Protect our Coral Sea coalition submission to the first public consultation period on the draft Coral Sea Commonwealth Marine Reserve management plan

4 December 2012

About the Protect our Coral Sea coalition

The Protect our Coral Sea coalition comprises 15 Australian and international conservation groups led by the Pew Environment Group. Other members are the Australian Conservation Foundation, Australian Marine Conservation Society, Cairns and Far North Environment Centre, Greenpeace, Humane Society International, International Fund for Animal Welfare, National Parks Association of Queensland, North Queensland Conservation Council, Project Aware, Queensland Conservation Council, The Wilderness Society, Whale and Dolphin Conservation Society, Wildlife Preservation Society of Queensland and WWF-Australia. The goal of the Protect our Coral Sea coalition is the establishment of a large, world-class, marine reserve in the Coral Sea that will provide ecosystem-scale benefits and help conserve our global marine heritage. The coalition has used many tools to promote the need for the Coral Sea Marine Reserve and to gather support for its establishment. Reports on science, economics and management, brochures, briefing notes, community events, photographic exhibitions, letterboxing, advocacy with members of federal parliament, meetings with local community leaders along the Queensland coast, radio, TV and newspaper ads, website, emails and submissions. It will continue to use these tools during the period of public consultation, plan preparation and parliamentary review to ensure that the best outcome possible for the protection of the Coral Sea.

The authors

Until recently **Chris Smyth** was the Healthy Oceans Campaigner at the Australian Conservation Foundation where his nine years of work focused on the establishment of marine protected areas, ecosystem-based regional marine planning, national marine legislative reform and sustainable seafood. It was the second time Chris had worked for ACF, during the first in the 1990s he edited ACF's membership magazine, *Habitat*, produced ACF's diaries and at different times carried out the roles of marketing manager and general manager. Prior to his return to ACF, Chris worked for three years at the Victorian National Parks Association coordinating its campaign for marine national parks in Victoria and an integrated national park at Point Nepean, and twelve months managing education programs for a northern Melbourne urban creek management committee. He has now established a private consultancy specialising in research, analysis, project management and writing of environment-focused reports, submissions, brochures and other publications, as well as strategic planning advice on environmental campaigns. **Chris is the author of the submission other than sections 3, 6 and 7.**

Dr Leanne Fernandes holds Masters Degrees in both Tropical Ecology and in Economics. Her Ph.D. in Geography incorporated natural and social sciences into an integrated decision-support system for coral reef management. Over the last fifteen years she has applied her knowledge to address marine resource management problems in the Pacific, the Maldives, the Coral Triangle, the Caribbean, the North Sea and coastal Australia. Notably, Dr Fernandes was Manager of the Representative Areas Program at the Great Barrier Reef Marine Park Authority, which led to the current zoning in the Great Barrier Reef Marine Park. She has also been a Senior Manager at the Authority. These experiences, coupled with other work in coastal and marine parts of Australia, have led to her having a thorough understanding of the governance and compliance needs that pertain to managing Australia's marine protected areas. **Dr Fernandes is the author of sections 3 and 6.**

Dr Daniela Ceccarelli is an independent marine ecology consultant with extensive training and experience in tropical marine ecosystems. She completed a PhD in coral reef ecology at James Cook University in 2004. Her fieldwork has taken her to the Great Barrier Reef and Papua New Guinea, and to remote reefs of northwest Western Australia, the Coral Sea and Tuvalu. In recent years she has worked as a consultant for government, non-governmental organisations, industry, education and research institutions on diverse projects requiring field surveys, monitoring programs, data analysis, reporting, teaching, literature reviews and management recommendations. Her research and review projects have included studies on coral reef fish and invertebrates, seagrass beds and mangroves. She also continues to collaborate with colleagues in academic institutions to further her research interests on coral reefs. **Dr Ceccarelli is the author of section 7.**

Acknowledgements

John Knott, Knott and Associates, Compliance Management Advisor, has reviewed all but Section 7 of this submission. Associate Professor Anthony J. Richardson, CSIRO Marine and Atmospheric Research, and Centre for Applications in Natural Resource Mathematics (CARM), University of Queensland, reviewed Section 7.

Contents

Executive Summary

The Protect our Coral Sea coalition's submission outlines the key elements of the Coral Sea Marine Reserve draft management plan required to effectively achieve the reserve's objectives. A full list of the submission's recommendations is found at the end of this Executive Summary.

Section 1. Introduction

Section 1 provides context to the Protect our Coral Sea coalition's campaign for the Coral Sea Marine Reserve and the purpose of this submission. The goal of the Protect our Coral Sea coalition is the establishment of a large, world-class, marine reserve in the Coral Sea that will provide ecosystem-scale benefits and help conserve our global marine heritage. It has this goal because of the Coral Sea's immense natural and cultural heritage values. As these values have been well described in previous SEWPaC consultation documents and will be summarized in the draft management plan, they will not be described in this submission except where needed to support the case for changes to the zoning scheme and permitted uses.

Section 2. Coral Sea Marine Reserve management planning

Section 2 discusses how a Coral Sea Marine Reserve management plan should be structured, the nature of its content, and the objectives and strategies that should drive management. This section uses the draft management plan for the south-east marine reserve network as a guide to the nature, structure and contents of the Coral Sea Marine Reserve management plan. The Protect our Coral Sea coalition believes the south-east network's management plan has a number of weaknesses in relation to its objectives, management strategies and permit approval processes. This section outlines how to overcome these weaknesses in the Coral Sea Marine Reserve management plan.

Section 3. Future governance of the Coral Sea Marine Reserve

Section 3 considers the future governance, management structures, funding, staffing needs and management costs of the Coral Sea Marine Reserve. The key recommendation in this section is that the Great Barrier Reef Marine Park Authority should also manage the Coral Sea Marine Reserve. The reasons for this are many but include: the Authority's vast experience and expertise in reserve management; the objectives of the marine reserve and its management systems being similar to that of the Authority's for the marine park; the Coral Sea and Great Barrier Reef are intimately connected; the Authority already knows and has good relationships with existing stakeholders; and the cost effectiveness of one common and consistent management system. This section also makes recommendations about the staffing and funding requirements for governance and provides estimates of the expenditure required to effectively manage the Coral Sea Marine Reserve. It is estimated that for governance (excluding compliance costs) the Authority would need an additional 17 Full Time Equivalent staff and recurrent management costs of $4 740 000 and set-up costs of at least $496 000. Estimated staff and funding requirements for compliance are provided in Section 6.

Section 4. The zoning scheme for the Coral Sea Marine Reserve

Section 4 outlines the nature and purpose of the reserve's zoning scheme, its relationship with IUCN protected area management categories, and the changes that need to be made to it to ensure that the objectives of the reserve are achieved and ocean life within it receives the protection needed. In this section recommendations are made to maintain the fishing-free nature of the Marine National Park Zone across the Coral Sea Marine Reserve, and to increase the coverage of that zone in both the Osprey-Shark-Vema group of reefs and the reserve's south.

Section 5. Permitted activities in the Coral Sea Marine Reserve

Section 5 discusses the impacts of three key uses in the Coral Sea Marine Reserve−commercial fishing, recreational fishing and shipping−and how they should be managed. It begins by outlining comments about extractive uses made by the IUCN in its guidelines on protected area management categories. The IUCN deems these inappropriate for IUCN categories Ia, Ib and II. This section then considers the impacts of commercial fishing, recreational fishing and shipping, and makes recommendations on their management to ensure they do not compromise the integrity of the Coral Sea Marine Reserve.

Section 6. Compliance management in the Coral Sea Marine Reserve

Good compliance management is essential to ensure the achievement of planned environmental outcomes. Section 6 discusses the framework for compliance management in the Coral Sea Marine Reserve, which the Protect our Coral Sea coalition recommends should be carried out by the Great Barrier Reef Marine Park Authority because of its proven, systematic approach to compliance management in the marine park and the World Heritage Area. This section also provides estimates of compliance staffing and funding requirements that should be provided as additional resources to the Great Barrier Reef Marine Park Authority. It is estimated by the Protect our Coral Sea coalition that 13 Full Time Equivalent staff will be required for education, liaison, field operations and investigations at an annual cost of $1 950 000. In total, the recurrent compliance costs would be $9 717 032 and the set-up costs $555 000.

Section 7. Critical scientific research for effective management of the Coral Sea Marine Reserve

Section 7 discusses the scientific research framework needed for the Coral Sea Marine Reserve by briefly outlining past research, the gaps in existing research, and what research projects are needed to fill these gaps. Current and future research needs are discussed for such matters as oceanography, climate, maritime archaeology and fisheries, as well as recommendations for the baseline monitoring of pelagic, deep-sea, terrestrial, reef and other habitats. Three research projects and their estimated costs are outlined: shallow coral reefs, seamounts, terrestrial cays ($298 500), mesophotic and deep-sea ($1 817 000), and pelagic ($660 000). The section concludes with recommendations on how to integrate science and management in the Coral Sea Marine Reserve. Research and monitoring programs in the Coral Sea should be preceded by the design of an adaptive management framework that uses information provided by science to inform management actions and decisions.

The submission ends with a list of references used as background for each section.

Recommendations in this submission

Section 2. Coral Sea Marine Reserve management planning

Recommendation 1: The two key objectives for the Coral Sea Marine Reserve should be:

> Objective 1: Provide for the protection and conservation of biodiversity and other natural and cultural values of the Coral Sea Marine Reserve
> Objective 2: Provide for the ecologically sustainable use of the natural resources within the Coral Sea Marine Reserve where this is consistent with objective 1.

Further, the criteria for ecological sustainability assessments of all uses, and any relevant programs or legislation under which these assessments are carried out, and the evidence for the ecological sustainability of each allowable use should be included in an appendix of the plan.

Recommendation 2: The nature of and the criteria to be used in the assessment, approval and permit issuing processes, and the relevant departmental policies, should be clearly stated in the Coral Sea Marine Reserve management plan. Within these processes there should be the opportunity for community engagement and comment.

Recommendation 3: To outline the details of what is allowed and excluded from the zones within the Coral Sea Marine Reserve, a descriptive approach should be used in the management plan with minimal cross-referencing to other documents. This approach should be used throughout the management plan to make is easier for the community to understand management processes.

Recommendation 4: Assessments, approvals and the issuing of permits for uses in the Coral Sea Marine Reserve should be conducted on a case-by-case basis rather than using Class Approvals. A public process that will engage the community in the permit approval process should be established to ensure that effective community understanding and participation is achieved.

Section 3. Future governance of the Coral Sea Marine Reserve

Recommendation 5: Management planning expertise should be seconded from the Great Barrier Reef Marine Park Authority to contribute to the development of the management plan for the Coral Sea Marine Reserve.

Recommendation 6: The Director of National Parks should delegate all powers (unfettered) for the administration, management and control of the Coral Sea Marine Reserve to the Great Barrier Reef Marine Park Authority as established by Section 6 of the *Great Barrier Reef Marine Park Authority Act 1975*.

Recommendation 7: Adequate additional resources (that is, at least $1 051 000 for set-up costs and $14 457 032 annual recurrent budget for management and compliance) are allocated to the Great Barrier Reef Marine Park Authority for management of the Coral Sea Marine Reserve and subject to CPI.

Recommendation 8: Allocated Coral Sea Marine Reserve resources should be managed via a dedicated account and accounting system similar to that used for managing the Great Barrier Reef Marine Park. All Coral Sea Marine Reserve management funds should be directed into the Great Barrier Reef Marine Park Authority and dispersed to any other agencies from the Authority.

Recommendation 9: The Minister should approve the Great Barrier Reef Marine Park Authority providing management and compliance assistance to the Coral Sea Marine Reserve under Section 7A of the *Great Barrier Reef Marine Park Authority Act 1975,* subject to the provision of the required additional resources.

Recommendation 10: A General Manager position (or higher) is created that is in charge of the Coral Sea Marine Reserve and reports directly to the Great Barrier Reef Marine Park Authority board.

Recommendation 11: Establish a high-level (Senior Executive Service level 2 or equivalent) Coral Sea Marine Reserve Strategy Group to advise the Great Barrier Reef Marine Park Authority board on management of the reserve. This group should have one representative from each of: SEWPaC, AFMA, Queensland Premier's Department, Queensland Department of National Parks, Recreation, Sport and Racing, Queensland DAFF (Fisheries Section) and two representatives from the Great Barrier Reef Marine Park Authority (relevant General Managers in charge of day-to-day field management and in charge of Coral Sea Marine Reserve). The Coral Sea Marine Reserve Strategy Group should have a rotating Chair and a Secretariat employed by the Great Barrier Reef Marine Park Authority.

Recommendation 12: An Operations Group should be established to brief the Coral Sea Marine Reserve Strategy Group and to guide daily decisions that pertain to the management of the reserve.

Recommendation 13: As far as possible, Coral Sea Marine Reserve management arrangements with partner agencies should be confirmed via Service Level Agreements or similar.

Recommendation 14: Staff should be employed at least 6 months prior to the Coral Sea Marine Reserve management plan being in effect, except for field surveillance and investigations staff who should begin four months ahead of implementation date.

Section 4. The zoning scheme for the Coral Sea Marine Reserve

Recommendation 15: The Marine National Park Zone in the Coral Sea Marine Reserve should continue to be assigned IUCN protected area management Category II that, according to the IUCN guidelines, excludes all extractive uses including commercial and recreational fishing.

Recommendation 16: To ensure that the entire seamount is protected, the current western boundary of Marine National Park Zone protection for the Osprey-Shark-Vema group of reefs should be moved parallel to and approximately ten kilometres to the west of the existing boundary. The new western boundary should be drawn as a straight line for ease of enforcement.

Recommendation 17: Both the seabed and the water column should be given greater protection in the southern Coral Sea Marine Reserve, which is a biodiversity hotspot for top ocean predators. Longlining and other commercial fishing should be excluded from what is currently the northern section of the Habitat Protection Zone (Seamounts) and Multiple Use Zone (to 152^{o}E longitude) by their conversion to Marine National Park Zone down to the 22^{o}S parallel of latitude. This zone should encompass Marion and Frederick reefs, with a small extension to the southern boundary along the 22^{o}S parallel of latitude to surround Wreck Reef.

Recommendation 18: To further simplify the zoning in the Coral Sea Marine Reserve, the Habitat Protection Zone (Seamounts) below the 22^{o}S parallel of latitude should be converted to a Multiple Use Zone. A superscript in the zoning scheme matrix, and shading over the area of the seamounts, should be used to signify that all demersal fishing is excluded from the seamounts area.

Section 5. Permitted activities in the Coral Sea Marine Reserve

Commercial fishing in the Coral Sea Marine Reserve

Recommendation 19: Sufficient funding should be provided for marine science, fisheries management research, monitoring and data collection in the Coral Sea Marine Reserve to ensure that the impacts of commercial fishing are avoided or minimised, and that the fisheries continuing to operate there are ecologically sustainable and managed within a precautionary and ecosystem-based approach. A clear set of criteria and a process for assessing the ecological sustainability of commercial fishing should be presented in the management plan. The results of these activities should be made public to build community understanding of the fisheries.

Recommendation 20: Strong conservation benchmarks and targets, supported by effective compliance management, should be established in the management of commercial fisheries in the Coral Sea Marine Reserve to allow the recovery of populations of targeted species. These benchmarks and targets should be used when monitoring compliance with permit conditions.

Recommendation 21: Due to the potential impacts of aquaculture, such a use should not be allowed within the Coral Sea Marine Reserve.

Recommendation 22: With ABARES in recent years assessing the active trawl effort in the East Coast Otter Trawl Fishery in this area, an equivalent number of effort units should be removed from the Great Barrier Reef Marine Park to ensure there is no increase of trawl effort there as a result of the displacement of effort from the Coral Sea Marine Reserve.

Recommendation 23: The mandatory public reporting of all catch data and the results of ecological sustainability assessments should be a permit condition for the continued operation of the Coral Sea Fishery in the Coral Sea Marine Reserve. Should this not be possible in any of the subsectors of the fishery, then that subsector should cease operation in the marine reserve.

Recommendation 24: All latent permits in the Coral Sea Fishery should be cancelled and the remaining active permits grandfathered and unavailable for sale. On retirement of the permit holder, the permit should be cancelled.

Recommendation 25: There should be no export of fins from sharks caught in the Coral Sea Marine Reserve, and this ban should be extended to sharks caught in the Great Barrier Reef Marine Park. A product tracing mechanism should be put in place to ensure compliance.

Recreational fishing in the Coral Sea Marine Reserve

Recommendation 26: To ensure consistency with Objective 2 of the Coral Sea Marine Reserve recommended in this submission, the Coral Sea Marine Reserve management plan should clearly outline the criteria and process for assessment of the ecological sustainability of recreational fishing in those zones and areas where it is allowed. As a minimum, charter and game fishing and fishing tournaments should be subjected to a public permit application and approval process.

Recommendation *27*: The Coral Sea Marine Reserve management plan should ensure that the management authority establishes a dedicated and ongoing program to monitor and estimate the number and distribution of recreational fishers, the size of their catches and their level of impacts in the Coral Sea Marine Reserve.

Recommendation 28: In recognition of the very low overall socio-economic value of the Coral Sea Marine Reserve to charter and private recreational fishers relative to the Great Barrier Reef Marine Park, and taking account of the potential impact of sustained recreational fishing on the unique and fragile reef systems in the Coral Sea, additional coral reefs in the marine reserve should be given Marine National Park Zone protection.

Recommendation 29: The Coral Sea Marine Reserve management plan should dedicate research to determine the nature and scale of the threats to the reserve's ocean and reef species, communities and ecosystems from recreational fishing. Where recreational fishing is permitted, it should be ecologically sustainable and managed with a precautionary and ecosystem-based approach.

Recommendation 30: The management of recreational fishing in the Coral Sea Marine Reserve, including allowable quotas, spatial restrictions and assessments of ecological sustainability, should be integrated with that of commercial fishing and supported by a detailed compliance management plan.

Recommendation 31: The management of recreational fisheries in the Coral Sea Marine Reserve should include consistent and effective licensing, data gathering and monitoring of recreational fishers.

Recommendation 32: Environmental impact assessments and management plans should be prepared for each recreational fishery in the Coral Sea Marine Reserve. Reviews should also be conducted on the management effectiveness of existing bag and size limits, boat limits, restrictions on gear types and other measures used to manage recreational fishing.

Recommendation 33: Recreational fishing lines used in the Coral Sea Marine Reserve should be biodegradable, as should bait bags. The use of metal J hooks should be banned, with circle hooks the only ones permitted for use by recreational fishers in the marine reserve.

Recommendation 34: There should be effective compliance, enforcement and penalty provisions in the management of recreational fishing in the Coral Sea Marine Reserve backed up by well-resourced education programs.

Recommendation 35: A major research project should be established to identify the nature and scale of the ecological impacts of catch and release fishing to determine whether it should be allowed in the zones assigned IUCN categories IV and VI in the Coral Sea Marine Reserve.

Shipping in the Coral Sea Marine Reserve

Recommendation 36: The Australian and Queensland governments should work together to ensure that the increased shipping movements in coming decades do not lead to damage of the environment of the Coral Sea Marine Reserve. As part of this collaboration they should seek to introduce mandatory piloting and vessel tracking systems to shipping routes through the Coral Sea Marine Reserve. Pilotage should be mandatory where the risk to sensitive environments or critical habitats is high, such as shelf and shallow environments or calving, feeding and resting grounds for whales and dolphins. This should be in conjunction with the establishment of an incident management strategy having due consideration for the logistical challenges in conducting damage assessment, emergency response and investigations.

Recommendation 37: The federal government should legislate to enable the refusal of port entry to ships travelling through sensitive areas in the Coral Sea Marine Reserve when they do not have tracking devices and a pilot on board.

Recommendation 38: Ballast water exchange, waste discharges (oil**,** noxious liquid substances, packaged harmful substances, and garbage from vessels), dredging and spoil dumping should not be permitted within the Coral Sea Marine Reserve. Every effort should be made to reroute loads deemed as high risk to avoid transiting through the Marine National Park Zone.

Recommendation 39: Alternative ship transiting routes through the Coral Sea Marine Reserve should be established for transit during migration seasons of large marine animals and around areas of critical habitat.

Recommendation 40: The Coral Sea Marine Reserve's management body (recommended in this submission to be the Great Barrier Reef Marine Park Authority) and other relevant agencies should ensure that there are adequate navigational aids not only in the water (where feasible) but also available electronically (such as reserve boundaries and zone boundaries, bathymetry, hotspots for large marine animals, shipping movements, traffic management) to minimise the impacts on ocean life and to maximise compliance. All ships transiting through the marine reserve should have vessel-monitoring systems on board and the ability to download detailed zoning maps and emergency procedures.

Recommendation 41: Single-hulled tankers (categories 1−3) should not be allowed to transit through the Coral Sea Marine Reserve.

Recommendation 42: Places of refuge for disabled ships in or near the Coral Sea Marine Reserve should be identified to minimise the environmental risk (subject to issues of human safety).

Recommendation 43: Merchant and naval ships should not be scuttled within the Coral Sea Marine Reserve.

Recommendation 44: The processes and systems, supported by guidelines and skilled personnel, for managing shipping incidents that are currently in place within the Great Barrier Reef Marine Park, should be extended to cover the Coral Sea Marine Reserve.

Recommendation 45: The federal government should work with the Protection and Indemnity Club to establish a contingency fund to enable an immediate response to a shipping incident in the Coral Sea Marine Reserve.

Section 6. Compliance management in the Coral Sea Marine Reserve

Recommendation 46: The Great Barrier Reef Marine Park Authority should be delegated to plan, manage and conduct all aspects of compliance in the Coral Sea Marine Reserve.

Recommendation 47: The Townsville office of the Commonwealth Director of Public Prosecutions should be given the responsibility and necessary resources to conduct the prosecution of offences under the legislation relevant to the Coral Sea Marine Reserve.

Recommendation 48: Successful prosecutions resulting from compliance management in the Coral Sea Marine Reserve should be well advertised and promoted to assist with deterrence.

Recommendation 49: Staff should be employed at least 6 months prior to the Coral Sea Marine Reserve management plan being in effect, except for field surveillance and investigations staff who should begin four months ahead of implementation date.

Section 7. Critical scientific research for effective management of the Coral Sea Marine Reserve

Recommendation 50: Targeted scientific projects should be established in the Coral Sea Marine Reserve to fill identified knowledge gaps.

Recommendation 51: Rigorous, well-designed and comprehensive monitoring programs should be initiated in the Coral Sea Marine Reserve to establish baselines and to provide a time series for tracking biophysical conditions.

Recommendation 52: Sufficient resourcing should be provided to the Great Barrier Reef Marine Park Authority (the recommended management body for the Coral Sea Marine Reserve in this submission) to fund at least three scientific baseline-monitoring expeditions in the reserve. The expeditions should include those for shallow coral reefs, seamounts, terrestrial cays ($298 500), mesophotic and deep-sea ($1 817 000), and pelagic ($660 000).

Recommendation 53: A scientific research program should be designed for the Coral Sea Marine Reserve that has an adaptive framework, lists the scientific information required to identify and support appropriate management actions, includes programs that provide that information, and is reviewed on a regular basis as new knowledge comes to light.

Section 1. Introduction

The significance of the Coral Sea Marine Reserve

The Coral Sea is a remarkable place. Lapping the shores of the Queensland coast, it stretches east through the Great Barrier Reef Marine Park, beyond Australia's Exclusive Economic Zone and into the waters of Papua New Guinea, the Solomon Islands and New Caledonia.

For many years, Australians knew only of the Coral Sea from its pivotal role in the turning of World War II in the Pacific against the Japanese. Three ruined US warships and their crews who perished in the battle still lay on the deep seabed.

Today the Coral Sea is becoming known around the world for the richness of its natural heritage–and the debate over its future in the Australian government's bioregional marine planning process.

The government's recent proclamation of the Coral Sea Marine Reserve, between the eastern boundary of the Great Barrier Reef Marine Park and that of our Exclusive Economic Zone, is a milestone for the protection of Australia's ocean life. Together with the proclamation of marine reserves in the south-west, north-west, north and temperate east marine regions, Australia can now rightly claim to be leading the world in oceans conservation.

The Coral Sea Marine Reserve covers 989,842 km^2 of what may be the world's last great tropical ocean ecosystem still in relatively pristine condition (Halpern et al 2008). It is home to oceanic reefs and atolls, sandy cays and islets, the northern end of a chain of seamounts and Australia's largest trough system. These provide habitats for whales, dolphins, turtles, rays, sharks, tuna, marlin, swordfish and many other species of the open ocean and reefs.

Climate change and fishing have already placed the values of this region under pressure. But unlike so many other locations in the Pacific, the large pelagic species that dominate this region (tuna, billfish and sharks) have not been severely depleted. With what was less than one percent of the Coral Sea in Australian waters found in reserves, with very little current fishing activity, and with its enormous natural and heritage values, the case for a dramatic increase in protection has been irresistible−and now that case is won.

Support for the Coral Sea Marine Reserve

Since 2009 the Protect our Coral Sea coalition has been publicly advocating the establishment of a large, world-class marine reserve in the Coral Sea. The coalition's founding members were The Pew Environment Group, the Australian Conservation Foundation (ACF), the Australian Marine Conservation Society (AMCS), the Cairns and Far North Environment Centre (CAFNEC), Project Aware and the Queensland Conservation Council (QCC). The previous year Pew, ACF, AMCS and CAFNEC had released the *Proposal for A Coral Sea Heritage Park*.

The membership of the Protect our Coral Sea coalition has steadily grown and now comprises 15 Australian and international conservation groups being the founding members plus Greenpeace, Humane Society International, International Fund for Animal Welfare, National Parks Association of Queensland, North Queensland Conservation Council, The Wilderness Society, Whale and Dolphin Conservation Society, Wildlife Preservation Society of Queensland and WWF-Australia.

As with the growth of the coalition's membership, so too has grown the support for the Coral Sea Marine Reserve across the Australian and international community−and it is not confined to community environment groups. Australian and international scientists, Queensland-based dive tour operators, commercial fishers active in the Coral Sea, and recreational fishers have been joined in support by:

- The Battle for Australian Commemoration National Council, RSL and individual veterans of the Battle of the Coral Sea
- Eminent Coral Sea Ambassadors including two former Chiefs of the RAN Admirals David Shackleton AO and Chris Ritchie AO, Tim Winton, Pat Rafter, Kristy Hinze and Jim Clark, Akira Isogawa, Cairns-based Hollywood actress Isabel Lucas, and singer-songwriter John Williamson
- Dr Sylvia Earle and the newly formed Ocean Elders group, which includes Queen Noor of Jordan and Sir Richard Branson.

A Newspoll dated September−October 2011 found that almost seven out of ten Queenslanders supported the protection of the entire Coral Sea Marine Reserve from commercial and recreational fishing and drilling for oil and gas. A similar level of support for broader oceans protection was measured by an Essential Research poll after the federal government's 14 June 2012 announcement to establish a national system of marine reserves.

Establishing a Coral Sea Marine Reserve makes good business sense and will support an ailing Queensland tourism industry. For instance, DialAFlight, one of the UK's leading travel operators, announced on 5 January, 2012 that the Australian government's plan to establish a marine reserve in the Coral Sea shows a positive step towards protecting a fragile area from degradation and could even strengthen tourism along Australia's Queensland coastline[1].

Further, in 2010, accounting firm KMPG undertook a detailed economic analysis of a highly protected marine reserve throughout the entire Coral Sea Conservation Zone. The report found a direct gain of $9.2 million per year (2009/10 prices) in dive tourism revenue. Taking account of revenue foregone from the fishing industry (commercial and recreational), it found a modest increase in national GDP of $9 million as a result of a Coral Sea Marine Reserve entirely free of fishing. With very conservative assumptions, it found a net increase of 178 jobs in the northern Queensland economy. Although the proclaimed marine reserve will not be free of fishing across its entire area, there will be significant economic benefits flowing from it and these are now being recognised in the community.

The Protect our Coral Sea coalition acknowledges that the Coral Sea Marine Reserve will affect some commercial fishing businesses. It supports the federal government's commitment to provide adjustment assistance to those commercial fishing businesses with a significant history of active effort in the proposed reserve consistent with its Fisheries Adjustment Policy.

Strengths and weaknesses of the proclaimed Coral Sea Marine Reserve

The Coral Sea Marine Reserve provides a strong foundation for effective future management and the Protect our Coral Sea coalition is very pleased that:

- the entire area will be free of mining and offshore petroleum exploration and production. The Protect our Coral Sea coalition strongly supports this ban

[1] http://www.marketwatch.com/story/new-marine-reserve-could-bolster-queensland-tourist-numbers-say-dialaflight-2012-01-05

- almost the entire area will be protected from demersal trawling, gillnetting and demersal longlining
- nearly three quarters of the area (approximately 706,000 km^2 or 71 per cent) will be protected from pelagic longline fishing, a gear type associated with a high level of mortality of non-target species
- a large Marine National Park Zone in the eastern Coral Sea Marine Reserve covers just above half the reserve and includes the Mellish and Kenn reef systems and the remains of the three U.S. warships from the Battle of the Coral Sea
- several improvements have been made to the coverage of the Marine National Park Zone. Other improvements have included a Conservation Park Zone being assigned to Flinders and Holmes reefs, thereby excluding most forms of commercial fishing that were to be allowed under the earlier zoning scheme.

However, there are a number of flaws in the Coral Sea Marine Reserve including:

- the western Coral Sea Marine Reserve, which contains most of the species-rich coral reefs and critical spawning sites for black marlin and other threatened species, remains open to fishing, even though the Coral Sea Fishery has historically low levels of production, value and effort, and the game and charter fishing industry is almost solely focused on the Great Barrier Reef Marine Park. Giving insufficient protection to the coral reef systems, the most important components of the Coral Sea, will hamper the achievement of the reserve's objectives
- the western boundary of the Marine National Park Zone covering the Osprey-Shark-Vema group of reefs is right up against the edge of the reef, leaving shark and other species dependent on the area extremely vulnerable to depletion from fishing, while also maximising negative edge effects along the zonal boundary
- longline fishing and subsectors of the Coral Sea Fishery will be allowed to continue in the southern Coral Sea Marine Reserve and continue to impact on aggregations of pelagic species around seamounts
- the Marine National Park Zone in the southern Coral Sea Marine Reserve has been reduced in width to accommodate the Habitat Protection Zone (Seamounts). This removes protection of ocean life in the water column of that area, the new zone only giving protection to the seabed.

The purpose of the Protect our Coral Sea submission

The long-term effectiveness of the Coral Sea Marine Reserve in achieving its objectives will be determined by the robustness of its management plan. As we begin the period of management plan consultation, preparation and parliamentary review between now and the middle of 2013, the Protect our Coral Sea coalition will, in this submission, raise major concerns and make strong recommendations about the proclaimed Coral Sea Marine Reserve and its future management. These concerns and recommendations cover the areas of management objectives and strategies, zoning, governance, permitted activities, compliance management systems and scientific research.

In general terms, this submission will not discuss the natural and cultural values of the Coral Sea Marine Reserve, other than where these are cited to provide support for the zoning changes to be recommended. It is presumed that a discussion of the reserve's natural and cultural values will be included in the government's draft management plan scheduled for release in 2013.

Section 2. Coral Sea Marine Reserve management planning

It is presumed by this submission that the content and structure of the draft management plan for the South-east Commonwealth Marine Reserve Network will guide the preparation of draft plans for the Coral Sea Marine Reserve and the reserves in the South-west, North-west, North and Temperate East marine regions. Based on this presumption, Section 2 considers key structural elements and content for the Coral Sea Marine Reserve management plan.

Structure of the Coral Sea Marine Reserve management plan

Although the Protect our Coral Sea coalition supports the basic structure of the template provided by the draft South-east marine reserve network management plan, it has a number of weaknesses that need to be avoided in the drafting of the Coral Sea Marine Reserve management plan. Based on the south-east template, the main structural elements of the draft Coral Sea Marine Reserve Management Plan should be:

1. A description of the Coral Sea Marine Reserve: this should include a summary of the reserve's natural and cultural heritage, conservation values, the threats to those values, and the economic and social uses of the reserve. These values are not covered in this submission.

2. IUCN protected area management categories: The management plan should outline the IUCN categories to be assigned to the zones within the zoning scheme. The categories assigned will reflect the objectives and outcomes to be achieved by the reserve. The Coral Sea Marine Reserve's management should be consistent with the relevant Australian IUCN reserve management principles prescribed for each category by Schedule 8 to the *EPBC Act 1999* Regulations. Sections 4 and 5 of this submission consider the application of these categories to the Coral Sea Marine Reserve.

3. The zoning scheme: this should provide a detailed map of the zones and define what can and cannot occur within the zones, along with the arrangements for managing that use. Section 4 and 5 of this submission discusses issues surrounding the current zoning scheme of the Coral Sea Marine Reserve and permitted uses. Section 4 also outlines changes needed to strengthen the zoning scheme in the Coral Sea Marine Reserve.

4. Management strategies: these strategies and their associated actions outline how the management body (recommended in this submission to be the Great Barrier Reef Marine Park Authority) will organise its work to achieve the objectives of the Coral Sea Marine Reserve. The plan here should include information about scientific research and monitoring, assessment and permitting, compliance, community participation, and environmental management. The overarching management strategies for the Coral Sea Marine Reserve are discussed below in 'Management strategies for the Coral Sea Marine Reserve management plan'. Sections 3 and 6 of this submission consider the governance and compliance arrangements for the Coral Sea Marine Reserve, while Section 7 outlines the critical scientific research needed to underpin the achievement of the marine reserve's objectives.

5. Managing the use of the reserve: this sets out, through management prescriptions, which activities can be undertaken and how they will be managed. This includes the use of permits and approvals to authorise activities, as well as determinations, prohibitions and restrictions made under the Regulations to regulate activities. Section 5 of this submission considers changes to and management of activities within the Coral Sea Marine Reserve.

6. Legislative and policy framework: the management plan should describe the legislative context and international agreements that influence the management of the reserve, along with the IUCN principles of protected area management.

Objectives of the Coral Sea Marine Reserve management plan

The two objectives included in the draft management plan for the south-east marine reserve network are here modified to refer to the Coral Sea Marine Reserve:

> Objective 1: Provide for the protection and conservation of biodiversity and other natural and cultural values of the Coral Sea Marine Reserve
>
> Objective 2: Provide for sustainable use of the natural resources within the Coral Sea Marine Reserve where this is consistent with objective 1.

The Protect our Coral Sea coalition supports the inclusion of Objective 1 in the Coral Sea Marine Reserve management plan but believes Objective 2 requires recasting before inclusion. It should instead read:

> Objective 2: Provide for the ecologically sustainable use of the natural resources within the Coral Sea Marine Reserve where this is consistent with objective 1.

Part 1 of Schedule 8 of the *Environment Protection and Biodiversity Conservation Act 1999* lists the general administrative principles that must be applied to the management of Commonwealth marine reserves. One of these is 'ecologically sustainable use'. Aiming for simply 'sustainable use', as is the case with the south-east plan's second objective, would allow uses such as fishing to simply maintain production or catches and be seen as 'sustainable'.

To be 'ecologically sustainable', uses must also have little impact on the ecological function, processes and services from the Coral Sea Marine Reserve. There is great uncertainty about the stock status of the Coral Sea Fishery and its subsectors and the impacts it is having on species and ecological processes. Tuna fisheries have also struggled with overfishing and concerns remain for some of the species targeted or caught as bycatch by the Eastern Tuna and Billfish Fishery in the Coral Sea Marine Reserve. Recreational fishing can also have many ecological impacts.

Recommendation 1: The two key objectives for the Coral Sea Marine Reserve should be:

> Objective 1: Provide for the protection and conservation of biodiversity and other natural and cultural values of the Coral Sea Marine Reserve
> Objective 2: Provide for the ecologically sustainable use of the natural resources within the Coral Sea Marine Reserve where this is consistent with objective 1.

Further, the criteria for ecological sustainability assessments of all uses, and any relevant programs or legislation under which these assessments are carried out, and the evidence for the ecological sustainability of each allowable use should be included in an appendix of the plan.

Management strategies for the Coral Sea Marine Reserve management plan

There are six management strategies listed in the south-east marine reserve network's management plan and, by and large, the Protect our Coral Sea coalition would support their inclusion in the Coral Sea Marine Reserve management plan. The six strategies, with text adjusted for the Coral Sea Marine Reserve, are:

1. Improve knowledge and understanding of the conservation values of the Coral Sea Marine Reserve and of the pressures on those values.
2. Minimise impacts of allowable activities through effective assessment of proposals, decision-making and management of activities.
3. Protect the conservation values of the Coral Sea Marine Reserve through management of environmental incidents.
4. Facilitate compliance with this management plan using a formal approach to compliance management involving strategies ranging from education to enforcement.
5. Promote community understanding of, and stakeholder participation in, the management of the Coral Sea Marine Reserve.
6. Evaluate and report on the effectiveness of this management plan through monitoring, measurement against key indicators, and review.

However, there will need to be greater clarity around Management Strategy 2 in the Coral Sea Marine Reserve management plan than currently exists in the draft management plan for the south-east marine reserve network. In that plan it is stated that in relation to allowable uses within the reserve network, uses will be allowed where they have been:

> 'previously authorised by approvals given by the Director under s. 359B of the *EPBC Act 1999*, including general approvals for commercial fishing and seismic survey, and some individual approvals. The impacts of these activities were considered prior to the approvals being given and are known, and no further assessment is necessary.'

A critical action that can help build the resilience of ocean life to climate change is the removal of threats and pressures, including extractive uses such as commercial and recreational fishing (and oil and gas production which is banned in the Coral Sea Marine Reserve). This can be achieved by considerably increasing the extent of the Marine National Park Zone in the Coral Sea Marine Reserve.

Presuming that the impacts of allowable uses 'are known', and that there is 'no further assessment necessary', is in contrast to principles of adaptive, ecosystem-based management which by definition changes with new knowledge and changes in environmental, social and economic circumstances. Regular monitoring, targeted scientific research and scientifically rigorous and transparent assessments of the allowable uses would be critical to the effectiveness of adaptive management.

The draft management plan for the south-east marine reserve network also states that the Department will:

> 'Establish a process for assessment, decision-making and authorisation of activities within the South-east marine reserves network that is in accordance with relevant departmental policy.'

And an outcome of that plan would be that:

> 'Potential impacts of allowable activities on the conservation values of the marine reserves network are identified and avoided or mitigated by appropriate assessment and authorisation processes.'

These statements are simply too vague and presumes that department policy is best practice. Such policy would need to be spelt out fully for the community to judge whether it is appropriate for the Coral Sea Marine Reserve. The sections of the draft south-east plan that deal with the assessment, approval and the issuing of permits to allowable uses for the marine reserve network lack sufficient detail to determine the worth of the processes mentioned in the above quotes. Another of the principles in Part 1 of Schedule 8 of the *EPBC Act 1999* is the need for 'transparency of decision- making'.

‘Community participation’ is another principle and it is also one of the plan’s management strategies. However, none of the above quotes give any indication that the community can be engaged in these processes. This must be addressed during the preparation of the Coral Sea Marine Reserve management plan.

Recommendation 2: The nature of and the criteria to be used in the assessment, approval and permit issuing processes, and the relevant departmental policies, should be clearly stated in the Coral Sea Marine Reserve management plan. Within these processes there should be the opportunity for community engagement and comment.

Processes for permitted activities in the Coral Sea Marine Reserve management plan

Matrices of uses to be allowed and disallowed

In the south-east marine reserve network’s draft management plan there is a great lack of detail in some of the matrices outlining what is allowed and not allowed within each of the network’s management zones. This is the case when the matrices refer to ‘Commercial fishing (except as indicated below)’. In each case the reader is expected to search for the details, whereas to aid transparency, community participation and education, they should be detailed in an appendix of the plan. Cross-referencing to other documents is used frequently in the plan and makes it very difficult for the reader to understand the plan’s scope and how it influences management.

Recommendation 3: To outline the details of what is allowed and excluded from the zones within the Coral Sea Marine Reserve, a descriptive approach should be used in the management plan with minimal cross-referencing to other documents. This approach should be used throughout the management plan to make is easier for the community to understand management processes.

Approvals of use

In the case of fishing, the use of Class Approvals is a ‘one-size-fits-all’ approach when individual assessments would provide for greater transparency of decision making and allow for sub-regional differences in environments and impacts to be considered.

Recommendation 4: Assessments, approvals and the issuing of permits for uses in the Coral Sea Marine Reserve should be conducted on a case-by-case basis rather than using Class Approvals. A public process that will engage the community in the permit approval process should be established to ensure that effective community understanding and participation is achieved.

A more detailed discussion of permitted uses in the Coral Sea Marine Reserve can be found in Section 5 of this submission.

Section 3. Future governance of the Coral Sea Marine Reserve

This section briefly outlines the likely management needs of the Coral Sea Marine Reserve, the management capabilities of one of the world's leading protected area managers, the Great Barrier Reef Marine Park Authority, and a rationale for why it is sensible to delegate responsibility for the management of the marine reserve to the Authority.

Management needs of the Coral Sea Marine Reserve

The final management plan for the Coral Sea Marine Reserve will provide the framework for its future management by identifying the management activities and actions required to achieve the objectives of the reserve. The Coral Sea Marine Reserve is a multi-zoned managed area that includes recreational fishing, ecotourism, commercial fishing, shipping, charter boat and game fishing, scientific research and more. All uses will need to be managed to minimise their impacts upon the Coral Sea Marine Reserve's ecosystems, including islands and cays. The management plan should provide guidance to managers on how to achieve this goal.

Once the management plan is in place, it will then need to be implemented, its success monitored and its features refined in response to lessons learned from the experiences of management and monitoring efforts. Implementation is likely to require:

- education and liaison with users and stakeholders
- educational tools and materials
- coordination and partnerships with other state and federal agencies
- international coordination and liaison
- application/management of permits (the Australian Fisheries Management Authority is already administering permits for commercial fishing in the reserve area)
- legal support
- management of islands/cays
- development of operational policies
- incident response
- site/issue specific planning
- compliance (see Section 6)
- administrative capacity.

Management of the Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park Authority has more than 30 years experience in managing a multi-zoned marine park in tropical Australia. It has experience managing all the same types of uses (and, in some cases, the same users) and ecosystems that are found in the Coral Sea Marine Reserve.

Recommendation 5: Management planning expertise should be seconded from the Great Barrier Reef Marine Park Authority to contribute to the development of the management plan for the Coral Sea Marine Reserve.

Daily management of the Great Barrier Reef Marine Park currently includes addressing low-level operational policy issues as they arise along all dimensions. The kinds of issues that the Great Barrier Reef Marine Park Authority has addressed over the years has included:

- permitting
- education of and liaison with resource users (including tourism, commercial and recreational fishers, shipping, researchers)
- development and implementation of operational natural resource management policies
- refinement of regulations
- developing partnership and stewardship programs with user groups
- factoring of climate change into management
- facilitation of agreed cooperation with other federal government and state government agencies
- guiding of research activities to priority topics
- management of Commonwealth Islands
- incident management
- overall compliance and enforcement activities.

The Great Barrier Reef Marine Park Authority has built strong relationships of trust and mutual support with agencies whose activities and jurisdictions overlap with or complement the functions of the Authority. These agencies include those listed in Table 1. Many of these will also be highly relevant to the management of the Coral Sea Marine Reserve.

Table 1 Federal and Queensland agencies and research organisations relevant to the Coral Sea Marine Reserve

Federal government	**Queensland government**
SEWPAC	Department of Environment and Heritage Protection
Department of Climate Change	Department of National Parks, Recreation, Sports and Racing
Department of Resources, Energy and Tourism	Department of Premier and Cabinet
Departments of Agriculture, Fisheries and Forestry	Department of Transport and Main Roads
Geoscience Australia	Queensland Parks and Wildlife Service
Coastwatch/Border Protection Service	Queensland Boating and Fisheries Patrol
Australian Federal Police	Maritime Safety Queensland
Australian Maritime Safety Authority	Queensland Water Police
Australian Quarantine Inspection Service	Departments of Agriculture, Fisheries and Forestry
Customs	State Penalties Enforcement Registry
Australian Fisheries Management Authority	
Department of Defence	
Research organisations	
Australian Institute of Marine Science	ARC Centre of Excellence in Coral Reef Studies
CSIRO	University of Queensland
James Cook University	Australian Museum

The government relationships are formalised through an Intergovernmental Agreement between the state and federal governments. With some of these groups, especially those related to compliance management activities, the Great Barrier Reef Marine Park Authority has Service Level Agreements and other cooperative arrangements in place to ensure service delivery against mutually agreed objectives and outcomes after the provision of funds from a dedicated pool of resources.

Why the Great Barrier Reef Marine Park Authority?

There are many reasons why using the Great Barrier Reef Marine Park Authority to implement the Coral Sea Marine Reserve management plan is the most desirable management outcome, and they inlcude:

- the objectives for both the Authority and the marine reserve are sufficiently similar that the application of the Authority's management systems to it would help achieve the reserve's goals
- by having a similar management system to that used by the Authority, the reserve would benefit from well over 30 years of learning about management systems relevant to the types of ecosystems, habitats and users found in the reserve
- the border between the Great Barrier Reef Marine Park and the Coral Sea Marine Reserve is artificial in terms of geography, ecosystems, fished stocks and many of the users. There is connectivity and movement of most of the components of both jurisdictions between them
- there is no need to establish a new management system from scratch when one exists that can form the foundations for management of the Coral Sea Marine Reserve. This represents a significant cost-saving, as does the additional savings that would accrue due to the economy of scale
- the Great Barrier Reef Marine Park Authority is already familiar with the majority of activities that occur in the marine reserve as they also occur in the marine park (including illegal long-lining and illegal foreign fishing vessels)
- many Coral Sea Marine Reserve users will be based in and/or come back to ports along the Great Barrier Reef coast–where the Authority already has a presence
- many of the operations and people who use the Coral Sea Marine Reserve now and who will use it into the future are based along the Great Barrier Reef coastline and the Authority already knows them
- the Authority has a pool of skilled, experienced personnel from which to establish a management team for the Coral Sea Marine Reserve
- the management partnerships required for the Coral Sea Marine Reserve are almost identical to those that the Great Barrier Reef Marine Park Authority has in place and for which they have already established strong professional relationships and agreed information-sharing protocols
- having, as far as possible, one management system for both areas where there is overlap of users, enhances the simplicity of voluntary compliance for marine resource users
- staff working in a joint Great Barrier Reef Marine Park and Coral Sea Marine Reserve management program will require more advanced training in the provisions of the *EBPC Act 1999*. By these staff working across both areas, it will lead to enhanced knowledge of the Act and its application
- the Authority has experience in the administration of Service Level Agreements to ensure that partner agencies provided with funding deliver upon mutually agreed outputs and outcomes.

Governance structures for effective management of the Coral Sea Marine Reserve

The legislative basis of the Coral Sea Marine Reserve is the *EPBC Act 1999*. This Act gives the Director of National Parks the power to conduct the administration, management and control of Commonwealth reserves established under it. Furthermore, the Director can delegate all or any of the Director's powers or functions under the *EPBC Act* (s. 515) and *EPBC Regulations* (r. 19.01A). This has occurred within the south-east marine reserve network's draft management plan, where the Director has delegated certain powers and functions for managing those reserves. In a similar manner, the Director of National Parks could delegate all or any of the Director's powers for the administration, management and control of the Coral Sea Marine Reserve.

The Great Barrier Reef Marine Park Act 1975 (Part II, 7A) states that 'the Authority may, at the request of another institution or person, provide assistance to the institution or person in matters relating to environmental management'. However, the Minister must approve this assistance and can only do so 'if provision of the assistance concerned is not likely to affect adversely the performance of the functions of the Authority conferred by other provisions of this Act'.

Recommendation 6: The Director of National Parks should delegate all powers (unfettered) for the administration, management and control of the Coral Sea Marine Reserve to the Great Barrier Reef Marine Park Authority as established by Section 6 of the *Great Barrier Reef Marine Park Authority Act 1975*.

Recommendation 7: Adequate additional resources (that is, at least $1 051 000 for set-up costs and $14 457 032 annual recurrent budget for management and compliance) are allocated to the Great Barrier Reef Marine Park Authority for management of the Coral Sea Marine Reserve and subject to CPI.

This recommendation inherently and purposely implies that the staff appointed using these funds will be those Great Barrier Reef Marine Park Authority staff dedicated (full-time or part-time) to management of and/or compliance to the Coral Sea Marine Reserve.

The justifications for these figures are supplied below in 'Funding the management of the Coral Sea Marine Reserve'. In summary, $4 500 000 of the recurrent budget is for staffing and the remainder is for operations including the procurement of adequate surveillance craft. This resource assessment excludes research, which should be an additional, and vital, component of planning forward for management of the Coral Sea Marine Reserve (Section 7 of this submission outlines the critical scientific research needs of the Coral Sea Marine Reserve and some estimates of research costs).

Notwithstanding the above recommendation, the resources allocated must be sufficient so that the added responsibility of management of the Coral Sea Marine Reserve in no way adversely impacts on the funding and/or management of the Great Barrier Reef Marine Park. As stated earlier, this is a requirement of the *Great Barrier Reef Marine Park Authority Act* (Section 7A (5)).

There must be transparent accounting of the funds allocated to the management of the Coral Sea Marine Reserve, therefore a separate account and accounting system should be established to reconcile expenditure of these funds.

Recommendation 8: Allocated Coral Sea Marine Reserve resources should be managed via a dedicated account and accounting system similar to that used for managing the Great Barrier Reef Marine Park. All Coral Sea Marine Reserve management funds should be directed into the Great Barrier Reef Marine Park Authority and dispersed to any other agencies from the Authority.

Recommendation 9: The Minister should approve the Great Barrier Reef Marine Park Authority providing management and compliance assistance to the Coral Sea Marine Reserve under Section 7A of the *Great Barrier Reef Marine Park Authority Act 1975*, subject to the provision of the required additional resources.

The Coral Sea Marine Reserve is in Commonwealth waters but has Queensland fisheries and Queensland-based users and companies involved in its use. It would therefore be advisable for the Great Barrier Reef Marine Park Authority to seek advice on the marine reserve's management from a high-level "Strategy Group" established for this purpose and comprising state and federal representatives.

To maintain accountability and transparency with regard to the day-to-day management and operational decisions that will need to be made in managing the Coral Sea Marine Reserve, a new, dedicated General Manager (Senior Executive Service level or higher) position should be created to which all staff working on the reserve should report. This position would report to the Great Barrier Reef Marine Park Authority directly.

Recommendation 10: A General Manager position (or higher) is created that is in charge of the Coral Sea Marine Reserve and reports directly to the Great Barrier Reef Marine Park Authority board.

Recommendation 11: Establish a high-level (Senior Executive Service level 2 or equivalent) Coral Sea Marine Reserve Strategy Group to advise the Great Barrier Reef Marine Park Authority board on management of the reserve. This group should have one representative from each of: SEWPaC, AFMA, Queensland Premier's Department, Queensland Department of National Parks, Recreation, Sport and Racing, Queensland DAFF (Fisheries Section) and two representatives from the Great Barrier Reef Marine Park Authority (relevant General Managers in charge of day-to-day field management and in charge of Coral Sea Marine Reserve). The Coral Sea Marine Reserve Strategy Group should have a rotating Chair and a Secretariat employed by the Great Barrier Reef Marine Park Authority.

This high-level group would need to be informed on issues about the daily management of the Coral Sea Marine Reserve by operational-level staff. These staff should be sufficiently senior so that they could work effectively and with authority across all the relevant sections of the Great Barrier Reef Marine Park Authority, as well as with partner agencies (as listed above), and provide relevant information from any one of these areas to the Coral Sea Marine Reserve Strategy Group.

Recommendation 12: An Operations Group should be established to brief the Coral Sea Marine Reserve Strategy Group and to guide daily decisions that pertain to the management of the reserve.

Although the reporting structure for the management of the Coral Sea Marine Reserve would be separate, but parallel to, that of the Coral Sea Marine Reserve Strategy Group, the intent is that the staff would physically sit within existing groups and units in the Authority. In this way there would be mutual learning and coordination of all management activities.

The Coral Sea Marine Reserve cannot be managed from within one agency working alone. The management partnerships are crucial, not optional. To ensure delivery against agreed reserve management objectives, Service Level Agreements (or similar) should be established with key service providers. This would ensure clarity of objectives, roles and responsibilities and provide accountability.

Recommendation 13: As far as possible, Coral Sea Marine Reserve management arrangements with partner agencies should be confirmed via Service Level Agreements or similar.

Funding the management of the Coral Sea Marine Reserve

Management of the Coral Sea Marine Reserve will be relatively 'cheaper' than for the Great Barrier Reef Marine Park because there are fewer users and the area is not adjacent to coastal populations and catchments. However, this is balanced by the marine reserve being almost three times larger than the marine park, directly abuts four other countries (New Caledonia, Solomon Islands and Papua New Guinea), has no shipping lanes to control movements and has issues which the Great Barrier Reef Marine Park Authority rarely needs to address (e.g. illegal foreign fishing vessels and international cooperation in terms of management and research activities).

Recurrent costs

Ban et al (2011) identified the need for 17 Full Time Equivalent staff (FTE) to support management of the Coral Sea Marine Reserve (excluding compliance management, see Section 6). The Protect our Coral Sea coalition agrees with this assessment allowing for the fact that each FTE might, in fact, be 'spread' across a number of staff depending upon the workload, issues and expertise required to fulfill management needs. Also added to this is a dedicated legal support officer. Assuming $150 000 per FTE, this leads to an annual recurrent cost of $2 550 000 in salaries (for details see Table 3)

Table 2 Estimated FTE for management of the Coral Sea Marine Reserve (excluding compliance)

Position	Full-time equivalent (FTE)
Planning	2 FTE
Permits	2 FTE
Incident response	1 FTE
Management	1FTE
Natural resource management experts	7 FTE
Legal support	1 FTE
Education/awareness	1FTE
Support services (secretariat, administration, computer support, financial services, human resources, etc.)	2 FTE
TOTAL	17 FTE

This analysis has applied the same estimate for operational costs as Ban et al (2011): $30 000/FTE, which includes all operational costs as well as the leasing of offices. This then will sum to an additional $510 000 per year for operational costs.

It is likely that at least one incident per year will require an immediate response whether it is a shipping issue or an issue with illegal foreign fishing vessels or illegal fishing. Ban et al (2011) estimated that incident response would require $1 680 000 per year.

All funds provided for management of the Coral Sea Marine Reserve should be subject to, at least, increases in the Consumer Price Index.

Table 3 Recurrent management costs (excluding compliance) for the Coral Sea Marine Reserve

Budget item	Expenditure
Salaries (17 FTE at $150 000 each)	$2 550 000
Operations (17 FTE at $30 000 each)	$510 000
Incident response (from Ban et al 2011)	$1 680 000
TOTAL	$4 740 000

The Protect or Coral Sea coalition recommends that these staff be in place and operational at least six months prior to the new management plan being in place and, therefore, that recruitment starts approximately 10 months before the management plan is in effect.

Recommendation 14: Staff should be employed at least 6 months prior to the Coral Sea Marine Reserve management plan being in effect, except for field surveillance and investigations staff who should begin four months ahead of implementation date.

Set-up costs

Recruiting, inducting and training staff requires resources and there will be need for a new orientation program, as the Coral Sea Marine Reserve has never been 'managed' as an entity before. It will be necessary to find additional office space for these new staff as the existing building housing the Great Barrier Reef Marine Park Authority is fully occupied. Any new office space would need to be fitted out. It is estimated that these set-up costs will be at least ~$496 000 in Year 1, and $150 000 in Year 2, the details of which are listed in Table 4.

Table 4 Set-up costs for management staff of the Coral Sea Marine Reserve

Budget item	**Expenditure**
Project officer (~1 year)	~$150 000
Computer and office equipment, phones, etc.	~$ 46 000
Initial office supplies	~$ 40 000
Refitting of office space	~$ 40 000 to $100.000
Engagement of staff	~$ 50 000 to $150.000
Staff induction and initial operational training	~$170 000 year 1 and $150.00 year 2
TOTAL	~$496 000 – 656 000 ($150 000 yr 2)

Section 4. The zoning scheme for the Coral Sea Marine Reserve

This section considers the strengths and weaknesses of the zoning scheme for the Coral Sea Marine Reserve and recommends zoning changes to improve the reserve's level of protection.

IUCN protected area management categories and the Coral Sea Marine Reserve

The Coral Sea Marine Reserve proclaimed on 16 November 2012 has a zoning scheme comprising six management zones. These zones are assigned protected area management categories of the International Union for the Conservation of Nature (IUCN), the world authority on such matters. The IUCN uses seven protected area management categories to help describe the varying management objectives for protected areas:

Category Ia: Strict nature reserve
Category Ib: Wilderness area
Category II: National park
Category III: Natural monument or feature
Category IV: Habitat/species management area
Category V: Protected landscape/seascape
Category VI: Protected area with sustainable use of natural resources.

The Coral Sea Marine Reserve zoning scheme uses three of these categories−II, IV and VI−to help describe the management objectives for each of the six management zones (see Table 5). The description and primary objective of each category are:

IUCN Category II National park: Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities. *Primary objective*: *To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation*

IUCN Category IV Habitat/species management area: Areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category. *Primary objective*: *To maintain, conserve and restore species and habitats*

IUCN Category VI Protected areas with sustainable use of natural resources: Areas which conserve ecosystems together with associated cultural values and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non-industrial natural resource use compatible with nature conservation is seen as one of the main aims [our underlining]. *Primary objective*: *To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial*.

At the recent World Conservation Congress, the Members Assembly, comprising representatives from government and non-government conservation bodies, endorsed new guidelines[2] for application of the categories in the management of marine protected areas. These guidelines clarify how to deal with permitted and excluded activities in category-assigned management zones.

[2] IUCN (2012), *Guidelines for applying the IUCN protected area management categories to marine protected areas*, Best Practice Protected Area Guidelines Series No.19, IUCN

Table 5 Management zones in the Coral Sea Marine Reserve zoning scheme

Zone	IUCN category	Comments
Marine National Park Zone 502 654 km^2 (50.8% of the reserve)	II	This zone has the highest level of protection within the marine reserve. It excludes all commercial and recreational extractive activities and covers the eastern half of the marine reserve.
Habitat Protection Zone (Coral Sea) 182 578 km^2 (18.5%)	IV	This zone was originally a Special Purpose Zone but has been renamed to make it consistent with the Great Barrier Reef Marine Park zoning scheme. Found over the Queensland Trough and the western side of the Townsville Trough, it excludes demersal fishing and pelagic longlining.
Habitat Protection Zone (Seamounts) 85 507 km^2 (8.6%)	IV	This broad north-south strip over the seamounts in the southern part of the Coral Sea Marine Reserve is similar to the Habitat Protection Zone (Coral Sea) in its permitted and excluded activities by allowing pelagic longlining and purse seining. However, in contrast it excludes commercial crab and fish traps/pots. It is essentially a benthic protection zone, providing no increased protection for the water column above the surface of the seamounts. By shrinking the western boundary of the Marine National Park Zone here to accommodate the new zone, the new zoning scheme reduces water-column protection in the southern part of the reserve.
Conservation Park Zone 20 570 km^2 (20.8%)	IV	This zone replaced the Habitat Protection Zone of the draft zoning scheme to be consistent with the Conservation Park Zone in the Great Barrier Reef Marine Park. It covers four reef areas used to different levels of activity by recreational, game and charter fishers. It excludes commercial fishing, except for handline rod and reel, and dive and hand gathering.
Multiple Use Zone 194 233 km^2 (19.6%)	VI	Found in the southern part of the reserve, it covers the eastern end of the Townsville Trough and waters down to the reserve's southern boundary. It excludes demersal fishing activities but allows pelagic longlining, charter and game fishing and most sub-sectors of the Coral Sea Fishery.
General Use Zone 4 300 km^2 (0.43%)	VI	This narrow strip in the south-west corner of the reserve has been created (it was not in the draft zoning scheme) to allow the continuation of bottom trawling for prawns by Queensland's East Coast Otter Trawl Fishery and so reduce the economic impact of the reserve. This fishery is also allowed in the Great Barrier Reef Marine Park.

Maintaining the Marine National Park Zone free of fishing

As in the Great Barrier Reef Marine Park, the Marine National Park Zone or 'green zone' is an area of high-level protection based on IUCN Category II, and excludes commercial and recreational extractive activities.

The Protect our Coral Sea coalition is pleased that some improvements have been made to the Marine National Park Zone between the release of the draft zoning scheme in 2011 and finalizing the zoning scheme proclaimed in November 2012. Marine National Park Zone protection has now been extended to parts of the Osprey-Shark-Vema group of reefs, and to Marion and Bougainville reefs, all of which were previously zoned Habitat Protection Zone.

The Protect our Coral Sea coalition endorses the use of the Marine National Park Zone and its permitted and excluded activities in the Coral Sea Marine Reserve. The use of this zone in the Great Barrier Reef Marine Park and in other marine protected areas here and around the world has provided well-documented benefits that include:

- protecting ocean life, including threatened species and critical habitats

- recovering the abundance of ocean life within and beyond marine national park boundaries
- increasing the abundance, size, diversity and biomass of ocean life
- increasing the resilience of ocean life to climate change
- improving health of ecosystems and habitats and maintaining ecological processes
- underpinning the future of commercial and recreational fisheries and coastal communities
- providing reference sites for future scientific research and public education

Examples of ocean life recovery in marine national park zones compared with adjacent fished areas can be found across Australia including:

- the size and number of coral trout doubling in marine national park zones in the Great Barrier Reef Marine Park
- significant increases in the size and abundance of red morwong in the highly protected zones of Jervis Bay Marine Park
- densities of spiny lobster 34 times higher in Rottnest Island's highly protected zones, and higher lobster size and egg production, while numbers of Western Australian dhufish and breaksea cod were 5-10 and three times greater respectively
- the number and size of mud crabs being greater at the Solitary Islands Marine Park in New South Wales and Moreton Bay Marine Park in Queensland, with some crabs moving from highly protected zones into fished areas, and in some cases fishers often targeting zonal boundaries.

Recent scientific findings (cited in Ceccarelli 2011), support the idea that large pelagic species, such as those found in the Coral Sea Marine Reserve, benefit from large marine national park zones because:

- protecting even a part of species' range or life cycles, especially critical habitat areas which function as important feeding or breeding grounds, reduces overall population mortality
- 70−90 percent of the populations of migratory species in the Coral Sea move no farther than 600 kilometres
- they ensure that top predators such as sharks, swordfish and marine mammals remain abundant
- they match the scale of management to the scale of important ecosystem processes, such as the dispersal and migration of many species between isolated offshore islands and reefs.

There have been calls by recreational fishers and game and charter fishing operators to allow them access to the Coral Sea Marine Reserve's Marine National Park Zone to extract fish. This would contradict the guidelines for IUCN Category II outlined above, as well as impact heavily on the ocean life within that zone. Recreational, game and charter fishing should continue to be excluded from the Marine National Park Zone because such activity has a number of environmental impacts including:

- localised overfishing where anglers target particular species in key areas. By reducing the abundance and density of the targeted species, particularly the larger, slower growing fish, the reproductive ability of the targeted species can be reduced
- collisions with whales, turtles, dugongs, sunfish and other large marine animals. With the ongoing increase in boat ownership in Queensland and elsewhere, collisions with these animals will rise. According to Greenland and Limpus (2003), vessel strikes accounted for 42 per cent of the 140 turtle deaths in Queensland attributed to humans in 2003
- entanglement of birds, turtles, fish and marine mammals in discarded or active fishing hooks, lines, pots and ropes. Greenland and Limpus (2003) reported that in Queensland in 2003, there were 22 turtles killed by ingestion of fishing tackle or entanglement in recreational crab pots and lines. Ferris and Ferris (2004) reported that 94 per cent of the 537 pelican rescued in the Richmond River, New South Wales from 1993 to 2002 were entangled in fishing line and hooks

- bait collection can have significant but local impacts according to Skilleter et al. (2005), who reported on the harvesting of ghost shrimp in a Queensland bay
- fragile habitats such as seagrass beds and coral reefs can be damaged by anchors and boating activity
- translocation of pests can occur on recreational fishing boats
- water pollution from waste such as bait bags, discarded lines and fuel leakages
- air pollution and greenhouse gas emissions from recreational fishing motor boats
- potential serial depletion of stocks as anglers move from an area of depleted stock to other areas which subsequently become depleted
- the rate of and the survival of discards of non-targeted fish or those fish released under catch and release varies but can have significant impacts on localised populations. A study of grey nurse sharks and their incidental catch by recreational fishers by Otway et al (2003) concluded that protection of known aggregation sites, breeding grounds or other critical habitat from fishing may be an important precautionary management step
- trophic impacts as shown by the differences between fished and unfished areas in places such as the Great Barrier Reef Marine Park and Ningaloo Marine Park.

Unlike commercial fishing, for which the economic imperative will limit fishing once stocks become too low, recreational fishing may continue even where stocks of particular species are very low. Ongoing fishing pressure will hamper the recovery of those stocks.

While Australia's governments continue to encourage recreational fishing with various support programs and infrastructure projects, the scientific understanding of the impacts of recreational fishing, and even of its targeted and non-targeted species, is severely limited in Australia and should be expanded.

What to do in response to the impacts of recreational fishing, and how to provide effective management to ensure that one of Australia's most popular pastimes is ecologically sustainable, is in need of considerable research investment. In the meantime a precautionary approach should be followed, as indicated by Otway et al (2003). This should begin in the way recreational fishing is managed in marine reserves nationally, including the Coral Sea Marine Reserve. Although it is an entirely inappropriate activity for the Marine National Park Zone, greater consideration should be given to how it is managed in the other management zones in the marine reserve.

Recommendation 15: The Marine National Park Zone in the Coral Sea Marine Reserve should continue to be assigned IUCN protected area management Category II that, according to the IUCN guidelines, excludes all extractive uses including commercial and recreational fishing.

Improvements needed in the zoning scheme for the Coral Sea Marine Reserve

Although the Protect our Coral Sea coalition gives qualified support to the Coral Sea Marine Reserve's zoning scheme and its permitted uses, there continues to be insufficient Marine National Park Zone protection of coral reefs, the eastern Townsville Trough and the southern seamounts.

The zoning scheme will continue to allow commercial fishing in different forms, as well as game and charter fishing, on 18 of the Coral Sea Marine Reserve's 29 coral reefs (see Table 6 for the zoning that is applied to each of the 29 reefs). The exposure of these coral reefs to continued fishing, while another three−Osprey, Shark and Vema−have inadequate Marine National Park Zone protection, is a serious weakness of the zoning scheme.

Table 6 Management zones assigned to the 29 coral reefs in the Coral Sea Marine Reserve

Marine National Park Zone No commercial or recreational fishing allowed	**Habitat Protection Zone (Coral Sea)** Recreational fishing and commercial handline/rod and reel; minor line/polling; dropline; dive and hand collection; crab and fish trap/pot allowed. Commercial purse seine, pelagic longline, demersal trawl and longline, and gillnetting not allowed	**Habitat Protection Zone (Seamounts)** Recreational fishing and commercial handline/rod and reel; minor line/polling; dropline; dive and hand collection; purse seine, pelagic longline allowed. Commercial crab and fish trap/pot, demersal trawl and longline, and gillnetting not allowed	**Conservation Park Zone** Recreational fishing and commercial handline/rod and reel; dive and hand collection; allowed. Commercial minor line/polling; dropline; crab and fish trap/pot, purse seine, pelagic longline demersal trawl and longline, and gillnetting not allowed	**Multiple Use Zone** All recreational and commercial fishing allowed except for gillnetting and demersal trawl and longline
Osprey Reef	Tregosse Reefs	Wreck Reefs	Saumarez Reef	Boot
Vema Reef	Abington reef	Cato Reef	Moore Reef	Ashmore
Shark Reef	Malay Reef	Frederick Reef	Willis Islets	
Coringa Islets (existing protection)	Heralds Surprise		Diane Bank	
Magdelaine Cays (existing protection)	Dart Reef		Holmes Reef	
Herald Cays (existing protection)	McDermott Bank		Flora Reef	
Lihou Reef (existing protection)			Flinders Reefs	
Marion Reef				
Mellish Reef				
Kenn Reef				
Bouganville Reef				

Coral reefs make up less than one per cent of the Coral Sea's area, but global biodiversity patterns suggest they host the majority of its marine species. The reefs provide temporary breeding, feeding and nesting grounds for many important species, such as pelagic fish, migrating cetaceans and marine turtles, and seasonally returning seabirds.

The unique assemblages of species on the reefs of the Coral Sea make them highly distinctive from the reefs of the Great Barrier Reef. In addition, the low level of connectivity between the reefs of the Coral Sea makes each individual reef highly distinctive from each other in the marine reserve. But this also makes them more vulnerable to irreversible decline.

Of those Coral Sea Marine Reserve species included on the IUCN Red List of Threatened Species[3], 219 (65 percent) are corals directly reliant on shallow-water habitat that has been left with inadequate protection in the marine reserve. Other IUCN Red List species likely to use the marine reserve's reefs and associated cays and islets as critical habitat include 24 species of seabirds, five species of marine turtles, and several species of fish, including the humphead maori wrasse, which was last year listed as Endangered on the IUCN Red List. The proposed Coral Sea Marine Reserve will not afford these species adequate protection because only 38 per cent of its reefs fall within its Marine National Park Zone.

[3] http://www.iucnredlist.org

Additionally, the reefs, shoals and cays of the Coral Sea Marine Reserve are vulnerable to the projected impacts of climate change[4], including increased sea surface temperature, ocean acidification[5] and storm intensity (an increase in severe Category 3–5 storms[6]). Protecting these habitats from human exploitation is the best and possibly the only available tool to improve the resilience of these reefs in the face of human-induced and natural disturbances.

The Protect our Coral Sea coalition believes that the weaknesses of the Coral Sea Marine Reserve's zoning scheme can be substantially addressed by increasing the level of protection in two regions: the Osprey-Shark-Vema group of reefs and the southern Coral Sea Marine Reserve.

The recommended extensions of the Marine National Park Zone in the southern part of the Coral Sea Marine Reserve will affect some commercial fishers currently operating there. The Protect our Coral Sea coalition supports the provision of financial assistance to the longline fishers who are willing to stop fishing down to 22^{o}S and enable extension of the Marine National Park Zone over this area (excluding Saumarez Reef and the General Use Zone) and an extension around the historically significant Wreck Reef. Many of these fishers are already supportive of such a change. This move would give high-level protection to more reefs, the Townsville Trough−a 'blue highway' important to migratory species–and part of the southern Coral Sea Marine Reserve which is a global predator hot spot for sharks, tuna and marlin (Worm et al 2005).

The submission will now outline the case for improvement in the protection levels for the Osprey-Shark-Vema group of reefs and the southern Coral Sea Marine Reserve.

Increasing Marine National Park Zone protection for the Osprey-Shark-Vema group of reefs
The Osprey-Shark-Vema group of reefs is found within the northern corner of the Coral Sea Marine Reserve on an underwater feature called the Queensland Plateau, a 'key ecological feature' in the marine reserve with reefs, cays and herbivorous fish. The location of these reefs, more than a 100 kilometres from other reefs in the Coral Sea Marine Reserve, and their depth, has encouraged the evolution of a unique mix of ocean life.

Osprey Reef, a large atoll (388 km^2) rising 2,000-3,000 metres from the seafloor on its western side, is the largest in the group. Its pelagic marine life, massive reef walls and plunging drop-offs are highly prized by recreational divers. It is no surprise that Osprey is the Coral Sea's most iconic dive location and one of the world's best, adding $6 000 000 each year in direct sales to the dive tourism industry in North Queensland.

Osprey is the largest of the three reefs–Shark is 92km^2 and Vema is 39km^2−and has been subjected to the most scientific research, the results of which support the need to increase their protection levels in the Coral Sea Marine Reserve's zoning scheme. The research shows that Osprey Reef has:

- very high shark densities at similar levels to those in the Preservation Zones of the Great Barrier Reef Marine Park. Some of these sharks migrate from Osprey to the Great Barrier Reef, demonstrating an important connectivity corridor between the two reef structures. The main shark species are grey reef, black tip reef, white tip reef, wobbegong, epaulette, silver tip, great hammerhead and tiger sharks

[4] Declaration of Intentions between France-New Caledonia and Australia for the Sustainable Management of the Coral Sea. Signed in Canberra 10th March, 2010.
[5] http://www.wri.org/map/threat-coral-reefs-ocean-acidification-present-2030-and-2050
[6] http://www.bom.gov.au/cyclone/climatology/trends.shtml

- high coral cover of 34.4−56.9 per cent, compared with the Great Barrier Reef average of around 14 per cent
- coralline sponges, 'living fossils' genetically distinct from other reefs in the Coral Sea Marine Reserve, reside in Osprey's shallow caves
- an extraordinary diversity of soft corals and gorgonian sea fans
- species new to science from both deep and shallow habitats: rock sponges, glass sponges, brachiopods and sea lilies
- a nautilus population believed to be genetically distinct
- many pelagic visitors such as barracuda, giant trevallies, mackerel, rainbow runners and dogtooth tuna, as well as large resident reef fish such as potato cods and humphead maori wrasse
- along with Shark and Vema reefs, deeper reef habitats than any other reefs on the Queensland Plateau.

The high density of sharks may be due to an agreement (no longer in force) between fishers and tourism operators not to fish at Osprey Reef. This demonstrates that Marine National Park Zone protection could greatly benefit shark populations at Osprey and other Coral Sea Marine Reserve reefs.

The most recent research (Barnett et al. 2012) on sharks at Osprey supports the need for the extension of the Marine National Park Zone there to give them greater protection. That research has shown that:

- most sharks reside year round and remain in relatively small and localised areas, suggesting that they would be 'highly vulnerable to targeted fishing pressure' and that 'residents in a small area could be easily targeted'
- the isolation of Osprey Reef would limit the immigration of sharks to replace those caught if fishing were to continue
- Osprey Reef is the most visited Coral Sea Marine Reserve reef by tourism operators, principally to conduct shark dives. According to the authors, 'any depletion of reef sharks at Osprey Reef would have financial ramifications for tourism in North Queensland'. The authors cite that the removal of only 20 grey reef sharks in the Maldives, with a market value of only AU$1 000, caused an estimated loss of AU$500 000 annually in diving revenue. This shows that maintaining live populations of sharks–and other ocean life−that can be viewed over many years is of greater economic value than killing them for a one-off economic return. Recent research by the Reef and Rainforest Research Centre has been used to estimate the economic importance to Queensland of the continuing presence of sharks. After surveying tourist divers they estimated that each shark siting was worth $1 375 to the region, each turtle sighting $1 360, and each big-fish sighting worth $1 354
- 'MPAs incorporating no-take of sharks would be effective in protecting reef shark populations at Osprey and Shark Reef', especially whitetip and grey reef sharks. The authors added that, 'ideally, a protection zone should extend a significant distance from the reef to incorporate areas used by reef associated species such as silvertip and hammerhead sharks'.

The authors noted that the 'tropical Indo-Pacific Ocean area has experienced significant increases in the harvesting of shark species, driven by a growing demand from Asian markets for shark products. These heavy levels of exploitation in conjunction with habitat degradation are severely threatening shark populations in reef systems. Shark stocks are experiencing huge declines in numerous locations, and with the high level of susceptibility this group has to over exploitation, there is a critical need for adequate conservation and management to protect their stocks'.

In the 2011 draft zoning plan for the Coral Sea Marine Reserve, the Osprey-Shark-Vema group of reefs was given Habitat Protection Zone status. Protection levels were improved with the conversion of some of that zone to Marine National Park Zone. However, this still falls short of what is needed to protect the group of reefs.

The Protect our Coral Sea coalition proposes that the Marine National Park Zone around the Osprey-Shark-Verna group of reefs be extended west by approximately 10 kilometres to ensure the whole of the seamounts of Osprey, Shark and Vema Reefs are included within it. This will ensure that the important reef-associated pelagic species and reef slopes are given high-level protection. These are vital elements of the reef system and the current zoning does not protect them. This change would come at no additional financial cost to the government.

The current boundary between the Habitat Protection Zone (Coral Sea) and the Marine National Zone is far too complex and the edge effects will be substantial, conflicting with reserve design principles. By moving the boundary 10 kilometres west, and drawing it as a straight line, it would simplify compliance and reduce the edge effect on fragile reef systems.

Recommendation 16: To ensure that the entire seamount is protected, the current western boundary of Marine National Park Zone protection for the Osprey-Shark-Vema group of reefs should be moved parallel to and approximately ten kilometres to the west of the existing boundary. The new western boundary should be drawn as a straight line for ease of enforcement.

Increasing protection in the southern Coral Sea

The key values of the eastern section of the Townsville Trough and the seamounts of the southern Coral Sea Marine Reserve are:

- spawning sites for globally vulnerable bigeye tuna, for near threatened yellowfin tuna and also for lanternfish in the Queensland Trough are known to extend into the waters of the Townsville Trough
- critical habitats such as the Frederick, Wreck and Cato seamounts and emergent reefs such as Marion and Saumarez, which function as important feeding grounds for large pelagic ocean fish
- underwater volcanoes (seamounts) that are globally significant hotspots for top ocean predators such as sharks, tuna and marlin
- Wreck Reefs, a series of reefs and cays where the *Porpoise* and *Cato*, two ships of Matthew Flinders, came to grief in 1803.

Spawning and breeding grounds are highly vulnerable to depletion from fishing. Protecting these areas can improve species breeding success and recovery through increasing the amount of larvae and young. However, the zoning scheme allows most subsectors of the Coral Sea Fishery, as well as commercial charter fishing and private recreational fishing to continue throughout this biologically important trough system. Although the proposed removal of pelagic longline fishing from the Queensland Trough and the western part of the Townsville Trough is a very positive step, the draft plan allows longline fishing to continue in the eastern part of the Townsville Trough.

The creation of the Habitat Protection Zone (Seamounts) has reduced the width of the Marine National Park Zone in the 2011 zoning scheme by 50-60 kilometres (27 minutes of longitude). It would appear that to compensate for this spatial loss, and to simplify zoning, the Marine National Park Zone was extended along its western edge to the north-west of the Lihou and Coringa-Herald reserves, and also in the far northern corner of the reserve. These two extensions of the Marine National Park Zone are positive changes between the draft and final zoning schemes.

However, the only difference between the Habitat Protection Zone (Seamounts) and the Multiple Use Zone it has replaced is the exclusion of crab and fish trap/pot commercial fishing (this subsector of the Coral Sea Fishery has been inactive in the past two years) and aquaculture, which is highly improbable this far offshore unless there are plans for seeding of species such as sea cucumbers. The rezoning is largely an improvement in protection on paper rather than in the water, and may have been more about making it consistent with the Habitat Protection Zone covering the Tasmantid chain of seamounts in the adjoining Temperate East Marine Region. This means that there has been a significant loss of Marine National Park Zone protection in this part of the reserve and little, if anything, gained as a result.

The Protect our Coral Sea coalition is very pleased that seamounts are beginning to be recognised for their unique natural features. Seamounts in the southern Coral Sea Marine Reserve, like their counterparts further south, act as refugia and stepping stones in the dispersal of ocean life, especially for the billfish and other large pelagic predators that gather around them as they migrate to other regions.

The protection of the seamounts in the southern Coral Sea Marine Reserve, where much of the visiting and resident ocean life congregates, is vital to maintain connectivity. However, the zoning scheme for the reserve, and for those in the Temperate East and South-east marine regions, has focused on protecting the seamount surfaces only. The Habitat Protection Zone (Seamounts) proclaimed here is effectively a benthic protection zone because it allows commercial and recreational fishing to continue in the water column. Such zoning ignores the connectivity between ocean life on the surface of the seamounts and the water above. This flaw in the protection of seamounts in Australia was exposed in the debate surrounding the arrival of the MV *Margiris* super trawler. The community was outraged that the trawler would be able to fish in the Huon Commonwealth Marine Reserve (which aims to protect seamounts to the south of Tasmania).

Recommendation 17: Both the seabed and the water column should be given greater protection in the southern Coral Sea Marine Reserve, which is a biodiversity hotspot for top ocean predators. Longlining and other commercial fishing should be excluded from what is currently the northern section of the Habitat Protection Zone (Seamounts) and Multiple Use Zone (to 152^{o}E longitude) by their conversion to Marine National Park Zone down to the 22^{o}S parallel of latitude. This zone should encompass Marion and Frederick reefs, with a small extension to the southern boundary along the 22^{o}S parallel of latitude to surround Wreck Reef.

Adjoining the current Habitat Protection Zone (Seamounts) to the west is a large area of Multiple Use Zone that covers the eastern end of the Townsville Trough as it opens out into the deeper waters of the Coral Sea Marine Reserve. The trough stretches west from here and joins the Queensland Trough found off Cairns. Both troughs appear to host a spawning area for large pelagic fish, such as tuna, targeted by commercial fishers and game and charter fishers. The Habitat Protection Zone (Coral Sea), which covers the Queensland Trough and the western end of the Townsville Trough, excludes longline fishing, but the Multiple Use Zone to its east in the southern part of the reserve does not.

Changing both the Habitat Protection Zone (Seamounts) and the Multiple Use Zone to Marine National Park Zone would substantially increase the level of protection of the southern section of the Coral Sea Marine Reserve while also simplifying the zoning scheme and making for easier management and compliance. The edge effects for Marion Reef, a tiny Marine National Park Zone currently surrounded by two extractive use zones, would be almost all removed. The edge effects of longline fishing for the north-south boundary of the current Marine National Park Zone would also be removed; the westerly extension of the zone would join to the Habitat Protection Zone (Coral Sea), where longlining is not allowed. Research has shown that the simpler the zoning scheme and the fewer

the number of zones, the cost of management and compliance are substantially reduced. Such action is also consistent with marine reserve design principles.

Recommendation 18: To further simplify the zoning in the Coral Sea Marine Reserve, the Habitat Protection Zone (Seamounts) below the 22°S parallel of latitude should be converted to a Multiple Use Zone. A superscript in the zoning scheme matrix, and shading over the area of the seamounts, should be used to signify that all demersal fishing is excluded from the seamounts area.

Increasing the area of Marine National Park Zone in the southern Coral Sea Marine Reserve would reduce the spatial area and impacts of the Eastern Tuna and Billfish Fishery, thereby increasing the effectiveness of the reserve for iconic species including turtles, seabirds and large pelagic fish such as sharks, tuna and billfish.

According to Ceccarelli (2011), a large Marine National Park Zone would 'protect a significant portion (if not all) of the home ranges and life cycles of most pelagic species that reside within it'. It would also be large enough 'to encompass a large variety of bathymetric and hydrographic features that provide key habitat for pelagic species at vulnerable times (feeding and breeding)'.

Increasing the area free of longlining in the Coral Sea Marine Reserve would make it more consistent with management in the Great Barrier Reef Marine Park. There pelagic longline fishing is prohibited due to concerns about bycatch, particularly that of threatened and depleted species such as seabirds, turtles and sharks.

Section 5. Permitted activities in the Coral Sea Marine Reserve

This section considers three major uses of the Coral Sea Marine Reserve−recreational fishing, commercial fishing and shipping−which pose the most significant threats to the natural integrity of the reserve.

Extractive uses in the Coral Sea Marine Reserve

As already mentioned in Section 4, the IUCN is about to publish new guidelines for the application of IUCN protected area management categories to marine protected areas. In the guidelines there is a matrix of appropriate activities for each of the seven IUCN categories. In the notes relating to IUCN categories Ia, Ib and II, the guidelines state:

> 'Extractive use (of living or dead material) is not considered consistent with the objectives of category II because such activities (particularly fishing), even if undertaken at low levels, are recognised as causing ecological draw-down on one of more components of the overall food web, which is incompatible with ecosystem protection. However, as with category Ib, in some circumstances, extraction for research, sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values.
>
> 'Category II areas should be managed for "ecosystem protection", but should also provide for visitation, non-extractive recreational activities and nature tourism (e.g. snorkelling, diving, swimming, boating, etc.) and research (including managed extractive forms of research).
>
> 'Since commercial and recreational fishing always has some level of ecological impact, these activities are considered inconsistent with the objectives of MPAs in categories Ia, Ib and II.
>
> 'Many recreational fishers use "catch and release" which is considered by some to be non-extractive. However there are ecological impacts from catch and release (e.g. post-catch mortality) and so this is also not considered to be an appropriate activity in category I to III MPAs. In general, recreational fishing in MPAs should be regarded in the same way as recreational hunting in terrestrial protected areas.'

Commercial fishing in the Coral Sea Marine Reserve

A number of different commercial wild-catch fisheries will continue to operate in 49.2 per cent of the Coral Sea Marine Reserve. The impacts of wild-catch commercial fishing on the marine environment include:

- habitat damage by fishing gear, for example, dragging of huge nets along the seafloor in bottom trawling
- overfishing: fish stocks reduced below a sustainable level or being fished at a rate that will see them decline to that level
- changes to ecosystem structure from targeting certain ocean species
- catching and discarding of non-targeted ocean life (bycatch), such as turtles and seabirds
- entanglement, injury and death of ocean life in fishing gear, for example, drowning of seabirds on longlines (long fishing lines with baited hooks)
- collisions with marine mammals and seabirds.

Aquaculture will also be allowed in the Multiple Use and General Use zones of the Coral Sea Marine Reserve zoning scheme. It too has impacts on the marine environment including:

- reduction in wild stocks of small pelagic species, such as pilchards, used in fish meal to feed farmed species
- water pollution from farmed fish wastes, chemicals, antibiotics and feed
- habitat damage from construction and operation of the farm
- escape of farmed species, such as atlantic salmon, that compete with or prey on local ocean life
- release and transfer of pests and disease such as bacteria, parasites, mudworms and flatworms
- entanglement and drowning of animals, such as seals and sharks attracted to the farm to feed on the fish inside
- attraction of scavenger birds that displace local birds
- impacts on wild stocks harvested to provide the fish to be fattened in the farm, for example, tuna.

All of the above impacts of wild-catch fishing and aquaculture could occur in the Coral Sea Marine Reserve.

Recommendation 19: Sufficient funding should be provided for marine science, fisheries management research, monitoring and data collection in the Coral Sea Marine Reserve to ensure that the impacts of commercial fishing are avoided or minimised, and that the fisheries continuing to operate there are ecologically sustainable and managed within a precautionary and ecosystem-based approach. A clear set of criteria and a process for assessing the ecological sustainability of commercial fishing should be presented in the management plan. The results of these activities should be made public to build community understanding of the fisheries.

Recommendation 20: Strong conservation benchmarks and targets, supported by effective compliance management, should be established in the management of commercial fisheries in the Coral Sea Marine Reserve to allow the recovery of populations of targeted species. These benchmarks and targets should be used when monitoring compliance with permit conditions.

Recommendation 21: Due to the potential impacts of aquaculture, such a use should not be allowed within the Coral Sea Marine Reserve.

Bottom trawling

After advocacy from fishers in Queensland's East Coast Otter Trawl Fishery, a strip of water in the south-west corner of the Coral Sea Marine Reserve has been zoned General Use to allow them to continue there and reduce the economic impact of the marine reserve on their operations. Prior to this, and like all the marine reserves proclaimed in the other four marine regions (except for the Hunter Marine Reserve in the Temperate East Marine Region), bottom trawling had been excluded from the Coral Sea Marine Reserve due to the extensive damage it causes to seabed habitats.

Recommendation 22: With ABARES in recent years assessing the active trawl effort in the East Coast Otter Trawl Fishery in this area, an equivalent number of effort units should be removed from the Great Barrier Reef Marine Park to ensure there is no increase of trawl effort there as a result of the displacement of effort from the Coral Sea Marine Reserve.

Coral Sea Fishery

The Coral Sea Fishery employs a number of gear types and techniques to harvest various marine species including fish, crustaceans and sea cucumbers. Its production levels and the number of active fishers are low. Because of this and under existing fisheries legislation, the public reporting of catches can be avoided. For example, there is no public reporting of the volume and value of catches and their distribution in the marine aquarium subsector of the fishery. Another result of the small size of the subsectors in this fishery is that insufficient research has been conducted to determine whether they are ecologically sustainable. Such a lack of reporting and assessments of sustainability are unacceptable when the Coral Sea Marine Reserve is a publicly owned resource and its environments are highly sensitive to disturbance.

The Coral Sea Marine Reserve zoning scheme will allow four of the five sub-sectors of the Coral Sea Fishery to continue: line and fish trap/pot; marine aquarium; sea cucumber; and trochus and tropical rock lobster. The only one excluded will be the trawl and trap sub-sector, which uses otter trawl and demersal trap gear to harvest tropical finfish and crustaceans. It is unclear why crab and fish trap/pot is retained, given the removal of other demersal fishing. The level of active effort in this fishery is very low (over the past two seasons there was no activity) and consequently the commercial value is very low, yet almost half of the reserve will remain open to this activity.

Recommendation 23: The mandatory public reporting of all catch data and the results of ecological sustainability assessments should be a permit condition for the continued operation of the Coral Sea Fishery in the Coral Sea Marine Reserve. Should this not be possible in any of the subsectors of the fishery, then that subsector should cease operation in the marine reserve.

The Australian Fisheries Management Authority (AFMA) Coral Sea Fishery rotational harvest strategy for sea cucumber (one of only four permits active in 2010) allows permit holders to have access to 21 reefs (AFMA 2010). Yet this strategy states that: 'Assessing stock status for this sector is expensive and problematic; consequently, it is difficult to conclusively demonstrate that catch is sustainable.' The 2010 ABARES Fishery Status Report also found that no current assessment of fishing mortality or biomass had been carried out for key sea cucumber species.

In recent years the marine aquarium sub-sector, which is comprised of only two permits, has by economic value, dominated the Coral Sea Fishery. The ecological consequences of the removal of large numbers of individual fish, such as the commercially targeted and endangered humphead maori wrasse, from these remote and highly individual reefs for use in aquariums, are unknown. Under Queensland regulations, the two aquarium permit holders have access to the Great Barrier Reef Marine Park, from where they obtain most of their income.

Recommendation 24: All latent permits in the Coral Sea Fishery should be cancelled and the remaining active permits grandfathered and unavailable for sale. On retirement of the permit holder, the permit should be cancelled.

Eastern Tuna and Billfish Fishery

The species targeted by the Eastern Tuna and Billfish Fishery are of global conservation concern. Last year, the IUCN added four fish species targeted by the fishery to its Red List: bigeye tuna (Vulnerable); and yellowfin tuna, albacore tuna and striped marlin (Near Threatened).

This longline fishery also captures a wide range of non-target species such as leatherback turtles and sharks. Species listed as protected under the *Environment Protection and Biodiversity Conservation Act 1999* such as leatherback and loggerhead turtles, will remain at risk of capture by longline fishing gear in the Coral Sea Marine Reserve. To reduce the impacts of the Eastern Tuna and Billfish Fishery, this submission has recommended that the spatial area of its operation be reduced in the southern part of the Coral Sea Marine Reserve (see Recommendation 17 in Section 4).

Each licensee in the Eastern Tuna and Billfish Fishery has a quota of 20 sharks per trip. At a time when countries around the world are severely restricting or even banning shark fishing, the zoning scheme allows for the continuation of commercial shark fishing in 29 per cent of the proposed Coral Sea Marine Reserve by allowing longlining to continue. This could lead to the export of shark fins from the world's largest marine reserve.

Recommendation 25: There should be no export of fins from sharks caught in the Coral Sea Marine Reserve, and this ban should be extended to sharks caught in the Great Barrier Reef Marine Park. A product tracing mechanism should be put in place to ensure compliance.

Recreational fishing in the Coral Sea Marine Reserve

Ecological sustainability of recreational fishing

Although recreational fishing is excluded from the Marine National Park Zone, as it should be, the draft south-east marine reserve network management plan would appear to presume that recreational fishing has no impact elsewhere. As a result, that draft management plan fails to outline a process to assess the impacts of recreational fishing and to determine whether it is ecologically sustainable. The take by recreational fishing is considerable, and there is an urgent need for greater research into the impacts of recreational fishing, especially game and charter fishing during which localised depletions could occur. The impacts of recreational fishing can include the:

- removal of large quantities of fish−in some cases equal to or greater than the commercial catch
- retention of undersized and juvenile fish
- death or behavioral change of fish that are caught and then released or discarded
- entanglement of ocean life in lost gear and litter, and ingestion of lost gear, for example, turtles and sharks swallowing fishing hooks and line
- habitat damage from propellers, anchors, boat grounding, collection of bait, trampling and infrastructure, for example, marinas
- pollution, for example, plastic bags, fuel spills and boat motor emissions
- boats striking animals such as turtles
- removal of larger fish, for example coral trout, could change the structure of ocean ecosystems
- bait collecting in sandy and muddy habitats reduces food available to wading birds.

The impacts of recreational fishing will also spread further as increasing boat ownership, larger boats, better fishing gear, advanced fish-finding technology and greater amounts of leisure time allow fishers to travel further, stay out longer and fish in deeper water.

According to a 2002 analysis (McPhee et al 2002), there had been little attempt in Australia to evaluate and control recreational fishing and its ecological impacts. In a 2010 recreational fishing analysis, Tasmanian scientist Jon Nevill (Nevill 2010) came to a similar conclusion.

To measure and manage the overall impact of recreational fishing−and determine whether it is ecologically sustainable−we need to know the number of recreational fishers, how many and which fish they catch, and where and how they catch them.

Recreational fishing in Australia has largely escaped scrutiny because the focus of management has been on commercial fishing or other ocean impacts such as water pollution. Few resources are given to develop effective and consistent angler management.

Recommendation 26: To ensure consistency with Objective 2 of the Coral Sea Marine Reserve recommended in this submission, the Coral Sea Marine Reserve management plan should clearly outline the criteria and process for assessment of the ecological sustainability of recreational fishing in those zones and areas where it is allowed. As a minimum, charter and game fishing and fishing tournaments should be subjected to a public permit application and approval process.

Recommendation *27*: The Coral Sea Marine Reserve management plan should ensure that the management authority establishes a dedicated and ongoing program to monitor and estimate the number and distribution of recreational fishers, the size of their catches and their level of impacts in the Coral Sea Marine Reserve.

Charter, game and private recreational fishing

Commercial charter fishing in the Coral Sea is an opportunistic activity for a small number of charter operators. Most charter fishing companies who hold Coral Sea permits do not advertise the Coral Sea on their websites, preferring to market other destinations, primarily the Great Barrier Reef, which is more conducive to the shorter trips that the majority of clients prefer.

Private game fishing also focuses on the Great Barrier Reef Marine Park. Information from the NSW National Game Fish Tagging Program shows that over a 20-year period (1989 –2009) north of 24°30'S, 99.2 per cent of tagged and reported game fish (mostly black marlin) were from the Great Barrier Reef Marine Park and 0.8 per cent from the Coral Sea. The Coral Sea Marine Reserve is an aspirational destination for a very small number of game fishers.

Given that the vast majority of commercial charter fishing and private game fishing takes place within the Great Barrier Reef Marine Park, the socio-economic impact of protecting additional Coral Sea Marine Reserve reefs (as recommended in Section 4) from this fishing will be low.

Private recreational fishing in the Coral Sea Marine Reserve is extremely limited relative to the Great Barrier Reef Marine Park. No government agencies, fishing groups or research institutions hold quantitative data on the full extent of the different types of recreational fishing in the Coral Sea. However, it is well known amongst key stakeholder groups, that most anglers who visit the area do so by charter vessel hire. It can be assumed that a very small number of individual boat owners, who own ocean-going boats, visit the area only occasionally. Closing additional reefs to this type of fishing will thus likely result in very little current economic change for those interested in engaging in it, but potentially huge conservation benefits for the reefs of the Coral Sea Marine Reserve.

Recommendation 28: In recognition of the very low overall socio-economic value of the Coral Sea Marine Reserve to charter and private recreational fishers relative to the Great Barrier Reef Marine Park, and taking account of the potential impact of sustained recreational fishing on the unique and fragile reef systems in the Coral Sea, additional coral reefs in the marine reserve should be given Marine National Park Zone protection.

Recommendation 29: The Coral Sea Marine Reserve management plan should dedicate research to determine the nature and scale of the threats to the reserve's ocean and reef species, communities and ecosystems from recreational fishing. Where recreational fishing is permitted, it should be ecologically sustainable and managed with a precautionary and ecosystem-based approach.

Recommendation 30: The management of recreational fishing in the Coral Sea Marine Reserve, including allowable quotas, spatial restrictions and assessments of ecological sustainability, should be integrated with that of commercial fishing and supported by a detailed compliance management plan.

Recommendation 31: The management of recreational fisheries in the Coral Sea Marine Reserve should include consistent and effective licensing, data gathering and monitoring of recreational fishers.

Recommendation 32: Environmental impact assessments and management plans should be prepared for each recreational fishery in the Coral Sea Marine Reserve. Reviews should also be conducted on the management effectiveness of existing bag and size limits, boat limits, restrictions on gear types and other measures used to manage recreational fishing.

Recommendation 33: Recreational fishing lines used in the Coral Sea Marine Reserve should be biodegradable, as should bait bags. The use of metal J hooks should be banned, with circle hooks the only ones permitted for use by recreational fishers in the marine reserve.

Recommendation 34: There should be effective compliance, enforcement and penalty provisions in the management of recreational fishing in the Coral Sea Marine Reserve backed up by well-resourced education programs.

Catch and release fishing

Recreational fishers claim that catch and release fishing enables them to operate without ecological impact. There is little scientific research available on this issue. What research is available has shown that the survival rate of released fish varies from species to species, and also depends on the skills of the recreational fishers in the handling of fish and the removal of hooks.

Recommendation 35: A major research project should be established to identify the nature and scale of the ecological impacts of catch and release fishing to determine whether it should be allowed in the zones assigned IUCN categories IV and VI in the Coral Sea Marine Reserve.

Shipping in the Coral Sea Marine Reserve

International shipping traffic through the Coral Sea Marine Reserve and the Great Barrier Reef Marine Park is set to increase substantially as Queensland develops its mineral and gas resources and associated ports.

Although the international shipping industry must comply with a number of international conventions including those for safety, air emissions, water pollution prevention, ballast water, oil and chemical control and hull design, impacts still occur, increased shipping traffic could lead to more groundings, collisions, oil spills, waste oil and garbage discharges, pest introductions and whale strikes.

In 2010 the bulk coal carrier *Shen Neng 1* sliced into the Reef off Gladstone, destroying three kilometres of coral that could take 20 years to mend. In 2009 the container ship, *Pacific Adventurer*, ran aground in Queensland's Moreton Bay, spilling oil on to nearby beaches that cost millions of dollars to clean up.

The local control of shipping movements is restricted by the international agreements, but Australia has been able to put in place mandatory piloting and a vessel tracking system in some sections of the Great Barrier Reef Marine Park. However, efforts by shipping companies to avoid the Great Barrier Reef sees more ships transiting the Coral Sea, an international icon dotted with reefs and subject to serious cyclonic activity and few shipping controls−it could be a maritime accident waiting to happen.

In summary, the impacts of shipping include:

- movement and spread of exotic marine pests on hulls, gear and ballast water
- loss of food sources for ocean life due to water pollution
- smothering of habitats from accumulation of debris through discharges, loss of containers and materials swept overboard
- the deliberate sinking of ships may create new habitat of use to fishers and divers, but can also attract species that become more vulnerable to targeted fishing
- habitat loss and damage from dredging, dumping of dredge spoil or waste overboard, groundings and sinkings
- air pollution that adds to climate change and can cause human health problems
- water pollution from the use of anti-fouling paints, chemical and oil spills and sewage
- operational noise interferes with ocean life that uses sound to communicate and to locate food, habitats and mates
- chemical and oil spills affect seabirds when they swallow the oil or it covers their feathers
- collisions with whales, seals and turtles.

Recommendation 36: The Australian and Queensland governments should work together to ensure that the increased shipping movements in coming decades do not lead to damage of the environment of the Coral Sea Marine Reserve. As part of this collaboration they should seek to introduce mandatory piloting and vessel tracking systems to shipping routes through the Coral Sea Marine Reserve. Pilotage should be mandatory where the risk to sensitive environments or critical habitats is high, such as shelf and shallow environments or calving, feeding and resting grounds for whales and dolphins. This should be in conjunction with the establishment of an incident management strategy having due consideration for the logistical challenges in conducting damage assessment, emergency response and investigations.

Recommendation 37: The federal government should legislate to enable the refusal of port entry to ships travelling through sensitive areas in the Coral Sea Marine Reserve when they do not have tracking devices and a pilot on board.

Recommendation 38: Ballast water exchange, waste discharges (oil**,** noxious liquid substances, packaged harmful substances, and garbage from vessels), dredging and spoil dumping should not be permitted within the Coral Sea Marine Reserve. Every effort should be made to reroute loads deemed as high risk to avoid transiting through the Marine National Park Zone.

Recommendation 39: Alternative ship transiting routes through the Coral Sea Marine Reserve should be established for transit during migration seasons of large marine animals and around areas of critical habitat.

Recommendation 40: The Coral Sea Marine Reserve's management body (recommended in this submission to be the Great Barrier Reef Marine Park Authority) and other relevant agencies should ensure that there are adequate navigational aids not only in the water (where feasible) but also available electronically (such as reserve boundaries and zone boundaries, bathymetry, hotspots for large marine animals, shipping movements, traffic management) to minimise the impacts on ocean life and to maximise compliance. All ships transiting through the marine reserve should have vessel-monitoring systems on board and the ability to download detailed zoning maps and emergency procedures.

Recommendation 41: Single-hulled tankers (categories 1−3) should not be allowed to transit through the Coral Sea Marine Reserve.

Recommendation 42: Places of refuge for disabled ships in or near the Coral Sea Marine Reserve should be identified to minimise the environmental risk (subject to issues of human safety).

Recommendation 43: Merchant and naval ships should not be scuttled within the Coral Sea Marine Reserve.

Recommendation 44: The processes and systems, supported by guidelines and skilled personnel, for managing shipping incidents that are currently in place within the Great Barrier Reef Marine Park, should be extended to cover the Coral Sea Marine Reserve.

Recommendation 45: The federal government should work with the Protection and Indemnity Club to establish a contingency fund to enable an immediate response to a shipping incident in the Coral Sea Marine Reserve.

Section 6. Compliance management in the Coral Sea Marine Reserve

This section outlines the importance of good compliance management for ensuring the achievement of planned environmental outcomes in the Coral Sea Marine Reserve. It also proposes the adoption of the proven, systematic approach adopted by the Great Barrier Reef Marine Park Authority in managing compliance in the Great Barrier Reef and World Heritage Area and its application to the Coral Sea Marine Reserve.

Compliance

The purpose of a planned, expert approach to compliance management is to ensure the achievement of objectives laid out in legislation, regulations, policies and plans. For example, the main purpose for the *Great Barrier Reef Marine Park Act 1975* is to provide for the long-term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.

Targeted compliance management activities aim to facilitate people doing the 'right thing', and to help them understand, and meet, their legal obligations. Factors that lead to non-compliant behaviour are identified and analysed, enabling the application of appropriate institutional responses.

Depending on the combination of personalities, motivations and the compliance strategies and institutional responses employed, some people may alter their behaviour to be more or less compliant. For example, without the basic tools to be compliant (e.g. speedometers in cars) voluntary compliance may not always be achieved, regardless how well intended the person might be. Similarly, where appropriate information, education and extension are lacking on rules and obligations, accidental non-compliance will increase. Further, if there is little perceived threat of being detected, opportunistic and intentional non-compliance will become more prevalent (Greenfield 2009).

The objective of compliance management activities is not to just 'police' those few who are intentionally or repeatedly non-compliant. The objective is to also implement responses that will encourage and facilitate compliance by those who might otherwise be motivated to be less compliant. This is achieved by maximising the incentives for voluntary compliance (e.g. effective awareness raising about the reasons for the rules, and widely publicising successful prosecutions) (Greenfield 2009).

In Section 3 of this Protect our Coral Sea coalition submission it was recommended that the Great Barrier Reef Marine Park Authority should be the governing management body for the Coral Sea Marine Reserve. Extension of the Great Barrier Reef Marine Park Authority's compliance capacity to include the Coral Sea Marine Reserve is also recommended. It will require a significant increase in resources but at the same time will provide savings compared with alternatives to establishing compliance capability.

Section 3 gives many reasons for making the Great Barrier Reef Marine Park Authority the governing management body for the Coral Sea Marine Reserve. There are additional reasons for also giving it responsibility for the reserve's compliance management including:

- the Coral Sea Marine Reserve is adjacent to the Great Barrier Reef Marine Park, so the operational bases from which resources need to be deployed can, usually, be the same as those used by the Great Barrier Reef Marine Park Authority

- it is highly likely that some people will be involved in illegal activities in both jurisdictions. By encompassing both areas within one compliance management system, chances of detecting and, subsequently, preventing such activities will be enhanced
- by encompassing both areas within one compliance management system, the likelihood of displacing illegal users to the area with a potentially weaker enforcement will be minimised
- the compliance partnerships required for the Coral Sea Marine Reserve are almost identical as those that the Authority already has in place and for which it has already established strong professional relationships and agreed information-sharing protocols
- many of the Authority's existing compliance partners are already present in the Coral Sea Marine Reserve for other purposes
- the state-of-the-art technologies, data and data systems and analyses that would support effective compliance in the Coral Sea Marine Reserve are already used by the Authority e.g. vessel monitoring and vessel tracking. The globally used Automatic Vessel Identification System will, in January 2013, be required for all Australian commercial vessels over 15 metres. The Authority's systems are ready to handle any new data that becomes available from this system
- the Authority will be able to expand upon existing partnerships to conduct compliance in the Coral Sea Marine Reserve and so avoid the need to purchase expensive new aircraft or large seagoing vessels for surveillance (assuming resources are available in partner agencies)
- having the Great Barrier Reef Marine Park and the Coral Sea Marine Reserve compliance contained within one compliance management program will enable coordination of activities and avoid jurisdictional 'competition' for compliance resources, especially surveillance resources. One compliance system for both areas, where there is overlap of users, enhances the simplicity of voluntary compliance for marine resource users.

Recommendation 46: The Great Barrier Reef Marine Park Authority should be delegated to plan, manage and conduct all aspects of compliance management in the Coral Sea Marine Reserve.

Compliance needs in the Coral Sea Marine Reserve

Compliance management in the Coral Sea Marine Reserve must be guided by the objectives of the reserve and be responsive to the assessed threats that are potentially damaging to the achievement of those objectives.

Threats to the Coral Sea Marine Reserve

Threats to the outstanding conservation and heritage values of the Coral Sea have been identified as:

- illegal Australian and foreign commercial fishing vessels (including pelagic long-lining, demersal line and trap fishing, trochus, lobster, sea cucumber and aquarium fishing, trawling)
- shipping
- demersal charter fishing
- human impacts on islands and cays
- pelagic game fishing
- climate change.

All but climate change can be mitigated through good reserve management and compliance with requirements outlined in legislation, plans of management and permit conditions.

Threats to the Coral Sea Marine Reserve have both domestic and international dimensions. The people and vessels that may negatively impact or illegally use the Coral Sea may be either Australian or from overseas. This has implications for the way in which compliance management is planned and will also require cooperation with international colleagues.

Given the combination of the objectives of the Coral Sea Marine Reserve (see Section 2), the values of the region (both to Australia and the world) and the threats that it faces, it is clear that a comprehensive and effective compliance management program will be required to ensure its values are protected.

Compliance management responses

Effective compliance management in the Coral Sea Marine Reserve will be central to achieving the planned environmental outcomes. The full range of compliance management responses will be required and applied in proportion to the assessed threat to the Coral Sea Marine Reserve's values. This includes the development and maintenance of specialist compliance capabilities and resources, and these are discussed below under the headings:

- education and outreach
- monitoring and analysis
- field surveillance
- vessel surveillance for domestic issues
- aircraft
- investigation and enforcement actions
- prosecutions
- deterrence
- institutional arrangements.

Education and outreach

It will be very important that a comprehensive education and awareness program is implemented with all users of the Coral Sea Marine Reserve to ensure they have adequate knowledge of the new rules and, therefore, an ability to comply with those rules. Consideration should be given to the use of 'applications' for mobile phones and other portable electronic devices (such as lap-tops and notebooks) that supply critical information including zone coordinates, restrictions, emergency procedures, contact information, etc. Partner agencies will also require training in the new regulations.

An ongoing communication strategy will need to be undertaken with the region's users, not least to encourage reporting of incidents of non-compliance. Similarly, staff engaged in compliance management activities will require regular updating and refresher training as the context of their operations changes or is refined.

Monitoring and analysis

Due to the remote location of the Coral Sea Marine Reserve, compliance activities will need to be conducted by mainly using fixed-wing aircraft but with the potential for back-up support from ship-based helicopters.

To optimise the use of these resources, there should be coordinated and effective gathering and analysis of intelligence, with surveillance efforts planned and prioritised based on that analysis. This includes an ability to centralise and analyse multiple data sources. Relevant data may be sourced from field reports, from vessel monitoring and vessel tracking systems, from satellite images to log books, from any of a number of sources including various government agencies and from a variety of geographies (including adjacent marine waters where the same operators may conduct activities).

To enable such intelligence gathering, coordination and analysis, the Coral Sea Marine Reserve compliance management team must have superior and demonstrated technical, analytical and field operation capabilities.

Field surveillance
It would be necessary to have appropriate and capable vessel and staff surveillance resources to monitor activities within the Coral Sea Marine Reserve and, most importantly, to have real-time response capabilities to interdict priority targeted offences.

Vessel surveillance for domestic issues
The establishment and management of adequate agreements and/or other management arrangements with relevant partner agencies in the enforcement and surveillance of activities in the Coral Sea Marine Reserve is critical. The skills of the most appropriate service providers must be made available, while patrol efforts would require support and direction from the intelligence and monitoring base.

Resources to be harnessed could include Police, the Queensland Boating Fisheries Patrol and the Customs Marine Unit. It is expected there would be an annual surveillance program (underpinned by an agreed level of effort, perhaps outlined in a Service Level Agreement or an MOU) with an additional proactive and reactive response capability to address priority incidents of non compliance.

It would be necessary to train all compliance staff from the various agencies in the *EPBC Act 1999*, the Coral Sea Marine Reserve zoning and its management plan, along with other relevant legislation. Refresher and follow-up training of field staff would need to be ongoing.

Vessel surveillance for international issues
It would be expected that the Australian Defence Force (Navy) would be able to undertake a lead role along with the Customs Marine Unit to manage the risk and threat from international offenders (e.g. foreign fishing vessels).

Aircraft surveillance
Automatic monitoring systems will provide a cost-effective method for broad scale primary tracking of the location (but not activity) of Australian commercial vessels. However, aircraft are essential to check on the activity of those vessels and to address vessels that do not carry monitoring devices (especially foreign fishing boats) and those that switch them off. For many offences, patrol vessels (as described above) will then be required to intercept vessels and determine the extent of illegal activity.

Border Protection Command (Coastwatch) is the primary source of aerial surveillance, intelligence and evidence gathering in the Great Barrier Reef Marine Park. It would be logical to expand these operations to the Coral Sea Marine Reserve (subject to accessing aircraft with the required range). Were Coastwatch to be the primary aerial surveillance provider for the Great Barrier Reef Marine Park and the Coral Sea Marine Reserve, serious consideration should be given to having dedicated resources solely for that purpose. If crews and aircraft were dedicated to these areas, then the crew(s) would be more familiar with the legislation, management plans and zoning restrictions, and this knowledge would enhance the quality of the surveillance activity.

There is an expectation that the Australian Air Force would be able to assist in some surveillance activities associated with border protection.

Investigation and enforcement actions
The compliance program needs to be supported by an investigative resource capability. It is essential that such investigative resources are based at locations where immediate responses and interdictions can occur.

The majority of the domestic incidents that will occur in the Coral Sea Marine Reserve will be with vessels that come into port in Queensland waters. To conduct investigations it will be important for the compliance management program to have the additional ability to meet incoming vessels at their port of arrival. Examples may include:

- an investigation team based in Gladstone, where there is a large volume of shipping traffic, to enable an effective response to pollution reports
- basing of resources at locations where the majority of commercial extractive industries (e.g. longline fishing) are located to enable immediate responses.

The staff meeting those vessels must be well-trained investigators with an adequate resource base.

Investigations should not be limited to ports and vessels but may also require investigations either in the field (within the Coral Sea Marine Reserve) or at the land-based facilities of the operation or person under investigation. Again, many of the land-based facilities will be located in Queensland towns.

Additional enforcement actions such as permit revocations, seizures and forfeitures would, in many instances, be an action available when responding to reported offences. These actions would be undertaken by investigators and would need the assistance of legal expertise from the day-to-day managing agency. Such responses and actions would require funding.

Prosecutions
The capacity to successfully prosecute offences under the relevant legislation is critical to deter offenders and to ensure integrity of the reserve's management plan and zoning of the Coral Sea Marine Reserve.

The Townsville office of the Commonwealth Director of Public Prosecutions, with its decades of history in effectively prosecuting Great Barrier Reef Marine Park offences, should carry out this function for the Coral Sea Marine Reserve. A good working relationship between this office and the day-to-day managing agency compliance team will be critical. Some additional resourcing would also be required for this Townsville office to manage these additional workloads.

Recommendation 47: The Townsville office of the Commonwealth Director of Public Prosecutions should be given the responsibility and necessary resources to conduct the prosecution of offences under the legislation relevant to the Coral Sea Marine Reserve.

Deterrence
Successful prosecutions have maximum deterrence impact when they are well advertised and promoted. This may occur through traditional media (newspapers, radio) or via industry newsletters and meetings. This raising of awareness may increase the future compliance of the people prosecuted but, more importantly, encourage those other users already complying with the rules to remain compliant.

Recommendation 48: Successful prosecutions resulting from compliance management in the Coral Sea Marine Reserve should be well advertised and promoted to assist with deterrence.

Institutional arrangements

Compliance management of the Coral Sea, to be cost effective, must be a coordinated, multi-agency program drawing upon the expertise and resources of both federal and state agencies. The institutional arrangements to make it happen will require collaboration between multiple agencies. Those listed in Table 7 have experience in coordination with and collaboration on, for example, surveillance efforts, investigations, prosecutions and more.

Table 7 Institutional arrangements for compliance management in the Coral Sea Marine Reserve

Agency	Role
Australian Fisheries Management Authority	Commonwealth fisheries management
Coastwatch/Border Protection Service	Aerial surveillance Vessel surveillance
Australian Federal Police (AFP)	Investigations (Crimes Act)
Queensland Police Service (QPS)	Vessel surveillance Investigations
Department of Defence (Navy, Airforce)	Vessel and aerial surveillance (addressing international breaches)
Australian Quarantine Inspection Service	Port inspections: quarantine inspection services for all vessels entering Australian waters
Australian Customs Service	Surveillance and other activities to enforce a range of Commonwealth laws at sea and at various international entry points, including ports
Australian Maritime Safety Authority	Management of shipping activities
Great Barrier Reef Marine Park Authority	Coordinates existing collaborative compliance efforts in the Great Barrier Reef Marine Park. Functions include: • intelligence analysis • field resources (allocation and coordination) • surveillance • investigation
Queensland Parks and Wildlife Service	Inshore boat-based support for maintaining contact with suspected vessels as they track from the Coral Sea Marine Reserve into/through the Great Barrier Reef Marine Park and Queensland waters
Queensland Boating and Fisheries Patrol	Responsible for enforcement of fisheries regulations and transport legislation. Will provide more inshore boat-based support by maintaining surveillance upon/contact with suspected vessels as they track from the Coral Sea Marine Reserve into/through the Great Barrier Reef Marine Park and Queensland waters
Maritime Safety Queensland	Is responsible for licensing, registration and the safe navigation of vessels
Queensland Water Police	Provision of law enforcement powers and investigative capabilities on the water
Commonwealth Director of Public Prosecutions (CDPP)	Primary prosecution currently critical to the compliance management of the Great Barrier Reef Marine Park
State Penalties Enforcement Registry	Ensuring that fines and penalties are applied

An existing marine compliance management system

The Great Barrier Reef Marine Park Authority has implemented a world-class model for managing compliance in a marine park that is fortuitously, located adjacent to the Coral Sea Marine Reserve.

Outcomes focussed
The Great Barrier Reef Marine Park Authority's current compliance management program has been developed over the last thirteen years and is focused upon outcomes. The compliance actions it takes are linked explicitly to positive environmental outcomes for the Great Barrier Reef Marine Park's ecosystems–usually the reduction or prevention of damaging behaviour. Other threats are those to the integrity of the marine park and to the government's revenue derived from the user-fees system.

Threat assessment
Non-compliant activities within the Great Barrier Reef Marine Park are identified, analysed and classified according to their level of threat to the objectives of the Great Barrier Reef Marine Park Authority and the values of the marine park.

Potentially damaging activities identified in the Great Barrier Reef Marine Park include illegal commercial netting and crabbing, line fishing, trawling, take of vulnerable species, recreational fishing/collecting, maritime incidents, tourism activities, Environmental Management Charge issues, commercial collecting, foreign fishing vessels and long-line fishing.

The conduct of threat assessments is based upon an analysis by centralised intelligence of activities in the marine park gathered over time from multiple sources (including surveillance, incident reports from community, industry, state and federal agencies) and geographies. This includes data from vessel monitoring and vessel tracking systems. Field reports are now entered electronically on board patrol vessels and can be reviewed in real time. Data is also downloaded automatically into a centralised database.

If there are particular people, companies, geographies or activities (or any combination) which pose a high level of threat, the operations team of the Field Management Compliance Coordination Unit will build a 'profile' that can then be the basis of a targeted special operation.

The technical skills, inter-agency and inter-personal relationships, field experience and analytical skills which enable these assessments to occur have been refined over the last ten years using a continuous improvement model.

Response assessment
At the time of the threat assessment, the required nature and level of mitigation required is also determined. This may involve one or more compliance management strategies commensurate with the potential harm to the marine environment. It may also require access to resources drawn from partner agencies in accordance, for example, with Service Level Agreements.

Compliance management planning
Planning for effective compliance management includes a three-year strategic plan to which the annual compliance management plan is aligned. This would involve input from key business units within the Coral Sea Marine Reserve management team so that the achievement of their strategic objectives are assisted by effective compliance management. Operational planning by the intelligence unit, field operators and investigators would be undertaken on a quarterly and weekly basis. In addition, plans would be reviewed on a pro-active basis if new information suggested immediate action is required.

This level of planned compliance management combined with inherent flexibility to be immediately responsive if required, demands careful planning and management of resources over each financial year.

Compliance activities and tools

As well as the intelligence gathering and analysis mentioned above, compliance activities include education, liaison, boat and aircraft surveillance, audits, crime scene investigation, and the use of 'warning letters', prosecution and fines.

Education and liaison is the foundation of compliance−most people, if they understand the rules and understand the reasoning behind the rules, tend to comply. Considerable resources have been and continue to be directed to ensuring Great Barrier Reef Marine Park users know and understand the rules regarding using the park. This community engagement to support compliance in the marine park has been so successful that, for example, one week after 'new' zoning became law (in 2004) records showed a higher level of compliance than before. Community education and engagement along the Great Barrier Reef catchment has been supported, at various times to varying degrees, by information shared per radio, newspaper, TV, liaison staff, websites, school programs, engagement programs with councils, fishers, farmers and more.

Each communication exercise is underpinned with a communication strategy that sets out the communication goals, key messages, the stakeholders being targeted and their viewpoints and concerns, and identifies the best methods of communication.

Field components of compliance include the more traditional cruise and peruse boat patrols and, more importantly, targeted special operations. The routine patrols are important for education purposes and for encouraging maintenance of voluntary compliance levels. Their patrol patterns are determined by the threat assessment–that is, focusing on areas known to have a higher likelihood of non-compliance.

Available surveillance platforms (aircraft, helicopters) and patrol vessels, beyond the routine patrols, are also deployed on the basis of the threat assessments. They are prioritised to go to locations at times when expected illegal activity is assessed to be most likely. Land-based investigators, similarly, are sent to ports where it is anticipated that they can meet vessels suspected of illegal activities as they return from sea.

Targeted special operations are almost always unique operations that address a particular threat and are designed in response to a high-threat profile that has been described and validated. These usually aim at repeat offenders with whom other forms of compliance action have failed.

Prosecution

'Catching the bad guy' is of no use, and possibly counter-productive, if it does not have consequences. This may be simply a warning letter, but it may also mean successful prosecution and the application of a significant financial penalty.

A warning letter is most often used in instances when the environmental crime has not resulted in great harm and is of an accidental nature. It has been found that the people who have received warning letters have not re-offended.

To support rigorous follow-up on more serious illegal activities, the Great Barrier Reef Marine Park Authority has developed a strong skills base in crime scene investigation techniques and evidence collection, as well as strong relationships with law enforcement agencies with expertise in these areas.

The Authority can have well over 100 current cases active at any one time, and is the biggest client of the Commonwealth Department of Public Prosecutions. In the last decade, of the hundreds of cases that the Authority has brought to the courts, they have lost fewer than one per cent.

Partnerships

The Great Barrier Reef Marine Park Authority has, over more than a decade, built strong relationships of trust and mutual support with agencies that partner in their compliance management activities. The partnership comes in the form of sharing information, resources and planning for compliance activities. One lesson that has been learned by all involved is that a 'bad guy' conducting environmental crime is quite probably also undertaking other illegal activities. These partner agencies include:

- Coastwatch/Border Protection Service
- Federal Police
- Department of Defence
- Australian Quarantine Inspection Service
- Customs
- Australian Maritime Safety Authority
- Australian Fisheries Management Authority
- Queensland Parks and Wildlife Service
- Queensland Boating and Fisheries Patrol
- Maritime Safety Queensland
- Queensland Water Police
- Commonwealth Department of Public Prosecutions
- State Penalties Enforcement Registry

The Great Barrier Reef Marine Park Authority provides a one-stop-shop for compliance management in the marine park and its functions include:

- education
- monitoring
- information collection (including incident and offence reporting)
- intelligence analysis
- threat assessment development
- resources coordination
- target development
- surveillance
- investigation response
- enforcement actions (seizure/forfeiture, permit suspension and revocation, prosecution).

The Authority also produces a comprehensive quarterly report that summarises the level of compliance management effort, the results from the previous quarter, trend analysis and emerging threats for the coming period.

Successful compliance

Over the last 10 years, the Great Barrier Reef Marine Park Authority has made significant advances in the development of an effective approach to compliance management, including the adoption of a best-practice compliance management model and related processes, systems and resources, as well as recruiting and training people skilled in all aspects of compliance management.

As evidence of this, the compliance management improvements have led, initially, to an increase in the number of offences recorded from information reports received (see Figure 1). This was attributed to improvements in the compliance management systems. Since 2007, the number of offences reported has declined and the trend is continuing downwards as the community attitude to conservation matures, in part due to the positive effects of the compliance management activities.

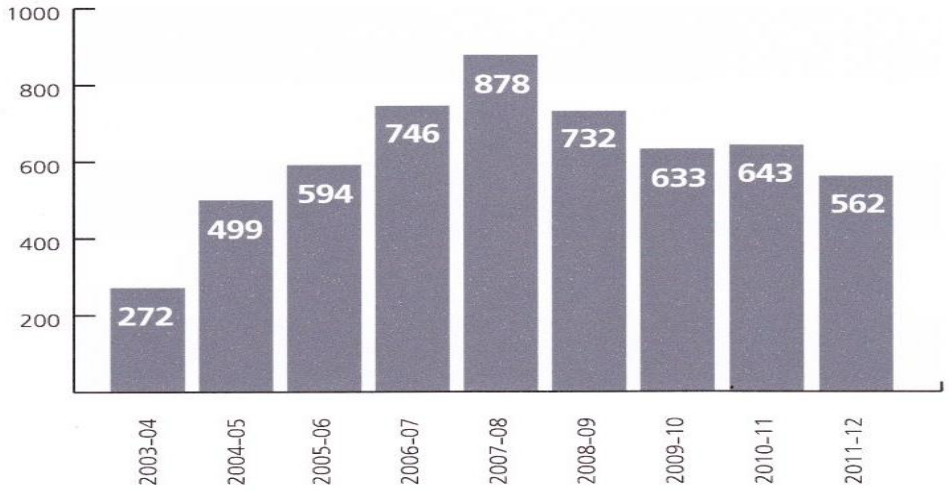

Figure 1 Number of offences recorded by the Great Barrier Reef Marine Park Authority Field Management Unit (Great Barrier Reef Marine Park Authority 2012)

Evidence from the field is also showing that the numbers of fish in the Marine National Park Zones have doubled and these increases have been maintained or improved over time (Russ et al 2008).

Indications are that the standard of the Great Barrier Reef Marine Park Authority's compliance management program is world class and positions it well to deliver best-practice compliance management in the Coral Sea Marine Reserve.

Resourcing the Coral Sea Marine Reserve compliance management system

The Coral Sea Marine Reserve is nearly one million square kilometres in area –almost three times larger than the Great Barrier Reef Marine Park. Despite the cost-efficiency of one unified compliance management system for both areas, managing compliance on the Coral Sea Marine Reserve will not be cheap. One mitigating factor relevant to compliance costs is that there are very few permitted commercial operations in the Coral Sea Marine Reserve. On the other hand, in the Coral Sea Marine Reserve it is anticipated that there will be more illegal activity potentially arising from illegal foreign fishing vessels and longlining–problems relatively rare in the Great Barrier Reef Marine Park.

It is estimated that there will be four aspects to the resourcing implications of extending the Great Barrier Reef Marine Park Authority compliance system to the Coral Sea Marine Reserve:

- human resource implications for the Authority
- project/equipment implications for the Authority
- set-up costs for the Authority
- human resource and equipment implications for the Authority's compliance partners.

Human resource implications of compliance management of the Coral Sea Marine Reserve
It is anticipated that the Great Barrier Reef Marine Park Authority will need to employ extra staff for compliance purposes, where compliance includes aspects of education and liaison. It is not considered that one dedicated full-time staff member will be required to attend to every aspect of education and liaison with Coral Sea Marine Reserve users and stakeholders. Rather, that some additional resources will be needed across the agency within already existing units. The estimated staff needs (see Table 8) have been summed to 13 full-time equivalent (FTE).

Table 8 Staff requirements for effective compliance with the Coral Sea Marine Reserve Management Plan

Staff item	Full Time Equivalent (FTE)
Education	0.2 FTE
Commercial fishing management/liaison	0.5 FTE
Charter and game fishing management/liaison	0.2 FTE
International/research/Defence liaison/coordination	0.5 FTE
Shipping management/liaison	0.2 FTE
Tourism (excluding charter & game fishing) management/liaison	0.2 FTE
Data collation, management and analysis	3 FTE
Investigations	3 FTE
Special field operations	3 FTE
Tactical legal	1 FTE
Administration	1.2 FTE
TOTAL	13.0 FTE

In making these estimates, an average cost of $150 000 per staff member has been applied, which includes the costs of all overheads, superannuation etc. This would lead to an annual recurrent staff cost of approximately $1 950 000. Field surveillance and investigations staff would need to be on board and ready from day one of the Coral Sea Marine Reserve management plan being in effect. All other staff should be in place six months prior.

Recommendation 49: Staff should be employed at least 6 months prior to the Coral Sea Marine Reserve management plan being in effect, except for field surveillance and investigations staff who should begin four months ahead of implementation date.

If the compliance management was established outside the existing Great Barrier Reef Marine Park Authority systems, then it is estimated that multiple times these levels of human resources would be required. This is another strong reason for giving the Authority the responsibility for compliance management in the Coral Sea Marine Reserve.

Project/equipment requirements for compliance management of the Coral Sea Marine Reserve
The major project costs would include travel costs for staff conducting liaison or compliance activities. Travel costs are estimated based upon an allowance of ~$300/day/person, which includes accommodation, food and incidentals. The estimates provided assume liaison (1.6FTE), field operations (3FTE) and investigations staff (3FTE) travel ~1/3 of their time and other staff (5.4FTE) travel 1/10 of their time. It is assumed that staff will need to fly to some destinations: liaison staff will four flights per year, field operations and investigations staff 12 flights per year, and all other staff two flights per year. The cost of air travel is assumed to be $1 000 per flight. Some investigations will require overseas travel, in the case of illegal foreign fishing vessels and shipping incident investigations. Twenty such flights per year have been allowed for at $5 000 per flight.

Staff will be working overtime in field operations, and $10 000 per year has been allowed for overtime for all field operations (3FTE) and investigation staff (3FTE). Additional overtime will be managed as time-off-in-lieu.

Whilst is it relatively efficient, and necessary, to access and use vessel monitoring systems and (in the future) the Automatic Vessel Identification Systems, these come at some cost to access and use the data to inform compliance activities. This analysis estimates the access cost to be approximately $50 000 per year.

Publication of educational materials and the use of awareness-raising media should also be budgeted for in an ongoing basis. An estimate of $20 000 per year for production and distribution of these materials has been applied.

Staff will also need to maintain and upgrade their knowledge of legislation, activities, threats, evidence handling, provision of information for use in the legal system, and changes in Coral Sea Marine Reserve management. It is estimated that the cost per staff member for dedicated training after the first year will be $5 000 per year (Note: A set-up training cost for each of the 13FTE staff in the first year is estimated at $20 000 and is included in Table 10, which lists the set-up compliance costs).

Liaison and compliance staff would need at least two vehicles to be able to travel up and down the Great Barrier Reef coast. One or both of these could be located at the Great Barrier Reef Marine Park Authority's regional offices. These would need to be maintained, with maintenance and fuel costs estimated for each vehicle to be $10 000 per year.

Where partner resources cannot be accessed, some operations may require the hire of boats or helicopters. A cost of $20 000 per day has been assumed, and that these assets will be hired for no more than 30 days in each year.

It is usual to seek high-level, external, legal expertise on occasions where the matters pertaining to the incident to be brought forward are more complicated than usual. The more straightforward matters will be dealt with completely in-house. This external expertise must be resourced and can cost from $400-$1000 per hour. The estimated costs in this submission allow for 100−250 hours of legal advice ($100 000 per year in total).

Running an office requires stationary, telephone, internet, electricity and equipment maintenance (e.g. maintenance of printers, computers, etc.). The compliance offices for the Coral Sea Marine Reserve will be supporting approximately 13 people who will need these supplies and services maintained. The recurrent cost for each staff member is estimated as being around $1 500 per year (~$20000 per year in total).

Special projects

The compliance management team will require the capacity to plan and deliver projects that address a variety of emerging compliance management issues ranging from the identification of emerging technology, the development of management guidelines e.g. for shipping, and the development of evidence matrices etc. The funding may be drawn from special allocations supported by a detailed business case.

Benchmarking

In the pursuit of best-practice management of compliance it is necessary to conduct benchmarking exercises with counterpart organisations and to engage external experts and institutions to review aspects of the compliance management model, procedures, processes, systems, resources and planning. Allowance should also be made for the Coral Sea Marine Reserve compliance management team to engage with such groups set up to manage compliance in newly declared marine protected areas in other regions of Australia.

Increasingly, the issues confronting the compliance management team will be common across international boundaries and there will need to be a mechanism for advancing international cooperation. The estimated annual allowance for these kinds of activities is $40 000.

In total, it is estimated that recurrent operational costs (excluding salaries and purchases of surveillance services) for compliance purposes will be $1 367 032 (Table 9).

Table 9 Estimated recurrent compliance costs of the Coral Sea Marine Reserve

Budget item	**Expenditure**
Salaries (13 FTE x $150 000)	*$1 950 000*
Operational costs (includes per FTE and other compliance costs discussed in the body text)	
Travel costs (accommodation, food and incidentals) at ~$300/day/person (liaison, field and investigation staff travel 1/3 of 220 (73.33) work days per year, other staff 1/10 of 220 (22) work days per year	$202 832
Domestic flights @ $1000 each: 1.6FTE liaison staff for 4 flights per year ($6 400); 6FTE field and surveillance staff for 12 flights per year ($72 000); 5.5FTE other staff for 2 fights per year ($10 800)	$89 200
Overseas flights: 20 flights @ $5000 each	$100 000
Overtime ($10 000 per year for 3 FTE field staff and 3 FTE investigation staff)	$60 000
Publications (education/awareness raising materials)	$20 000
Legal fees	~$100 000
Operating costs of vessel monitoring system and Automatic Vessel Identification System	~$50 000
Benchmarking with counterpart organisations	$40 000
Boat and helicopter hire @ $20 000 per day for 30 days	$600 000
Vehicle maintenance and fuel 2 @ $10 000 each	$20 000
Staff training @ $5 000 each per year	$65 000
Office supplies etc.	~$ 20 000
SUBTOTAL (Operational excluding salaries) *$1,367, 032*	
Purchase of services (e.g. surveillance)	*$6 400 000*
TOTAL	$9 717 032

Set-up costs

It costs time and effort to employ new staff and set them up and a dedicated, short-term project officer should be employed to make this happen. The staff employed would need the usual office space, equipment (computers, printer, phones). Aside from this, the operations control room of the compliance unit would need to be refitted to accommodate additional specialty computer hardware plus the staff involved in managing operations.

In addition to a generic orientation program, staff working on all aspects of compliance of the Coral Sea Marine Reserve would also need dedicated and specific training in the reserve, its natural and human attributes, values, threats, legislation and existing management arrangements, etc. It is estimated that the cost per staff member for their required training in the first year is $20 000.

All these costs are one-off set up costs and total $555 000 (see Table 10).

Table 10 Estimated set-up costs for compliance management of the Coral Sea Marine Reserve

Budget item	Expenditure
Project officer (~1 year)	~$150 000
Computer and office equipment, phones, etc.	~$35 000
Initial office supplies	~$30 000
Refitting of operations control room	~$30 000
Recruitment of staff	~$50 000
Staff induction and initial operational training	~$260 000
TOTAL	~$555 000

Resource implications for procurement of Coral Sea Marine Reserve partner agency services

A recent study (Ban et al 2011) estimated the resources required of partnering agencies contributing, in particular, to compliance activities in the Coral Sea Marine Reserve. The recurrent cost was estimated at $6 400 000 per year to pay for aircraft ($4 000 000) and on-water ($2 400 000) surveillance activities from partner agencies.

Total resource implications of compliance of the Coral Sea Marine Reserve

It is estimated that the additional, recurrent management costs to the Great Barrier Reef Marine Park Authority for expanding their compliance management system to the Coral Sea Marine Reserve will be in the order of $9 717 032 per year (that is, $3 317 032 plus $6 400 000 per year) and should be subject to, at least, the Consumer Price Index.

Warning–implications of Queensland government staff cuts

The implications of the downsizing by the Queensland government of existing compliance partnerships applying to the Great Barrier Reef Marine Park could impact on the ability of the joint day-to-day management compliance team to continue to operate as well as they have been. The compliance repercussions of these changes have not been realised, as yet. Consequently, this could then impact upon any ability by the Great Barrier Reef Marine Park Authority compliance team to take on a greater load.

Section 7. Critical scientific research for effective management of the Coral Sea Marine Reserve

Scientific research in the Coral Sea: the story so far

The vast size and remoteness of the Coral Sea Marine Reserve poses a challenge to scientific study, but the existing body of Coral Sea research indicates that careful and strategic planning can result in an effective scientific program (Young et al. 2012).

Australia's Coral Sea has hosted research expeditions since the mid 1950s (e.g. Endean 1957; Rochford 1957), and the volume of published and unpublished research has increased exponentially during the past decade. Initially dominated by oceanographic cruises and geological surveys (e.g. Wyrtki 1960; Shor Jr. 1967), science in the Coral Sea has broadened to understand the ecosystem and its management, including studies on fisheries (DAFF 2012), ecology (Ceccarelli et al. 2009), taxonomy (Svavarsson and Bruce 2012), genetics (van Herwerden et al. 2009), archaeology (Hosty 2009) and management (Ban et al. 2011).

However, efforts to establish ecological baselines (monitoring) have been piecemeal, focusing on individual reefs or islands, and have lacked information on open water and deeper habitats or integration with surrounding areas (Ceccarelli et al 2009). There is yet to be a cohesive scientific agenda that covers all major habitats that leads to an understanding of ecosystem functioning (Young et al. 2012).

The future of scientific research in the Coral Sea Marine Reserve is best approached from two related angles. Firstly, targeted scientific projects should be established to fill identified knowledge gaps. Secondly, rigorous, well-designed and comprehensive monitoring programs should be initiated to provide a time series for tracking biophysical conditions. In many cases, filling knowledge gaps will also serve the purpose of establishing a baseline for regular monitoring. These should be integrated into a management framework through the use of ecosystem models that include key ecosystem components, their drivers, human uses and management actions.

Recommendation 50: Targeted scientific projects should be established in the Coral Sea Marine Reserve to fill identified knowledge gaps.

Recommendation 51: Rigorous, well-designed and comprehensive monitoring programs should be initiated in the Coral Sea Marine Reserve to establish baselines and to provide a time series for tracking biophysical conditions.

Key gaps in scientific knowledge of the Coral Sea Marine Reserve

Climate and oceanography

- Broad hydrodynamic features and major currents are well known, but an understanding of finer-scale hydrodynamic patterns is still lacking. The main gaps still exist at the scale relevant to understanding connectivity between habitat-forming features at all depths. For instance, the nature and seasonality of oceanographic gyres around the Queensland and Marion plateaux need to be described. Source and sink areas for marine organisms, within and beyond Coral Sea Marine Reserve boundaries, need to be identified.
- There is some evidence that hydrodynamic features interact with the Coral Sea's geological structures, but this process has yet to be adequately described and measured.

- Effects of El Nino-Southern Oscillation cycles and other drivers of the Coral Sea's prevailing weather patterns and physical oceanography need to be resolved.
- The response of oceanographic jets to climate variability has not been established. These jets form as the South Equatorial Current enters the Coral Sea between the islands of Solomon Islands, Vanuatu and New Caledonia.
- There is a need to identify the hydrological connectivity between habitats to the north (e.g. Papua New Guinea) through the Hiri Gyre, and to the south through the East Australian Current, especially for understanding pathways of migration and larval transport.
- Potential impacts of climate change on the Coral Sea have yet to be understood. Neither sea surface temperature nor sea-level rise is measured directly, but both can be estimated from satellite data.

Geology and geomorphology

- Basin-scale topography and the Coral Sea's complex bathymetry have been defined; there is a need to identify fine-scale features, especially submerged seamounts.
- Existing mapping projects identifying fine-scale topographic features in the Coral Sea need to be continued and expanded to areas beyond Australia's Exclusive Economic Zone. Without an understanding of the influence of the major features on the Coral Sea's eastern edge, our understanding of the Coral Sea as a marginal sea is limited.
- The sedimentology and bathymetry of the Coral Sea's plateaux, slopes, troughs and abyssal plain are not well understood.
- An inventory is needed of habitat metrics, such as the area of key habitats (e.g. reefs, seamounts, canyons), distance to other similar habitats, exposure regimes, habitat complexity, and other metrics relevant to ecological communities.
- There is a need to continue geological and geomorphologic studies to assess the age and evolution of the Coral Sea basin.
- Evolutionary studies need to take place at scales relevant to biology.

Ecology and biology

- Basic ecological knowledge is lacking for most Coral Sea Marine Reserve habitats. Little is known about the ecological communities, their interactions and processes in the open ocean, deep-sea demersal habitats, seamounts, reefs and cays. For instance, only four of the 30 plus major reefs have been studied at more than superficial levels, the taxonomy and distribution of most mid-trophic fish and squid are unclear, and biological collections have been made at few points in the vast expanse of deeper water. Understanding the role of seamounts in broader ecosystem function is a priority.
- There is still a need for a basic biodiversity inventory and characterisation of ecological communities and key species in all habitats, including terrestrial communities.
- In deeper areas, ecological communities associated with major seabed and shelf features such as the slopes of the continental shelf and plateaux, troughs, canyons, seamounts and knolls need to be described.
- Evolutionary studies need to take place at scales relevant to biology.
- Genetic studies need to be incorporated into other research, as they offer powerful tools to study isolated ecological communities, especially for identifying patterns of connectivity and rates of adaptation in isolated populations, and for validating and expanding existing biogeographic and evolutionary theories of the Coral Sea. Collecting specimens for molecular analysis can easily be incorporated into existing field surveys.
- A monitoring program is needed to document change in pelagic and demersal communities (see also monitoring section below). The focus, at least initially, will need to be on accessible depths (e.g. reefs) and key organisms where monitoring has been shown to be effective (e.g. turtles).

Where monitoring programs exist, these should be continued; this includes tagging studies (e.g. seabirds, tuna). The viability of recommencing the turtle monitoring program on Coral Sea cays needs to be assessed. Only by establishing the baseline and then monitoring the rate and direction of community recovery after disturbances can we assess the resilience to the Coral Sea and all its habitats.

- The region has important populations of threatened or endangered sea turtles, seabirds and cetaceans. The occurrence and population status of most of these is unknown. There is particularly sparse information on the occurrence of the beaked whale. Questions remain about whether cetaceans feed in the region.
- Migratory pathways, residence times, spawning aggregations, areas of feeding, and regions for breeding are unknown for most large migratory species.
- In the pelagic realm, there is little understanding of the biology and life history of unfished species. Fishery-independent data are needed on the population status and distribution of large pelagic predators (tunas, billfish, sharks) and their prey.
- Our understanding of the role of oceanic reef lagoons as nursery grounds, and of the frequency of closed life cycles on Coral Sea reefs, is still in its infancy and needs to be expanded.
- There is a need to understand larval dispersal to assess the extent to which reefs in the Coral Sea may be supplying recruits to the Great Barrier Reef.
- Examining key symbioses and the incidence of disease, would provide a measure of health and stress in key species.
- There is limited information on microbial, gelatinous and benthic foodwebs. Overall, productivity in the Coral Sea is low, but there are hotspots of productivity that support significant populations of large pelagic fish, seabirds, sea turtles and cetaceans. These include black marlin and longtail tuna spawning areas, and tuna aggregations where they feed on myctophids off the outer Great Barrier Reef and extend over the Queensland and Townsville Troughs in the Coral Sea. A better understanding is required of the spatial and temporal dynamics of these productivity hotspots, their biophysical drivers, consequences for pelagic species, and connectivity between pelagic and benthic communities.
- Predictions suggest that to maintain their current thermal environments as oceans warm, species in the Coral Sea will need to move rapidly southwards, especially in the north of the region (Burrows et al. 2011). Ongoing monitoring of species distributions will ensure they are adequately represented within current protected areas.

Fisheries

- Fishery-independent research is needed to ascertain the sustainability of spawning aggregations of tuna and billfish. An assessment of whether the targeting and bycatch of the black marlin spawning aggregation by the sport fishing industry is sustainable is overdue.
- There is a lack of logbook data from charter fisheries in the Coral Sea; the level of take in the recreational sector is unknown.
- Stock assessments for blue and black marlin in the Coral Sea have not be been completed.
- Stock connectivity for large pelagic fish in the greater western Pacific is not well understood.
- Bycatch data need to be compiled and collated for all Coral Sea Marine Reserve fisheries.
- To assess the impact of recreational reef fisheries, the density of target species and the state of the ecosystem between fished and unfished areas should be compared. For coral reefs, the original Commonwealth Marine Reserves (Coringa-Herald and Lihou Reef National Nature Reserves) offer a compelling baseline for comparisons with similar reef systems. A pre-closure survey of additional reefs to be protected under the new Coral Sea Marine Reserve would provide an essential starting point against which to measure recovery of target species and associated community structure.

History and archaeology

- There are 104 known shipwrecks in the Coral Sea, of which only 8 have been located. Charting and locating shipwrecks will add significantly to our understanding of the region's history.
- The actual number of vessel losses is unknown. A review of the vessels listed as 'lost at sea' to determine those likely to have disappeared in the Coral Sea would provide a valuable addition to the known shipwrecks. Identifying as many lost vessels as possible may assist in recording the entire span of European history in east Australian waters, including the question of early Portuguese exploration of Australian waters.
- Ongoing archaeological studies should be supported and continued, to assist the reconstruction of historical shipping and trading corridors between Australia and Asia, and to understand the history of direct human use in the Coral Sea, such as whaling, bêche-de-mer fishing and guano mining.

Baselines and monitoring in the Coral Sea Marine Reserve

There is a need for baseline studies, perhaps focusing on identified indicator groups, to ensure that there is at least basic ecological knowledge for key habitats in the Coral Sea Marine Reserve, including open ocean, deep-sea demersal, seamounts and reefs. New data collected will improve our understanding of ecological function (e.g. by collecting data on functional groups such as grazers, predators, habitat builders) trophic relationships, genetic characteristics, and measures of ecological health.

Monitoring the biophysical conditions of ecosystems is an integral component of adaptive management (see 'Integrating Science and Management in the Coral Sea Marine Reserve' below). Ideally, monitoring and reporting exist within a framework where specific management responses to likely scenarios are already established before monitoring begins (Gerber et al. 2005; Nichols and Williams 2006).

Most of the Coral Sea Marine Reserve's habitats lack even a baseline species inventory. For both baseline studies and continued monitoring, sampling designs should include representative areas in the Coral Sea Marine Reserve's Marine National Park Zones and zones where fishing will continue. A series of research priorities is listed for each major habitat in Table 11.

Compliance monitoring

Although not specifically listed here as a research gap (see Section 6), human attitudes, behaviour and compliance are key issues affecting the success (or otherwise) of marine reserves in protecting species and ecosystems from human exploitation. Information gathered from compliance monitoring is likely to offer some of the most valuable guidance to managers in the development of strategies to educate the public and ensure a sense of stewardship for the marine environment.

Terrestrial habitats

The Coral Sea Marine Reserve's terrestrial environments are restricted to sand cays and islets, but despite their small size and proportionally minimal extent, they provide critical habitats for seabirds and turtles. Vegetation (Batianoff et al. 2008), terrestrial invertebrates (Greenslade and Farrow 2007), seabirds (Wilcox et al. 2007) and turtles (Harvey et al. 2005) have been studied, and in some cases monitored for several years, but a more comprehensive program across the Coral Sea Marine Reserve is needed.

Table 11 Summary of monitoring recommendations for the Coral Sea Marine Reserve's main habitats

Habitat	Recommended research
Terrestrial	Mapping of vegetated and unvegetated cays throughout the Coral Sea Marine Reserve Vegetation assessments on vegetated cays Sea level monitoring Seabird and turtle monitoring Genetic studies on effects of isolation and connectivity
Coral reefs and seamounts	Basic metrics, consistent with other variables used elsewhere, to establish a baseline for reef communities: • coral cover and composition • benthic composition and macroinvertebrates • fish species and functional group composition (with separate methods for surveying large reef predators) Sampling design: inside-outside Marine National Park Zones, bioregions, reef vs seamount
Mesophotic zone	Species composition and depth ranges of benthic organisms, fish and other mobile organisms Sampling design: inside-outside Marine National Park Zones, bioregions, reef vs seamount
Deep sea	Exploratory collections and imagery Potential for bioregionalisation based on sedimentology, topography and deep oceanography Trophic linkages between deep-sea and shallower habitats (e.g. through vertically migrating and deep-diving species)
Pelagic	Temperature, chlorophyll and other physical variables to be sampled at scales and in areas relevant to ecosystems Ongoing integration of oceanographic data and biological/ecological dynamics Establish clearer links between temporal changes in productivity levels and migration pathways or aggregations of pelagic species Pelagic Baited Remote Underwater Video Stations Expansion of the existing Integrated Marine Observing System to monitor pelagic communities

Shallow reefs and seamounts

Coral reefs are perhaps the best understood of the Coral Sea Marine Reserve's habitats, and they are the most accessible to direct human observation. Their role in supporting high biodiversity and their vulnerability to multiple impacts have contributed to their prioritisation in research programs. They respond rapidly to environmental degradation and serve as a useful indicator of detrimental change. However, despite repeated surveys on a number of the Coral Sea's reef systems (e.g. Oxley et al. 2003; Oxley et al. 2004; Ceccarelli et al. 2008; Williams 1982), there has yet to be a unified monitoring protocol that can yield a consistent time series of how these communities may be changing.

Mesophotic benthic habitats

Recent technological innovations have allowed the exploration of deeper reef, seamount, plateau and slope ecosystems, which appear to be unique and diverse (Woerheide et al. 2011; Bongaerts et al. 2011). Investigations are underway to determine whether deeper (mesophotic) areas can act as refugia for shallow-water communities that are damaged by cyclones or bleaching events (Bongaerts et al. 2011). Baseline investigations can be coupled with fine-scale topographic maps to locate areas (e.g. hard substrates, complex topography) likely to host high-density benthic communities (Harris and Whiteway 2009; Anderson et al. 2011). Remote sampling can provide images of the same sites over time, providing valuable time-series.

The deep sea

Research in the deep sea (below 1 000 metres) is in its infancy, and broad coverage is unlikely to be possible given logistical difficulties posed by this environment. Environmental change is likely to be minimal (Glover and Smith 2003), and snapshot surveys, including remote imagery and collections, may be best for increasing our understanding (Beaman 2010; Beaman and Webster 2008; Davies et al. 2007). Linkages and dependencies between the deep sea and species and communities in

shallower (<1 000 metres) habitats will provide a better understanding of ecological functioning in the Coral Sea Marine Reserve.

Pelagic habitats

The open ocean makes up the majority of the Coral Sea Marine Reserve's surface area, but is perhaps the most difficult to monitor. However, there are a number of well-developed systems for studying this habitat, including the use of satellites for chlorophyll, continuous plankton recorders for plankton, and bioacoustics for fish and squid. In particular, the existing Integrated Marine Observing System could be expanded to include the Coral Sea Marine Reserve beyond the Great Barrier Reef. Physical variables can also serve as proxies for biologically relevant conditions.

Draft budgets for scientific expeditions in the Coral Sea Marine Reserve

Shallow coral reefs, seamounts, terrestrial cays

This budget in Table 12 is drafted for an expedition that would survey shallow coral reef and seamount habitats, and terrestrial cay ecosystems, covering the first two rows of Table 11. It corresponds to an expedition of 20 days, allowing the survey of eight reefs/seamounts and associated habitats, with two days at each location and additional steaming time. It is envisaged that within a monitoring framework, one or two expeditions of this kind would take place each year, rotating the target reefs and cays so that each one is surveyed every two years. This means that in two years, with two expeditions per year, 32 locations could be regularly surveyed. The minimum personnel would be:

- fish surveyor (transects)
- fish surveyor (long swims for sharks and other large predators and herbivores)
- coral taxonomist
- benthic surveyor (benthic composition on transects)
- macroinvertebrate surveyor
- collector of genetic samples
- 2 terrestrial (vegetation, seabirds, turtles)
- island mapper/ biophysical measurements/ remote sensing person
- students/volunteers for student projects, and assistance
- remote nurse/doctor (self-funded).

Table 12 Estimate of budget per expedition to monitor shallow coral reefs, seamounts, terrestrial cays

Budget item	Expenditure
Liveaboard boat charter with SCUBA diving gear, $6000 per day	$120 000
Transfer to Mackay or Cairns, or Gladstone, 10 people a` $ 800	$8 000
Per diems and incidentals for traveling, 10 people a` $ 500	$5 000
Equipment (e.g. survey+ safety gear, video camera for benthic transects)	$8 000
Gear shipping	$1 500
Salaries or fees for field experts, analysis	$96 000
Cost of lab analysis of genetic samples (RA salary, processing)	$22 000
Salary for project manager (per year, part-time)	$38 000
Total	**$298 500**

Mesophotic and deep-sea

Because these habitats are so poorly described, initial expeditions would be designed to ground-truth a number of areas, from which a number of representative locations could be chosen for regular monitoring. The frequency of monitoring would need to be discussed with deep-sea experts, but it is expected that as the rate of change is slower at depth, monitoring expeditions may only need to take place every five years. The estimated budget costs for each expedition are listed in Table 13. Note that

many of these costs could be combined and reduced through the use of the National Research Facility, the *RV Investigator*, which is outfitted with all the equipment necessary to conduct deep-sea research. The minimum personnel would be:

- ROV operators (at least 3)
- fish taxonomist
- coral taxonomist
- macroinvertebrate taxonomist
- sample collectors and sorters
- students/volunteers for student projects, and assistance
- Remote nurse/ doctor (self-funded).

Table 13 Estimate of budget for each per expedition to monitor mesophotic and deep-sea

Budget item	**Expenditure**
Liveaboard boat charter, $ 6000 per day	$120 000
Transfer to Mackay or Cairns, or Gladstone, 10 people a` $ 800	$8 000
Per diems and incidentals for traveling, 10 people a` $ 500	$5 000
Equipment (e.g. safety gear, video cameras collection equipment, ROV)	$1 500 000
Gear shipping	$4 000
Salaries or fees for field experts, analysis	$120 000
Cost of lab analysis for sample identification and genetic samples (RA salary, processing)	$22 000
Salary for project manager (per year, part-time)	$38 000
Total	**$1 817 000**

Pelagic

Pelagic research has similarities to deep-sea research in its difficulty of establishing monitoring areas or protocols. However, the ocean's surface lends itself to remote monitoring, with targeted expeditions to areas identified as having increased productivity or activity. A monitoring sequence could combine real-time satellite imagery, followed up by aerial surveys along flight paths determined through the remote information, in turn followed up by (e.g. 20-day) vessel expeditions. The estimated budget costs of this monitoring expedition are listed in Table 14. The minimum personnel would be:

- satellite image analyst
- megafauna specialists for aerial surveys (2)–assuming 10 days of surveys based on remote imagery
- megafauna specialists for vessel surveys (3)
- operators for pelagic Baited Remote Underwater Video Stations and divers (4)
- sample collectors and sorters (2)
- students/volunteers for student projects, and assistance

Table 14 Estimate of budget per monitoring expedition

Budget item	**Expenditure**
Equipment for satellite image analysis	$5 000
Transfers to charter flight (2 people)–may need multiple transfers	$8 000
Transfer to Mackay or Cairns or Gladstone for vessel boarding, 10 people at $800	$8 000
Aircraft and pilot costs $5 000 per day	$50 000
Per diems and incidentals for traveling $500 per day	$5 000
Vessel charter at $6 000 per day	$120 000
Equipment (e.g. safety gear, video cameras, collection equipment)	$200 000
Gear shipping	$4 000
Salaries or fees for field experts, analysis	$200 000
Cost of lab analysis for sample identification and genetic samples (RA salary, processing)	$22 000
Salary for project manager (per year, part-time)	$38 000
Total	**$660 000**

Recommendation 52: Sufficient resourcing should be provided to the Great Barrier Reef Marine Park Authority (the recommended management body for the Coral Sea Marine Reserve in this submission) to fund at least three scientific baseline-monitoring expeditions in the reserve. The expeditions should include those for shallow coral reefs, seamounts, terrestrial cays ($298 500), mesophotic and deep-sea ($1 817 000), and pelagic ($660 000).

Integrating science and management in the Coral Sea Marine Reserve

Broad-scale pelagic environments are considered the 'last frontier of ocean protection' (Game *et al.* 2009). Working towards a scientific agenda for regional marine planning and protected areas in the Coral Sea Marine Reserve will benefit substantially from collaborations and linkages with neighbouring countries.

Ultimately, understanding of the functioning of the Coral Sea Marine Reserve will need to embrace the entire marginal sea, especially since human use is generally higher in neighbouring Exclusive Economic Zones. Given the predicted population increases in western Pacific islands and the subsequent demand for protein from the sea, it is likely that there will be added pressure on regional fish stocks. Ensuring food sustainability will be a major international political challenge requiring sound science. Collaboration on resource management and environmental protection has a basis in the 1982 United Nations Convention of the Law of the Sea (Young et al. 2012).

Ideally, research and monitoring programs in the Coral Sea Marine Reserve would be preceded by the design of an adaptive management framework that uses information provided by science to inform management actions and decisions. In such a framework, research would be tailored to answer specific questions pertinent to achieving predetermined goals. Compliance monitoring would need to be an integral part of the adaptive management framework, coupled with the development of management actions targeting human attitudes and behaviour. Monitoring a range of target variables, both physical and biological, is likely to provide the most comprehensive inputs into decision-making processes. Therefore, designing a scientific research program in the Coral Sea Marine Reserve would comprise the following steps:

1. The design of an adaptive management framework, including goals for marine environment protection, actions necessary to achieve those goals, and information needed to inform those actions. The framework would need to be adaptive so that new scientific results could add or remove actions as more information becomes available and we learn more about the system.

2. Information necessary to determine initial management actions is listed. A valuable first step will be to identify data sources, especially those not yet published, which may assist in filling gaps. These datasets should be collated, analysed and published. Initial management actions may be possible based on information already available. Recent reviews have synthesised the contents of existing documents; these reviews contain guidance for filling knowledge gaps and for tailoring monitoring programs to assist management (Ceccarelli 2011; Young et al. 2012).

3. Research programs are designed to provide the required information, along the lines of filling knowledge gaps and establishing monitoring programs. Monitoring programs will focus on logistically viable indicators that provide as much information as possible to management agencies. To address logistical constraints for research in the region, it would be worthwhile to assess the viability of establishing a 'Coral Sea Marine Reserve Research Station', potentially in conjunction with the Bureau of Meteorology's weather station on Willis Island.

4. The backbone of an integrated and adaptive management plan for the Coral Sea Marine Reserve would be an ecosystem model. This would bring together our current knowledge and data on the key habitats, physical drivers of hotspots, major human uses such as commercial and recreational fishing, and threats from pollution and climate change. Such a tool would evaluate current and future management strategies, including the efficacy of protected areas, different marine zoning and fisheries management, and monitoring programs. It would also support the continued review of the Coral Sea Marine Reserve management plans as more is learnt about the ecosystem.

Recommendation 53: A scientific research program should be designed for the Coral Sea Marine Reserve that has an adaptive framework, lists the scientific information required to identify and support appropriate management actions, includes programs that provide that information, and is reviewed on a regular basis as new knowledge comes to light.

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