COMISION PERMANENTE DEL PACIFICO SUR - CPPS
SECRETARÍA EJECUTIVA DEL PLAN DE ACCIÓN PARA LA PROTECCIÓN DEL MEDIO MARINO Y ÁREAS COSTERAS DEL PACÍFICO SUDESTE
CONSERVACIÓN INTERNACIONAL – CI

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V REUNIÓN DEL GRUPO AD-HOC DE EXPERTOS EN ÁREAS MARINAS Y COSTERAS PROTEGIDAS PARA DEFINIR LOS MECANISMOS DE IMPLEMENTACIÓN DE LA RED REGIONAL DE AMCP DEL PACÍFICO SUDESTE

Guayaquil, Ecuador, 27-29 de febrero de 2008

THE BENEFITS OF THE MARINE PROTECTED AREAS

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Photography courtesy of the Great Barrier Marine Park Authority.

This document has been prepared by the Commonwealth Department of Environment and Heritage from material supplied by Richard Kenchington, Trevor Ward, and Eddie Hegerl.

A technical support paper is also included in this resource kit, providing more details on current issues and practice for those who have not yet been involved in the processes of creation and management of marine protected areas.

This summary of the benefits of marine protected areas is based on the scientific contributions of numerous authors. We acknowledge these sources, and specific contributions are cited in the accompanying technical support paper.

THE BENEFITS OF MARINE PROTECTED AREAS

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THE BENEFITS OF MARINE PROTECTED AREAS

What is a marine protected area?

A marine protected area (MPA) is an area of sea especially dedicated to the protection and maintenance of biodiversity, and of natural and associated cultural resources, and managed through legal or other effective means.

MPAs include marine parks, nature reserves and locally managed marine areas that protect reefs, seagrass beds, shipwrecks, archaeological sites, tidal lagoons, mudflats, saltmarshes, mangroves, rock platforms, underwater areas on the coast and the seabed in deep water, as well as open water (the water column).

In 1988, The World Conservation Union (IUCN) General Assembly called upon national governments, international agencies and the non-governmental community to:

Provide for the protection, restoration, wise use, understanding and enjoyment of the marine heritage of the world through the creation of a global, representative system of marine protected areas and through management in accordance with the principles of the World Conservation Strategy of human activities that use or affect the marine environment.

In many parts of the world there is a growing focus and appreciation of the need for more MPAs and for better management generally of coastal and marine environments.

Why do we need marine protected areas?

Modern technology has increased the range of uses of, and access to, marine environments, supporting industries such as fishing, tourism, aquaculture and the development of new forms of drugs from marine biodiversity. But unless managed sustainably, the uses and users of marine ecosystems can threaten, change and destroy the very processes and resources that they depend on.

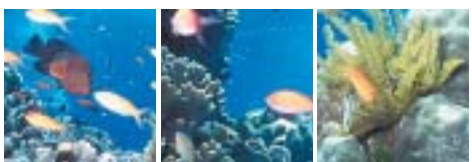
Current management systems are failing to maintain the productivity, biological diversity and the ecosystems of marine ecosystems. The consequences of this failure are serious and far-reaching. The most obvious effect is seen in impacts on the longstanding and widespread use of marine resources for seafood. The global fish catch has been in consistent decline since 1989 and the downward trend is projected to continue.

Marine biodiversity, ecosystems and resources are also threatened by impacts reaching the sea from the land, through pollution by nutrients, chemicals and silt, and through changed river flows.

Marine protected areas help protect important habitats and representative samples of marine life and can assist in restoring the productivity of the oceans and avoid further degradation. They are also sites for scientific study and can generate income through tourism and sustainable fishing.

MPAs provide a range of benefits for fisheries, local economies and the marine environment including:

- conservation of biodiversity and ecosystems;
- arresting and possibly reversing the global and local decline in fish populations and productivity by protecting critical breeding, nursery and feeding habits;
- raising the profile of an area for marine tourism and broadening local economic options;
- providing opportunities for education, training, heritage and culture; and
- providing broad benefits as sites for reference in long-term research.



LORD HOWE ISLAND MARINE PARK

There are significant benefits both to biodiversity and stakeholders from the effective management of activities in MPAs that are assessed to be compatible with the protection of biodiversity values of the reserve. It can often result in a larger area being declared as an MPA and provide more compatible management adjacent to any 'no-take' zones in the reserve.

Situated within a World Heritage Area, 700 kilometers north-east of Sydney, Australia, the 300,510 ha Lord Howe Island Marine Park (Commonwealth waters) is an example of multiple-use management designed to protect marine biodiversity, habitats and ecological processes associated with the volcanic seamount system. The management arrangements for the Park also ensure the long-term maintenance of the Island's tourism industry and the traditions and lifestyle of the local community.

Approximately 70% of the Park is assigned to IUCN Category IV (Habitat Protection Zone) and allows for hand lining, trolling and strictly controlled drop line fishing to occur. Only Island residents are permitted to drop line, gear must be limited to 3 lines and 15 hooks per line, a radio beacon must be fitted to each line to prevent lines becoming lost and 'ghost fishing', and fish can only be taken for consumption on the Island. Charter and recreational hand lining, trolling and breath-held spear fishing are allowed within the Habitat Protection Zone provided they are carried out in accordance with any relevant concessions and are consistent with legal lengths, catch limits, permitted gear and other relevant regulations.

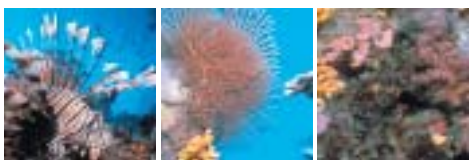
The remaining 30% of the Park has a very high level of protection and has been assigned to IUCN Category 1a (Strict Nature Reserve), prohibiting all forms of fishing and other extractive activity. These Sanctuary Zones ensure that the area is managed in as undisturbed state as possible and provide scientific reference areas to monitor the potential impacts of neighbouring activities.

The role of MPAs in protecting marine habitats and biodiversity

Properly designed and managed MPAs play important roles in:

- conserving representative samples of biological diversity and associated ecosystems;
- protecting critical sites for reproduction and growth of species;
- protecting sites with minimal direct human impact to help them recover from other stresses such as increased ocean temperature;
- protecting settlement and growth areas for marine species so as to provide spill-over addition in adjacent areas;
- providing focal points for education about marine ecosystems and human interactions with them;
- providing sites for nature-based recreation and tourism; and
- providing undisturbed control or reference sites serving as a baseline for scientific research and for design and evaluation of management of other areas.

'No-take' MPAs are free from fishing and harvesting and, as far as practicable, protected from other human impacts are an essential component of ecosystem-based management of the oceans.



MARINE BIODIVERSITY

What is biodiversity?

Biological diversity (usually shortened to biodiversity) is the variability of life in all its forms, levels and combinations, and the ecosystems within which it operates.

Biodiversity is the combination of a three-tiered structure and the operation of the dynamic processes that maintains the structure and the functional linkages within and between each tier.

Genetic diversity: the variety and frequency of different genes and/or genomes within each species.

The characteristics of genetic diversity in marine plants or animals that are valuable for human use, such as resistance to a pest or disease, or medicinal potency, may occur in only a few individuals of a species, or in a small sub-population. The basic unit of conservation of genetic diversity is therefore the plant or animal population.

Species diversity: the variety and frequency of different species.

The importance of species diversity is that it identifies and characterises the biological community of a habitat and ecosystem.

Ecosystem diversity: the variety and frequency of different habitats or ecosystems and the processes that shape them.

The biological structure is maintained by dynamic processes: physical (including ocean currents, wind, waves and erosion); chemical (including salinity, sediment geochemistry and pH, runoff from land masses); and biological (including migration, predation, reproduction and larval drift).

Conserving biodiversity and ecosystems

Some change to coastal and marine ecosystems happens on a time-scale that makes it hard to realise its nature, extent or magnitude. All too often the significance of biological diversity and ecosystem processes is only appreciated after they have been lost or damaged.

Without measures such as MPAs and 'no-take' reserves, marine biodiversity is likely to be lost before we of know of its existence or importance for humanity, or how it should be managed for long-term sustainability.

The most immediate benefits of MPAs are that they provide natural areas with lower human impacts. Most species and biological communities have evolved some capacity to survive or recover after periodic stresses such as high or low salinities, temperatures or severe storms.

Research into high temperature-induced coral bleaching suggests that corals from areas with low stress from human activities have a higher capacity to recover and are less likely to suffer or be killed by extreme coral bleaching.

Maintaining representative samples of marine ecosystems in intact condition, aiming for them to be self-sustaining and able to adapt to incremental changes in ocean climate, is a prudent investment for the future.

Maintaining a comprehensive gene pool of marine species, covering their natural ranges of populations and their functions, will help ensure the broadest possible variety of biodiversity options for the future.

Centres of dispersal

MPAs can provide reservoirs of genetic material for the natural or assisted recovery of areas affected by pollution, by overfishing or natural causes. Natural refuges in the ocean have long provided an *in situ* reservoir of genetic material. These natural refuges were once areas that were too remote or too difficult to fish, but they are now being rapidly lost with advances in fishing techniques.

SINKS AND SOURCES

The young life forms of coastal marine organisms have the potential to disperse from less than a metre up to hundreds, and in some species, thousands of kilometres, but their effective dispersal may be much less than this maximum potential distance. This is because it takes more than a single new recruit to recolonise an area and form a viable population.

The effective dispersal distance of a marine species depends on where they are, the prevailing water currents, the time of year when spawning occurs, their ability to live without feeding, and their behaviour in the water column (some sink to the bottom where currents are weak, while others swim to the surface where currents may be stronger).

Simulation models using observed and estimated dispersal distances suggest that, for the coasts of continents or large islands, reserves should be about 4–6 kilometres in size and located about 20 kilometres apart. Such reserves, it is suggested, would provide adequate insurance for populations of many common benthic marine species, although would not be adequate for larger mobile fish which may range across wider areas and need reserves of a different design.

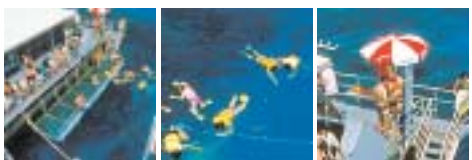
Reserves that provide insurance for fish stocks may require a larger area than those strictly for conservation purposes alone, because of the need for higher levels of recruitment of the harvested species needed into other areas to support the fishery.

Repairing damage

Reserves with undisturbed marine biodiversity and ecosystems are particularly important in the search for effective methods to mitigate damage and restore damaged ecosystems. Without biodiversity reference areas and benchmarks it is difficult to study and assess the outcomes of restoration attempts or improve past performance.

Many reports of the condition of the world's coral reefs indicate that efforts to restore or rehabilitate damaged ecosystems are an increasingly important management issue, particularly to those close to major cities and heavily populated coasts. While it is preferable and most cost-effective to prevent or minimise damage as far as possible, a range of restoration and rehabilitation techniques are being developed.

The focus of restoration and rehabilitation needs to be on removing threats and accelerating natural recovery processes.



How do MPAs benefit fisheries?

Marine protected areas with core 'no-take' reserves can play an important role in arresting and possibly reversing the global and local decline in fish populations and productivity.

The global fish catch is reported to be in decline since the late 1980s. Indications of this decline include:

- fishing for smaller and lower-value species;
- having to fish further from home bases; and
- the destruction or degradation of fish habitats in coastal areas.

The effects of a declining fish catch fall disproportionately on poor coastal communities, as an estimated 94% of all fishers are subsistence fishers, producing nearly half of the world's fish for human consumption. In the face of increasing world population, reversing the decline and maintaining the high quality protein supply from the sea will require considerable improvement in the management of wild capture fisheries, aquaculture and the health of the ecosystems upon which they depend.

There is a substantial weight of evidence in favour of the beneficial role of MPAs in a range of different types of fisheries, in different global localities, and within different fisheries management regimes. MPAs on their own are not sufficient as a single management tool, except possibly in small-scale subsistence fisheries where other management systems may not be very effective.

For fisheries, MPAs generally can be considered to provide four basic benefits:

- support for stock management, including:
  - protection of specific life stages (such as nursery grounds);
  - protection of critical functions (feeding grounds, spawning grounds);
  - provision of spillover of an exploited species; and
  - provision of dispersion centres for supply of larvae to a fishery.
- improved socio-economic outcomes for local communities;
- support for fishery stability; and
- ecological offsets
  - trade-off for ecosystem impacts; and
  - better understanding of impacts and options.

Support for stock management

Traditionally MPAs and reserves (including specific fisheries management measures such as closures and catch restrictions) have benefited fisheries through stock enhancement and management. Protection of habitat is important to key life cycle stages including spawning, juvenile settlement, nursery grounds and major feeding grounds. Strategically located protected areas provide sites for settlement and early growth of juveniles which when mature, spill over into adjacent fished areas.

Support for fishery stability

Studies of marine protected areas with core 'no-take' reserves established in coastal and island areas which have been overfished show a significantly improved fish catch and has led to sustained catch levels.

THE SPILLOVER EFFECT IN COMMERCIAL AND RECREATIONAL FISHERIES

The Merritt Island National Wildlife Refuge at Cape Canaveral, Florida, USA, contains two areas that have been closed to fishing since 1962—the Banana Creek Reserve and the North Banana River Reserve. Like many areas closed for national security, defence, or other military purposes, these areas were not chosen for the purposes of biodiversity protection or fisheries enhancement.

The two estuarine areas that make up the refuge are closed to public access for the security of the nearby Kennedy Space Center, and have a total area of 40 square kilometres. Before these areas were closed, there was intensive commercial and recreational fishing in the area and fish stocks were heavily exploited. Between 1957 and 1962, an average of 2.7 million kilograms of fish were landed annually in the vicinity of Merritt Island by 628 commercial fishers, and a further 1.47 million kilograms landed by an average of 764,000 sport fishers.

The value of this reserve for the adjacent recreational fishery has been assessed by examination of the number of record-size ('trophy') fish caught by recreational fishers. The area enclosing 100 km to the north and south of the reserve was found to provide 62% of record-size black drum, 54% of red drum and 50% of spotted sea trout. The area considered comprises only 13% of the Florida coast, and the habitats found in the Merritt Island National Wildlife Refuge are also found in many other parts of Florida.

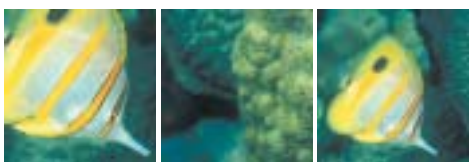
Since the mid-1980s most Florida data for black drum and red drum have been recorded from the vicinity of the Merritt Island Refuge. Fish tagging studies show that these species move out of the reserve and into surrounding waters, and this, together with the reported record sizes, is evidence for substantial spillover of these fish from the reserve into the adjacent recreational fishery.

TROPICAL SUBSISTENCE FISHERIES

In 1995 in St Lucia, West Indies, a network of four reserves was created to cover about 35% of available fishing grounds (reef and offshore waters) to attempt to restore a fishery that had no other form of management and was severely over-exploited. Research indicates that the reserves increased the adjacent local fishery catches by 46% for large fish traps and 90% for small fish traps in five years, and an overall increase in yield of the fishery.

Similar outcomes were achieved in a small-scale fishery in Egypt where, in 1995, in collaboration with local Bedouin and fishermen, five 'no-take' fisheries reserves were established within the Nabq Natural Resource Protected Area, South Sinai, in the Egyptian Red Sea. The abundance, size, structure and catch of commercially targeted groupers, emperors, and snappers were investigated before the establishment of these reserves, then in 1997 and again in 2000. By 1997, these fish had shown a significant increase in mean abundance within two of the reserves. By 2000 each fish family and three individual species had increased in abundance in the reserves. Mean recorded catch per unit of fishing effort within the adjacent fished areas increased by about two-thirds during the five years.

The establishment of the reserves appears to have played a key role in maintaining the sustainability of the fishery. The involvement of local Bedouin and fishermen in the co-management of fisheries resources was considered to be critical to the success of this initiative.



PROTECTION AND FISHERIES ON GEORGES BANK

The fisheries for groundfish, a species living close to the seabed, on the US and Canadian Georges Bank in the north-west Atlantic Ocean were once one of the most productive in the world. After decades of intensive fishing the stocks of several of these species, including cod and haddock, declined and eventually collapsed in the 1980s and early 1990s. Overfishing and the impact of intensive scallop dredging on juvenile stages of the groundfish and their habitats were considered to be the major causes of the fishery crashes.

In 1994 in the US waters of Georges Bank and Southern New England, three large areas of about 17,000 square kilometres of historic importance to groundfish spawning and juvenile production were closed to any fishing gear capable of capturing groundfish (trawls, scallop dredges, gill nets, hook fishing). In the following five years, the closed areas significantly reduced fishing mortality of protected groundfish stocks. The location of the reserves also provided year-round protection to the stocks of sedentary fishes, primarily flounders, skates, miscellaneous other fish, and bivalve molluscs. The closures afforded less protection to migratory age groups of cod and haddock, but additional fishing regulations in the fished areas and in the Canadian parts of Georges Bank contributed to stock-wide reductions in fishing mortality. They have not yet recovered, but there are encouraging signs from the reports of fishers and from research surveys that stocks of cod are recovering from their former highly depleted condition.

Overall, fishery closures of large portions of Georges Bank and adjacent areas have proved to be an important element leading to more effective conservation of a wide range of commercial and non-commercial species, even though the closed areas were selected on the basis of seasonal spawning grounds of haddock and the distribution of yellowtail flounder. There is clear evidence that the MPAs have provided a very important contribution to ongoing restoration of the fisheries in this area.

Ecological offsets

There is often conflict between fisheries and protected areas even though marine protected areas provide benefits to both fisheries and conservation. Recent technical reviews have consistently identified the high potential value of MPAs, and specifically 'no-take' reserves, for fisheries management purposes. Increasingly, fisheries operate in communities where concern at long-term decline in productivity, environmental damage and the adverse impacts on other users and interest groups is a matter of political and economic sensitivity.

One approach is to encourage the fishery to be managed in a way that is designed to be environmentally sustainable, but also protects other areas from these impacts to ensure the viability of marine species and their habitats. Such 'offsets' can compensate for areas that have been selected for fishing and other activities that have an ongoing impact on the marine environment.

Where ecological impacts of a fishery are uncertain, 'no-take' reserves are usually identified as the most cautious and effective solution to the need for conservation in a region.

Many fisheries already use various forms of MPAs in their routine management, including seasonal and spatial closures of fishing grounds.

THE AUSTRALIAN NORTHERN PRAWN FISHERY

The Northern Prawn Fishery (NPF) is Australia's most valuable federally-managed fishery, with an average annual catch of about 8,000 tonnes, worth between $A100 million and $A175 million and now taken by 100 modern trawlers. The NPF operates within a 771,121 square kilometre area across most of the top of northern Australia.

The fishery survived the early history of overcapitalisation/overfishing common to most prawn trawl fisheries during the 1970s and early 1980s, when up to 302 trawlers were operating. Since the mid-1980s, fishing effort has been greatly reduced through industry-funded buybacks, spatial and temporal closures, and substantial gear (net) reductions. The fishing season has been reduced from the entire year to just over four months. The fishery has been highly innovative in addressing by-catch issues, including being the first Australian fishery to voluntarily withdraw from shark fishing, formerly a profitable by-product, in order to protect shark species.

Currently, all known critical juvenile prawn nursery seagrass areas in the NPF are protected from trawling under the NPF Management Plan in what are called Fishery Closure Areas. Continuous surveillance ensures that the closures are protected from trawling. There are 15,830 square kilometres of juvenile prawn habitat that mostly could be fished, but is now protected within permanent closure areas, and a further 51,470 square kilometres protected within seasonal closure areas. These amount to 2% and 6.7% of the NPF managed area respectively. While it is to the NPF industry's credit that such extensive areas of prawn habitat are protected from prawn fishing, these areas are not protected from other human activities, including other forms of fishing.

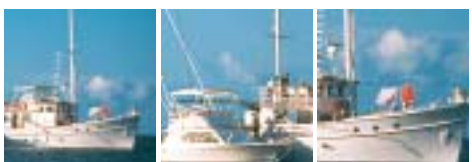
The NPF has recognised that 'no take' marine protected areas are an important management tool that can benefit the fishing industry by providing greater protection to critical nursery habitat than can currently be provided by Australian fisheries legislation, as well as providing refugia for many of the benthic and by-catch species impacted by NPF trawling.

The NPF now has a significant research effort underway to identify benthic species assemblages, model the performance of existing spatial closures, and identify different reserve configurations that can fully achieve biodiversity conservation objectives, while at the same time maximising the value of the commercial fishery.

Even closures that are managed by limitations on the range of fishing gear (such as permitting fishing with traps, but not nets or lines) or on the number of people allowed to fish (such as in a controlled subsistence fishery) can help conserve a range of species and habitats that are not directly affected by the traps or by the removal of the exploited species.

The benefits of less strictly protected MPAs for aspects of biodiversity other than the harvest of exploited species have not generally been studied. Such MPAs can be expected to provide important contributions to broader fishery management and biodiversity conservation.

The fishing industry is increasingly recognising the need for effective ecosystem-based management, and the potential broad range of benefits that can be delivered by MPAs for sustainable harvesting.



How do MPAs benefit tourism?

Tourism is now a primary source of income in many developing countries and frequently exceeds the value, particularly the foreign currency value, of marine fisheries in those nations.

In Australia the Great Barrier Reef attracts about 1.8 million tourist visits with the industry valued at over $A1 billion per year, compared to estimates of $A359 million for the annual worth of Great Barrier Reef fisheries.

THE GREAT BARRIER REEF MARINE PARK

Australia's Great Barrier Reef Marine Park (GBRMP) extends over 345,000 square kilometres of which 16,000 square kilometres is zoned as a 'no-take' marine reserve.

From an economic point of view, tourism is the most significant industry in the Great Barrier Reef catchment and lagoon. The Productivity Commission recently reported that tourism expenditure in 1999 was $4,269 million, far exceeding the gross values of recreational fishing ($240 million) and commercial fishing ($119 million). Because tourism is an inherently labour-intensive industry, it is also by far the largest employer among the Great Barrier Reef industries, with around 47,600 employed persons in 1998-99, equivalent to 10% of the total workforce.

Recent analysis by the Great Barrier Reef Marine Park Authority indicates that Reef tourism specifically contributes $1.4 billion every year into the Australian economy.

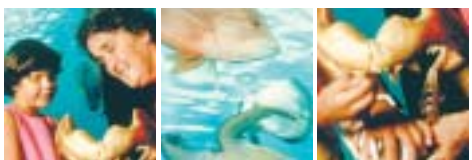
Over 1.8 million tourist days are spent in the GBRMP each year (not including ferry passengers). Use of the GBRMP by locals and free and independent travellers has not been well quantified, but has been estimated to be in the order of 2 million days a year; giving us a grand total of roughly 3.8 million visitor days per year. This compares with annual visitor rates to other World Heritage Areas like Kakadu National Park of 160,000 visitors and Uluṟu - Kata Tjuṯa of 385,000 visitors.

The management budget for the GBRMP for 2002/03 was $A32.6 million. Since mid-1993, the Australian Government has recovered part of the management costs for the GBRMP through an environmental management charge (EMC) on each tourism operator (based on passengers carried).

In 2002/03 the EMC raised $A6.7 million from more than 1.8 million visitor days. The tax revenue to government from the GBRMP, however, is higher as the Reef tourist industry is subject to various additional charges, including a tax on fuel, which is a substantial cost to many operators.

Despite the importance to tourism of the quality of the natural environment, coastal and marine tourism areas are vulnerable to hasty and inappropriate development. Poorly managed tourism can lead to site degradation and a decline in visitor numbers.

The components of coastal and marine environments that are important for tourism include clear water, clean sandy beaches and opportunities to view marine life.



Well-managed marine protected areas with core 'no-take' reserves are often major tourist attractions. An important attraction for many visitors is to view abundant marine life from observatories, with glass-bottomed boats, by snorkelling or scuba diving. The quality of these experiences depends on the ability to see large fish and the diverse life of algal beds, rocky seabeds and reefs undisturbed and undamaged in their natural environment and free from the debris of lost fishing gear, discarded plastic and drink containers.

The establishment of a marine protected area is an excellent way to raise the profile of an area for marine tourism and to broaden the local economic options. It is important that the introduction and development of tourism is carefully planned to ensure that it is acceptable and sustainable for the local human communities. With appropriate training and support, local communities can gain additional economic benefit through managing the MPA and involvement in businesses that take visitors to the marine reserve, as well as receiving the benefits of improved local fishing.

Experience in many countries shows that protected areas often earn significant revenue and make an important contribution to local economies.

BONAIRE MARINE PARK

Bonaire is an island of 288 square kilometres located in the Caribbean Sea some 80 kilometres to the north of the Venezuelan coastline. The 2700 hectare marine park, covering all coral reef areas around the island, was created in 1979, although a management regime did not begin until 1984.

While the resident population was estimated at only 10,800 in 1990, almost 17,000 scuba divers visited Bonaire in 1991. The economic mainstay of the island is tourism, particularly dive tourism. Growth in dive tourism in this period was 9–10% a year.

Total gross revenue generated through dive-based tourism was estimated at $US23.2 million in 1991. The government generated an additional $US340,000 through taxes levied on visiting divers. The costs directly associated with the establishment, subsequent rehabilitation and initial operation of the park was about $US518,000 with annual recurring costs of $US150,000, which was more than covered by visitor fees. The park also generates substantial employment with up to 755 local workers and 238 foreign workers employed in park-associated activities.

While a more recent economic assessment is not yet available, by 1994 annual visitor numbers to the park had increased to 65,820, of whom 24,081 were divers. 57 cruise boats also visited the park.

There are now five full time staff for the park; current annual visitation is about 70,000.

The Bonaire government has ceded management of the park to a local non-government organisation called STINAPA. The STINAPA board has recently been restructured to include key user groups (hoteliers, dive operators, fishermen and the tourist office).

The Bonaire tourism industry has successfully helped to protect the marine environment and uses programs to educate tourists and industry professionals concerning the sustainable use of the Bonaire Marine Park.

WHALE WATCHING IN NEW ZEALAND

Many whales pass New Zealand's coast on their way to and from breeding grounds in the Pacific and feeding grounds in the Antarctic, but some have formed pods in certain areas of the country. Almost half of the world's 80 species of whales are seen around New Zealand.

Just off the coast from Kaikoura, on east coast of New Zealand's South Island, is an ecosystem which is rich in nutrients, providing ideal conditions for a resident pod of young male Sperm whales.

The local Maori community, the Ngai Tahu, has lived and worked to a philosophy of sustainable management and sensible use of natural resources since arriving in the Kaikoura area in 850AD. The Ngai Tahu owned whale watching company operates strictly within this philosophy.

People are taken to visit whales in their natural environment, and nothing is done to jeopardise the ecosystem that maintains the whales in their natural environment and keeps them close to Kaikoura. The company constantly monitors and patrols the Kaikoura coastline for any signs of environmental stress or danger to whales which may be caused or triggered by human interference.

The resulting rapid growth of the tourist industry has helped to transform the town from an economically depressed area with few opportunities for local employment into one of New Zealand's 'boom towns'.

What are the broader benefits of MPAs?

While the benefits of MPAs for fisheries are generally understood, the value of marine ecosystem services, including waste assimilation, coastal protection, flood management and provision of critical environmental requirements for fished species, is often unrecognised. Marine protected areas can help to ensure continuity and future options for those benefits by protecting the health of marine ecosystems.

For example, the ecosystem services of coral reefs include shoreline protection, sediment production, and sediment retention. Figures for limestone production per square metre of healthy coral reef range from 0.8 to 8.9 kilograms per year. Fragments of calcium carbonate skeleton accumulate as sediments on the sheltered, low energy side of reefs. There they may foster the growth of mangrove forests and seagrass beds, which in turn also assist shoreline protection and produce ecosystem goods in the form of seafood products.

It may be possible to identify and value the current range of goods and services provided by a particular marine or coastal ecosystem, but little is known of what the ocean might provide in the future in the way of new products, new resources and new opportunities to create wealth. Keeping samples of the ocean ecosystems in their natural form is a prudent investment in the future.

The interactions in coastal and marine ecology are becoming clearer. It is now understood that the physical structure of coastal and marine habitats can play a crucial role as the spawning and nursery grounds supporting many fisheries. Similarly increasing understanding of the defence mechanisms of marine plants and animals is revealing an array of marine biochemical compounds, some of which have been identified as having value as sunscreens, anti-viral, anti-inflammatory or related medicinal applications.

More recently the oceans have been found to support an entire set of ecosystems that are independent of carbon produced from the sun's energy (the sulphur-based geothermal vent fauna) where rare-earth minerals are also concentrated. The full potential of these discoveries has yet to be realised.

Coastal and marine ecosystems contribute to beach and shoreline stability, assimilate and process wastes and contribute to the quality of life of coastal people. A wide range of goods and services can be provided by these ecosystems, many representing options for possible future uses and benefits.

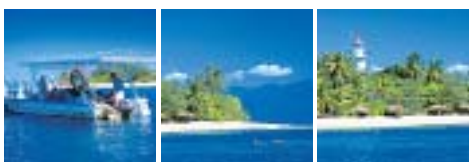
COASTAL AND MARINE ECOSYSTEM GOODS AND SERVICES

Goods

- seafood products
- raw materials such as seaweed
- cultivated food and material production
- medicinal treatments and products
- live specimens for aquariums
- non-renewable or very slowly renewable building materials
- minerals, oil and gas

Services

- shoreline maintenance
- flood and storm protection
- sand production
- nutrient cycling
- waste assimilation and remediation
- water quality maintenance
- habitat
- maintenance of biodiversity
- maintenance of biological resilience
- mixing and transport of organic production to food webs
- development and transport of larvae and young
- wave and tidal energy
- recreation
- inspiration and support of cultural, aesthetic and spiritual values



Education, training, heritage and culture

Education

Marine protected areas are particularly important because they provide opportunities for people to experience and study marine plants and animals that are undisturbed by fishing and other impacts. They can thus become places where people can observe and compare with the impacts from disturbance.

Education centres and trained education staff based around MPAs have an important role in helping children and older students learn how fish and other marine animals find food, hide from predators, grow, reproduce, migrate or defend their territories. As children learn and share their knowledge with their families and the wider community, they play a significant role in developing community understanding and demand for sustainable management of their marine environments.

Repeated field surveys by student classes over many years can provide good information about long-term change that cannot be obtained in any other way. Participants in these activities are also more likely in later years to be informed contributors to future decisions about marine environments and resources.

Training

A further important educational role of MPAs is in the training of resource management staff. Typically most staff come from backgrounds with little exposure to the nature and values of marine plants, animals and ecological processes. Courses at MPA field stations can provide a valuable introduction and contribute to the understanding of these values.

Marine protected areas with education facilities also play an important role in tourism through providing training, support and information for local people involved in the tourist industry. The centres themselves often provide an attraction for tourist visitors seeking local knowledge of the area.

Culture, history and heritage

MPAs have a major role in educating local communities and visitors about the culture, history and heritage of the areas they protect. In most coastal areas there is a history of use, culture and values associated with specific localities in the marine environment. There are often links to prehistoric use and legend, and traditional practices of use that are important in the understanding of present values and future options.

Today governments and local communities in some countries are protecting these sites of historic, cultural, and religious significance through the declaration of various forms of MPAs. Some historic and cultural MPAs are declared to fulfill a single purpose, such as protecting a submerged cultural resource site from amateur souvenir hunters or professional salvagers, or to protect a single marine species from exploitation. Others are created within a multiple-use approach that includes protecting historic and cultural values alongside biodiversity conservation and sustainable use.

Educating visitors about sites of historic significance helps illustrate the relationship between people and marine environments. These sites can include:

- shipwrecks
- lighthouses
- customary tenure boundaries
- battle sites
- hunting and collecting areas
- ceremonial and sacred sites
- middens
- fish traps
- harbours
- coastal fortifications
- fish markets
- whaling stations
- fish smokers
- salting and drying sheds

- sail lofts, and
- old ships and small boats.

Such sites are also important for developing local understanding of rights and responsibilities in using and caring for marine environments.

MPAs with a cultural component could include trans-boundary MPAs established where two or more adjoining protected areas are established between adjacent countries and managed cooperatively. 'Parks for Peace' are trans-boundary protected areas that are formally dedicated to the promotion of peace and cooperation, the protection and maintenance of biological diversity and natural and associated cultural resources.

Trans-boundary MPAs are particularly important in areas where a single marine ecological unit is shared by the jurisdictions of two or more countries. Where there is a history of rivalry or conflict between adjacent nations, the conservation of a shared resource can be an important step in building mutual understanding and cooperation.

THE RED SEA MARINE PEACE PARK

Israel and Jordan share 41 kilometres of shoreline around the northern Gulf of Aqaba/Bay of Eilat. This area contains outstanding coral reefs which attract large numbers of visitors and associated tourist development.

In 1994, during the Trilateral Peace Negotiation Process between Jordan and Israel with the support of the United States, the two countries agreed to develop a Binational Red Sea Marine Peace Park within the framework of an Agreement on Special Arrangements for Aqaba and Eilat. The Agreement calls on the parties to 'collaborate in research efforts on coral reefs and marine biology, and in implementing comparable policies and regulations designed to protect the coral reefs as a tourist attraction which is soundly managed from an ecological point of view.'

Jordan established a marine park off the shores of Aqaba and designated a protected coral reef strip stretching seven kilometres on the eastern side of the northern Gulf of Aqaba. Israel has set aside the southern part of the Eilat coast for nature conservation. A four-kilometre 'marine protected belt' lies in the sea, approximately parallel to two on-shore nature reserves which stretch from the southern end of the city of Eilat to the border crossing to Egypt at Taba.

There is a cross-boundary cooperative research, monitoring and management program that is assisted by the National Oceanographic and Atmospheric Administration and US-AID.

MPAs and research

Research baselines or reference sites

MPAs protecting representative samples of biodiversity provide broad benefits as sites for reference in long-term research. This may involve the understanding of marine ecosystems and ecosystem services, developing and evaluating techniques for sustainable management and exploring options for new forms of use.

The slow and incremental changes caused by human activities and natural events can be difficult to measure. Without reference sites the value of comparisons is limited. 'No-take' reserves provide a crucial means for establishing points of reference to assess human and other impacts on adjacent marine environments.

Targets for restoration

Many coastal ecosystems are highly degraded, and these areas are now the focus of attempts to restore the original services, such as flood and storm protection. Even after mitigation or removal of the main impacts, such as erosion, it has been difficult to determine how to re-establish the former ecosystems, what they should contain, and how they should function. These restoration efforts need information from non-degraded areas to provide guidance on approaches and priorities for restoration.

Understanding climate impacts

The oceans are experiencing the effects of a gradually changing climate. This is evident in the trend to warmer average surface ocean temperatures, and in the increased number of extreme temperature and storm events affecting the ocean.

Planning to cope with these changes requires the ability to predict how the oceans' ecosystems will respond. Measurements of long-term changes from researching MPAs are the main way that the changes in biodiversity can be determined.

Research and monitoring tools

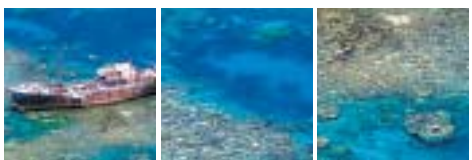
Sustainable use of marine resources requires detailed knowledge of the oceans' biodiversity. There has been a recent emphasis on developing more sophisticated tools for observing and measuring the physical, chemical and biological characteristics of the oceans.

New initiatives in the past decade include high-resolution and multi-spectral satellites designed to measure ocean wave heights, currents and phytoplankton productivity; acoustic techniques for mapping of water column and seabed habitats; and video techniques for improved census of fish populations in continental shelf waters.

The development of much new ocean technology depends, to some extent, on the availability of areas where trials can be conducted free of interference from other users and impacts and where there are normal ocean biological conditions. This is especially true of the video and acoustic technologies, which require natural systems complete with typical levels of primary and secondary production, such as the natural levels of zooplankton and phytoplankton, in order to determine the effectiveness of the equipment across a range of biological conditions.

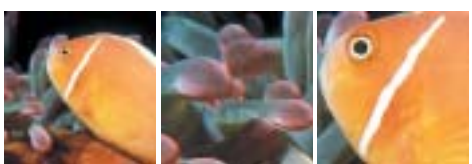
Other technology that requires testing in natural conditions includes antifouling designs and treatments, fish-finding equipment, benthic ecosystems mapping, in-water calibration for satellite-based ocean and marine weather observing systems. Near-pristine ecosystems allow the developers of new technology to assess the performance of such systems within ecosystems that are behaving 'normally'.

One of the major constraints on managing marine ecosystems is the lack of empirical observations and data on larger and mobile marine organisms in waters beyond comfortable scuba diving depths (deeper than 10 metres). This is due to the increasing safety issues with scientific diving, the sheer extent of the area of marine habitats and the high cost of maintaining active teams of scientific divers.



The recent development of remotely deployed video technology is likely to provide a major boost to the capture of knowledge in marine ecosystems. Deployment of remote video may be able to provide data across large areas and in deep water that are inaccessible to divers. However, the effectiveness of video as a sampling tool has to be tested, and this can only be effectively calibrated within highly protected areas where near-pristine conditions can be expected to prevail.

The decline in marine ecosystems around the globe needs to be reversed. Otherwise a sustainable supply of marine products, such as high quality protein, cannot be maintained. Realising the potential of other uses and values requires careful management of what remains. Marine protected areas are an important tool to help manage the oceans and meet the needs of the increasing world population and demands for a reasonable quality of life.



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