishing and Compliance officer working group MCA manageability scores for Port Stephens - Great Lakes Marine Park sanctuary zones

| Name of sanctuary zone | Com officer WG | Com Officer WG (reviewed criteria) | Rec Fish WG | Area of zone (ha) | Distance from office (m) | Number of offences | No. Offences / hrs | No. Offences / hr / area of zone x$10^4$ |
|---|---|---|---|---|---|---|---|---|
| Corrigans Bay | 0.924 | 0.758 | 0.871 | 257 | 44767 | 0 | 0 | 0 |
| Cromartys Bay | 0.896 | 0.773 | 0.885 | 180 | 7263 | 0 | 0 | 0 |
| Salamander Bay | 0.887 | 0.570 | 0.471 | 42 | 4512 | 13 | 0.045 | 10.729 |
| Zenith Beach | 0.851 | 0.566 | 0.563 | 20 | 4052 | 2 | 0.006 | 3.026 |
| Boolambayte Lake | 0.847 | 0.728 | 0.771 | 962 | 32004 | 1 | 0.014 | 0.144 |
| Mallabula | 0.838 | 0.558 | 0.729 | 50 | 11120 | 3 | 0.010 | 2.080 |
| Twelve Mile Creek | 0.828 | 0.735 | 0.866 | 94 | 20565 | 0 | 0.000 | 0.000 |
| Little Swan Bay | 0.816 | 0.662 | 0.479 | 943 | 16202 | 8 | 0.028 | 0.294 |
| Little Branch Creek | 0.802 | 0.643 | 0.754 | 23 | 20096 | 2 | 0.007 | 3.014 |
| Number One Cove | 0.791 | 0.629 | 0.759 | 26 | 16034 | 0 | 0.000 | 0.000 |
| Myall River | 0.788 | 0.601 | 0.682 | 64 | 10794 | 5 | 0.069 | 10.851 |
| Fingal Island | 0.769 | 0.716 | 0.619 | 297 | 6320 | 13 | 0.039 | 1.324 |
| Fenningham's Is. and Wallis Ck | 0.768 | 0.626 | 0.880 | 44 | 8925 | 1 | 0.003 | 0.788 |
| Kataway Bay | 0.739 | 0.758 | 0.847 | 389 | 41015 | 0 | 0 | 0 |
| Karuah River | 0.737 | 0.704 | 0.592 | 57 | 28600 | 0 | 0 | 0 |
| Smiths Lake | 0.730 | 0.707 | 0.689 | 419 | 48252 | 0 | 0 | 0 |
| Mayers Bay | 0.727 | 0.723 | 0.846 | 1535 | 39948 | 0 | 0 | 0 |
| Bombah Broadwater | 0.717 | 0.718 | 0.771 | 734 | 25409 | 0 | 0 | 0 |
| North Arm Cove | 0.716 | 0.550 | 0.659 | 126 | 11120 | 0 | 0 | 0 |
| Pindimar | 0.702 | 0.578 | 0.647 | 78 | 6871 | 7 | 0.024 | 3.111 |
| Jimmy's Beach | 0.683 | 0.469 | 0.823 | 28 | 4505 | 0 | 0 | 0 |
| Fame Cove | 0.617 | 0.555 | 0.630 | 16 | 8535 | 0 | 0 | 0 |
| South Celito | 0.616 | 0.546 | 0.675 | 140 | 49229 | 0 | 0 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| The Pinnacle | 0.605 | 0.536 | 0.444 | 2064 | 69726 | 19 | 1.188 | 5.753 |
| Cabbage Tree Island | 0.604 | 0.580 | 0.362 | 369 | 8106 | 92 | 0.278 | 7.544 |
| Fly point (Corrie Island) | 0.551 | 0.460 | 0.347 | 1004 | 2790 | 157 | 0.544 | 5.420 |
| Seal Rocks | 0.499 | 0.561 | 0.312 | 6580 | 47801 | 14 | 0.042 | 0.064 |
| Broughton Island | 0.452 | 0.454 | 0.405 | 828 | 21240 | 56 | 0.169 | 2.046 |
| Fiona Beach | 0.393 | 0.421 | 0.647 | 381 | 39782 | 0 | 0 | 0 |

(Grey shadowing identifies sanctuary zones with a score <6.0 - the threshold for further consideration to improve compliance performance).

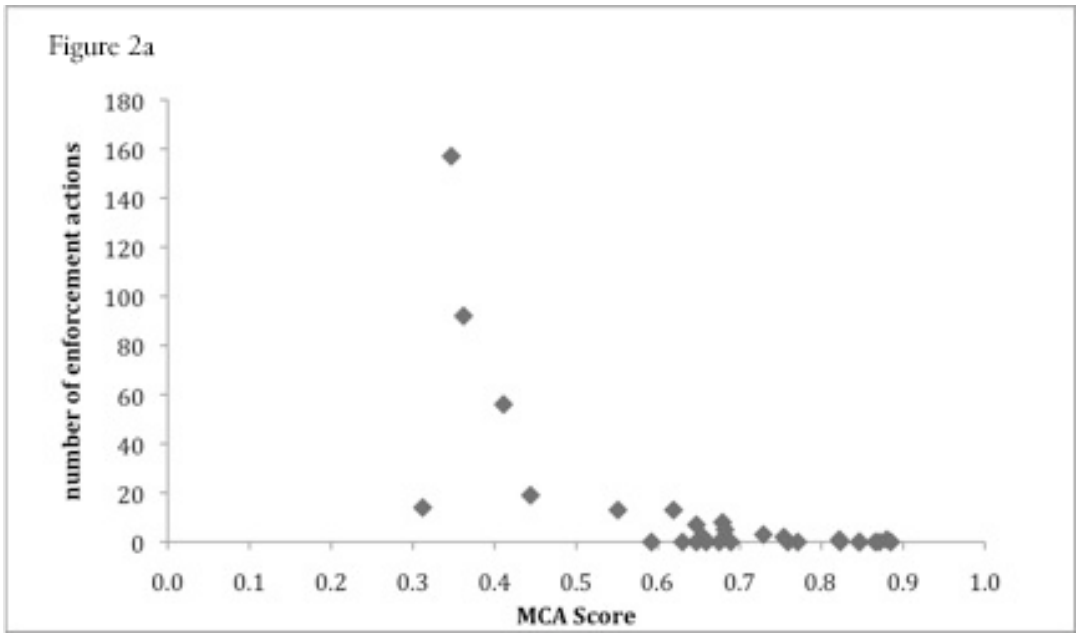


Figure 5.3 - Recreational Fisher Working Group MCA zone score against number of enforcement actions in the zone ($r=0.66$, $p<0.01$, $n=29$).

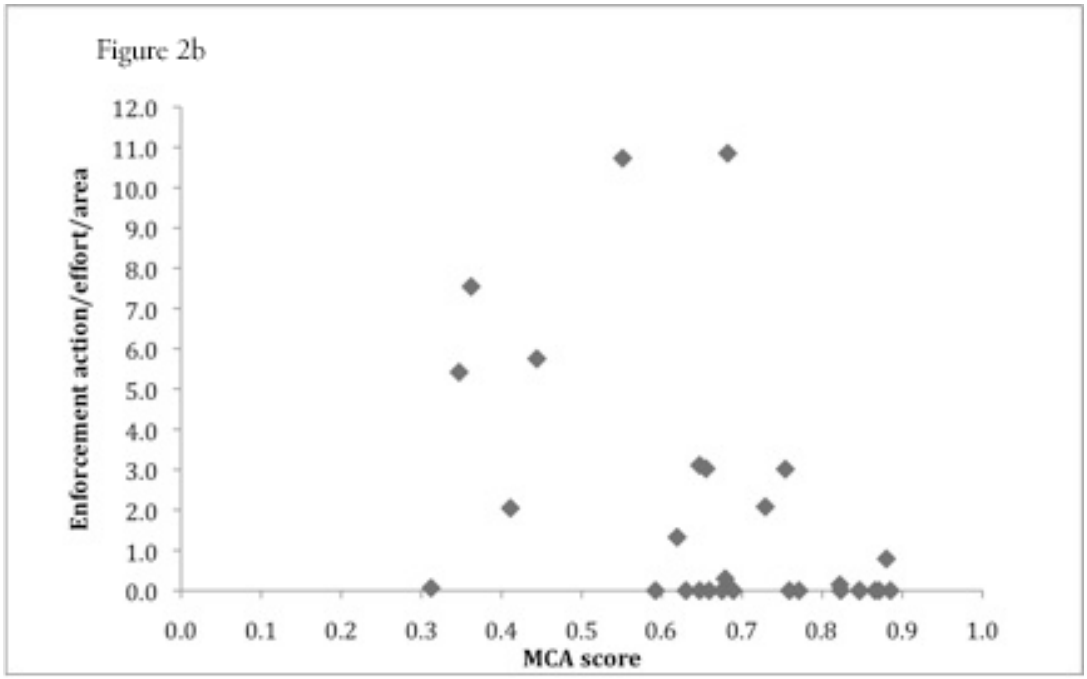


Figure 5.4 - Recreational Fisher Working Group MCA zone score against number of enforcement actions/effort (hr)/area (ha) in the zone ($r=0.45$, $p<0.01$, $n=29$)

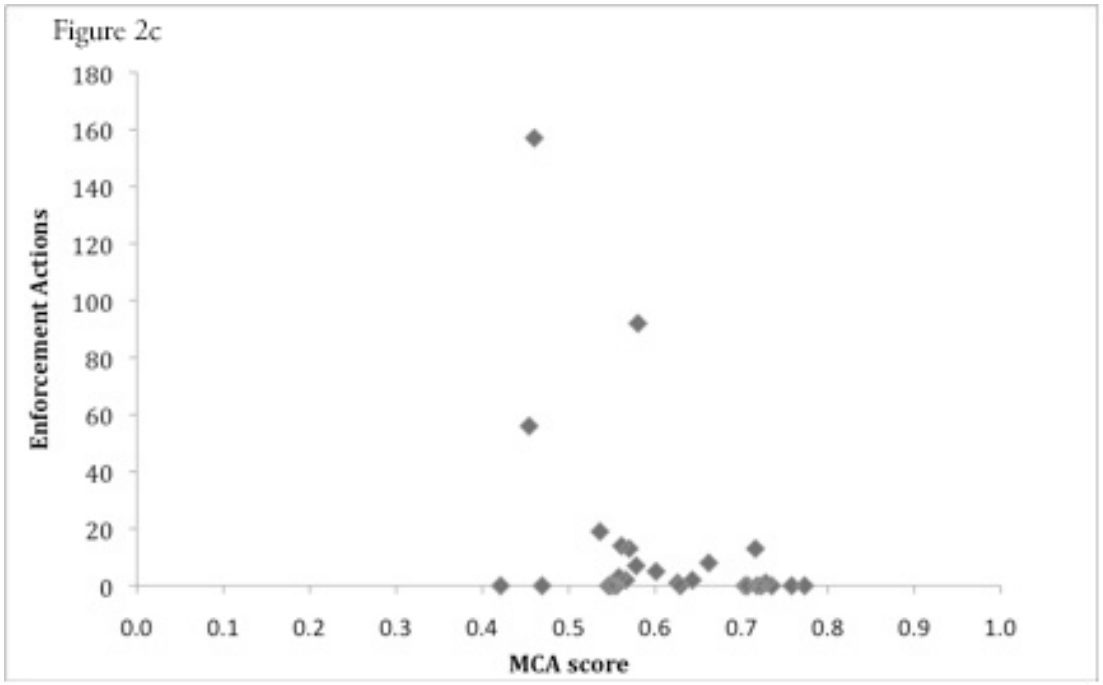


Figure 5.5 - Compliance Officer Working Group MCA zone score (using reviewed criteria) against number of enforcement actions in the zone ($r=0.40$, $p<0.05$, $n=29$).

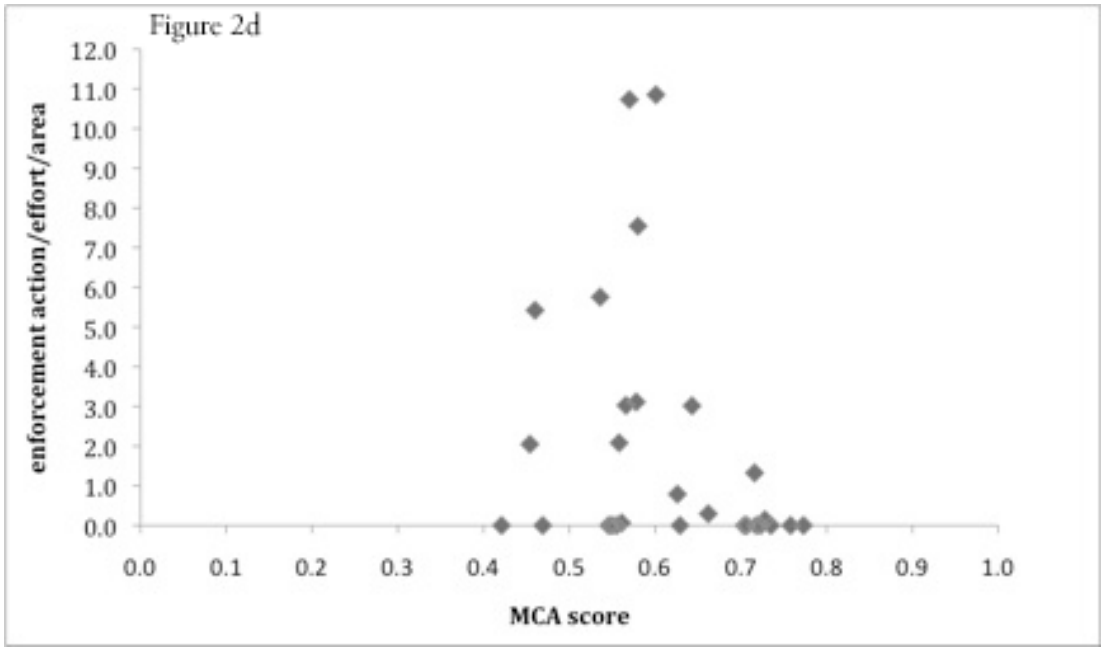


Figure 5.6 - Compliance Working Group MCA zone score (using reviewed criteria) against number of enforcement actions/effort (hr)/area (ha) in the zone ($r=0.30$, $p<0.05$, $n=29$).

## 5.4 Discussion

The underlying objectives required to optimize voluntary compliance is to gain both public support and community acceptance of MPAs. Zoning criteria play an important role in this regard, by providing uniformity, objectivity and transparency in decision-making to ensure that the key issues of conservation, sustainability and manageability are considered and the objectives of the marine park are adequately addressed (Marine Parks Authority, 2001c). It follows that the systematic application of zoning criteria can be critical in the success of a marine park. An analysis of international MPA literature identified at least 35 zoning guidelines associated with facilitating compliance planning that have been reported to play a notable role in optimizing voluntary compliance (see Table 5.1). While not all criteria listed in this table are relevant to every MPA (e.g. installation of marker buoys is immaterial to large oceanic zones), it represents a useful checklist, supporting a systematic approach to compliance planning when developing MPA zoning and management arrangements. As demonstrated in this study, few criteria are weighted the same, either in regard to their application, or to the interests of stakeholder groups.

From a management perspective, applying weightings to zoning criteria reduces flexibility in how criteria are applied, which is an advantage in dealing with sectoral interests, as it places management in a neutral position to commence negotiations. However, weighting preferences is legitimate in decision-making, and by better understanding preferences an improved framework for resolving differences is more likely. The current study demonstrated that MCA was a relatively easy tool to apply to the analyses of zone planning options and proved powerful in setting weightings, applying sensitivity tests, systematically analyzing zoning options and demonstrating the decision-making process. Together with other spatial planning tools such as Marxan and C-Plan modelling, there exists considerable scope to improve the application of zoning guidelines with more active involvement by stakeholders in decision-making (Carwardine et al., 2007).

### 5.4.1 Comparison between compliance officers and recreational fishers

When asked to develop a list of manageability criteria to optimize voluntary compliance, recreational fishers in this study suggested 29 separate criteria to be applied in planning MPAs. This immediately suggests that recreational fishers have a considerable depth of understanding of compliance problems and further justifies the direct engagement of this sector in the planning of MPAs. It is clear that recreational fishers have their own perspective on MPAs, which needs to be accommodated in the planning process as they represent a large proportion of the local stakeholder group (e.g. for PSGLMP they accounted for more than 95% of the enforcement actions in 2009/10). Of importance to recreational fishers is the need to maximize legitimacy, specifically in relation to scientific justification of an MPA, including the location and associated rules that might apply to individual zones. For example, in the case study there was little understanding of the need for inclusion of no-take zones on sandy beach habitats, as these habitats are generally included to ensure effective representation of all habitat types. It was suggested that in order to improve MPA acceptance and compliance there was a need to give closer consideration to high use areas, such as sandy beaches, with a view to make more realistic compromises for on-going use. It is noted that such considerations have already been necessitated in other jurisdictions (Wescott, 2006). Of equal importance to the matter of legitimacy, recreational fishers highlighted the need of adequately involving and engaging stakeholders in both the planning and management of the MPA. While this appears to be common sense, this criterion is not always achieved to a level that is acceptable to recreational fishers, but is known to have a great impact on compliance outcomes (Gambino et al., 2002). Indeed, increased voluntary compliance has occurred with improvements in legitimacy consideration, through fairness; sense of ownership and community participation in the process (Kuperan and Sutinen, 1998; Kareiva, 2006). Conversely, inadequate consultation and participation of the local community is likely to lead to conflict and a slow uptake of MPA management and voluntary compliance (Nyawira Muthiga Kenya Wildlife Service, 2003; Zinn et al., 2007).

Education and awareness was rated as critical by both recreational fishers and compliance officers as a prerequisite to community compliance. This is a long-established international paradigm for MPA planning, whereby targeted education and awareness programs at the time of MPA establishment reduces the level of non-

compliant behaviour by improving knowledge of the rationale of MPA management and associated rules (Kritzer, 2004; Lundquist and Granek, 2005). Of particular interest in this case study was the high priority placed by recreational fishers on training and capacity building. As an example, recreational fishers suggested that training in the use of GPS and plotters would significantly improve voluntary compliance, consistent with that seen amongst commercial fishers that commonly use the technology.

Incentives to encourage compliance were recognized by recreational fishers as being important. This included compensation for lost fishing grounds (e.g. by creating artificial reefs) and ensuring that good fishing grounds were accessible in close range of local communities. Ensuring on-going access to fishing grounds can also reduce impacts on local village businesses and tourism sectors, as well as provide recreational activities for local communities. Recreational fishers identified that a fundamental issue affecting compliance was loss of important and historic fishing grounds; and that if the reasons for these closures were not well understood, then voluntary compliance would be more difficult to achieve. Similar issues and weightings relating to economic losses and impact on community businesses were also observed by Himes (2007a) in his comparison of sectoral views in relation to MPAs. Improving compliance with the use of incentives, such as the use of grants to promote sustainable fishing methods, improve fishing grounds and establish vessel monitoring, was also suggested by Stephens et al. (2006). In comparison, compliance officers understood why loss of fishing grounds was an issue to recreational fishers, but did not weight this as an important criterion from an enforcement perspective. Likewise, compensation and impacts on community were understood, but were not considered a factor of importance for the enforcement of marine park laws.

Both recreational fishers and compliance officers considered that simplified zoning boundaries and management rules were critical to optimizing voluntary compliance. From the compliance officers' perspective, legal defences to prosecutions were generally based on the complexity of rules and, as a result, visitors would often receive only a caution. From the recreational fishers' perspective, complex rules raised difficulties in compliance, even for well-intentioned users. Both working groups also gave a high weighting to clear and unambiguous zoning identification. Recreational fishers placed an even higher priority on line-of-sight

definitions, as this approach was explained as being a common method used by fishers for identifying their fishing grounds.

Another manageability criterion suggested by recreational fishers as high priority was the need for equity in the rules applying to different user groups. For example, recreational fishers considered it inequitable for scuba divers to be allowed to dive in no-take zones that had been established primarily to protect a threatened species (e.g. grey nurse shark *Carcharias taurus*), when fishing methods they considered low risk were not permitted. Compliance officers considered that equity between user groups had little bearing on enforcement, and provided rules were simple and areas easy to identify, voluntary compliance would be improved. Not surprisingly then, the two groups had different viewpoints about the effectiveness of no-take zones in the PSGLMP, although MCA ranking of the zones were highly correlated ($p<0.01$). Also of note, was the similarity in MCA rankings for the manageability of no-take zones, even when different planning criteria and weightings were adopted by the different user groups. This indicates that both sets of criteria have similar utility in ranking and identifying manageability effectiveness.

### 5.4.2 Manageability scores and enforcement actions.

The correlations found between the "manageability" scores for zones in the PSGLMP and the recorded number of enforcement actions (see Figures 5.3–5.5), provides some empirical evidence that the weightings on manageability criteria for criteria developed by the working groups may be useful when revising existing park regulations. Only a few other studies have provided empirical evidence of this type (Crawford et al., 2004; Viteri and Chávez, 2007). It would be incorrect, however, to presume that the correlation between manageability and enforcement actions was the direct result of a cause and effect relationship. This is important as the zones referred to in the case study were based on many other criteria, and site specific factors such as geography. Thus, although there is a clear correlation between the manageability scores and the number of enforcement actions, the manageability criteria and associated zoning scores listed by the recreational fishers are not necessarily the cause for this effect. Another point to consider is the potential for counteracting influences of the criteria on the hypothesized correlation. For instance, some of the

manageability criteria relate to ease of enforcement, which might logically suggest more enforcement actions would be observed, however this was not the case. This can be explained that improved ease of enforcement can result in improved potential voluntary compliance, either by improving zoning definition or acting as a deterrent, which would see lower numbers of breaches being observed. In the case study this particular counteracting situation was not significant with respect to ranking of the criteria scores; however, it is acknowledged that counteracting criteria might influence the veracity of the correlation in some circumstances. Clearly factors influencing enforcement action numbers, such as inconsistent application of enforcement, time of day, and factors resulting in variations in enforcement effort can also influence the correlation. In this case study the inconsistent application of enforcement actions was unlikely to affect the numbers of actions in each zone, as clear and unambiguous guidelines are in place in the PSGLMP to prevent inconsistent use of discretion by marine park enforcement officers.

Finally, while the correlation demonstrates that the compliance criteria and weightings may be used to support a case to change park rules, the focus must be on ensuring all MPA management objectives are met. For instance, there is no point achieving good manageability if the key resources are not adequately protected by the MPA. In this regard it should be acknowledged that while some important conservation zones may rank low in terms of manageability, there may be other planning criteria that may prevent zone modification to improve compliance. This study illustrates is that in such circumstances more targeted surveillance and an increased emphasis on extension/education in those locations is required to overcome compliance planning deficiencies. Conversely, a circumstance where a no-take zone continues to attract illegal activities, despite targeted enforcement and extension, it is clear that it will fail to meet its intended conservation objectives. We contend that this should serve as strong feedback to modify the plan and or compliance strategies.

### 5.4.3 Manageability effectiveness of PSGLMP no-take zones

The MCA scores generated for no-take zones in the PSGLMP from both working groups indicated that most zones satisfactorily met manageability criteria, with 86% and 76% of zones, respectively scoring ≥0.6, the trigger value that was agreed to for closer inspection of the zone design and management. Generally, the

zones that did not adequately meet criteria were considered to have complex rules and boundaries. There were also several zones that could be modified or removed, either because they were not considered legitimate, or were considered too small for effective compliance (Davis and Morett, 2005) (See Table 5.4 below). Under the NSW marine parks legislation, as well as local social and political demands, revisions to MPA zone boundaries is a slow and costly process, requiring detailed documentation, agreement between government agencies, public review of options and implementation by regulation (Banks and Skilleter, 2010). In the meantime, there may be immediate on-ground actions that could improve manageability of the low-ranked zones, such as improved signage and placing marker buoys along zone boundaries (See Table 5.4 below).

Table 5.4 - Planning and management recommendations to improve voluntary compliance outcomes for Port Stephens-Great Lakes Marine Park sanctuary zones.

| Sanctuary zone name | Simplify rules | Alignment to lat and long. And or resolve with contours | Straighten lines and reduce number of boundaries | Improve line of sight | More signage | Add marker buoys | Modify or remove zone is too small for compliance or enforcement |
|---|---|---|---|---|---|---|---|
| Smiths Lake | | | | | √ | | |
| Fingal Island | | √ | √ | | √ | | |
| Pindimar | | | | | √ | √ | |
| Mallabula | | | | | | | √ |
| Broughton Island | √ | √ | √ | √ | | | |
| Number One Cove | | | | | | | √ |
| Myall River | | | | √ | √ | | |
| North Arm Cove | | | | √ | | | √ |
| South Celito | | | | | | | √ |
| Little Swan Bay | | | √ | √ | √ | √ | |
| Little Branch Creek | | | | | | | √ |
| Salamander Bay | | √ | | | | | √ |
| Fame Cove | | | | | | | √ |
| Cabbage Tree Island | √ | | | √ | | √ | |
| Karuah River | | | | | √ | | |
| Fiona Beach | | √ | | | √ | | |
| The Pinnacle | √ | √ | √ | | | | |
| Fly point - Corrie Island | √ | | √ | | √ | √ | |
| Seal Rocks | √ | √ | √ | √ | √ | √ | |

## 5.5 Conclusion

It is recognised that non-compliance has a significant effect on MPAs capacity to provide effective conservation and sustainability outcomes. It follows that the overall success of MPAs in this regard is highly dependant on adequate compliance planning and operations. Improving zoning guidelines to address manageability and compliance criteria, and applying these guidelines is considered a necessary way forward to optimize voluntary compliance. To this end, this study provided empirical evidence that indicates that the application of compliance criteria to a zoning plan may improve voluntary compliance. Our results strongly support the need for greater focus on compliance criteria when designing and reviewing marine protected areas to improve their compliance feasibility and, in turn, for ecological outcomes to be realized and maximized.

As MPA planning and establishment requires high levels of public support to ensure their success, a means of better understanding sectoral interests, as well as a pathway for compromises to be achieved is needed. Above all, there is a need to better explain MPA decision-making and justify management decisions. We conclude that management tools, such as MCA have considerable utility for this purpose. Another benefit of applying decision support tools is that they provide a neutral platform to facilitate engagement with stakeholders and a more definitive means of incorporating stakeholder views in planning and management of MPAs. Finally, in regard to the PSGLMP case study, we conclude that the majority of zones in the PSGLMP are effectively meeting manageability criteria that optimize voluntary compliance; however, there is potential to improve both the design and management of the poorer performing zones, which we predict would greatly improve current levels of compliance.

# 6 EFFECTIVENESS OF COMPLIANCE OPERATIONS IN NSW MARINE PARKS

## 6.1 Introduction

The critical role of compliance in marine conservation and sustainable development governance is internationally recognised (Chapter 5 presented an analysis of the importance of compliance consideration during the planning of MPAs). International institutions and conventions share a common calling for the promotion and establishment, and strengthening of authorities and mechanisms to deliver effective legal governance, compliance coordination and enforcement (United Nations, 2002; International Network for Environmental Compliance and Enforcement (INECE), 2003). Over the last decade there has been a shift in emphasis from quantity to quality of MPAs, which are effectively managed, integrated and enforced (Christie and White, 2007; Monteiro et al., 2010; De Santo, 2013b; Rodolphe et al., 2014). Inadequate compliance and enforcement are frequently observed in many MPAs around the globe, resulting in little or no protection of the MPA values, with a side effect of diminishing community support for their establishment (Guidetti et al., 2008; Thomassin et al., 2010; De Santo, 2013b; Liu, 2013). Claudet and Guidetti (2010) suggest that "*without compliance and enforcement, a MPA is just a paper park and no protection effects should be expected*". There is a clear and uniform message in MPA literature that conveys an urgent need for improved compliance to ensure their long-term effectiveness. It is not surprising that measuring the 'level of compliance' has emerged as a key performance indicator for MPA success world-wide (Stahl, 2003; Himes, 2007a; Pajaro et al., 2010; Rife et al., 2013; Rossiter and Levine, 2014).

Through careful location, design (e.g. boundary definition) and community awareness, high levels of voluntary compliance of MPAs can be achieved at the time of their commencement[74] (Stahl, 2003; Sesabo et al., 2006; Read et al., 2011; Warner and Pomeroy, 2012). This early focus on planning to achieve compliance objectives is arguably the most important consideration for successful MPA compliance (Monteiro et al., 2010; Warner and Pomeroy, 2012). From a compliance perspective,

[74] See Chapter 5 of this thesis.

locating MPAs and zoning to provide for optimal compliance outcomes is not always an option, with biodiversity conservation, socio-economic considerations and political objectives more often taking precedence (Read et al., 2011). It follows that the quality and sustainability of ongoing compliance operations is, in practice, the most critical management function to achieve MPA objectives (Christie and White, 2007).

This chapter presents analyses of quantitative compliance and enforcement data from five marine parks in New South Wales, Australia (see Chapter 1 and 2), collected between 2007 and 2013 (see Sections 6.5–6.6). This is a period after the marine parks had established and their management plans had been implemented. The analyses compare the progress of compliance and associated enforcement activities in the five mainland marine parks[75]. MPA enforcement results are discussed in regards to: the overall effectiveness and quality of MPA compliance in NSW; compliance trends across the MPA system; the utility of the current data in understanding compliance performance; compliance performance against the NSW Marine Parks Compliance Plan objectives[76] and opportunities for future improvements. Prior to the analyses, reviews of compliance tools (Section 6.2), compliance evaluation (Section 6.3) and compliance management in NSW MPAs (Section 6.4) have been included.

## 6.2 Compliance tools

Compliance tools generally involve a combination of: *compliance assistance* (education and outreach to encourage observance with the law); *compliance incentives*, which provide benefits to those being regulated to meet certain compliance performance objectives; *compliance monitoring* to ensure that those being regulated observe the laws (e.g. vessel patrols, aerial surveillance and automatic vessel identification systems); and, *enforcement action* against violators to deter non-compliance of the law (e.g. penalties and prosecution) (International Network for Environmental Compliance and Enforcement, 2002; Shimshack, 2007).

[75] The Lord Howe Island Marine Park is not included in this study.
[76] The NSW marine parks compliance plan includes five intermediate (short to medium-term) priority objectives – see Page 146 of this thesis (NSW Marine Parks Authority, 2009b).

In combination, these compliance activities aim to both promote and compel behavioural change. Deterrence for an offence varies depending on enforcement actions. For example, deterrents may involve administrative warnings, fines, civil and criminal actions each of which can have different compliance results on individual and community behaviour (Shimshack, 2007). In a comprehensive review of existing environmental compliance literature, Shimshack (2007) concluded that legislation and regulation were the more important drivers of compliance behaviour compared to any other single factor, and that compliance monitoring and enforcement actions resulted in individual and general deterrence that could be measured empirically. Generally, for government agency actions to have a deterrent effect on non-compliance, those regulated must believe that the probability of being caught is likely, and, that if caught, the penalty will outweigh the benefits of non-compliance. It follows that deterrence may be enhanced by increasing awareness of enforcement, expanding monitoring activities (i.e. increasing the likelihood of being observed) and raising penalties and enforcement capacity to prosecute (INECE Expert Working Group on Enforcement and Compliance Indicators, 2005; Miller et al., 2013). However, increasing monitoring effort can be very costly (e.g. aerial surveillance and vessel patrols can cost thousands of dollars per hour), and increasing penalties are often politically and legally difficult. Also, increasing penalties may not achieve these desired results. For example, the penalty for recreational fishing offences in the Great Barrier Reef Marine Park is now so high that recreational fishers are more likely to decide to have the matter heard in a Court. This diminishes the benefits of issuing such administrative penalties in the first place (Department of Sustainability Environment Water Population and Communities, 2009).

To achieve optimum voluntary compliance, compliance activities need to be tailored for the given circumstance in a strategic and planned way. Strategically targeted enforcement activities, through consultative planning that identifies priorities for enforcement, is emerging as a standard practice (Christie and White, 2007). This process involves a risk assessment, which identifies where and when potential illegal activities are likely, and the associated scale of potential impacts on MPA values. One of the key objectives for compliance is to reduce the likelihood of illegal activities over time, especially highly damaging activities. Using a risk-based process, compliance actions can be tailored for the illegal events, to reduce their

likelihood over time. The first task in this case is to remove the likelihood of accidental illegal actions through improved awareness and prevention measures. Identification of compliance risks is a process that involves data gathering and intelligence analysis, which is significantly enhanced by collaboration with other enforcement agencies (see Chapter 4). The identification of compliance risks may also benefit from input other MPA users and stakeholders (Fletcher, 2005). For example, the Australian Fisheries Management Authority (AFMA) undertakes an annual risk assessment using the feedback from a range of stakeholders including industry, data processing contractors, AFMA fishing observers, fisheries managers, domestic compliance staff and intelligence officers. This broad range of views and compliance intelligence not only expands the overall understanding of potential illegal activities, but helps to avoid biased evaluations of risks (Australian Fisheries Management Authority (AFMA), 2010). Compliance planning has also been shown to benefit from the use of spatial planning tools to analyse use patterns and illegal activity 'hot spots' (Plumptre et al., 2014a). Government compliance plans include the list and extent of actions to be undertaken to improve compliance for each identified potential illegal activity, and importantly include long-term and intermediate objectives. Where high risks are identified it might be expected that a range of compliance activities need to be executed, such as increased targeted surveillance, increased presence on the water, targeted awareness and media campaigns, and application of specialised incentives, in order to bring about a change in behaviour. By way of example, when on-going non-compliance was observed within the Cod Grounds Commonwealth Marine Reserve, despite routine vessel patrols, Parks Australia developed a site specific compliance plan, with multiple compliance actions designed to address the potential causes of non-compliance, including installation of a marker buoy and a targeted media campaign. Compliance planning should also include an active program of organisation capacity development, performance reporting and adaptive management (National Fisheries Compliance Committee, 2005, 2010). Actions that support MPA compliance activities are varied, but often include the following:

- Improving utility of laws through the full enforcement of existing regulations, the review of penalty rates to maximise deterrence, and removal of ineffective legal obligations on users (e.g. deregulation) (Miller et al., 2013);
- Optimising surveillance using satellite monitoring systems (i.e. automatic identification and vessel monitoring systems), vessel patrolling, aerial surveillance, and public and volunteer sightings (Monteiro et al., 2010)
- Improving user awareness through media, user guidelines, installation and management of signage and boundary markers;
- Enhancing user education (e.g. targeted training programs for commercial operators);
- Developing partnerships with other enforcement agencies, including authorisation, asset sharing and coordinated enforcement (see Chapter 4);
- Developing partnerships with user organisations to identify incentives for compliance (Read and West, 2014);
- Consistent and sustainable enforcement actions, including enforcement capacity and officer training (INECE Expert Working Group on Enforcement and Compliance Indicators, 2005);
- Comprehensive information management, including standardised effort and enforcement action data (Miller et al., 2013); and
- Performance reporting, including indicator identification and measurement.

## 6.3 Compliance evaluation

Compliance evaluation is primarily undertaken to improve effectiveness of management. In this process, performance indicators are generally developed that allow for the analyses of compliance activities, enforcement trends over time and comparisons of the effectiveness of specific actions and approaches. The results from monitoring these performance indicators should feed back into compliance planning and associated resource allocation, through an adaptive management approach. Critical to the evaluation process is the interpretation of quantitative and qualitative compliance data, with the aim of determining which compliance activities are responsible for specific outcomes. For example, the evaluation process may need to

determine whether the targeted media campaign or increased surveillance resulted in an observed reduction in enforcement actions. Data that can be used to evaluate compliance includes: direct observation and indirect observation; law enforcement records; surveys; expert opinion; and, scenario modelling (Bergseth et al., 2013). As data sources have biases and errors, it is argued that a combination of datasets (including both qualitative and quantitative data) should be used for more robust interpretation (Shimshack, 2007; Bergseth et al., 2013). Compliance effectiveness (success) should be measured against the intended intermediate and long-term outcomes of the compliance program (Stahl, 2003; INECE Expert Working Group on Enforcement and Compliance Indicators, 2005; Environment Canada, 2009).

Compliance performance indicators for MPAs are often categorised as either input or output indicators (Bergseth et al., 2013). Input indicators include the effort that is put into compliance. For example, the number of compliance officers, number hours of patrols and size of budget (see Table 6.1). Output indicators represent the product of compliance effort, such as the number of enforcement actions, amount of penalties received, number of successful prosecutions and amount of seized equipment. Output indicators provide a "*sense of enforcement*" and the extent to which deterrence is being used to bring about compliance (Stahl, 2003). Compliance rates (i.e. output trends) have been described as one of the best overall measures of enforcement success, which makes sense when high compliance rates are a primary goal for many compliance programs. They are also easily understood, and show what has resulted from the invested resources (Stahl, 2003; Davis and Morett, 2005) Inconsistencies in categorising of input and output indicators are apparent in the literature. For example, the number of inspections has been described as both an input and an output indicator (International Network for Environmental Compliance and Enforcement, 2003; Bergseth et al., 2013). In practice this is not a problem provided that the indicator measures are well understood, consistently applied and that trends can be interpreted and triggers that prompt management responses are identified.

Final outcome indicators aim to show how compliance has resulted in protection of conservation values. Although understanding this link is most desired and is the ultimate reason for undertaken compliance, these indicators are very difficult to identify and are not sufficient on their own for assessing the effectiveness of compliance activities because conservation values are influenced by factors

outside compliance actions (International Network for Environmental Compliance and Enforcement, 2003). For example, it may be difficult to determine the role enforcement had in conserving biodiversity, when compared with MPA design and management, fisheries management policies and natural environmental forces. A recent example of empirical research pointing to compliance achieving the final outcome is by Pierpaolo et al. (2013), who examined the early effects of protection measures on fish assemblages in the Plemmirio Marine Reserve, Italy. Their study showed that the reserve's conservation outcome correlated with the level of successful enforcement inside the MPA; whereby, successful enforcement was deemed to be a function of a low frequency of illegal fishing being detected within the reserve whilst on patrol (<25% observance rate) and a high rate of active surveillance throughout the year (>75% of the year).

Input, output and outcome indicators all have some limitations (Shimshack, 2007). They cannot measure spatial and temporal patterns of non-compliance, nor their degree and/or duration. They are also not reliable if data is not consistently recorded and interpreted correctly. For example, a high compliance rate could be the result of poorly planned patrols occurring in the wrong place and time rather than no illegal actions taking place (Plumptre et al., 2014a). Being aware of their limitations and how they are measured is critical in compliance evaluation. To minimise the errors that might be observed using a single indicator and measurement, there is consensus in MPA compliance literature that a range of indicators and measurements are needed to evaluate the effectiveness and cause and effect of compliance programs (Stahl, 2003; Davis and Morett, 2005; International Network for Environmental Compliance and Enforcement, 2009; Miller et al., 2013). More recently, there has been a move towards applying 'intermediate outcome' indicators to measure progress towards achieving final outcomes. Intermediate outcomes *are the effects of the outputs on those who were reached* (INECE Expert Working Group on Enforcement and Compliance Indicators, 2005). These indicators describe anticipated changes in behaviour, knowledge or conditions that result from program activities. Barett and Pascoe (2003) suggest the following key questions that should be asked to evaluate the success of intermediate outcomes:

- *Are we achieving appropriate compliance levels?*
- *Are we improving environmental performance?*
- *Are we increasing the effectiveness of the program?*

- *Are we demonstrating the value of our activities to the public?*

Surveys that ask relevant questions to gauge intermediate outcomes allow links to be identified with compliance actions and this leads to a better understanding of what is working and those actions that need improvement. Such improvements are associated with, or are needed to achieve final outcomes. An example of an intermediate outcome indicator for a MPA compliance program might be the level of user awareness of MPA boundaries and regulations. An increase in this indicator could lead to a final outcome of "increased size and quantity of fish" in the MPA, through improved voluntary compliance (see Table 6.1).

Table 6.1 - Examples of MPA compliance performance indicator types and measures (International Network for Environmental Compliance and Enforcement, 2003; Stahl, 2003; Bergseth et al., 2013).

| Indicator Type | Indicator | Indicator Measurement |
|---|---|---|
| Input | Level of resourcing. | Number of enforcement officers in the MPA, budget ($) |
| | Level of surveillance. | Number of patrols, hours of patrols, patrol coverage. |
| Output | Enforcement actions. | Nature of offence, number of enforcement actions, age of offenders. |
| | Offence locations. | Location of offenders (Post Code). |
| | Offender details. | Gender and age recording |
| Intermediate Outcome | Improved knowledge of MPAs by commercial fishing operators. | Number of operators completed relevant training courses. |
| | Local awareness, compliance and support. | Decline in local enforcement actions over time; and<br>Increase in the number of locals reporting offences.<br>Number of enforcement actions by category by address. |
| | Improved change of behaviour in commercial users. | Decline in number of enforcement actions over time.<br>Declining risk rating of potential illegal actions. |
| | Increase in user awareness of marine reserves and their locations. | Increase observed through surveys (knowledge of boundaries and take up of electronic maps on vessels) |
| | Reduced number of illegal incursions by the local community. | VMS alert messages to operators result in greater awareness - review of VMS data indicates that the number of boundary incursions is declining. |
| | Increased successful prosecutions on a sector. | Percentage of prosecutions success and penalty ($) increase over time. |
| | Integrated services with partner agencies. | Number of joint patrols, number cross authorisations, number of joint training exercises. |
| | Increase in skilled staff. | Enforcement qualifications and training attainment. |
| Outcome | Protection of threatened species. | Number of species, size of populations. |
| | Protection of endemic species and habitat. | Number of species, percentage of habitat protected. |

## 6.4 Compliance management in NSW MPAs.

Compliance in NSW marine parks is governed by the *Marine Parks Act 1997* (the Act), which has a chapter dedicated to enforcement (Part 7). The Act outlines all the powers of fisheries officers under the *Fisheries Management Act 1994* (Divisions 1–4, Part 9) and the powers of national park rangers under the *National Parks and Wildlife Act 1974* (Sections 157–159) that apply in marine parks. Together, these powers present a comprehensive suite of provisions to deal with non-compliance with marine park zoning plans and regulations. For instance, they provide for: entry and search of a vessel or premise (without a Court warrant); powers to detain a vessel; and powers to arrest. To address non-compliance, the Act has provisions to issue penalty notices for specified regulations and also prosecute offences against corporations (s.41)[77]. It also allows for serious offences to be specified by regulations (s.17A), resulting in a five-fold increase in the maximum penalty[78]. The *Marine Park Regulations 2009* provide for: permitting of activities; the capacity to remove persons and property from a marine park; remove heavily fouled vessels; seize property; and to schedule fines for offences (ranging in value from $200 to $500). Sanctuary zone offences and the taking of protected species are specified as serious offences by the *Marine Park (Zoning Plans) Regulations 1999*[79]. Seizure powers are derived from the *Fisheries Management Act 1994* (Division 4, Part 9) and allow a marine park ranger to seize anything (other than a boat or motor vehicle[80]) that is found by the officer in a search whereby the ranger had reason to believe it was connected with a marine park offence. These seizure powers are substantial in comparison to other jurisdictions, such as the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*, which only allows boarding a vessel if, in the enforcement officer's opinion, an offence has been committed and seizure only for evidence purposes.

The capacity of marine park enforcement officers to use their powers as authorised officers under the Act is underpinned by state and agency level compliance

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[77] Taking action against Corporations for their involvement in illegal activities is a key recommendation to address international living resource crimes (Rose and Tsamenyi, 2013). Also, the Commonwealth marine reserves compliance strategy now has a focus on corporations, taking civil action as a matter of course for most contraventions in these reserves.

[78] At 2014, one penalty unit in NSW = $110AUD. The maximum penalty is 1000 penalty units for corporations and 500 penalty units for individuals.

[79] Marine Park zoning plans came into effect in Jervis Bay and Solitary Islands Marine Parks in 2002; Cape Byron Marine Park in May 2006; and April 2007 and June 2007 for Port Stephens - Great Lakes Marine Park and Batemans Marine Park respectively.

[80] A vessel can be seized if it is in relation to an illegal commercial operation *NSW Fisheries Management Act 1994* (s.265)

policies, which provide general and specific guidance for the application of enforcement powers (NSW Marine Parks Authority, 2008). Marine park enforcement officers undertake an extensive training regime, ranging from occupational health and safety, to defensive tactics (baton and handcuff) training. They are also required to undertake certified formal enforcement training before they are authorised to use these powers.

A state-wide compliance plan for marine parks has been developed, which seeks to maximise voluntary compliance, to create an effective deterrent against illegal activities, and to measure, review and improve compliance operations (NSW Marine Parks Authority, 2009b). Under the state-wide compliance plan, an operational plan is established for each marine park, with the aim of providing a framework for both routine and tactical (risk-based) compliance, whereby high-risk areas and seasonal activities are targeted. Similar to compliance programs in other Australian jurisdictions (e.g. the Great Barrier Reef Marine Park), the primary method for monitoring compliance in NSW marine parks is by land and vessel-based patrols, as well as reporting of illegal activities by marine park users and the general public. NSW fishing licences and endorsements do not require vessel identification systems or other types of remote vessel monitoring devices to operate in their managed fisheries.

## 6.5 Methods used to evaluate compliance effectiveness in NSW marine parks.

### 6.5.1 Analysis of enforcement actions (output indicators)

NSW marine park surveillance and enforcement data 2007–2013, recorded in the NSW Department of Primary Industries (DPI) Nautilus database[81] were analysed to assess compliance actions and other compliance information for five NSW marine parks. Raw data from the Nautilus database were extracted and pivot tables were designed to analyse compliance information trends. Enforcement data has been extracted and analysed to examine:

- Total number of enforcement actions / financial year, for all marine parks. This indicator provided an overview of the NSW marine park estate enforcement actions by financial year. Analyses of combined total enforcement actions, at the

[81] The NSW DPI Nautilus database is a customised and integrated compliance database, which manages input and output indicator measurements for all fisheries and marine park enforcement activities, as well as enforcement case management and associated reporting requirements.

estate level, have been used as high level performance reporting, to depict trends in overall compliance results; and

- Number of enforcement actions / marine park / financial year. This indicator was derived from the number of enforcement actions by financial year for individual marine parks, and provided data on finer-scale trends in compliance.

To avoid potential biases resulting from inconsistent decision-making between marine park officers, all enforcement actions[82] were grouped together and considered (and weighted) the same as each other. For example, if an officer issued a warning notice for an offence, and another officer issued a penalty infringement for the same offence, there would be a bias if the action types were analysed separately. By grouping all action types together, however, this bias is eliminated. Another bias is to consider all offence types the same (Keane et al., 2011). Analysing different types of offences separately has been suggested to be a preferable approach, as they are subject to different influences (e.g. time and resources for enforcing pollution offences is not the same as required to enforcing sanctuary zone offences). Given the complexities involved in separately analysing each offence type, in this study all marine park offences under the *NSW Marine Parks Act 1997* and Regulations were aggregated and treated the same. To understand the significance of this potential error, an analysis of the composition of offence types was undertaken across three consecutive years to determine variation and composition. A high variation of offence types would result in a greater error (Keane et al., 2011). Analyses of NSW marine park offence types, however, were observed to be consistent and similarly proportioned across these years, with 52–63% associated with fishing in sanctuary zones, and 27–29% associated with recreational fishing licence offences. Given this consistency and lack of variation (the similar time and resources would be allocated to each offence type), any bias of grouping the offences together was considered low.

[82] For the purpose of this thesis, an enforcement action is defined as any enforcement response resulting in the action being recorded in a compliance and enforcement database, including: a written warning (with no fine); a penalty notice (with fine); and prosecution. It does not include verbal warnings.

### 6.5.2 Analysis of enforcement effort (input indicators)

Three patrol types have been reported on the Nautilus database, these include: 1) vessel, 2) vehicle, and 3) aerial patrols[83]. Patrol effort was recorded in 0.5 hr (30 min.) slots per patrol type per day and was spatially recorded[84]. Jervis Bay and Batemans marine parks had continuous and reliable patrol effort data for four financial years (2009–2012). However, patrol effort data from other marine parks was not reliable and ceased to be collected in 2011. Consequently, these data were not used in compliance effort analyses.

Guidelines for recording effort and enforcement actions came into effect in December 2009[85], with the objective to standardise data collection procedures across all marine parks, and minimise data biases from individual officer data collection. Potential data collection biases include:

- Surveillance being undertaken closer to the working place (Plumptre et al., 2014b).
- Surveillance being poorly directed in areas and in time whereby the likelihood of non-compliance might be low[86] (Gavin et al., 2010; Read and West, 2010);
- Surveillance effort biased towards more easily recognised and "straight forward" offences (e.g. enforcing bag and size limits compared to enforcing speeding or pollution incidents, is less complex and takes less time to document and record).
- Differing behaviours between officers (e.g. morale).
- Differing skills between officers (e.g. level of training and individual abilities).
- Potential corruption (e.g. deliberately over-reporting patrol hours to gain overtime or other benefits, or gaining supervisor praise to achieve promotion opportunities; or, not recording minor infractions, to avoid additional reporting inconveniences (Keane et al., 2011).

Patrol effort data from Jervis Bay and Batemans Marine Parks were used to analyse the number of patrols hours and days in each financial year. This data was tabulated with corresponding output data to examine rates of enforcement actions (i.e. number of enforcement actions by patrol hour). In these analyses, it has been cautiously

[83] Aerial surveillance was not undertaken by NSW marine parks during the data collection period.
[84] Effort data recording on Nautilus (patrol number and hours) commenced on July 2009 and ceased in 2013.
[85] These guidelines were prepared by the author.
[86] See Chapter 5.

assumed that MPA patrols approximated optimal effort[87] (i.e. patrols were risk-based and targeted, both spatially and temporally, to protect important areas, such as sanctuary zones and research monitoring locations within the marine parks). Standard regression analysis has been used to compare enforcement actions by patrol effort in fisheries; however, it is recognised that the relationship between patrol effort and enforcement actions is not necessarily linear, for example, increasing patrol effort is likely to result in increased detection and also produces a deterrent effect, leading to fewer illegal actions being committed (Hilborn et al., 2006b). Keane (2011) point out that if not recognised, non-linear relationships can have important consequences. For example, in relationships where the number of illegal actions detected per patrol declines more rapidly than the number of enforcement actions, this might result in overestimating effectiveness of effort. On the other hand, relationships where the number of illegal actions detected per patrol declines more slowly than the number of illegal actions, could result in overspending, with the assumption that illegal actions were more frequent than what is the case.

### 6.5.3 Analysis of local and visitor enforcement data

Offender postcodes were extracted from the Nautilus database to distinguish local from visitor enforcement incidents. Postcodes immediately adjacent to the land boundary of each marine park (approximately 30–50 km radius from the marine park) were used to indicate locals. All other postcodes were considered to be visitors. These data were separated for each individual marine park to determine if there were any differences between enforcement action rates of locals and visitors.

### 6.5.4 Analysis of repeat offenders data

Repeat offender data was extracted from the Nautilus database. For the purpose of this study, a repeat offender was defined as "an offender that offended more than once under the *Marine Parks Act 1997* over the six-year data period (2007–2012), regardless of the offence location or offence type". Repeat offender information is considered an

[87] To minimise these potential biases in effort data collection, compliance planning in NSW marine parks over the recording period was risk-based and patrols were targeted to locations and times of high illegal incident risk (i.e. risk = potential environmental impact x likelihood of non-compliance).

important indicator of individual deterrence (INECE Expert Working Group on Enforcement and Compliance Indicators, 2005). High rates of repeat offenders (i.e. a common occurrence of repeat offenders) might suggest penalties are insufficient to deter future violations. It could also indicate, however, that the offender believes the chances of getting caught again are low. An the other hand, low rates of repeat offenders might suggest that the penalties of getting caught a second time adequately deter future violations, or that the offenders believe the chances of getting caught are more probable, on the basis of their experience of being caught previously.

### 6.5.5 Analysis of offender age

Offender age was extracted from the Nautilus database for each marine park and recorded by financial year (2007–2012). Mean ages and standard deviation were calculated (MS Excel software) and graphs were prepared to show average offender age for each financial year for each marine park.

Understanding age demographics of offenders can help to target compliance strategies with age-cohort behavioural patterns (Davis and Morett, 2005). For example, increasing monitoring and punishment, including societal pressure, made a difference to younger fisherman than to older fishermen in Brazil (Karper and Lopes, 2014). Examining trends in the age of offenders over time can indicate whether compliance strategies are making progress. For example, a positive trend in offender age (i.e. an aging population of offenders) could indicate that younger age classes are changing in behaviour. Age information could also be used to measure performance of marine park education programs. For example, an MPA education program for school children might have an intermediate outcome to observe a reduction in the number of young offenders over a time period.

### 6.5.6 Location of enforcement actions in marine parks

The NSW Nautilus database includes location data (latitude and longitude coordinates) for each offence committed. As an example of this type of information, data for offence locations in Jervis Bay Marine Park for 2009/10 were mapped using ArcGIS software. A composite map was generated that included overlays of marine park zoning types and boundaries and other geographic features. Statistical ‘hotspot’ modelling of data clumps

was not undertaken; however, visual analysis of the geographical distribution provides a useful rapid approach to show key areas where offences occur (Plumptre et al., 2014a). Understanding spatial and temporal risks of illegal actions is fundamental for undertaking risk-based compliance planning (Plumptre et al., 2014b). It was assumed that this was undertaken in all marine parks during the study period (see Section 6.5.4).

### 6.5.7 Assessment of performance against compliance objectives.

The NSW MPA compliance plan, referred to in Section 6.4, set five priority areas for compliance effort allocation in NSW marine parks for 2009–2012. These priorities were:

1) Protection of unique, sensitive and high-risk sanctuary zones and ensuring compliance of sanctuary zones.
2) Improving community awareness, understanding and support for marine parks, and highlighting the benefits of multiple use management within NSW marine parks.
3) Ensuring integrity of research and monitoring results, ensuring linkages are made between research programs and local compliance actions in order to minimise the risk of non-compliance confounding research results.
4) Protection of the marine environment from pollution.
5) Ensuring fishing activities are ecologically sustainable with enforcement priority exercised in respect to fisheries management laws, in particular bag and size limits for recreational fishing, and restrictions on commercial fishing operations (NSW Marine Parks Authority, 2009b).

In order to assess the performance of the NSS MPA compliance plan, these priority areas were interpreted as intermediate outcomes to be achieved by the end of the plan. As there are no indicators or indicator measurements identified in the plan, analyses of compliance data presented in Sections 6.6.1–6.6.5 was used to support a preliminary performance appraisal of these outcomes (Section 6.6.6).

## 6.6 Results

### 6.6.1 Enforcement action and patrol effort trends

Figure 6.1 shows total marine park legislative and regulatory enforcement actions for all NSW marine parks (executed by authorised officers from both marine Parks and the NSW Department of Primary Industries). Grouping these data provides an overview of marine park offences from financial years 2007/08 to 2012/13. Over the six-year period, a total of 5003 enforcement actions were executed (mean = 830 enforcement actions per financial year)[88].

The majority of the offences resulting from an enforcement action in NSW marine parks for the years 2008/09 to 2010/11 were committed by recreational fishers and related to illegally fishing in sanctuary zones (i.e. IUCN Category II zones where no fishing or other forms of extraction/interference are permitted). These offences made up over 70% of all enforcement actions in marine parks (see Table 6.2). One out of five enforcement actions resulted in fishing gear being seized and catch discarded.

In the financial year 2007/08 marine park zoning plans were relatively new and, consequently, the compliance focus was on user awareness and education of marine park rules. This explains the relatively low rate of enforcement actions in this year compared to later years. Also of note, was the application of verbal cautions by Marine Park officers was prevalent and not recorded[89]. Post 2008/09, verbal cautions were no longer recognised as an enforcement action. Following a peak in 2008/9, the number of enforcement actions across the marine park estate declined for four consecutive years (2008/09–2011/12) and then increased by approximately 40% in 2012/13 to the 2009/10 level (Figure 6.1). Figures 6.2– 6.6 show total marine park enforcement actions for the five mainland marine parks, namely: Cape Byron Marine Park; Solitary Islands Marine Park; Port Stephens - Great Lakes Marine Park; Jervis Bay Marine Park and Batemans Marine Park.

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[88] Includes *Marine Parks Act 1997* and associated regulatory and zoning offences and *Fisheries Management Act 1994* and regulatory offences in marine parks.

[89] Standardised guidelines for enforcement decision-making came into effect in December 2009 (i.e. issuing of warning and penalty notices or proceeding with legal action). Prior to December 2009 consistency in decision-making between marine parks varied considerably between the issuing of warning and penalties. In the first year of enforcement output recording (2007/8) there was also notable inconsistency between verbal warnings and issuing of written warnings.

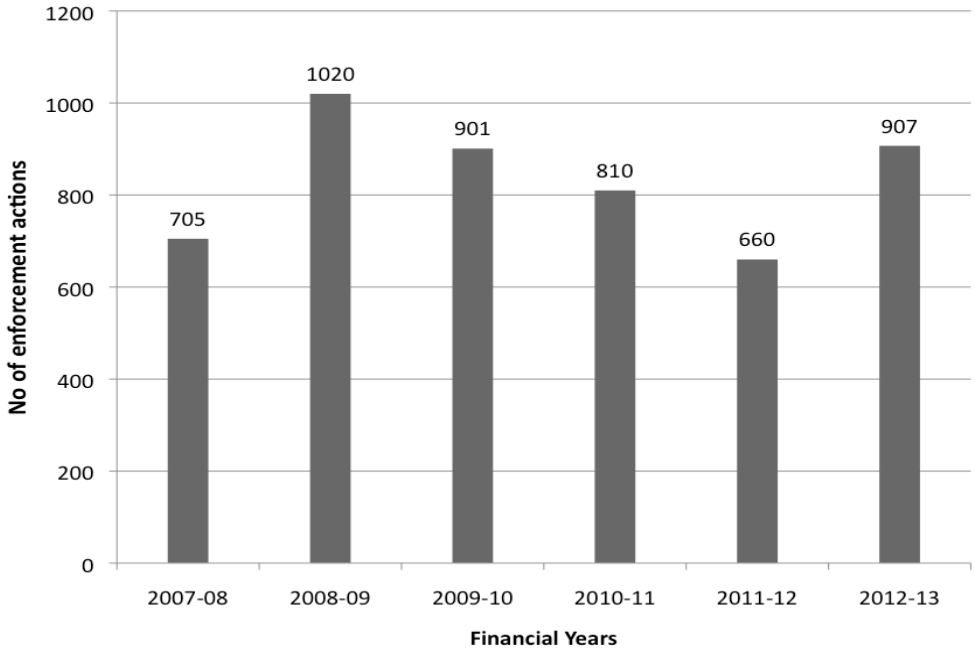


Figure 6.1 - Aggregated NSW marine park enforcement actions by financial year summed across all marine parks.

Table 6.2 - Types of offences committed in NSW marine parks - ranked by number recorded in each year (2008/9 –2010/11)

| Offence | 2008/9 | 2009/10 | 2010/11 |
|---|---|---|---|
| Section 17A – Harm or attempt to harm an animal in sanctuary zone - designated a serious offence, MPA 1997 | 61% | 52% | 48% |
| Section 34J (2) - Recreational fisher fails to have official receipt in possession or S 34J (1) – Recreational fisher fails to pay fishing fee, FMA 1994 | 23% | 22% | 22% |
| Section16 (1) - Possess prohibited size fish, FMA 1994 | 4% | 6% | 7% |
| Clause 12(2)(b), Take/attempt to take fish in habitat protection zone in contravention of zoning plan, MPA 1997 | 6% | 3% | - |
| Clause 1.25 (2) - Possess equipment for taking prohibited plant/animal, MP (ZP) R 1999.* | 2% | - | 7% |
| Section 24 (1) – Unlawfully use net or trap for taking fish, FMA 1994 | - | 3% | 2% |
| Others (e.g. other fisheries and marine park offences, including, anchor/moor vessel in sanctuary zone, illegally bring a domesticated animal into marine park, etc) | 8% | 14% | 14% |

*Note Possession of equipment for taking prohibited plant and animals is regularly used as an alternative for Section 17A - sanctuary offences.

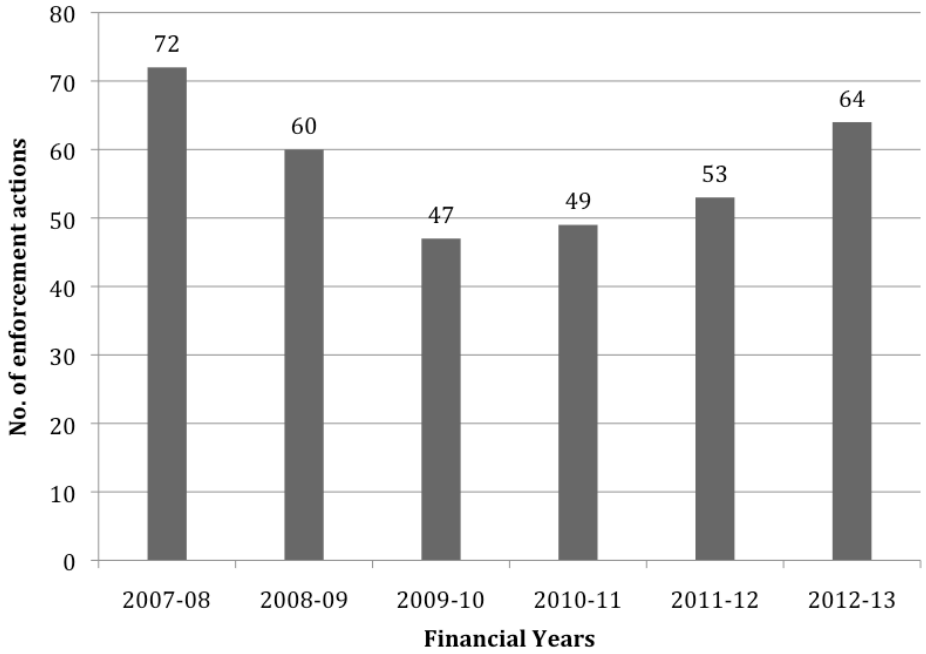


Figure 6.2 - Cape Byron Marine Park - Enforcement actions by financial year.

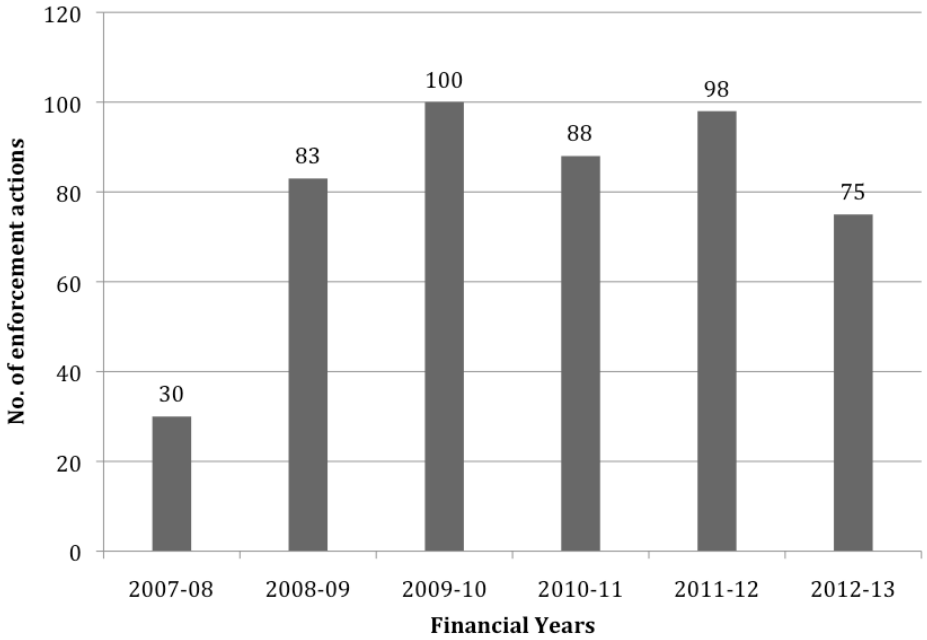


Figure 6.3 - Solitary Islands Marine Park – Enforcement actions by financial year.

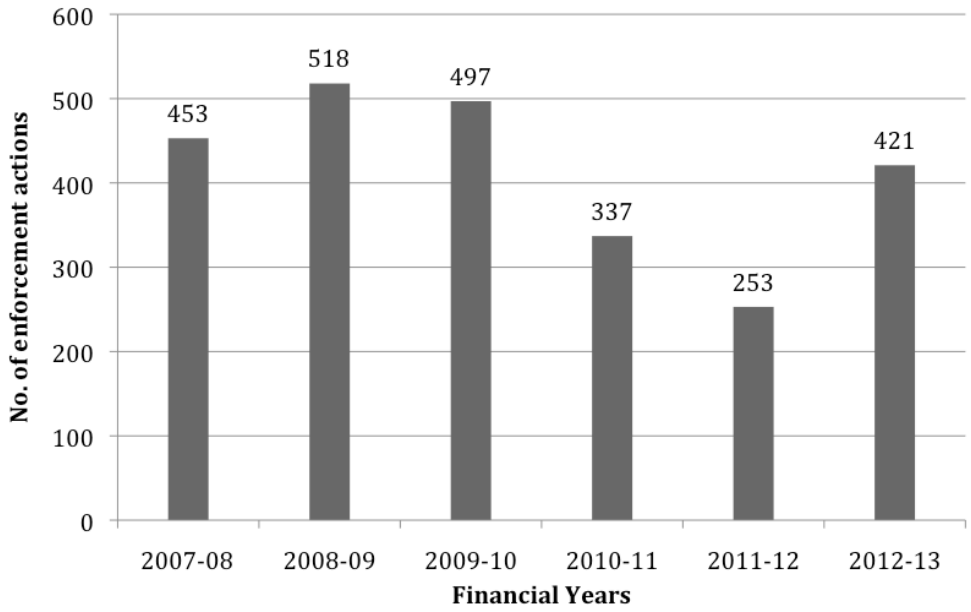


Figure 6.4 - Port Stephens - Great Lakes Marine Park - Enforcement actions by financial year.

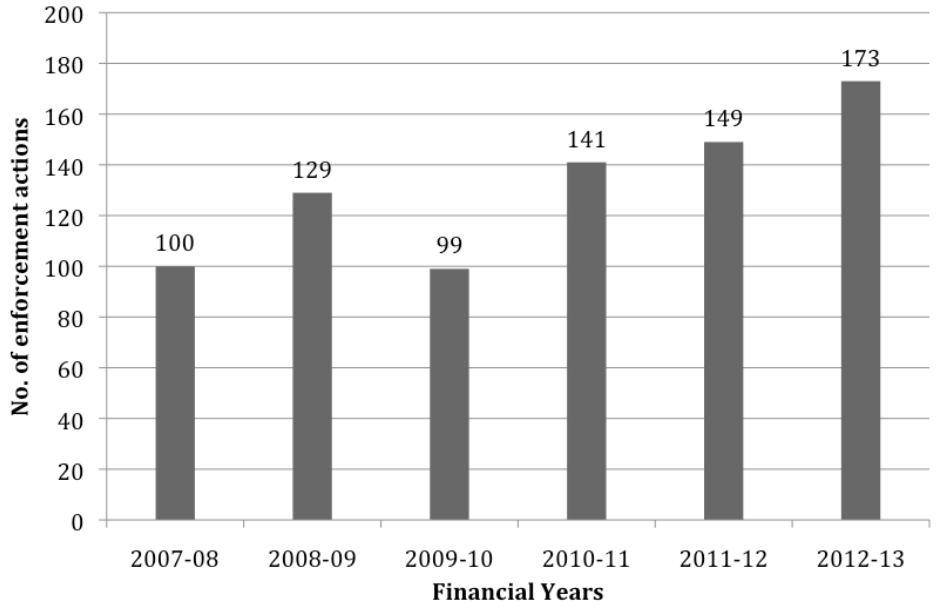


Figure 6.5 - Jervis Bay Marine Park - Enforcement actions by financial year.

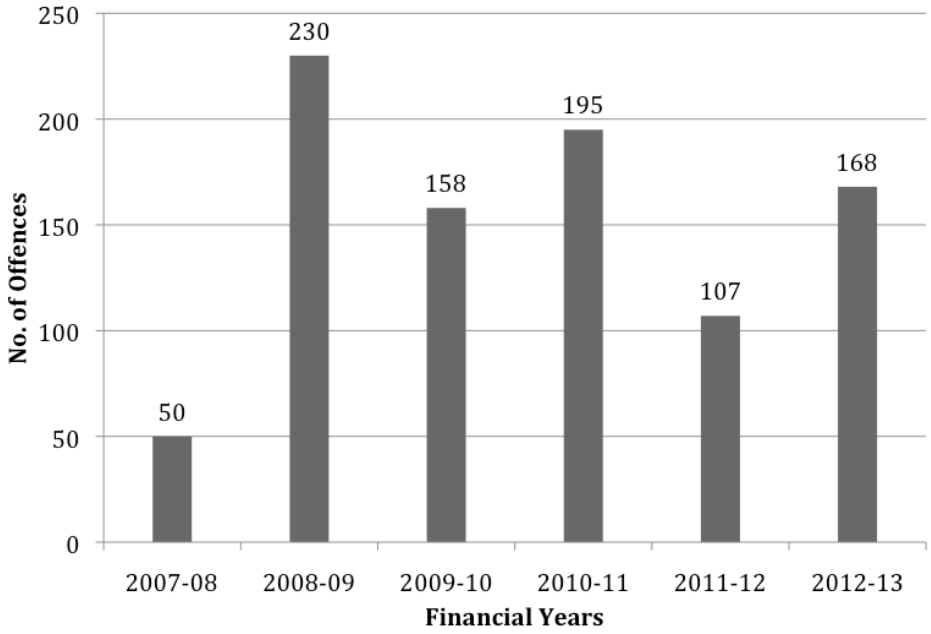


Figure 6.6 - Batemans Marine Park - Enforcement actions by financial year.

The number of enforcement actions by financial year indicates the level of compliance output only (i.e. Figures 6.5–6.6). In Figures 6.7 and 6.8, enforcement actions are overlaid with the corresponding patrol effort (number of hours patrolled) for Jervis Bay and Batemans Marine Parks[90]. In both cases, this highlights that patrol rates are not constant over time and varied by several hundred hours each financial year. The highest patrol effort for Jervis Bay Marine Park was recorded in 2011/12. During this financial year, nearly 900 hours of patrol time was recorded on 209 separate days (57% of the year, see Table 6.3). This enforcement input corresponded to an output of 149 enforcement actions. When standardised as enforcement actions per hour (patrol hr/officer), the enforcement action (offence) rate for Jervis Bay Marine Park in 2011/12 was 0.084 enforcement actions/patrol hr. (Figure 6.7). In Figure 6.7, the Jervis Bay Marine Park enforcement action (output) data indicates an increasing trend in number of enforcement actions executed each year (94–165 enforcement actions). The patrol effort, however, appears to be declining over the same period. Standardised enforcement actions/patrol hr. highlights this trend, rising steadily over the four-year

[90] Jervis Bay and Batemans Marine Park are the only marine parks with multiple year effort data, other marine parks ceased patrol effort collection in 2011/2012. Also note that Figures 7 and 8 show enforcement actions executed by marine park officers only.

reporting period (0.058–0.125). Batemans Marine Park displayed variability in the number of enforcement actions (outputs) over time, with 2010/11 being the highest (153) and 2011/12 being the lowest (68) year for number of enforcement actions (see Figure 6.8). Patrol rates were at their highest in 2010/11, with almost 1700 hours recorded on 216 separate days on patrol (59% of the year, see Table 6.3), and at their lowest in 2011/12 (approximately 1000 hrs). When enforcement rates are calculated for Batemans Marine Park and plotted, a decreasing trend of enforcement rates was observed from 2009/10 to 2011/12 (0.05–0.033 enforcement actions/hour), followed by an increase in 2012/13 of 0.047 enforcement actions/hr (see Figure 6.8). If you assume that two officers work together on most occasions, the Jervis Bay Marine Park offence rate in the last recorded year (2012/2013) was 0.25 enforcement actions/actual patrol hr., or one enforcement action for every four hours of patrolling (see Figure 6.7). Batemans Bay Marine Park in the same year had an offence rate of 0.09 enforcement actions/patrol hr (i.e. one enforcement action every 11 hours of patrolling). Table 6.3 shows the data converted to a daily rate, with offences per patrol day for Jervis Bay and Batemans marine parks, which shows a similar outcome (i.e. in 2012/13 - 1.03 enforcement actions/day and 0.62 enforcement actions/day, respectively).

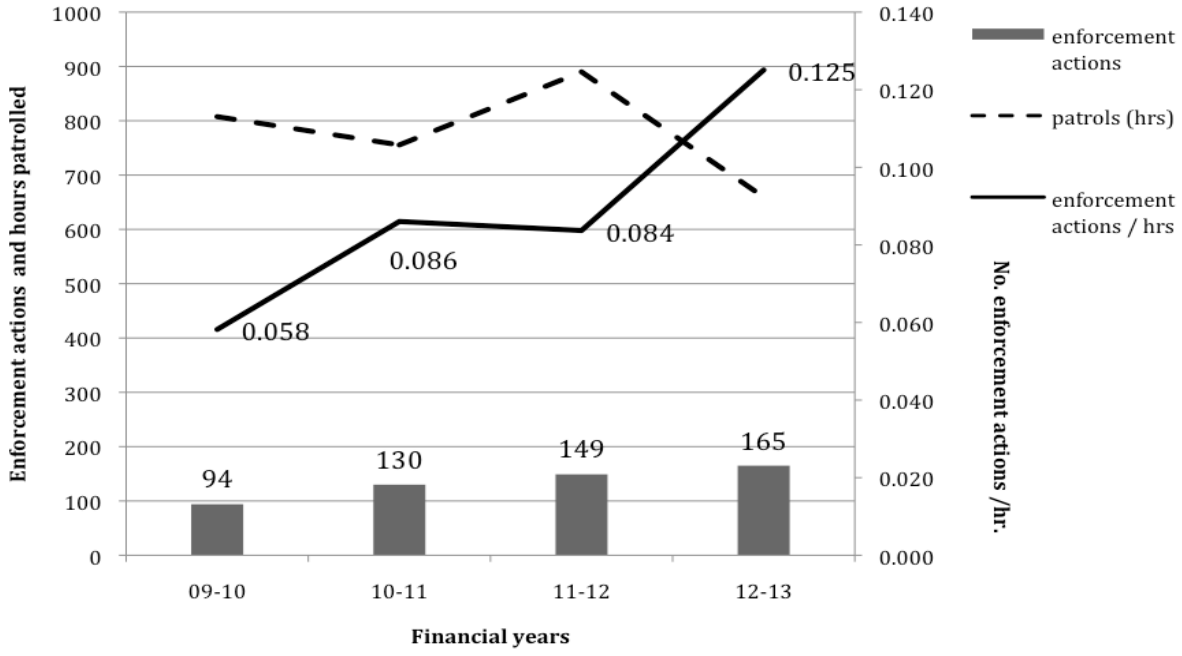


Figure 6.7 - Jervis Bay Marine Park – Enforcement actions by patrol hours by financial year (marine park officers only).

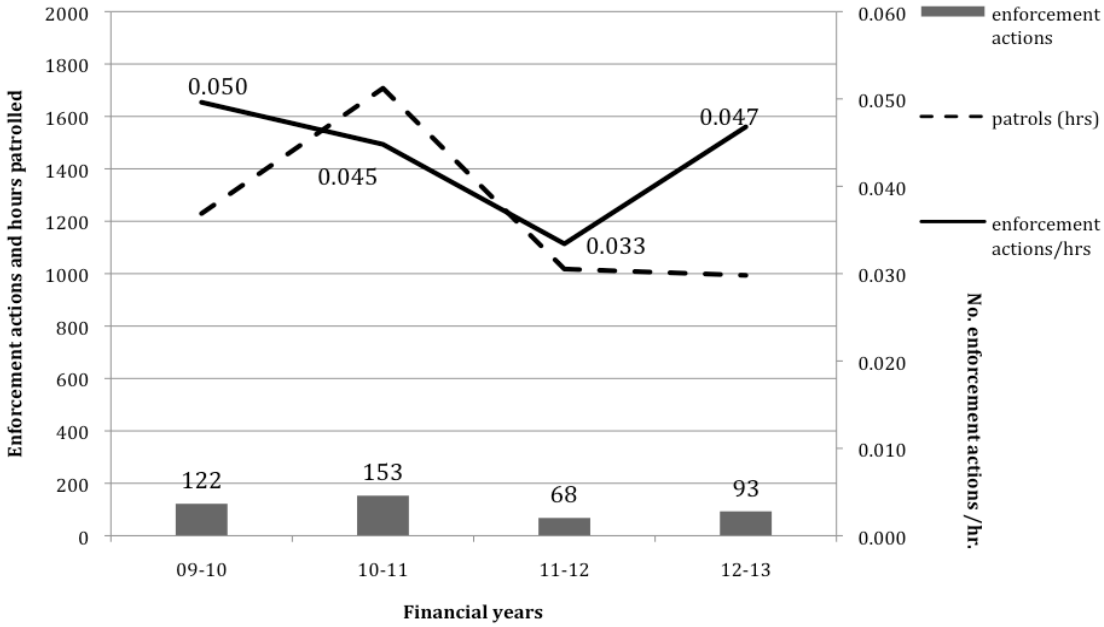


Figure 6.8 - Batemans Marine Park – Enforcement actions by patrol hours by financial year (marine park officers only).

Table 6.3 - Number of days on patrol by financial year and offence rates in Jervis Bay and Batemans Marine Parks (2009/10–2012/13).

| Financial Year | Jervis Bay Marine park | | | Batemans Marine Park | | |
|---|---|---|---|---|---|---|
| | Days on Patrol | Per cent of year (%) | Offence rate (Actions/ day) | Days on Patrol | Per cent of year (%) | Offence rate (Actions/ day) |
| 2009/10 | 175 | 48 | 0.54 | 181 | 50 | 0.67 |
| 2010/11 | 166 | 45 | 0.78 | 216 | 59 | 0.70 |
| 2011/12 | 209 | 57 | 0.71 | 156 | 43 | 0.44 |
| 2012/13 | 160 | 34 | 1.03 | 149 | 41 | 0.62 |

### 6.6.2 Local and visitor compliance trends.

Enforcement actions (i.e. numbers of offences reported) can be categorised as either local or non-local (visitor) offenders (Table 6.4, Figures 6.9–6.15). Local compliance data has been analysed to identify trends in local behaviour, with the notion that locals are a captive audience and might be a better indicator of the effectiveness of a compliance program. For example, changing behaviour of users. Local versus visitor ratios are highly variable between individual marine parks and between years (see Table 6.4). Cape Byron Marine Park and Solitary Islands Marine Park stand out with high ratios of local to visitor enforcement actions than parks to the south. Port Stephens - Great Lakes and Jervis Bay marine parks have similar ratios, however these parks have noticeably lower number of locals to visitors offending (ranging 0.12–0.26 and 0.13–0.39 respectively). Batemans Marine Park has ratios ranging more in the mid ranges from 0.26–0.54. Port Stephens - Great Lakes, Jervis Bay and Batemans Marine Parks show noticeably higher number of enforcement actions/year, than Cape Byron Marine Park and Solitary Islands Marine Park, with Port Stephens - Great Lakes Marine Park by far the highest figures (Table 6.4).

Table 6.4 - Local and visitor enforcement actions ratios for NSW marine parks (Marine parks legislation) for the financial years 2007/8 to 2012/13 as reported by Marine Park Officers.

| **FN YEAR** | **CBMP** | | | **SIMP** | | | **PSGLMP** | | | **JBMP** | | | **BMP** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | V | ratio | L | V | ratio | L | V | ratio | L | V | ratio | L | V | ratio |
| 2007/8 | 39 | 33 | 1.18 | 18 | 12 | 1.50 | 54 | 399 | 0.14 | 17 | 83 | 0.20 | 16 | 34 | 0.47 |
| 2008/9 | 34 | 26 | 1.31 | 63 | 20 | 3.15 | 63 | 455 | 0.14 | 15 | 114 | 0.13 | 71 | 159 | 0.45 |
| 2009/10 | 31 | 16 | 1.94 | 56 | 44 | 1.27 | 102 | 395 | 0.26 | 28 | 71 | 0.39 | 44 | 114 | 0.39 |
| 2010/11 | 29 | 20 | 1.45 | 51 | 37 | 1.38 | 35 | 302 | 0.12 | 26 | 115 | 0.23 | 40 | 155 | 0.26 |
| 2011/12 | 27 | 26 | 1.04 | 54 | 44 | 1.23 | 50 | 203 | 0.25 | 35 | 114 | 0.31 | 36 | 71 | 0.51 |
| 2012/13 | 32 | 32 | 1.00 | 44 | 31 | 1.42 | 54 | 367 | 0.15 | 51 | 122 | 0.42 | 59 | 109 | 0.54 |

CBMP = Cape Byron Marine Park; SIMP = Solitary Islands Marine Park; PSGLMP = Port Stephens-Great Lakes Marine Park; JBMP = Jervis Bay Marine Park; and BMP = Batemans Marine Park.

Local enforcement action rates (number of enforcement actions) by financial years are shown in Figures 6.9–6.13. In general, local rates of offences show a downward trend for Cape Byron Marine Park, Solitary Islands Marine Park, Port Stephens - Great Lakes Marine Park and Batemans Marine Park. However, enforcement action rates for local offenders in the Jervis Bay Marine Park are increasing (see Figure 6.12). When enforcement action rates are standardised with patrol effort for Jervis Bay and Batemans marine parks (Figures 6.14–6.15) an upward trend is also apparent for Jervis Bay Marine Park. Batemans Marine Park indicates a more an even trend, with offence rates only slightly varying, at around 0.01 enforcement actions/hr over the four-year period (see Figure 6.14).

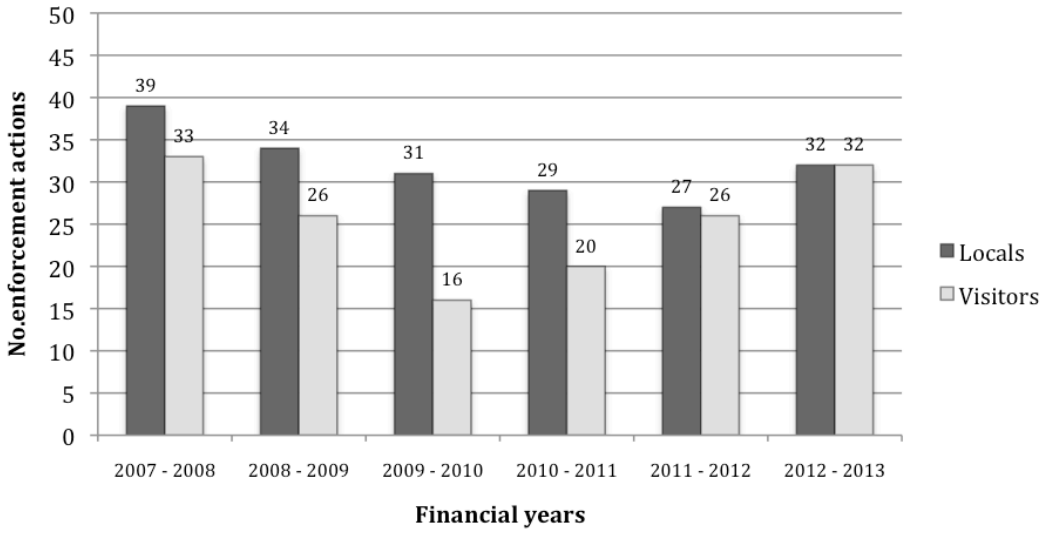


Figure 6.9 - Cape Byron Marine Park - Comparison of the number of enforcement actions for local and visitors by financial year.

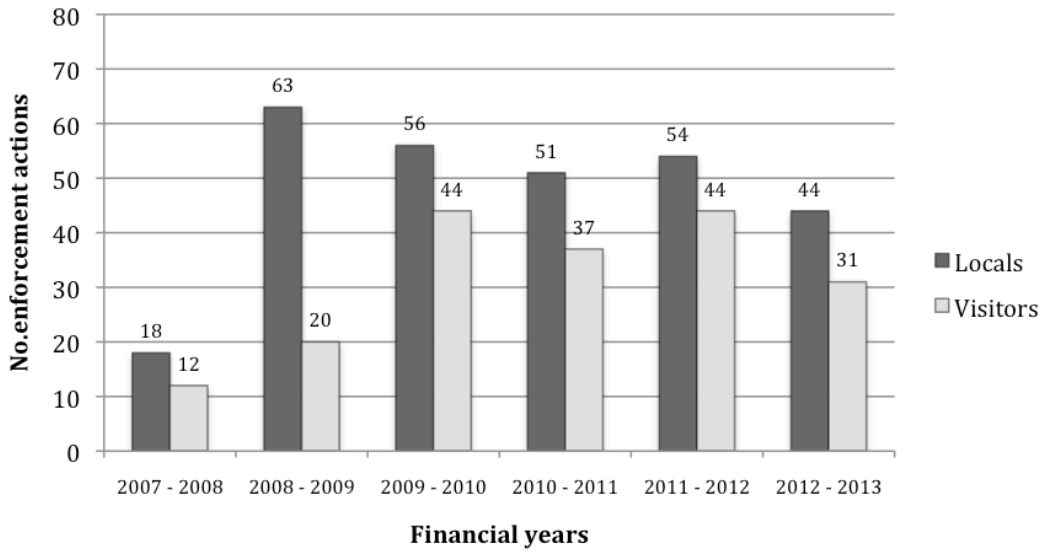


Figure 6.10 - Solitary Islands Marine Park - Comparison of the number of enforcement actions for local and visitors by financial year.

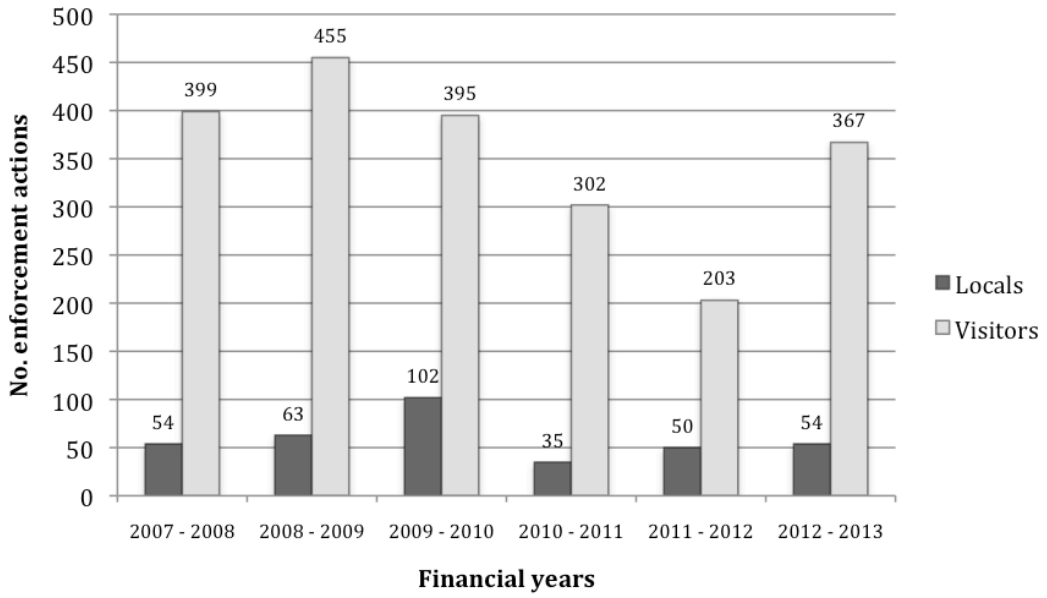


Figure 6.11 - Port Stephens - Great Lakes Marine Park - Comparison of the number of enforcement actions for local and visitors by financial year.

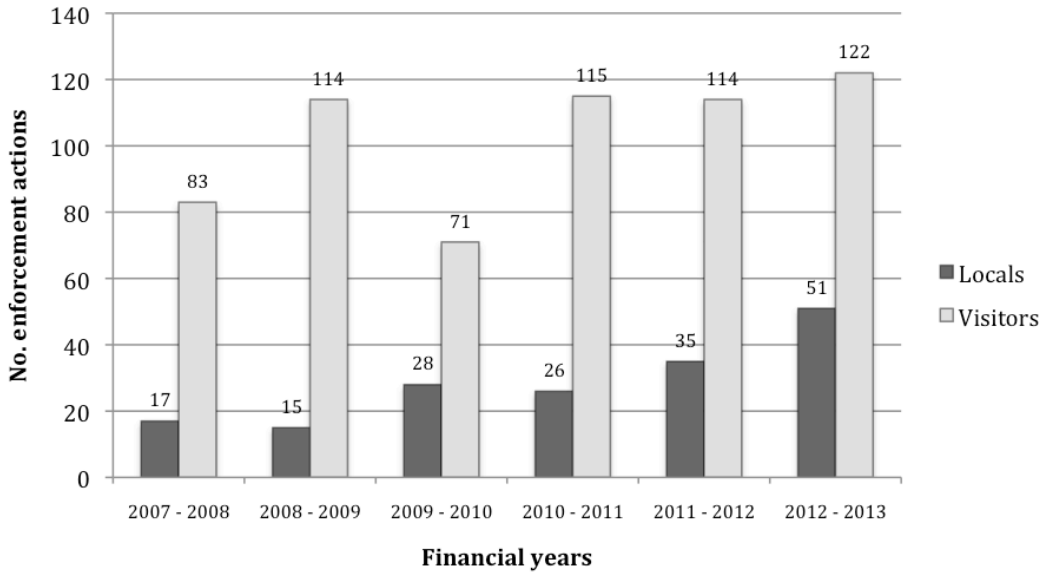


Figure 6.12 - Jervis Bay Marine Park - Comparison of the number of enforcement actions for local and visitors by financial year.

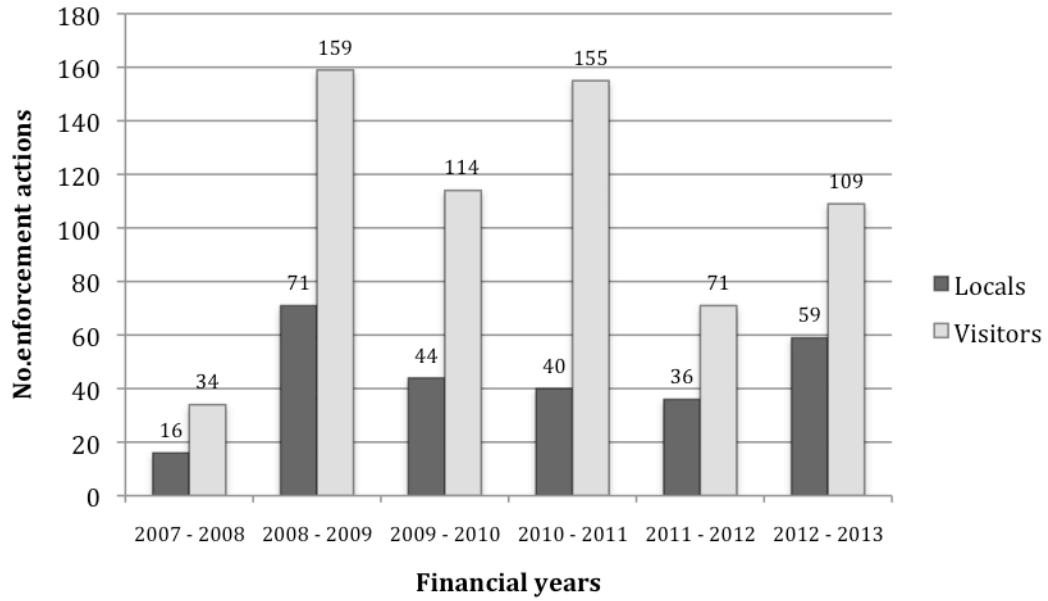


Figure 6.13 - Batemans Marine Park – Comparison of the number of enforcement actions for local and visitors by financial year.

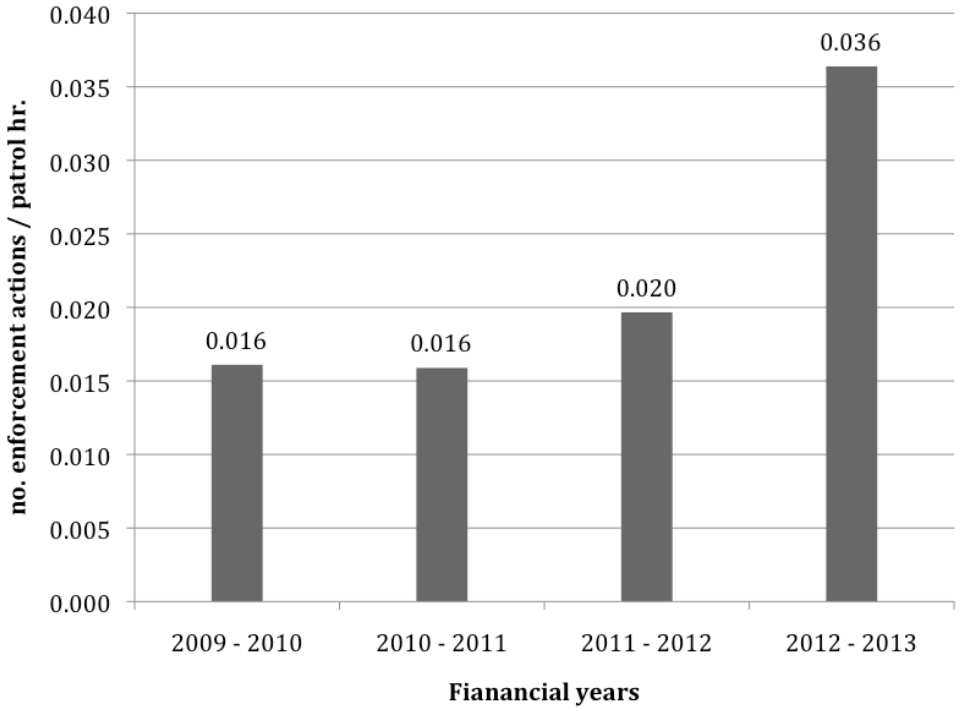


Figure 6.14 - Jervis Bay Marine Park - Local enforcement actions (offender rate) by patrol hour for financial years 2009/10 to 2012/13.

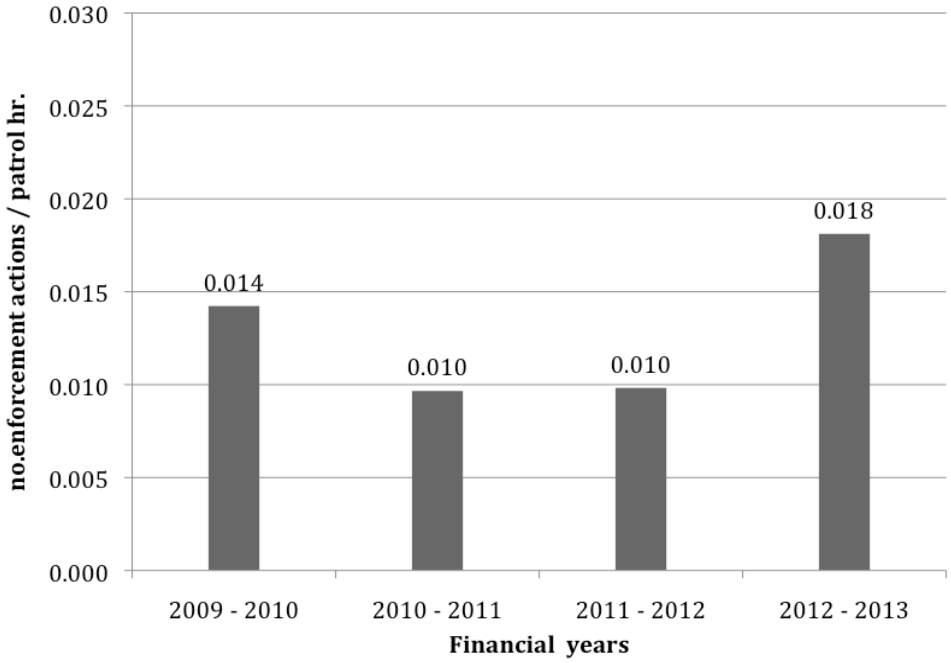


Figure 6.15 - Batemans Marine Park - Local enforcement actions (offender rate) by patrol hour for financial years 2009/10 to 2012/13.

### 6.6.3 Location of enforcement actions

Enforcement actions recorded on the Nautilus database include spatial data, which can be represented on a GIS data layer for the analysis of enforcement action by location (see Figure 6.16 which illustrates offences recorded in the Jervis Bay Marine Park in 2009/10 in a spatial presentation). This spatial information provides insight of where offences are taking place in the marine park. In areas were high numbers of actions are recorded, sometimes referred to as 'hot spots', compliance awareness and compliance monitoring activities can be targeted (Plumptre et al., 2014a). In this illustration, higher densities of offences occurred near Huskisson, Hare Bay and Groper Coast locations, and most offences were recorded inside the Bay, with only a few offences observed outside the headlands.

### 6.6.4 Offender age results

Table 6.4 shows the average age of offenders by marine park by year. Over the period 2007/8–2012/13, the average offender age was 39– 40, indicating little difference from year to year for most marine parks. Cape Byron Marine Park however, consistently had a lower average offender age than any other marine park. Figures 6.16–6.20 show more detailed information on the age ranges of offenders for the five marine parks. In Cape Byron Marine Park, one standard deviation extends below 25 years of age for most of the years recorded, and never above 55 years of age. Solitary Islands Marine Park and Batemans Marine Park share a similar offender age demographic, and one standard deviation extends in most years above the 25 years of age and above 55 years of age. For Port Stephens - Great Lakes and Jervis Bay Marine Parks the offender ages are predominately between the ages of 25 and 55 years.

Table 6.5 - Average age of offender categorised by Marine Park and financial year.

| FN YR | CBMP | SIMP | PSGLMP | JBMP | BMP | Total average |
|---|---|---|---|---|---|---|
| **2007 / 08** | 36 | 40.7 | 40.9 | 40.4 | 37.3 | **39.1** |
| **2008 / 09** | 35 | 41.4 | 39.5 | 38.5 | 42.1 | **39.3** |
| **2009 / 10** | 35.2 | 44.2 | 40 | 41.1 | 41.2 | **40.3** |
| **2010 / 11** | 38 | 40.6 | 41.7 | 39.4 | 41.2 | **40.2** |
| **2011 / 12** | 35.8 | 37.6 | 40.7 | 40 | 41.9 | **39.2** |
| **2012 / 13** | 36.4 | 45.5 | 41.3 | 40.2 | 43 | **41.3** |
| **TOTAL** | **36.1** | **41.7** | **40.7** | **39.9** | **41.1** | |

CBMP = Cape Byron Marine Park; SIMP = Solitary Islands Marine Park;
PSGLMP = Port Stephens-Great Lakes Marine Park; JBMP = Jervis Bay Marine Park; and
BMP = Batemans Marine Park.

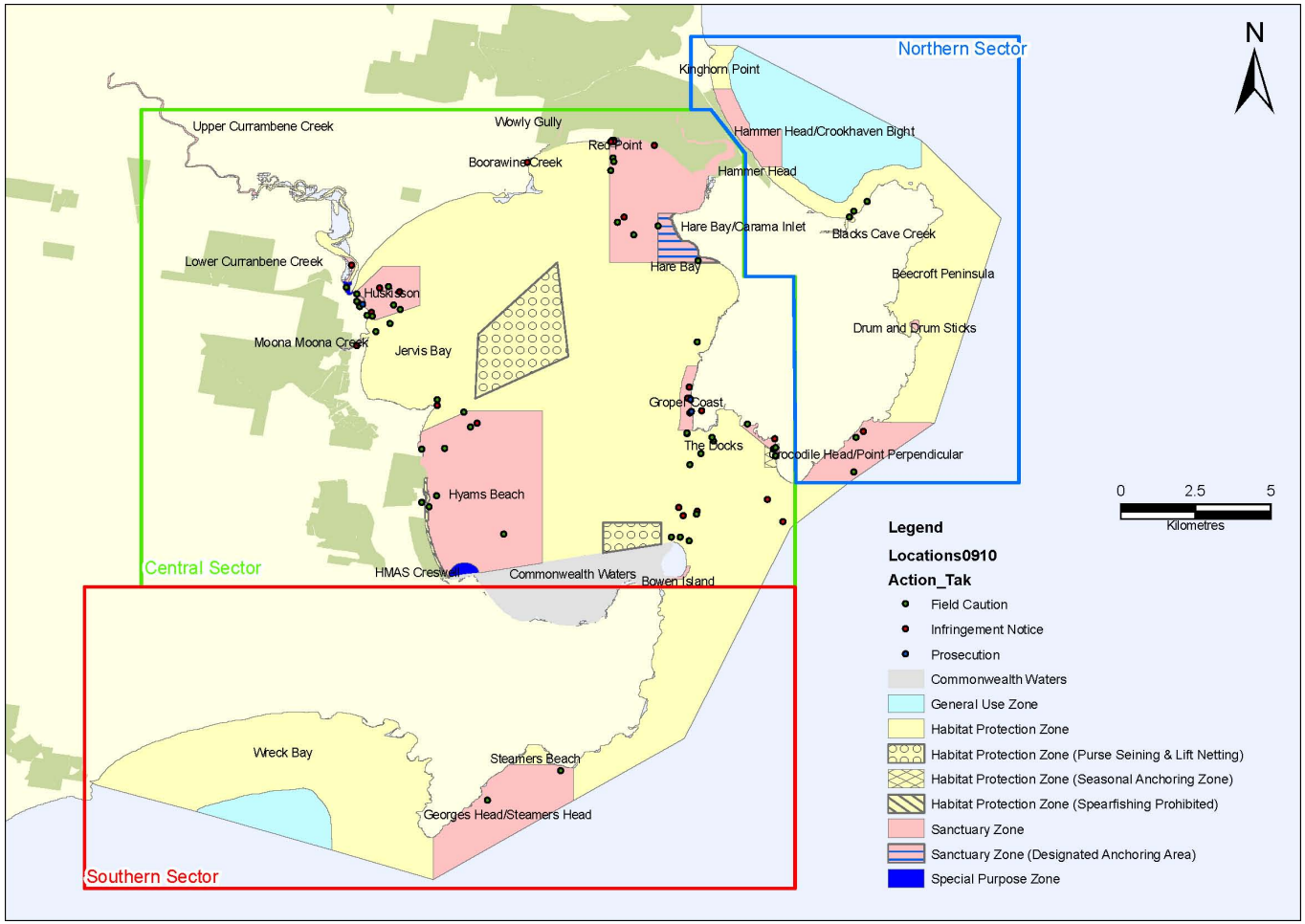


Figure 6.16 - Reported enforcement actions in JBMP by location in 2009/10 (prepared by P. Rofe and used with permission of NSW Department of Primary Industries).

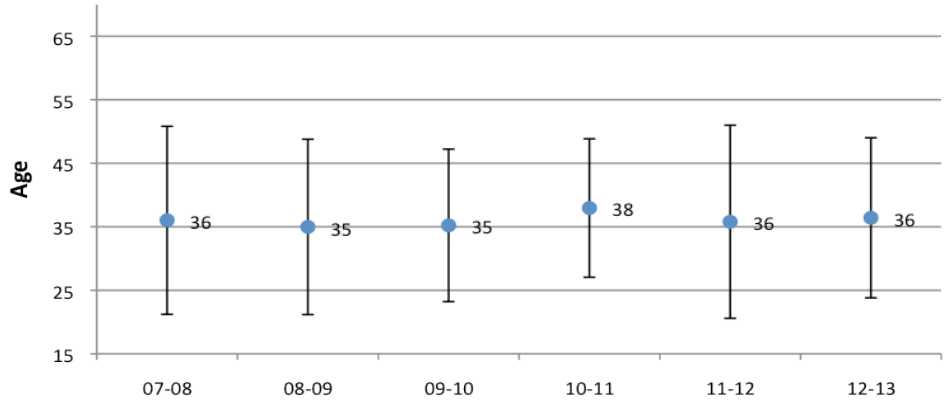


Figure 6.17 - Cape Byron Marine Park - Average age of offender by financial year, displaying one standard deviation bars.

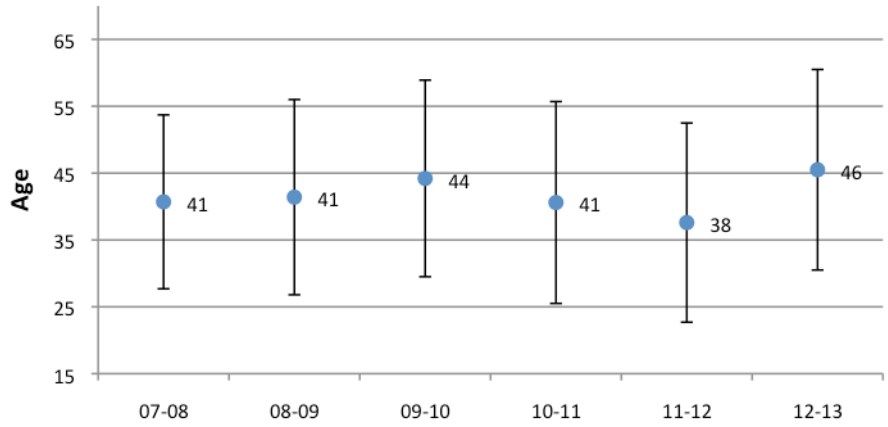


Figure 6.18 - Solitary Islands Marine Park - Average age of offender by financial year, displaying one standard deviation bars.

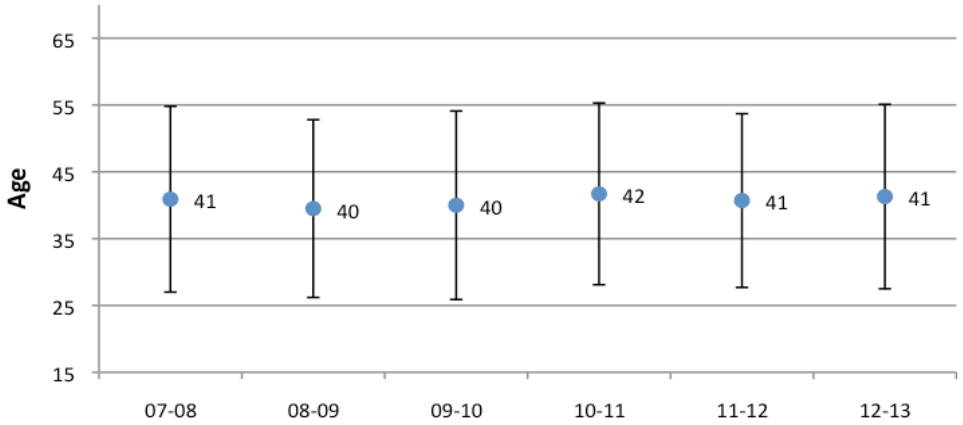


Figure 6.19 - Port Stephens - Great Lakes Marine Park - Average age of offender by financial year, displaying one standard deviation bars.

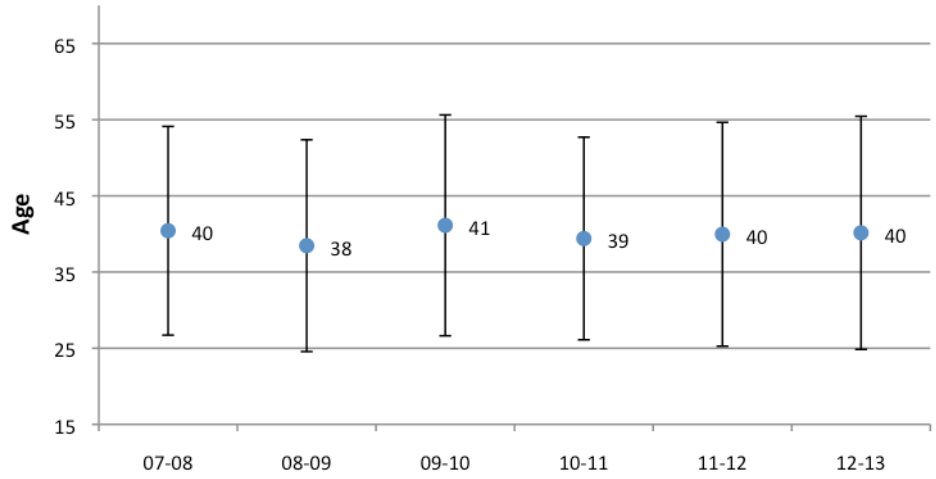


Figure 6.20 - Jervis Bay Marine Park - Average age of offender by financial year, displaying one standard deviation bars.

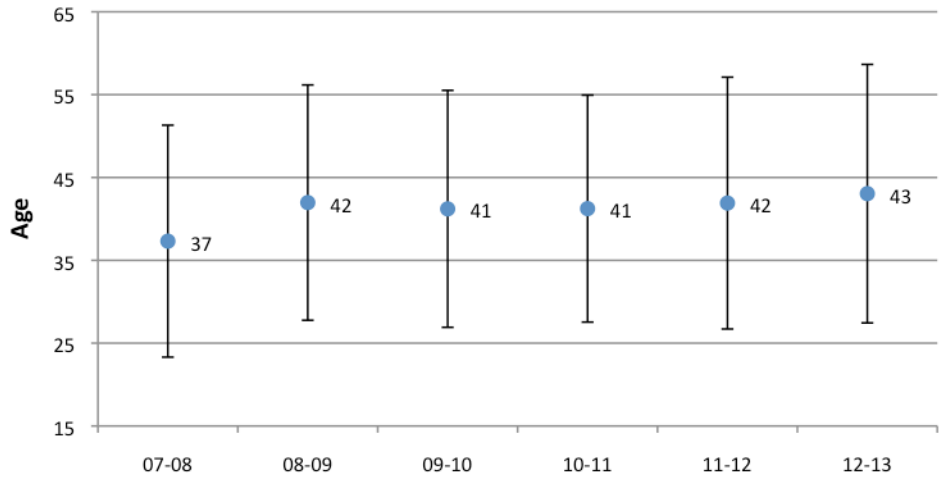


Figure 6.21 - Batemans Marine Park - Average age of offender by financial year, displaying one standard deviation bars.

### 6.6.5 Repeat offender results

Table 6.6 shows the number of multiple offenders (offending more than once) for offences under the *Marine Parks Act 1997* and associated Regulations. The percentage of recidivist offenders in a NSW marine park, by year, ranges from 0.13 to 0.83 (i.e. 1.3–8.3 recidivists for every 1000 offenders).

Table 6.6 - Percentage of repeat offenders in NSW marine parks categorised by financial year.

| Financial Year | Number of Multiple offenders | Total number of Offenders | Percentage of Multiple Offenders (%) |
|---|---|---|---|
| 2007 / 2008 | 1 | 692 | 0.14 |
| 2008 / 2009 | 3 | 964 | 0.31 |
| 2009 / 2010 | 7 | 845 | 0.83 |
| 2010 / 2011 | 1 | 773 | 0.13 |
| 2011 / 2012 | 1 | 321 | 0.31 |
| 2012 / 2013 | 4 | 847 | 0.47 |

### 6.6.6 Evaluation of outcomes from the NSW Marine Park estate compliance plan.

Table 6.7 presents an overview of 'intermediate' outcomes for individual marine parks against the state-wide compliance plan, over the life of the plan (2008–2012). It could be concluded that no marine park adequately protected unique, sensitive and high-risk sanctuary zones (Objective 1 - see Section 6.5.7). Although, enforcement effort focussed on sanctuary zones, which is evidenced by the high percentage of sanctuary zone offences compared to other offences (Table 6.2), enforcement effort and enforcement actions suggest that marine park non-compliance rates were substantive (Figures 6.1–6.6). Offence rates appear to be declining in Cape Byron, Solitary Islands and Port Stephens - Great Lakes marine parks; however, an increasing trend in offence rates was apparent in Jervis Bay Marine Park and, perhaps, Batemans Marine Park. The prevalence of repeat offenders in NSW marine parks was low, indicating individual deterrence was being achieved (see Table 6.6).

Improving community awareness, understanding and support for marine parks, (Objective 2 - see Section 6.5.7) is difficult to assess using the information recorded from the Nautilus database. Local versus visitor enforcement actions data shows no clear trend in the numbers of locals offending compared with visitor offenders by marine park (see Table 6.4). However, local offence rates in Jervis Bay Marine Park appear to be increasing, which indicates that the objective of "improving community awareness" was not being achieved for this marine park. Likewise, local offence rates in Batemans Marine Park suggest that community awareness was not improving (see Figures 6.14–6.15). Port-Stephens-Great Lakes and Cape Byron marine parks recorded variable, and slightly improving local compliance rates. Solitary Islands Marine Park recorded a consistent reduction in local offences over the life of the compliance plan (63–54), indicating some improvement in community awareness. User surveys undertaken in 2002–2005 confirm this observation, indicating a relatively high level of community awareness (74–78% of survey respondents) visiting the Solitary Islands Marine Park (Ryan, 2005). Data on offender age over time shows no demonstrative sign of change that might be expected with a successful local education and awareness program (see Table 6.5).

Local compliance planning and risk assessment was assumed to be in place for all marine parks, ensuring compliance monitoring was prioritised and weighted to locations where scientific monitoring is occurring and known offence locations (Figure 6.16). Analyses of data from the NSW Nautilus compliance database provided no indication to confirm if Objective 3 was achieved (Table 6.7). Likewise, it was assumed that protection of the marine environment from pollution from vessel and land-based pollution are recognised in local compliance planning (Objective 4 in Table 6.7). Again, analyses of data from the NSW Nautilus compliance database provided no indication to confirm if this objective was achieved. It is also noted that no pollution offences were recorded in any of the NSW marine parks over the life of the plan (Table 6.7).

The relatively high number of offences recorded under the *Fisheries Management Act 1994* compared with marine park offences under the *Marine Parks Act 1997* indicates that marine park enforcement activities also focused on fisheries breaches (see Table 6.1). The author is aware that when boarded by MPA and Fisheries officers, marine park users are first checked for fishing licences and bag limits before considering other offences. Accordingly, Objective 5, which required a focus on enforcing fishing offences (Table 6.5.7), was rated as being achieved.

Table 6.7 - Achievement of State-wide compliance plan outcomes for individual NSW marine parks (2008/2009–2011/2012).

| COMPLIANCE PLAN OUTCOMES | CBMP | SIMP | PSGLMP | JBMP | BMP |
|---|---|---|---|---|---|
| Objective 1: Ensuring compliance of sanctuary zones. | P<br>Sanctuary offences are being enforced; however, results indicate a marginal decline in offender rates, with low number of repeat offenders | P<br>Sanctuary offences are being enforced; however, results indicate a marginal decline in offender rates, with low number of repeat offenders | P<br>Sanctuary offences are being enforced; however, results indicate a marginal decline in offender rates, with low number of repeat offenders | X<br>Sanctuary offences are being enforced; however, results indicate a marginal increase in offender rates. Low number of repeat offenders. | X<br>Sanctuary offences are being enforced; however, results indicate little improvement in offender rates. Low number of repeat offenders |
| Objective 2: Improving community awareness, understanding and support | √<br>Local offence rates may have marginally declined. | √<br>Local offence rates declined | √<br>Local offence rates declined. | X<br>Results indicate a marginal increase in local offender rates. | X<br>Results indicate no improvement in local offender rates. |
| Objective 3: Linkages are made between research programs and local compliance actions. | ND<br>No evidence of linkage on enforcement database. | ND<br>No evidence of linkage on enforcement database. | ND<br>No evidence of linkage on enforcement database. | ND<br>No evidence of linkage on enforcement database. | ND<br>Literature indicates that better linkage is required. |
| Objective 4: Protection of the marine environment from pollution. | ND<br>No offences recorded on compliance database. | ND<br>No offences recorded on compliance database. | ND<br>No offences recorded on compliance database. | ND<br>No offences recorded on compliance database. | ND<br>No offences recorded on compliance database. |
| Objective 5: Enforcement priority on fisheries laws. | √<br>Fisheries permit, bag and size limits are being enforced. | √<br>Fisheries permit, bag and size limits are being enforced. | √<br>Fisheries permit, bag and size limits are being enforced. | √<br>Fisheries permit, bag and size limits are being enforced. | √<br>Fisheries permit, bag and size limits are being enforced. |

CBMP = Cape Byron Marine Park; SIMP = Solitary Islands Marine Park; PSGLMP = Port Stephens-Great Lakes Marine Park; JBMP = Jervis Bay Marine Park; and BMP = Batemans Marine Park.
(X = not achieved, P = partially achieved/needs improvement, √ = achieved, ND = not determined)

## 6.7 Discussion

### 6.7.1 Enforcement trends

Enforcement output data are often used for reporting purposes, providing an indicator of deterrence that is being used to bring about compliance, and suggesting compliance trends over time (Stahl, 2003; Hilborn et al., 2006a). Analysing trends over time is one of the main aims of a compliance monitoring program - to assess both the numbers of illegal activities and compliance effort (Jachmann, 2008; Gavin et al., 2010). Enforcement output data are arguably the largest sources of quantitative

compliance information used in peer reviewed publications for this purpose (Bergseth et al., 2013). Being the product of enforcement effort, however, offence data cannot be analysed in a meaningful way without considering effort information. Rates of non-compliance need to contain information about compliance monitoring and other observations to standardise the data and remove inherent bias (Keane et al. 2011). It follows that without this additional information, analyses and review of compliance strategies can be unreliable (Bergseth et al., 2013; Plumptre et al., 2014b). Analyses of the enforcement action results aggregated across all NSW marine parks required a multitude of assumptions to be tested. For example, the low number of enforcement actions in 2007/8 was not an anomaly, but was most likely due to this year being the first year of new management plans for the Port Stephens - Great Lakes and Batemans Marine Parks, when compliance focussed user awareness and verbal (educative) warnings (Figure 6.4 and 6.6). Such information cannot be ascertained from the Nautilus database metadata. Figure 6.1 suggests a trend of declining numbers of offences between 2008/9 and 2012/13, and on "face value" this could be assumed that compliance programs were effective across all marine parks during this time, except for 2012/13 when a major shift in compliance behaviour or agency operations appears to have occurred. When this assumption was tested, it was found that 2012/13 was not a spike in non-compliance, but appeared that way due to less enforcement actions resulting in 2011/12 in Batemans Marine Park and Port-Stephens - Great Lakes Marine Park. Figure 6.8 confirms this test result, showing a sizable reduction in patrol hours and lower rates of illegal actions being observed in 2011/12. It is understood that the reasons for reduced patrol rates, in both marine parks, were human resource related (Mr M. Haste 2014, pers. comm.)[91]. This example demonstrates the significance of errors that can result from interpreting aggregated compliance data and how false conclusions can easily be derived Unfortunately, this is a common problem with compliance data (Plumptre et al., 2014b). This conclusion was also reached by the Victorian Environmental Assessment Council's assessment of the effectiveness of marine reserves, that concluded that the six years of available compliance data on infringements did not necessarily provide a reliable measure of the effectiveness of enforcement and without knowing the extent of illegal activities, it was difficult to gauge the

[91] Mr. M. Haste (former Manager for the Port Stephens - Great Lakes Marine Park) confirmed by telephone, March 2014.

proportion of activities that were prevented or apprehended by analysing the enforcement data (State of Victoria, 2014).

### 6.7.2 Compliance monitoring considerations

Jervis Bay Marine Park enforcement actions 2007/8–2011/12 (see Figures 6.5 and 6.7) indicated an increasing number of offences over time. This could be perceived as a poor outcome of the compliance program, as there appears to be a persistent and increasing level of non-compliance. However, it could also be explained in positive terms as the result of greater patrol effort, and enforcement targeting over time. When patrol effort is factored into the enforcement action results (see Figure 6.7), it is apparent that patrol effort had not increased over time, in fact it sharply decreased in 2012/13, and the number of enforcement actions increased. When enforcement and effort is indexed, a more compelling picture is revealed, suggesting that the explanation for the increasing enforcement actions is less likely to be effort related. In this case, the increasing trend of enforcement actions is less likely an indication of good performance, but instead indicating an increasing behaviour of non-compliance in this marine park.

Whether the above assumptions are true or not is a moot discussion. More importantly, these results should be used to trigger further investigation into the possible causes of this trend. Such investigation might consider individual zone level considerations, for example where these enforcement actions are occurring and why (see Figure 6.16). For instance, it has been demonstrated that some zones are more prone to non-compliance than others; principally due to their design or management arrangements (Read et al., 2011). In respect to the Jervis Bay Marine Park, the Huskisson Sanctuary Zone appears to be a hot spot compared to other areas, suggesting that a specific compliance approach should be purpose-designed for this location. Analysing law enforcement monitoring data using GIS (management and geographic information database systems e.g. MIST) is routine in many national parks in Africa, whereby ranger collected GPS information on patrol coverage and compliance incidents are recorded (Plumptre et al., 2014b). Maps of illegal activities are of particular value, as over time they build up a picture of where each illegal action occurs to better target illegal activities. Care must also be taken when interpreting GIS maps as the data needs to be compared with patrol information

(Plumptre et al., 2014a). As explained, there might be many other causes for the observed results, including offender demographics. To identify and better understand compliance drivers the use of social surveys has been shown to be an effective tool (Arias and Sutton, 2013; Bergseth et al., 2013). Plumptre et al. (2014b) explains trend assessments can only be calculated for the protected area as a whole rather than part of it, as it assumes that the whole protected area was patrolled in the same way each month to enable comparison over time periods. Consequently, enforcement data should factorise area coverage and include spatial analysis to explain trends. For example, a study of ranger patrols in terrestrial national parks in Uganda showed that only 23% of the area was patrolled and when the frequency of illegal activities were modelled it showed a decline in the frequency of illegal activities (deterrence effect) up to about 3–4km from ranger post only (Plumptre et al., 2014a). It follows that spatial methods of detecting trends in illegal activities and improving the effectiveness of compliance surveillance are becoming more relevant, which allow estimation of patterns of illegal activities independent of the probability of their detection (Beale et al., 2014).

In regard to the Batemans Marine Park offence rate observations, a different compliance situation to that of Jervis Bay Marine Park is observed (see Figure 6.8). Enforcement action by patrol effort over time indicates a negative trend, suggesting that there has been an improvement in compliance since the marine park's management plan was introduced. This result is consistent with Kelaher et al. (2014) who found that a significant relationship exists between enforcement actions and reserve performance in the Batemans Marine Park. However, they also found variation in sanctuary zone success in protecting species, supporting a view that compliance planning and analysis should be focussed at the zone level (*cf*. marine park level) (Read et al., 2011).

### 6.7.3 Local and visitor compliance trends

NSW has high levels of transient coastal visitation, with significant numbers of holidaymakers venturing out from major cities, such as Sydney to coastal destinations. There are marked differences in the ratios of local to visitor offender numbers across the NSW marine parks (Table 6.3). For example, Cape Byron and Solitary Islands Marine Parks stand out with noticeably more locals than visitors

offending, compared with marine parks further south where there are far fewer numbers of locals offending compared with visitors. These results are important to understand in order to know where and how to target compliance resources in these parks. Cape Byron has good fishing opportunities, but it is not a destination recognized for fishing. Surveys by the NSW Marine Parks Authority indicate beach-combing, swimming, walking, and surfing are recognised as the most popular recreational activities of visitors to this marine park (Marine Parks Authority, 2003). Solitary Islands Marine Park is similar (Ryan, 2005). In contrast, Port Stephens, Jervis Bay and Batemans Marine Parks contain some of the best game fishing locations in the state and, consequently many visitors go to these places with the main intention to fish (Marine Parks Authority, 2010b; Voyer et al., 2013b).

All NSW marine parks are subject to significant increases in visitation from major centres, including Sydney, Wollongong, Canberra and Newcastle, during the summer months and holiday periods. The influx of transient and uninformed visitors is a major challenge for compliance officers. Local and regional awareness activities, including media, do not reach these users of marine parks (Ryan, 2005). User surveys undertaken by the Solitary Islands Marine Park support this conclusion, with one-third of the respondents living beyond two hours drive from the park not knowing of the park's existence (Ryan, 2005).

Attempting to reach the broader community, to improve their awareness in a meaningful way is both very costly and unlikely to achieve sustainable results. Therefore, improving visitor compliance is a long-term outcome to achieve, whereas achieving improved local compliance is plausible in the medium-term, through targeted compliance awareness. This approach of targeting local compliance also has a spin off, in that locals may become stewards and advocates for their marine park, helping to educate visitors and monitor compliance. One indicator of progress towards achieving this intermediate outcome of local compliance would be is to see reductions in the number of locals committing offences over time (see Figure 6.1). With this consideration, the analyses of local offender rates by year for each marine park, on face value, indicates that local marine park compliance programs are making progress in improving local compliance (see Figures 6.9–6.13).

Jervis Bay Marine Park is, however, an exception to other marine parks in that the offence rate by locals appears to be increasing (Figure 6.12). Standardising the enforcement action data using compliance effort (Figures 6.14–6.15) for the Jervis

Bay and Batemans Marine Parks indicates that this reduction in local compliance rates in the Jervis Bay Marine Park is probable. This negative trend is a trigger for further validation and investigation to understand why this compliance result is being observed. The Great Barrier Reef Marine Park Authority has observed a similar situation in some areas, with apparent rises in locals offending (up to 20%); however, these increases in detections were a reflection of increased number of patrols (pers. comm. J. Aumend, 2013)[92]. A more detailed investigation of the Jervis Bay Marine Park compliance program is needed to uncover the cause of the increasing offence rates by locals. Although analyses of compliance rates for Batemans Marine Park indicate that the compliance trend is improving (Figure 6.13), when effort and enforcement action rates are standardised this is might not the case (Figure 6.15). The results indicate that local offender rates are consistent over time or slightly increasing.

These results for Jervis Bay Marine Park, and to a lesser extent Batemans Marine Park, are significant for a number of reasons. Considerable cost and effort goes into marine park awareness programs at the park level, including preparation of brochures and guidelines, signage maintenance, local event displays, school education and media. The inherent goal of this work is to observe improved stewardship, marine park support and compliance and advocacy, however if compliance levels are observe. If local compliance is not improving, then it could be an indicator that the awareness program is not being effective. Importantly, if local non-compliance is increasing it is more than likely that visitor rates of non-compliance will also increase, which appears to be the case (see Section 6.7.2). The end result is a lack of protection of values and ineffective management of the marine park.

### 6.7.4 Offender age trends

Understanding motivation for non-compliance is complex (Sutinen and Kuperan, 1999 ). However, one of the few facts agreed on in criminology is the age distribution of crime (Hirschi and Gottfredson, 1983). The age and crime paradigm (the age-crime curve) explains that most crimes are prevalent during mid to late

[92] Mr J. Aumend, (Great Barrier Reef Marine Parks Authority) confirmed by email on 26 October 2013.

adolescence, with the incidence of crime increasing with age until about 20 years of age at which time the incidence of crime decreases with age in adulthood. Recent studies indicate the age at which crime occurs depends on many conditions and varies significantly across offences (Fagan and Western, 2005).

Published studies of age association with non-compliance in MPAs is scarce. One study of age and compliance, associated with small-scale commercial fishing in Brazil, suggested that age had an influence on noncompliance when the level of punishment was altered. In this case study, younger fishers (<40 years of age) were shown to be more inclined to comply with fishing rules as the penalty increased (Karper and Lopes, 2014). In a study of compliance rates of illegal red abalone fishing in Northern California, however, age had no bearing, at all, on illegal take (Blank and Gavin, 2009). With respect to NSW marine parks it also appears that age plays little or no bearing on noncompliance, with the average offender age showing little difference in all marine parks with respect to the number of enforcement actions across the 25–55 year old range by financial year over six consecutive years (Figures 6.17–6.20).

One of the aims of MPA education programs is to educate young people to understand the values of MPAs - in order to achieve long-term and sustainable trends of younger people being more compliant with MPA rules. In this regard, Batemans Marine Park was the only marine park where an increasing trend in mean age was indicated, with the mean age appearing to be getting older each year (i.e. 37–43 year old over the six year reporting period - see Figure 6.21). This is encouraging information, as it indicates that there are less younger people making up the population of offenders. Established marine parks, such as Jervis Bay Marine Park and Solitary Islands Marine Parks, which have had local educational programs in place for more than 10 years, might have been expected similar results, but this was not the case. These results prompt a rethink into the effectiveness of marine park education programs in relation to target areas, and educational objectives with respect to compliance outcomes.

Of interest, the Cape Byron Marine Park (Figure 6.17) stands out from other marine parks with a lower mean age of offenders, with the age distribution for Cape Byron indicating most offenders are in this age cohort. Such information provides some intelligence to assist with targeting media and awareness programs for this lower age group.

### 6.7.5 Deterrence

There is considerable consensus that strong enforcement, with clear penalties and sanctions are required in order to preserve MPA integrity (Rossiter and Levine, 2014). In a review of key empirical studies that measure the specific deterrence effects of domestic environmental monitoring and enforcement Shimshack (2007) found that both civil as well as administrative penalties reduced repeat offenses, and that both did so about equally. With a repeat offender rate of 1.3–8.3 for every 1000 offenders, NSW marine parks statistics are similar to those for the Great Barrier Reef Marine Park, where a repeat offender rate of approximately four in every 1000 for recreational fishing offences has been recorded (Mr J. Aumend, 2013. pers. comm., 26 October)[93]. The NSW figure is well below the performance indicator level of 5% proposed by the South Australian Department of Environment, Water and Natural Resources for their marine parks and suggests that individual deterrence following detection is successful (Mr. A. Mitchell, 2014. pers. comm.)[94]. For the Great Barrier Reef Marine Park, Arius and Sutton (2013) found in that the main driver for individual deterrence was a concern of receiving a penalty or loosing their fishing equipment; however, they concluded that compliance levels were mostly dependent on enforcement require a strong enforcement presence. This view is consistent with the theory that deterrence is a function of the likelihood of detection and the severity of punishment (INECE Expert Working Group on Enforcement and Compliance Indicators, 2005). General deterrence in NSW marine parks appears not to be altered by the number of individual enforcement actions executed and the message of high penalties and equipment forfeiture has not got around (despite much media), with local offence rates consistent and perhaps even increasing over time in the Jervis Bay Marine Park. One hypothesis is that deterrence is lacking due to a general belief that the likelihood of getting caught is low in these places. This may be supported with

[93] Mr J. Aumend, (Great Barrier Reef Marine Parks Authority) confirmed by email on 26 October 2013.
[94] Mr. A. Mitchell, (Department of Environment, Water and Natural Resources), Marine Parks Strategy and Funding, confirmed by email on 5 May 2014.

patrol rates occurring on average 50% of the year in some marine parks (see Table 6.3), when above 75% is suggested to be effective (Pierpaolo et al., 2013). This suggests that measuring individual and general deterrence effects of compliance monitoring and enforcement is worth pursuing through additional survey analyses (Shimshack, 2007). It is likely, however, that survey outcomes will point to the need for increased compliance resources to improve compliance monitoring in marine parks, and to improve relationships with fishers to assist in achieving voluntary compliance (Porter et al., 2013).

### 6.7.6 Performance against compliance objectives.

There is no standard consensus on the best way of measuring the success of an enforcement program (International Network for Environmental Compliance and Enforcement, 2003; Environment Canada, 2009; Bergseth et al., 2013). Further, there is ongoing deliberation by enforcement practitioners about how success should be measured. What is precipitating from these discussions is an acknowledgement that a single measurement will not suffice, and that both quantitative and qualitative information, using a variety of measures, is needed to derive an understanding their linkages with compliance activities (Bergseth et al., 2013). It is the case that compliance performance for many jurisdictions is indicated by assessing the trend in the compliance output rates (International Network for Environmental Compliance and Enforcement, 2003; Davis and Morett, 2005). This is also the primary approach used to measure performance in NSW marine parks compliance reporting, and other Australian MPA and fisheries jurisdictions. However, there is recognition of the shortcomings in making conclusions from this enforcement data. An evaluation of the progress towards meeting the intermediate priorities within the NSW state-wide compliance plan, in terms of the allocation of compliance effort, has not been undertaken to date. The recent review of Environment Canada's compliance program (Environment Canada, 2009), which used informant interviews, group discussion, case studies and quantitative performance measurement data to query relevance, success, cost effectiveness and design and delivery evaluation criteria, provides a practical example of the type of review that could be undertaken to reset the NSW marine park compliance program. Any future enforcement program, however, should

be based on a logical framework[95], which shows the linkages between activities and intended intermediate and long-term outcomes. In respect to the results and analyses undertaken in this Chapter, some general observations can be made in relation to meeting the intermediate priorities under the NSW marine park compliance program:

1) Protection of unique, sensitive and high - risk sanctuary zones and ensuring compliance of sanctuary zones: Enforcement effort has focussed on sanctuary zones. Enforcement output indicators suggest that marine park compliance rates are declining, although substantiation through more detailed studies and qualitative survey work is needed to understand current deterrence and enforcement activity linkages. The prevalence of repeat offenders in NSW marine parks is very low, indicting individual deterrence is being achieved; however, general deterrence remains an issue, and requires additional compliance monitoring and more targeted local media dissemination of enforcement actions to achieve results.

2) Improving community awareness, understanding and support for marine parks, and highlighting the benefits of multiple use management within NSW marine parks: Little is known about the effectiveness of local marine park awareness programs in respect to contributing to voluntary compliance. Data associated with offender age and analyses of local offender rates indicates that local community awareness programs are not targeting potential offenders or improving compliance rates to a level that might be expected at time[96].

3) Ensuring integrity of research and monitoring results, ensuring linkages are made between research programs and local compliance actions in order to minimise the risk of non-compliance confounding research results: Research programs utilise compliance information to help select sites that are less prone

[95] Logic frameworks (sometimes referred to as program logic, program theory, theory of change, causal model, results chain and intervention logic) show how program activities are understood to contribute to a series of intermediate outcomes that then produce the intended long-term impacts, aim to show the logic between activities and expected results.

[96] In the last 18 months the NSW Department of Primary industry has commenced gathering awareness information (knowledge of laws) when offences have been detected, but only for some programs being commercial fisheries generally and recreational abalone (pers comm. Phil McCarthy, 22 April 2014).

to illegal activity. For example, research work in Batemans Marine Park (Kelaher et al., 2014) has linked compliance rate to conservation protection, illustrating that research can be undertaken in marine parks where there is an understanding of compliance risks. Formal arrangements are not in place in NSW marine parks to ensure linkages are made between research and compliance; however, local compliance planning and risk assessment has the capacity to weight zoning impacts and prioritise enforcement actions.

4) Protection of the marine environment from pollution: Although this was not specifically considered in this paper, it is a major issue of concern to marine park users, and the effectiveness of marine parks in protecting the marine environment from vessel and land-based pollution (Beeton et al., 2012). Enforcement of pollution from vessels in marine parks is undertaken by the NSW Department of Transport and works under a Memorandum of Understanding, whilst local councils and the NSW Office of Environment and Heritage enforce land-based pollution incidents. The author is not aware of any marine park specific compliance program addressing pollution.

5) Ensuring fishing activities are ecologically sustainable with enforcement priority exercised in respect to fisheries management laws, in particular bag and size limits for recreational fishing, and restrictions on commercial fishing operations: It is understood that marine park enforcement actions result in a high prosecution success rate; however repeat commercial fishing offenders remain a concern. To improve performance in this area, enhanced punishment power could to be explored, such as marine park access suspension and bans. Improving compliance monitoring, such as mandatory use of vessel monitoring systems whilst in marine parks, which is currently being proposed by the Great Barrier Reef Marine Park Authority to address illegal commercial fishing are also options that could be pursued (Australian Fisheries Management Authority, 2007; Bergseth et al., 2013; Great Barrier Reef Marine Park Authority, 2013).

## 6.8 Conclusion

The quality and sustainability of ongoing compliance operations is critical in order to achieve the expected outcomes of a MPA (Christie and White, 2007). This preliminary study of five years of enforcement data from NSW marine parks has provided the first time series analyses of compliance progress of the NSW compliance program, and an understanding of the value and limitations of the enforcement data being captured. Improving the quality of data over time to minimise error capture is essential. The analysis has demonstrated that considerable care needs to be taken in drawing conclusions from compliance output data, given the limitations and potential errors associated with its capture. This weakness is well understood by enforcement agencies worldwide, but this type of information remains the most commonly used indicator for compliance performance. Acknowledging the limitations of the enforcement data is essential, but it is also important to recognise its utility. The data is also very important for understanding offender demographics, to help target compliance activities. Consequently, the collection, improvement and ongoing maintenance of the enforcement data are necessary for future observations and review. This research has also demonstrated the need to obtain and record information on the level (and coverage) of enforcement monitoring involved in obtaining enforcement data. Integrating the use of qualitative surveys to ground-truth enforcement dataset is highly recommended to understand compliance behaviour. For example, in NSW marine parks, site-specific compliance analysis appears warranted for the Jervis Bay Marine Park, in order to better understand local compliance behaviour to improve compliance rates. Using a logic framework to ensure objectives and intermediate outcomes are better linked to compliance activities, and appropriate performance indicators and measures are developed. With this in mind, a general review of the NSW marine park compliance program is warranted. The current preliminary study has indicated that over the six-year period of data collection there has been some slight improvement in compliance rates in most NSW marine parks. Deterrence of repeat recreational fishers is high, however, first offence (general) deterrence remains an issue. It could be argued that the current rates of non-compliance are not conducive towards meeting the conservation outcomes expected for some zones and areas within the NSW marine park estate.

# 7 CONCLUSIONS AND RECOMMENDATIONS

## 7.1 Introduction

The establishment of Marine Protected Areas (MPAs) is recognised internationally to be the primary mechanism to achieve global marine biodiversity conservation. International efforts have been resolute in respect to establishing a global system of MPAs, and target levels for MPA coverage have been agreed to by nations, including Australia, in order to progress national programs for establishing MPAs. There is, however, increasing international concern that meeting MPA coverage targets is not itself a sufficient indicator of effectiveness of marine conservation. Of particular concern is that many MPAs might not be meeting conservation or sustainability objectives due to ineffective management and integration within broader marine management systems. This thesis has researched three leading determinants that are regarded as being fundamental for effective management of MPAs, namely that:

1) The establishment of MPAs and zoning must articulate and define their objectives of management, and allow only those activities that are appropriate and consistent with those objectives (see Section 7.2 below);
2) The establishment and management of MPAs must be considered within the broader context of ecosystem-based management, and be integrated in this process (see Section 7.3 below); and, that,
3) The establishment and management of MPAs must be supported by effective compliance (see Section 7.4 below).

Focussing on these requisites, the primary goal of this thesis was to explore the extent of which the system of multiple use marine parks in NSW was meeting its management objectives. This assessment has been achieved through a series of case studies, which have presented new information to evaluate each of these key determinants.

As an introduction to the NSW MPAs, Chapter 2 explored whether the system of NSW marine parks was appropriately located and designed, in order to meet international and national MPA establishment and management principles. A

quantitative gap analysis of ecosystem and habitat representation within MPAs demonstrated that the NSW system of MPAs was well advanced, and met current international and national commitments, including the CBD target of 10% representation of effectively managed MPAs by 2020. As of 2014, NSW marine parks comprised over 36% of NSW state waters, and included a high level of species surrogate representation in four of the six bioregions and the Lord Howe Province. The analyses indicated that NSW had appropriately located MPAs in each bioregion to represent key ecosystems, habitat and species found in these areas. This was found to be consistent with Comprehensiveness, Adequacy and Representativeness (CAR) principles. It was recommended that ten new aquatic reserves, which were strategically located in the Manning, Hawkesbury and Twofold Bioregions to represent ecosystem and habitat gaps, would complete the representative system of MPAs in NSW. It is pointed out, however, that there are many MPA options available to complete the NSW of marine parks. Currently, there is a high level of recreational fisher and to a lesser extend commercial fisher angst for the creation of new MPAs in NSW and, consequently, establishing new MPAs in the near future is politically sensitive. A new approach involving more inclusive engagement and collaboration with these sectors will be essential to progress MPA establishment.

## 7.2 Assessment of allowable activities and multiple use zoning

A systematic assessment of activities that are allowed in multiple use zones in NSW, presented in Chapter 3, aimed to determine if allowable activities in multiple use zones were consistent with zone objectives. This case study adopted a similar ecological risk assessment process to that applied to fisheries management. However, rather than assessing fishing methods against fisheries sustainability objectives, the research assessed fishing and as well as other activities (such as commercial tour operators) against marine park and zoning objectives. At the time this research was undertaken there were no equivalent published examples of MPA activity risk assessments that focussed on MPA objectives and outcomes. The objectives and spatial considerations of MPAs are very different to that of fisheries management. Activity risks in MPAs relate to the potential impact of fisheries and other activities on MPA objectives, which are not at the same scale as whole-of-fishery

sustainability objectives. For these reasons, risk assessments undertaken for fisheries management purposes cannot be applied to MPAs in the same way. The qualitative risk assessment and analysis of allowable activities across NSW marine parks identified that allowable activities varied considerably between individual marine parks, particularly in general use and habitat protection zones. The conclusion from this research also suggested that multiple use zones in NSW marine parks might not be achieving their stated objectives because allowable and permitted activities were not consistent with zone objectives.

To determine if a particular activity is consistent with MPA zone objectives, a clear definition of the zoning objectives is necessary to assign and analyse risk. The lack of clearly stated objectives has been raised in international literature as the fundamental reason why management performance, in many cases, cannot be accurately gauged. The case study in Chapter 3 also highlighted this issue. In regard to the assessment of allowable uses in habitat protection and general use zones, the NSW marine park legislative objectives for these zone types were vague and ambiguous. This finding was a significant outcome of this case study. The publication of Chapter 3 resulted in an amendment being drafted to the *Marine Parks Act 1997*, which better clarified the habitat protection zone objective statement. Key recommendations for NSW marine parks arising from this risk assessment were to:

1. *Exclude high-risk activities (e.g. bottom trawling) from general use zones in marine parks.* Whilst the preferred option is to provide for sustainable use consistent with MPA objectives, an alternative is to modify marine park boundaries to excise fishing grounds. This might be appropriate when identified fishing grounds are essential for the fishery and the commercial fishing imperative is greater than the conservation imperative. Implementing this recommendation is relatively straightforward compared to establishing new MPAs. Although it makes good sense, It is unlikely, however that any government would alter the external boundaries to allow fishing to proceed, even if the grounds within the MPA are of high importance to the fishery. Consequently, this recommendation would be implemented as part of the review of a marine park management plan. Subject to funding being made available to 'buy-out' affected fishers, the planning process allows for such changes to be made.

2. *Standardise zoning and allowable activities across all marine parks.* Marine parks in NSW are located relatively closely to one another, and in many cases share the same marine users (e.g. Jervis Bay and Batemans marine parks, and Cape Byron and Solitary Islands marine parks are located very close to one another). Removing potential confusion caused by inconsistent zoning restrictions has a desirable outcome of reducing inadvertent non-compliance. Implementing this recommendation requires a strategic explanation to be made to stakeholders and an understanding of the potential impacts of this decision, both on marine users and MPA management. A practical approach would entail gaining consensus on priority areas to be standarised and to roll-out changes over time as part of management plan reviews, subject to these priorities.

3. *Introduce a program to encourage and or require the use of low impact gear technology and other best practice operations in marine parks*. Ecologically sustainable management is a principal objective for multiple-use marine parks. It follows that management practices should be cognisant of their potential impacts on the ecosystem as a whole, and not just target species. Minimising impacts on non-target species, endangered species and habitat ensure these activities are sustainable in the long-term and consistent with MPA objectives. This recommendation requires active participation and a partnership approach with fisheries management to be implemented (see Chapter 4). The introduction of new gear technology that minimises impacts on non-target species and habitat is known to be a high priority for NSW.

4. *Actively manage allowable activity effort in MPAs.* Currently, there are no caps or capacity thresholds set in marine parks in NSW. Increasing user effort over time without understanding ecological carrying capacities of activities has the potential to impact on MPA sustainability outcomes. For example, the accumulation of effort by lower risk activity has the potential to result in medium or even high-risk outcomes if this effort is not managed. Although controlling effort in NSW marine parks may not be required in the short-term, it is prudent to establish a monitoring program to assess effort over time for all activity types that potentially impact on marine park and zoning objectives. As user pressure increases for access into marine parks with growing populations, the capacity to manage effort will be critical for achieving ecological sustainability objectives, particularly if these activities are

currently allowed without access restrictions, which is the case for commercial fishing in NSW marine parks. It is recognised that this recommendation would be potentially difficult to implement. Although moratoriums on issuing permits have been put in place in the past by marine parks for commercial tourist operations (effectively placing a cap on effort), the concept of capping allowable activities that do not require a permit, such as commercial fishing, is problematic and requires revisiting and possibly amending legislation. Again, this work would require collaboration with fisheries management. Improving understanding of carrying capacity for high-risk activities (both social, and ecological capacity) and modelling these over time is recommended in the first instance.

## 7.3 Assessment of MPA integration with fisheries management

Central to the success of MPAs is that they are implemented within the broader context of ecosystem-based management (EBM) and not managed in isolation. It follows that to manage MPAs effectively, cooperation, coordination and collaboration between institutions with mandates over the management of activities and developments that affect the marine environment are essential. Such partnerships are needed not only for consistency and operational cost-effectiveness reasons, but are fundamental to ensure the protection of the marine environment and sustainability of all marine uses. Of concern, MPAs around the globe have been, and continue to be, implemented without the level of integration that is required to meet their conservation and ecological sustainability objectives, particularly in terms of fisheries management. It has even been suggested that the long-term failure of conservation and fisheries institutions to integrate their efforts to address the governance of preservation, conservation and sustainable management of the marine environment remains as one of the key barriers to MPA objectives being realised. Measuring the performance of the integration between MPA and fisheries agencies, in particular the success of their partnerships and outcomes of these arrangements, is necessary to ensure ongoing improvement in the integration of their sectoral services over time. The published case study in Chapter 4 illustrates how MPA and fisheries management partnerships can be improved. It presents a comprehensive list of performance criteria and methodology to evaluate this important partnership. The

case study of the partnership between NSW marine parks and fisheries agencies highlights the complexities of this partnership, and is of particular relevance to MPA and fisheries agencies for all countries managing MPAs. With respect to NSW, the evaluation of the marine parks and fisheries agencies partnership indicated that the partnership had resulted in positive impacts in respect to marine parks and fisheries management outcomes, which would not have resulted without the partnership. The evaluation identified a number of ways the partnership could be improved, particularly in respect to operational processes, and notably in relation to community and stakeholder communication and engagement. Key recommendations for improving MPA and fisheries management integration in NSW are proposed as follows:

1. *Marine parks and fisheries management should enter into an agreement*. The development of a formal agreement would allow for shared objectives and targets to be defined and understood by both internal and external stakeholders. Formalising and defining functional and reportable arrangements are also critical to realise the benefits of this important collaboration. Implementation of this recommendation would best be achieved at the top level down. 'Champions' to progress and introduce a framework for a sustainable partnership are essential.

2. *Identify and prioritise marine park targets and indicators to evaluate the effectiveness of marine parks*. As part of agreeing to and defining partnership objectives and processes, MPA and fisheries management need to be positioned to evaluate performance against targets. Partnership priorities need to be identified. The preparation of an agreed work plan that focuses on priority tasks for the partnership is also recommended. Working towards on an agreed program of work would inevitably result in a discussion on short-term and long-term objectives and pathway to achieve and measure outcomes. Targets should be considered and agreed to with regard to what is needed to complete the system of NSW MPAs. The author recommends ecosystem and habitat representation targets, for each bioregion, should be the primary focus (see Chapter 2).

3. *Implement a risk management approach to deliver marine parks and fisheries management objectives*. Instigating a joint approach to identify and treat risks associated with partnership activities is strategically prudent. As a priority, the

development and implementation of a joint public communication and engagement strategy and program is suggested. The program should be risk managed and aimed at increasing public and marine user awareness, understanding and participation in marine parks and fisheries management.

4. *Monitor and review the performance of the partnership*. Implementing a formal mechanism to ensure both effective partnership delivery and performance is essential. It is highly recommended that these arrangements include incentives to support the partnership, such as mandatory performance reporting requirements. This might be best implemented as part of a discussion to develop formal arrangements and a program of work (see above), to ensure monitoring, evaluation and reporting and improvement (MERI) are embedded in the agreement.

## 7.4 Effectiveness of compliance

The overall success of MPAs is highly dependant on effective compliance. This requires consideration of compliance requirements at the designing stage of MPAs, as well as on-going and sustainable compliance operations. Compliance is an area that has been less studied than most aspects of MPA management, and there are few studies that have analysed compliance planning in respect to optimising voluntary compliance in MPAs. The research presented in Chapter 5 is original in that it compared compliance views of recreational fishers and compliance officers using multi-criteria analyses. This research assembled a comprehensive list of manageability and compliance criteria for assessing and reviewing compliance feasibility at the planning stage of a MPA. Chapter 5 concluded that a necessary way forward to optimize voluntary compliance is to ensure that zoning guidelines adequately incorporate compliance criteria. These criteria need to be more appropriately weighted against other planning criteria and considered when making decisions about zoning boundaries. In respect to MPAs with zoning plans that are already in place, applying compliance criteria is best achieved during the planning review stage when MPA zoning boundaries can be adjusted.

Of particular note, Chapter 5 provides empirical evidence that adopting compliance criteria during zone planning could lead to a marked increase in voluntary compliance in MPAs. This evidence is of significance for all MPA

planners and managers. In respect to NSW, the case study presented in Chapter 5 concluded that most zones in the Port Stephens - Great Lakes Marine Park, were relatively effective in terms of optimizing voluntary compliance, in respect to their zoning location and management. Given that a similar planning approach had been adopted for other NSW marine parks, it is most likely that this conclusion would be relevant across the MPA estate. The case study also indicated that there was considerable potential to improve the design and management of some zones. This included modifying zone boundaries, and for some zones removing them entirely.

The prevalence of poor compliance and enforcement of MPAs is internationally acknowledged and, as a consequence, there has been an international shift in focus from quantity to quality of MPAs, to ensure that they are effectively managed and enforced. The performance of compliance activities has become a key indicator of MPA success. Measuring compliance performance is, however, problematic and making conclusions from enforcement data about the state of compliance can be misleading. Critical to this measurement is the analysis and interpretation of quantitative and qualitative compliance data, to evaluate the cause and effect of compliance activities and their outcomes.

Chapter 6 was dedicated to understanding and improving compliance evaluation. The quantitative analysis of compliance and enforcement data from NSW marine parks provided a series comparison of enforcement from 2007 to 2013. These analyses demonstrated the critical need to acknowledge and understand potential data errors before making assumptions about compliance trends. It also reinforced a need to measure related input and output enforcement data, and not rely on one data set. Importantly, it is concluded that additional qualitative information is paramount to test compliance trend assumptions. These conclusions support the case for a systematic approach to compliance programming, designed to identify compliance drivers and controllers, and link activities to outcomes.

Although each marine park supports local marine park education and awareness programs, little is known about their effectiveness in respect to contributing to voluntary compliance. The analysis of offender age data indicated no sign of change over time that might be expected with a successful local education and awareness program (i.e. less local younger people offending). From a community education perspective, there are no indications of any MPA offence

being age dependant. All age groups offend at similar rates. Thus, a broad-based community education strategy might be more effective than targeting a particular age cohort.

In respect to NSW, the analysis of series enforcement data has indicated that, in general, NSW marine park compliance rates might be gradually declining. The MPA compliance data shows that the prevalence of repeat offenders (particularly recreational fishing offenders) is very low, with only a small number (<10) of recidivists for every thousand offenders. These low rates indicate that individual deterrence for offending a second time in marine parks is effective. However, general deterrence for first time offenders is an issue for all NSW marine parks, with an average of more than 800 incidents annually across the MPA estate. This is particularly concerning for the Jervis Bay Marine Park where non-compliance rates appear to be increasing. Despite encouraging compliance trends for most NSW marine parks, this current level of non-compliance is not conducive to achieving anticipated conservation objectives of the marine park system. The significance of this non-compliance on the effective management of MPA cannot be overstated. Key recommendations to improve compliance in NSW marine parks (from Chapter 5 and 6) are proposed as follows:

1. *Attention to compliance planning during MPA zoning*. Adopting compliance planning criteria during zone planning can significantly improve voluntary compliance. It is prudent for many reasons to focus zoning design and management to support compliance objectives. The NSW MPA planning guidelines already contain a number of criteria associated with manageability. Accordingly, implementing this recommendation would be relatively straightforward. Revisiting the planning guidelines and weighting them, prior to the next management plan review, is suggested.

2. *Review the NSW marine park compliance program.* A compliance program, underpinned by a program logic framework, would help to ensure intermediate and long-term objectives are achieved. Outcomes need to be linked to performance indicators, which are measured consistently over time.

3. *Improve compliance monitoring*. There is justification for improved compliance monitoring in NSW marine parks. Given a relatively high rate of

recidivists within the commercial fishing sector and the significance of commercial fishing impacts on marine park values, mandatory use of satellite vessel monitoring systems is recommended. Increased vessel and aerial patrols, particularly in priority areas, are also recommended; with a view to more assertively engendering deterrence. It is understood that in order to implement this recommendation additional funding is needed. Development of a business case to justify and itemise funding requirements is a first step in this process.

4. *Target local media to advertise enforcement outcomes.* Although media information is routinely released by NSW for fisheries management offences, the same approach needs to be undertaken for marine parks. Building up awareness of compliance activities and demonstrated likelihood of detection, particularly with local residents, will support general deterrence.

5. *Explore options to enhance enforcement powers*. Despite NSW marine parks legislation and regulations providing for relatively high fines and equipment forfeiture for offences, additional administrative powers should be considered to address non-compliance in MPAs. For example, the use of 'on the spot' access suspensions for recreational use offences (i.e. days, weeks, months), and access bans for commercial use offences, are powerful deterrents that have been used in other MPAs. At the national level in Australia a number of compliance information sharing forums have been held, which support the transfer of information across jurisdictions. Greater use of these forums is suggested as a means to identify new approaches and technology.

6. *Maintain enforcement monitoring/effort (input) data management*. The analysis of compliance data has demonstrated the benefits of analysing input and output data together. A review of effort monitoring and the type of data (including metadata) that should be recorded is recommended, with the aim of improving the quality of data over time and minimising data errors. Implementing this recommendation should be a priority, noting that a broader review of enforcement data and its collection is also warranted.

7. *Introduce a marine user survey program for compliance*. Qualitative information from compliance surveys aid in the understanding of user behaviour and compliance drivers. Importantly, a survey program focussing on compliance

behaviour and issues in marine parks may also assist with interpreting quantitative enforcement data, and can be particularly useful for retrieving information on targeted user groups or locations of interest (e.g. enforcement hot-spots). The random response technique (RRT) applied to assess recreational fishers compliance in the Great Barrier Reef is an example of the type of surveys available to collect sensitive data.

8. *Enhance compliance resourcing in MPAs*. The study has indicated that non-compliance in MPAs in NSW remains a significant issue, with potential impacts on the achieving MPA objectives. It has also identified that increased compliance monitoring is required to address the apparent low level of general deterrence. The magnitude of resourcing needed to change compliance behaviour in MPAs is difficult to determine, however, it is suggested that at least a doubling of the current level compliance monitoring is needed in some places. Use of remote vessel monitoring of commercial operations, including commercial fishing and commercial charter operators, would free up considerable resources for recreational use compliance monitoring. New technologies (e.g. UMVs and remote cameras) are rapidly evolving (i.e. capacity and availability) and should be assessed to enhance surveillance. The reliance on costly and resource demanding water-based patrols might also be reviewed.

## 7.5 Future research directions and general recommendations

The research presented in this thesis aims to progress the collective understanding of MPA management effectiveness evaluation. A key issue for evaluation is that there is no universal agreement on performance measures for MPAs. The answer to what makes a MPA effective is still somewhat elusive, as all aspects of management need to effective. Good design without adequate management and good management without appropriate design will result sub-optimal outcomes. There are many variables impacting on MPA effectiveness in meeting their objectives, testing their relative contributions is exceedingly complex. With an international focus on effective and integrated MPAs, research should also refocus on these areas, in particular the integration of MPAs more effectively with

fisheries management (and catchment management) to support ecosystem based management objectives. The utility of multiple use MPAs and no-take MPAs in contributing to ecosystem-based management is poorly researched, yet this is arguably their most important role into the future. Little research has also been undertaken on optimising compliance and evaluating compliance performance measures. If advanced states, like New South Wales, that have access to hi-tech compliance monitoring and enforcement equipment, have difficulties with compliance, it is likely that the majority of MPAs throughout the world are in a similar or worse position. The 'business as usual' approach to compliance and enforcement does not appear to be achieving compliance objectives. A collaboration of compliance experts, economists, statute lawyers, technicians and scientists is warranted, to re-think our approach to compliance in an attempt to make it more cost effective. How might compliance be done in a scientifically meaningful way (e.g. compliance planning methodology, data collection and analysis)? Deregulation, simplification, and user-pay approaches may need to be explored as possible solutions. This study has highlighted a number of areas where research could be extended using similar decision tools and themes that have been applied in this thesis. Suggested research areas to progress the evaluation of MPA management effectiveness are as follows:

- *research to improve decision-making for MPA design and management*, including using decision-tools, such as MCA, weighted planning criteria and modelling to optimise MPA design to meet MPA objectives and broader marine management integration;
- *research to improve risk assessment of fishing techniques* (and accumulated impacts) for MPAs, using EBM principles and zoning objectives;
- *research to improve understanding of the relationship between deterrence and enforcement activities in MPAs,* and to measure deterrence effect of various compliance monitoring tools and strategies; and
- *Case study research to enhance knowledge of governance practices* that illustrate and support effective and resilient partnerships between agencies responsible for marine management.

## 7.6 Final conclusions

Few studies have been undertaken on the effectiveness of multiple use marine parks in meeting conservation and ecologically sustainable development objectives. This thesis contributes to several areas of MPA management effectiveness evaluation of interest to planners, policy makers and managers, and should be instructive for international MPA agencies in managing marine parks. The research undertaken here has benefits for decision -makers in planning and designing MPA zones, particularly in developed countries. The study, which assessed allowable activities against marine park objectives (Chapter 3) was possibly the first of its kind and illustrated how risk assessment methodology can be applied to all MPAs to assist in activity risk assessment. The case study on the effectiveness of sectoral integration between MPA and fisheries agencies (Chapter 4) has provided significant insight into this important partnership and highlighted ways to improve resilience and sustainability of this essential partnership. This research proposed a framework and performance indictors help to evaluate this partnership, and the research will aid in the growing discussion of improving MPA integration with the broader marine management into the near future. The study has also demonstrated that optimising voluntary compliance can be pursued through more considered planning using manageability criteria to improve design of MPAs (Chapter 5). The comprehensive list of criteria is of high interest and instructive to MPA planners and enforcement personnel. Importantly, the value of recreational fisher engagement in MPA planning processes to maximise voluntary compliance and manageability was demonstrated. A study of series enforcement data from NSW marine parks (Chapter 6) has provided for the first time an analysis of compliance trends. In doing so, it has contributed to the understanding of the value and limitations of the enforcement data being captured. This research has provided solid guidance for future improvements in compliance data gathering and reporting for not only NSW MPAs, but is of relevance to all MPAs.

Finally, the complexity of MPAs and their management, and their relationship to the broader marine environment makes their performance incredibly difficult to measure. There are many factors that can affect MPA performance, yet understanding these factors, both individually and cumulatively, is critical for MPAs to achieve their stated objectives. This study has demonstrated that the benefits of

MPA and fisheries integration must be realised to optimise biodiversity and sustainable fisheries outcomes, and that early planning to achieve compliance objectives is arguably the most important consideration for successful MPA compliance. Finally, the quality and sustainability of ongoing compliance activities is paramount to achieve desired MPA objectives.

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# APPENDIX 1 - MARINE PARKS INTEGRATION WITH CATCHMENT MANAGEMENT IN NSW, AUSTRALIA.

# Marine parks integration with Catchment Management in NSW, Australia.

(Unpublished paper prepared by Andrew D. Read for the NSW Marine Parks Advisory Committee)

## 1. Introduction

This article provides an overview of current national and regional legislative and policy protection of the relevant to the coastal marine environment and its management in NSW. Land-based management and integration with marine park management is explained to better understand the utility of this partnership to address and effectively manage coastal activities.

The cumulative impacts of land-based activities on the marine environment have long been recognised. The Natural Resource Management Ministerial Council of Australia has identified that globally, about 80% of marine pollution is generated from land-based activities, including diffuse pollution from urban and agricultural areas, point source emissions and solid wastes. Land-based activities and pollutants from land-based sources can adversely impact marine life and ecosystems, and also marine-dependent industries (e.g. tourism, fisheries and mariculture), public health, foreshore stability, recreation and aesthetics. Once in the marine environment pollutants are absorbed by marine life, settle in river mouths and on the ocean floor, or follow with currents and eddies to distant locations. Large coastal population centres and those receiving waters from highly modified agricultural catchments raise particular problems given the ongoing effects of existing activities and additional impacts from new development place greater pressure on marine ecosystems (at the Australian national scale, nutrients originating from diffuse catchment sources account for an estimated 85% of total nutrient loading to the coastal zone[97]). The extensive clearing or modification of floodplains in lower catchments has also exacerbated the impacts of high natural loads of sediment and nutrients on the marine environment by removing the major abatement mechanism these floodplains provided. The feasible rate of rehabilitation of riparian, floodplain

[97] Natural Resource Management Ministerial Council Australia's National Programme of Action for the Protection of the Marine Environment from Land-based Activities (2006)

and wetland areas cannot substantially reduce these heightened 'natural' loads, much less the high additional loads from land development and clearing.

Under the United Nations Convention on the Law of the Sea, parties have a responsibility to protect the marine environment from land-based activities. In 1995 the international community agreed to the non-binding Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. This program and the need to address land-based sources of marine pollution is accepted by all Australian government jurisdictions.

In 2006 Australia developed its National Programme of Action (NPA) for the Protection of the Marine Environment from Land-based Activities, which identifies major challenges for catchment management to be catchment degradation, coastal development, industrial development and habitat loss. The NPA identifies a current absence of high-level coordination of research, education or monitoring initiatives aimed at either point or diffuse sources of marine pollution. To address these issues, the NPA outlines an integrated and targeted program of priority action areas, including: national cooperative approach to integrated coastal zone management; national water quality management strategy; national pollutant inventory; national action plan for salinity and water quality; national water initiative; state of the environment reporting; bilateral coastal catchments initiative. NPA priority catchment issues include[98]: diffuse rural pollution from agriculture and grazing; diffuse urban pollution run-off from existing and developing urban areas; point source pollution from regulated and unregulated emission sources; and protection of foreshore and neighbouring areas from land use changes.

While jurisdictions have different legislative and administrative frameworks for managing the coastal zone, adopting a national cooperative approach aims to address cross border and sectoral issues to achieve consistent management of common issues and investments from all jurisdictions. An important component of the NPA is the Coastal Catchments Initiative (CCI), which projects implemented in partnership with state and local governments, and regional natural resource management organisations. The CCI seeks to achieve targeted reductions in land-based pollution to coastal water quality 'hotspots', pursued through the development

[98] Natural Resource Management Ministerial Council Australia's National Programme of Action for the Protection of the Marine Environment from Land-based Activities (2006)

and implementation of Water Quality Improvement Plans (WQIPs). These plans are prepared in accordance with the Australian Government's Framework for Marine and Estuarine Water Quality Protection. The ongoing challenge is the differences in approaches between jurisdictions and the difficulty in achieving effective integration, which can result in duplication or gaps in effort. This often arises from inadequate coordination and communication across jurisdictions. The national implementation plan seeks to address this through nationally cooperative outcomes within nominated timeframes. The National Cooperative Approach to Integrated Coastal Zone Management – Framework and Implementation Plan sets out, under identified strategic priority areas, implementation objectives and actions required to address coastal management issues[99].

## 2. Legislative protection of the coastal marine environment in NSW

Principal legislation addressing the protection of coastal and marine resources in NSW are the *Protection of the Environment Operations Act 1997*, which deals with pollution control and management, and the *Coastal Protection Act 1979*, which deals with the protection of coastal habitat and vegetation. These Acts have specific objectives relating to the protection of the marine environment from land-based sources of pollution or direct habitat destruction. The *Protection of the Environment Operations Act 1997* also plays a critical role and controls the release of contaminants to the marine or coastal environment either through licensing point source discharges or through creating an offence for releasing a pollutant or causing environmental harm. The latter approach is relevant to both point source and diffuse discharges, with the vast majority of regulatory activity dealing with point-source offences. Management of most diffuse land-based sources of pollution is being addressed through better guidance and encouraging best practice. Other relevant legislation focuses on the protection of terrestrial and near shore habitats primarily with the aim of conserving biodiversity, for example National Parks and Wildlife,

[99] The implementation of the Framework for a National Cooperative Approach to Integrated Coastal Zone Management is managed through the Intergovernmental Coastal Advisory Group, comprised of representatives from the Australian Government, each state and territory government, and the Australian Local Government Association.

Marine Parks and Fisheries Management legislation. While marine parks and national parks legislation provide for the protection of coastal and marine vegetation and habitats, they are generally limited to defined locations. Fisheries Management legislation, on the other hand, is relevant to all NSW waters.

The State Environmental Planning Policy No. 71 - Coastal Protection (under the *Environmental Assessment and Planning Act 1974*) has broad aims that cover the majority of NPA threats including the objective of preserving the marine environment of NSW. The principal thrust of this policy is the protection and preservation of coastline habitats and amenity. Clauses 15 and 16 of this policy prohibit the approval of developments if they discharge untreated storm water or effluent to coastal waters. The State Environmental Planning Policy No. 14 – Coastal Wetlands was made to ensure that coastal wetlands are preserved and protected. This SEPP 14 prescribes a number of activities including clearing of vegetation, levee bank construction, draining and filling which are deemed to be designated developments, requiring the preparation of an environmental impact statement, if proposed within wetland areas shown on maps which accompany the Policy.

The NSW Coastal Policy 1997 guides decision-making relevant to the unique and specific planning and management needs in the coastal zone[100]. The Policy specifically mandates co-ordination of all levels of government involved in coastal zone management. It articulates the principles of ecologically sustainable development as a means of supporting decision making between the competing use demands for the coastal environment by identifying strategic actions directed at water management, nature conservation, public access, agency coordination, climate changes and cultural heritage. Catchment management reforms over the past decade have culminated in the establishment of the NSW Natural Resource Commission (NRC)[101] and 13 State Catchment Management Authorities (CMA)[102]. The NRC and CMAs have since prepared individual Catchment Action Plans for each CMA area,

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[100] Coastal zone is defined as the area of interaction in which terrestrial processes and land uses directly affect oceanic processes and uses, and visa versa.

[101] In 2004 the Healthy River Commission was discontinued and replaced by the Natural Resources Commission (NRC) established by the *Natural Resources Commission Act 2003* with a broad function of providing the NSW Government with independent advice on a range of natural resource management issues.

[102] CMAs are statutory bodies established under the *Catchment Management Authorities Act 2003*

and developed state-wide. Between 2004 and 2008 the Australian and NSW Governments jointly invested over $400 million in catchment management actions under the NRC program in NSW[103]. The standards and targets provide a quality assurance framework and clear goals to ensure that the investments of CMA approved programs are cost effective and protect and improve high value natural resource assets. More recently the NRC has investigated arrangements for 'monitoring and evaluation' to support state-wide targets. CMAs are responsible for involving regional communities in management of the natural resource management issues facing their region, and are the primary means for the delivery of funding from the NSW and Australian governments to help land managers improve and restore the natural resources of the State. Coastal CMAs are required to address coastal and marine issues within their Catchment Action Plans. For example, some CMAs, such as the Northern Rivers, have made major investments into coastal floodplain and acid sulphate soil water quality management projects.

In NSW the majority of national initiatives implemented for the protection of the marine environment from land-based activities are aimed at addressing threats associated with sediment and nutrient inputs and habitat destruction (including coastal vegetation). Many of these threats are recognised in the United Nations Global Program of Action representing a notable coverage of GPA threats in NSW. Importantly, the high priority pollutant, nutrient and sediment threats are well represented across the range of initiatives, demonstrating the need to treat these threats holistically wherever possible. There are numerous programs in NSW dealing with threats identified within the GPA. Program themes include, stormwater, wetlands, coastal land management and estuaries. For example, the Urban Stormwater Program, administered by the Stormwater Trust, has been very active and successful, over a number of years, providing seed funding for stormwater quality hot spots. The most common capital investment in NSW aimed at water quality improvement has been in wastewater treatment infrastructure. While sewage treatment is managed by local governments in NSW, Sydney Water has adopted an integrated approach in Sydney and Illawarra. In 2004-2005, ten treatment plants owned by Sydney Water discharged to coastal waters (87% to deep water

[103] The Natural Resources Commission NRC Strategic Plan 2009 – 2012 (2009)

outfalls)[104]. The majority of these discharges were treated to a primary treatment standard with monitoring indicating that the treatment plants had a negligible impact on the marine environment. The Aquatic Habitat Rehabilitation Program, administered by NSW Department of Primary Industries has made significant inroads relevant to land-based threats, in particular with regard to in stream and riparian habitat rehabilitation and protection of inland waterways, wetlands and littoral forests. Education and monitoring programs are numerous in coastal towns. Prominent projects have included the Urban Stormwater education program, the "Don't be a Tosser" litter prevention campaign, and the Harbourwatch and Beachwatch recreational water quality monitoring.

## 3. Management of land-based impacts affecting marine parks.

Potential impacts on marine parks from catchment planning and development decisions and unlawful activities can result in significant and lasting damage to marine life, habitat and ecosystems and degrade social values[105]. Determining the best way to integrate and influence catchment management programs is therefore a key strategic priority for marine park management.

Despite having a limited statutory role to directly manage the impacts of land based activities, NSW marine parks have considerable capacity to integrate and influence consent authorities during consideration of developments that may affect marine parks. Section 30 of the *Marine Parks Act 1997* provide support to the functions of the Marine Parks Authority, with specific provisions to: investigate assess and consider proposals for marine parks; make recommendations for the classification of areas within marine parks; manage and control activities that may affect marine biodiversity, habitats and ecological processes in marine parks; provide for and regulate ecologically sustainable use of marine parks; encourage scientific research; and encourage public appreciation (including public recreation), understanding and enjoyment of marine parks.

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[104] (Natural Resource Management Ministerial Council, 2006)
[105] Ehler, C. N., 2005, Kay R. & Alder, J., 1999.

Table 1 – Examples of Potential land based Impacts on marine parks

| PHYSICAL | NATURAL | COASTAL USE |
|---|---|---|
| Loss or decline of land, seascape and heritage values | Loss or decline of habitat | Conflicts with rights of marine park users |
| Disruption of sediment transport | Disturbance to coastal ecosystems and processes | Uses incompatible with location |
| Decline of amenity resources (beaches, dunes, reefs) | Decline in fish resources | Pressure for services and facilities (e.g. moorings, monitoring, signage, compliance) |
| Impacts on hydrology and geomorphology | Threats to protected and threatened species (e.g. turtle nesting, birds roosting, grey nurse shark aggregation sites) | Impacts on existing uses, including cultural, recreational and commercial |

Section 20 of the Act requires that a consent authority, in determining a development application under Part 4 of the *Environmental Planning and Assessment Act 1979*, must take into consideration the objects of the Act, permissible uses and advice from the Authority for a development proposal in the locality of the marine park and consult the Authority prior to finally determining the application (but only if the consent authority is of the opinion that the development is likely to have an effect on the plants and animals and their habitat within the marine park). The same conditions apply for a determining authority under Part 5 the *Environmental Planning and Assessment Act 1979*.[106]

Under the *Protection of the Environment Operations Act 1997* (the POEO Act) the Marine Parks Authority is declared to be the appropriate regulatory authority (ARA) for 'non-scheduled' activities within marine parks at the local level (NSW Maritime is the ARA for vessel related activities, including noise pollution). Under the POEO Act there is some scope for the Authority (as an ARA) to enforce external activities in the event of a pollution incident originating from a land-based development, which has the potential to impact on a marine park. The Marine Parks Authority does not have a lead role in catchment management. The Authority actively pursues opportunities to influence catchment management and coastal management adjacent to marine parks.

[106] See http://www.legislation.nsw.gov.au/viewtop/inforce

NSW Government agencies are aware that integrated approaches to catchment management are more likely to succeed with improvements in communication between all sectors and government agencies. However, strategies aimed at better communication between government, industry and community have been little affective. In particular, the realisation of like problems and impacts; improved understanding of the roles and responsibilities of agencies, including agency 'cultures' and legislative capacities; defining partnerships including administrative and service level agreements; agreeing to standards, indicators and reporting; awareness and opportunities for integrated planning; and development of regional and local priorities and targeted resourcing, have not been effectively achieved.

The Marine Parks Authority has the capacity to identify key estuarine and coastal habitats and heritage values and to provide for their protection through zoning and can also assign special purpose zones to facilitate environmental rehabilitation. In turn, zoning influences adjacent land use practices through local government requirements to take into consideration zoning objectives. For example, the Batemans Marine Park has been able to influence the local government to zone land adjacent to waterways as natural, and to create and maintain 80m natural vegetative buffers adjacent to sanctuaries and habitat protection zones. Notably, an opportunity for integrated planning exists during the development of zoning plans. Examples of integration include mariculture planning, fisheries management planning, defence infrastructure, and Coastline and Estuary Management Plans. Integrated management has also been facilitated by integrating management arrangements for foreshore use with local council, National Parks and Wildlife Service and Department of Lands (i.e. dog walking, vehicle access, signage) and for boating use with NSW Maritime.

Marine park operational plans provide a mechanism[107] to prioritise and resource actions to influence catchment outcomes. Examples of catchment and water management involvement by marine parks are listed in Table 2 below. When considered collectively, these actions significantly improve and focus catchment management programs to achieve MPA objectives. Marine parks provide comment, direction and support to relevant bodies on policies, local planning, development applications and environmental protection projects to help safeguard the marine

[107] See Chapter 2 of this thesis for operational plans.

environment. Marine parks also support regional education, research, communication and tourism through park specific projects. Although partnerships have been fostered with CMAs over the last decade, the capacity to influence catchment management will be enhanced as formals agreements are reached and roles defined with local councils, other land managers and government agencies.

Table 2 – MPA and land based integrated activities in NSW

| MARINE PARK ACTIVITY | OUTCOME |
|---|---|
| Policy/Planning | |
| Regional working groups for coastal strategies and state plans. | Plans adequately address and protect marine park values, particularly in respect to future public and private development. |
| Local council working groups for environmental policy and planning. | Local Environment Plans and strategies address Marine Park values and incorporate protection measures for their conservation and protection.<br><br>Adjacent estuary management plans ensure that marine park values are conserved and protected. |
| Development of local Conservation Plans. | Rehabilitation works support local community aspirations. |
| Developments/Maintenance works | |
| Comment/input into major development proposals. | Potential impacts of developments on Marine park values are formally considered and safeguards are applied to prevent or minimise impacts. |
| Assessment of land-based development risk on marine park values.<br>Proposal to apply risk assessment techniques to identify catchment and land-based threats to local marine park values and to determine appropriate responses. | Priority protection of marine park values by the most effective and efficient means. |
| Project Partnerships/Agency Agreements | |
| MoU with local councils. | Better communication between Marine Parks Authority and local council. Facilitates opportunities for integration and coordination. |
| Agreement with other state government agencies. | Direct negotiation between state agencies involved in land management can ensure government controlled land management practices do not impact |

| | |
|---|---|
| | on the marine park values. |
| Environmental Improvement Projects. | Identification of key environmental issues and ways to address them, as well as developing and implementing projects that lead to communities, businesses and agencies undertaking on ground environmental works and environmental interpretation. |
| Education/Communication | |
| Development of Education material. | Educates community about the importance of estuaries/linkage with the marine park, and threats to estuaries. |
| School excursions and school talks. | Understanding of and education on, importance of sustainable use and catchment management. Educates our future custodians about the importance of estuaries, the surrounding catchment & the built environment. |
| Advisory signs. | Local community and visitors informed about the importance of estuarine and marine habitats and the values of marine parks. |
| Workshops/Conferences | |
| Sponsoring and delivery of workshops and conferences. | Workshops and conferences collate literature and ideas, and identify issues and ways to address impacts associated with catchment land use. |
| Enforcement | |
| Regular patrols of estuary and marine foreshores, including aerial patrols to inspect land clearing and development impacts. | Identification of foreshore and catchment activities that potentially impact on the marine environment. Impacts are minimised, and offenders prosecuted under relevant legislation. Frequency of illegal activities reduced through on going enforcement and public awareness. Public appreciation and support for marine parks. |
| Cross authorisation of regulatory functions. | Improved overall compliance of marine parks and adjacent land use activities with increased numbers of enforcement officers in the field. |
| Research | |
| Monitoring changes in estuarine seagrass habitats. | Improved information on key estuarine habitats in several south coast estuaries, and more broadly, examine the effects of direct impacts such as anchor and propeller scarring, and potential pressures (e.g. climate change) and pulse impacts (e.g. |

| | |
|---|---|
| | developments, spills). |
| Collaborative projects with industry partners including ecological performance and managing coastal lakes to minimise invasion. | Identification of causal links between environmental stressors and biological patterns in estuarine environments subject to different levels of industrial activity and urbanisation. Pest research will assist managers in their efforts to control spread of pests by ascertaining whether coastal lakes serve as barriers to the spread of pests and whether the way in which lake entrances are managed may influence their susceptibility to invasion. |
| Collaboration with fisheries agency on seabed mapping projects aimed at determining the extent and distribution of aquatic macrophytes (i.e. seagrass, mangroves and saltmarsh) and nearshore reefs. | Provision of maps of key seabed habitats identified to be affected by catchment activities allowing accurate assessments of change through time. |

## 4. Conclusion

There is positive progress in respect to integration with new and stronger consultative linkages being developed between marine parks and state and local government agencies. Improvement in understanding and relations with agencies for responding to non-scheduled pollution events is important. As pollution events can have significant and long lasting impacts on marine parks. An opportunity exists for marine parks to be more actively involved in local environmental planning and planning policies and strategies in the future.

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