

13. STATUS OF CORAL REEFS IN POLYNESIA MANA NODE COUNTRIES: COOK ISLANDS, FRENCH POLYNESIA, NIUE, KIRIBATI, TONGA, TOKELAU AND WALLIS AND FUTUNA

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ABSTRACT

Status of coral reefs in the Polynesia Mana node is predominantly healthy.

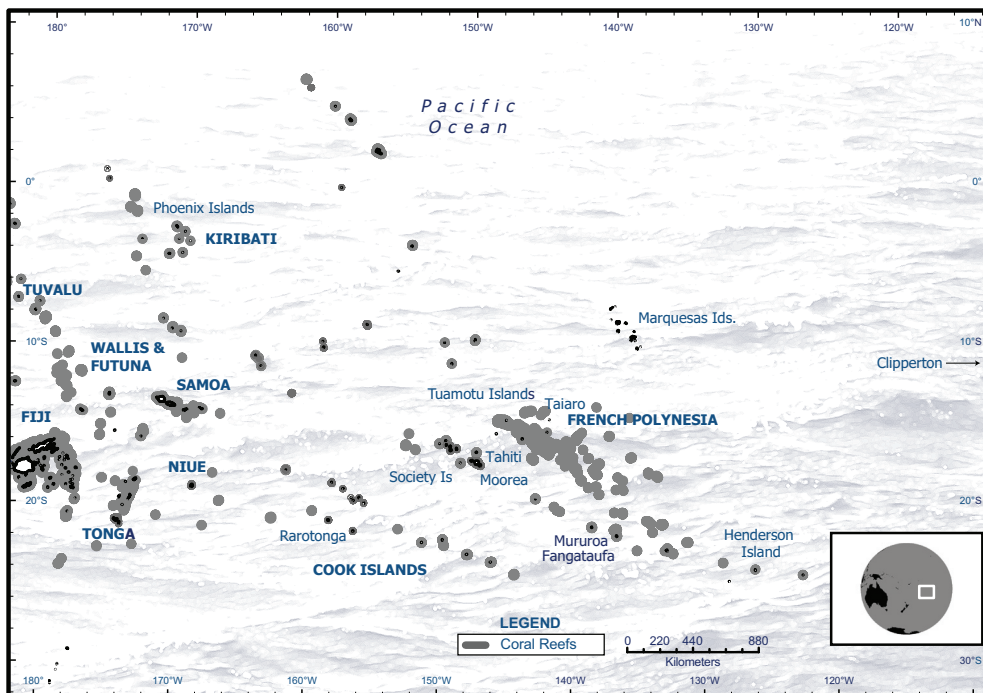
- There are 6733 km² of reefs scattered over 347 islands. Most (90%) are healthy, 5% have been destroyed or are at a critical stage and 5% are under threat;
- Reefs have been degraded around populated areas of Rarotonga (Cook Islands), Tahiti and Moorea (French Polynesia) and South Tarawa (Kiribati);
- Coral reefs support the livelihoods of Polynesian populations through subsistence fishing in all countries and through tourism and black pearl industries in French Polynesia and the Cook Islands;
- The main threats to the reefs are global warming for the remote reefs and land-based pollution for reefs near urban areas. Dynamite fishing still occurs in Wallis and Futuna;
- Reefs are mostly healthy in Wallis and Futuna, Tuamotu-Gambier and the Marquesas Archipelagos of French Polynesia;
- Reefs have largely recovered from past bleaching events in Phoenix Islands and Tarawa in Kiribati, and reefs are recovering from crown-of-thorns starfish (COTS) outbreaks in Rarotonga (Cook Islands) and from a cyclone in Niue;
- Reefs are facing a major COTS outbreak in the Society Archipelago of French Polynesia; and
- Socioeconomic assessments are now being implemented in the region, in parallel with ecological monitoring, to support coral reef management.

INTRODUCTION

The countries of Polynesia Mana (Cook Islands, French Polynesia, Kiribati, Niue, Tokelau, Tonga, and Wallis and Futuna) have vast areas of coral reefs scattered over 12 million km² of EEZ with 347 islands representing 6000 km² of land and only half a million inhabitants. Reefs sustain tourism and black pearl industries as the main income in French Polynesia and the Cook Islands. Reef-based tourism has generated revenue of US\$130 million in 2007 and employs 60% of the population in the Cook Islands. French Polynesia produced 6.4 metric tons of black pearl in 2006, to a value of US\$100 million and employs 5000 people in more than 50 islands. Other countries have some form of tourism, usually to a lesser extent, and reefs mainly sustain livelihoods through subsistence fishing.

Until early 2004 the reefs of French Polynesia, Wallis and Futuna, Phoenix and Gilbert outer islands, and North Tarawa (Kiribati) were generally healthy. Reefs on Tokelau and Cook Islands were in a recovery stage: Tokelau after a bleaching that had probably taken place in 2002 or 2003; and the Cook Islands after a COTS outbreak that started around 1995. In the Cook Islands all sites surveyed were dominated by algae, with large populations of urchins present. Soft corals were present, indicating an early recovery stage of the reef. Another positive sign was the absence of recently dead coral, apparently stable populations of corals and no evidence of COTS, as the previous plagues have disappeared.

In Niue just as reefs were recovering from the 1990 cyclone, Ofa, Cyclone Heta hit the islands in early 2004 and had disastrous impacts on both land and reefs. About 20–90% of reefs were flattened on the west coast, where most of the economic activities occur, especially reef fisheries and tourism ventures such as diving.



In Kiribati reefs near the very populated South Tarawa atoll showed coral cover below 20% and very low diversity. This is interpreted as being due to local human damaging effects.

Global warming remains the major threat for reefs in Polynesia Mana as most reefs are located well away from major human disturbances. However, other limited disturbances are occurring in Polynesia Mana countries and water quality is generally poor around the main populated islands of the Cooks, French Polynesia, Wallis and Futuna, and Kiribati. Sand mining, dredging and ocean reclamation are also resulting in decreasing water quality. Dynamite fishing is still a threat in Wallis and Futuna; as is proximity to all major population centres such that populations of key target fish species are low as a result of over-fishing and some habitat destruction. Cyclones are a prevalent threat in the Cook Islands as they lie on a major cyclone route; in 2005, 5 cyclones hit the Cook archipelago, as well as Niue where the main damage to reefs in the past 30 years has been due to cyclones. Crown-of-thorns starfish (COTS) are also a threat for the Cooks and some islands of French Polynesia. It is worth noting the effects of volcanoes and earthquakes that regularly affect the islands of Alofi and Futuna. Although the impact on reefs of these events has not been studied, it is important to note previous experience with the last major eruption and seismic episode in 1993 which inflicted significant damage to coral populations.

STATUS OF CORAL REEFS IN 2008

The following sections consider the reefs within the Polynesia Mana Node from the perspective of their status, rather than their geographic or political status.

Healthy Reefs: Wallis and Futuna, Tuamotu-Gambier and Marquesas Archipelagos of French Polynesia. Coral cover on the reefs in Wallis and Futuna showed a general trend of increasing cover between 2002 and 2005. Coral cover observed at the 2 permanent Wallis sites was always higher than 28%; probably due to the buffering effect provided by the large lagoon which separates the outer reefs from damaging human activities. Conversely, low coral cover values observed on the islands of Alofi and Futuna (respectively 21.4%, 7.5%, 13.3%, 15.4% on Futuna west, Futuna east, west Alofi, Alofi south-west in 2005) are very likely to be a consequence of reef proximity to the main islands.

Since 2005 concrete actions to improve environmental conditions have been undertaken or are planned (a waste treatment plant and establishment of MPAs). It is hoped that these on-going initiatives will improve the health of coral reefs over the long-term, especially in Futuna, as they are currently in an intermediate state between recovery and on-going degradation.

The vast majority of the 15 000 km² of reefs and lagoons of French Polynesia are in good health and are considered to be under low risk of degradation in the coming decades; provided that the impacts of climate change are not too strong. However, the situation of reefs and lagoons is worrying in the Society Islands.

Results of monitoring of habitats in the lagoon, and especially of key resources (fishes, molluscs and crustaceans) in the former nuclear test sites at Mururoa and Fangataufa show that short half-life elements are no longer detectable, activity of radioactive elements with an average decay period has dropped to normal background levels, and the activity of long period elements is very low and decreasing over time.

In French Polynesia there has been strong recovery of live coral cover on Moorea and Raiatea in the Society Archipelago where there had previously been serious damage from recent COTS outbreaks.

Recovered Reefs: Kiribati. The reefs at North Tarawa recovered quickly after the 2005 bleaching event, with the same for South Tarawa, except that there has been a decrease in coral diversity as most coral cover is now composed of *Porites rus*: few *Pocillopora* and *Acropora* species have come back. A bleaching event occurred around Tarawa at the end of 2004 and significantly damaged *Pocillopora* species, resulting in a decrease of live coral cover in North Tarawa, and a population shift from *Pocillopora* species to *Porites rus* in South Tarawa: the net effect now is that live coral cover for these sites is not significantly different. Thus in 2006 the reefs have been modified to have more of the temperature resistant *Porites* compared to more sensitive species like *Pocillopora* which both bleaches and dies in higher temperature waters. The large increase in *Porites rus* at 1 of the 2 sites in South Tarawa may be an adaptive response to human pressure: the other site shows a persistent decline in coral reef health.

Detailed surveys have been undertaken in the Phoenix Islands. Surveys at Kanton Island in 2000 and 2002 described probably the most highly developed *Acropora* species community seen anywhere in the world. In December 2004 all of this *Acropora* community was found dead. The only living coral seen was a monospecific patch of *Pavona* species. Satellite images have shown that persistent and abnormally high sea surface temperature water covered the area from August 2002 to March 2003. A survey in July 2002 reported low numbers of partially bleached colonies; thus the massive bleaching event occurred soon after that. However, surveys in 2006 have shown exceptional recovery: these results will be published shortly.

Reefs Undergoing Recovery: Cook Islands (Rarotonga) and Niue. A comparison of repeated surveys up to the present clearly indicate that outer reefs around Rarotonga have been degraded and a phase shift in benthic community to a more algal-dominated reef has occurred. The shift was also evident in fish community assemblages between 1999 and 2006 (no fish surveys were undertaken in the intervening years), with a general decrease in the abundance of planktivores and corallivores, an increase in herbivores, and a general increase in omnivores. While the phase shift was largely due to the recent outbreak of the crown-of-thorns starfish (COTS; lasting about 10 years), damage caused by 5 cyclones that passed in 2005 may have been minimal due to the already degraded state of the fore-reef.

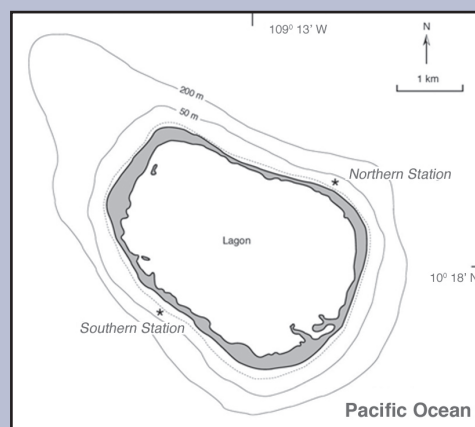
Recent coral size data indicate that 86% of colonies on the fore-reef slope were new recruits, with 82% of these being hardy to bleaching and storm resistant corals, suggesting that recovery is still in its early stages and less hardy corals are colonizing only slowly. Furthermore, the establishment of soft corals and coralline algae at leeward sites, as well as increased herbivore abundance at all sites, may be indications that conditions are well set for recovery which is now underway.

The COTS outbreak caused a massive decline in live coral cover and a proliferation of algae. A large sea urchin population developed due to proliferation of algae starting in 2003; this population is now declining in line with the decline in algal cover. An increase in soft coral cover is a sign of coral reef recovery and virtually no COTS are evident.

Bottom communities within the lagoon back-reefs of Rarotonga have high cover of turf algae, and coral colonies are larger within the lagoon than on the fore-reef, suggesting that most of the damage by COTS was on the fore-reef. Herbivores have dominated most lagoon sites with benthic invertebrate predators dominating a few sites. Macro-algae and blue-green algae were observed in all areas of the lagoon indicating that the lagoon may be experiencing elevated nutrient levels overall as a result of terrestrial runoff.

CORAL REEF MONITORING IN THE VERY REMOTE CLIPPERTON ATOLL

During the Clipperton expedition organised by Jean-Louis Etienne in 2005, two survey stations were established between 10 and 12 m depth on the northern and southern outer slopes of the atoll. Live coral cover varied considerably with 27% average at the southern station and 63% in the north. *Pavona* and *Pocillopora* were dominant southern species (12.0% and 10.7% respectively); while *Porites* largely dominated in the north (44.3% cover). Algal cover (coralline, macroalgae and turf) was particularly high in the south (57.7%) and much lower in the north (28%). There was a high density of sea urchins in the south with 112 individuals per 100m², mostly *Diadema mexicanum* and *Tripneustes depressus*; compared to 8–12 in the north. *Holothurian* (sea cucumber) numbers were much less (4/100 m², south: 20/100 m², north), predominantly *Holothuria leucospilota*. Fish abundance was similar at the two stations (208 and 284 individuals/100 m²), but species diversity (33) was richer at the south station (north, 22). These surveys showed that Clipperton Atoll has low hard coral (19), fish (37) and echinoderm (3) species diversity. Even with this low diversity, living coral cover, sea urchin abundance and fish populations are relatively high compared to other coral reefs in the central Pacific such as French Polynesia and the Great Barrier Reef. Such high coral cover and abundant, high biomass fish populations indicate that this is a healthy coral reef. Moreover, there are high proportions of large and old coral colonies with very small proportions of recently dead corals. This indicates that these reefs have not suffered major natural perturbations such as cyclones, coral bleaching or crown-of-thorns starfish plagues. There is also no evidence of direct human damage on these outer slopes of Clipperton.



Two sets of monitoring results for Niue in 2005 and 2007 show very slow recovery of the reefs. In the two sites surveyed live coral cover has not significantly increased, however, coralline algal cover has increased and turf algae decreased, showing that conditions for coral recruitment have improved.

Degraded Reefs: Society and Austral Archipelagos (French Polynesia) and South Tarawa (Kiribati). During the period 2003–2007 the coral reefs of French Polynesia escaped major natural disturbances, with the exception of a recent COTS outbreak. No cyclones occurred, nor have there been any major bleaching or severe algal blooms in the lagoons. Any bleaching observed was of low intensity, very localized and did not result in significant coral mortality. However, since 2006 there has been a COTS outbreak in Moorea that has already reduced coral cover on the outer slopes by 20% and COTS are also thriving in the lagoon. Thus a decrease in coral cover, as large as that seen in the early 1980s, is expected in the next few years. There are major outbreaks at several islands of the Society Archipelago (Huahine, Bora Bora, Tahaa, Raiatea, Moorea, Tahiti) and on one island of the Austral archipelago (Rurutu). No COTS outbreaks have been reported on the atolls, although several individual COTS have been seen in Fakarava.

Coral reefs near high urban concentrations of people have not undergone major human-induced degradation. However, protection of many sites has been enhanced by coral reef conservation and management measures to conserve their resources (PGEM Moorea - Biosphere Reserve and PGEM atoll of Fakarava).

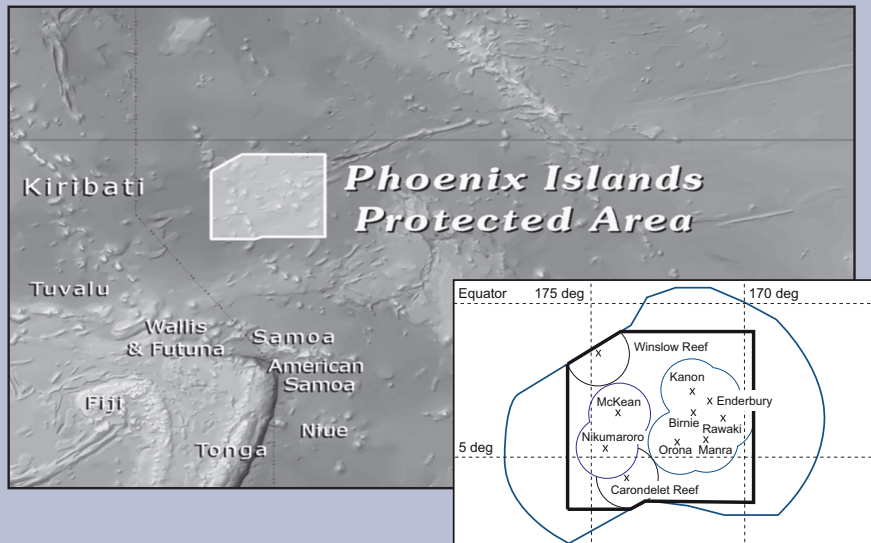
Reefs Under Socioeconomic Assessments: Moorea, Society Archipelago, French Polynesia; and Takitumu Lagoon Conservation Area, Cook Islands. Polynesia Mana countries have not started to integrate much socioeconomic monitoring, or even socioeconomic assessment, in parallel with ecological monitoring. The Pacific region launched the GCRMN socioeconomic monitoring guidelines (SEM Pasifika) in 2008 and, along with some funding, it is expected that the next status reports will contain a much larger socioeconomic component.

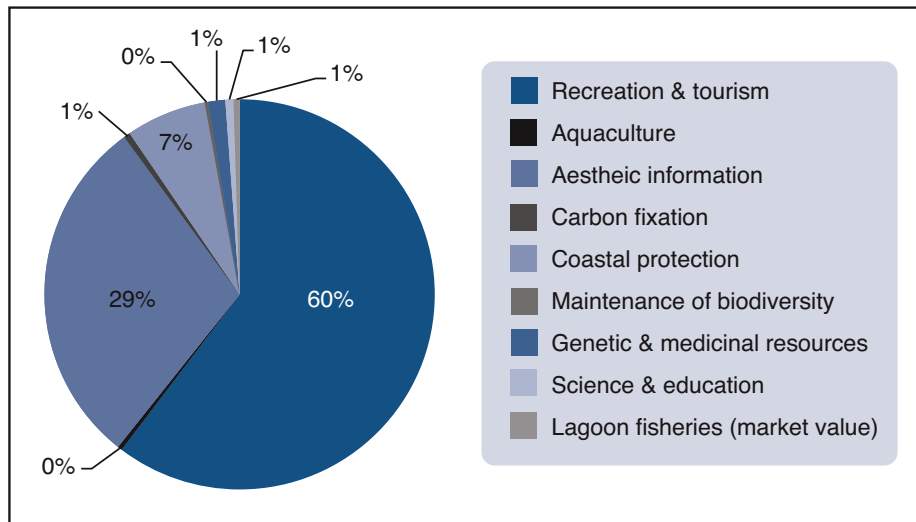
Moorea in French Polynesia is a high volcanic island of 150 km² surrounded by a coral reef and lagoon ecosystem of about 50 km² that has recently been assessed to evaluate the goods and services reefs provide: recreation and tourism (58%); aesthetic values (housing, 28%); coastal protection (7%); maintenance of biodiversity (5%); and just 2% in providing food from fisheries. Moorea is a relatively densely populated island with 15 000 people and is the sister island of Tahiti, such that it now functions as a suburb of Tahiti Papeete, the major urban centre of commerce and government activities. A management plan of the lagoons and reefs (PGEM) was launched in order to solve conflicts of interest among all stakeholders.

Socioeconomic data on the economic exploitation of coral habitats and resources are available in French Polynesia. Reef fisheries catches are about 3400 metric tons per year, with take decreases in crustaceans and increases in giant clam (*Tridacna maxima*); 125 tons of *Trochus niloticus* (for buttons and paint) was exported in 2006; and black pearl production, which was 11 tons in 2000, had fallen to 6.4 tons in 2006.

PHOENIX ISLAND PROTECTED AREA: THE WORLD'S LARGEST MPA

The small Pacific island nation of Kiribati has become a global conservation leader by establishing the world's largest MPA (410 500 km²). The Phoenix Islands Protected Area (PIPA) conserves one of the world's last intact oceanic coral archipelago ecosystems, consisting of 8 coral atolls and 2 submerged reef systems in a nearly uninhabited region, with abundant marine and bird life. PIPA also includes underwater seamounts and other deep-sea habitats. The New England Aquarium has led 3 research expeditions since 2000 and found high marine biodiversity, including more than 120 coral species, 520 fish species; including some undescribed species. PIPA contains some of the most important seabird nesting populations in the Pacific, as well as healthy fish populations, including large numbers of top predators, along with healthy sea turtle populations. This biodiversity illustrates the pristine nature of the area and its importance as a reservoir and migration route. Protecting the Phoenix Islands means restricting commercial fishing, resulting in a loss of revenue for the Kiribati government that would have come from issuing commercial fishing licenses. The New England Aquarium and Conservation International (CI) are helping Kiribati design an endowment system to cover the core recurrent management costs of PIPA and compensate the government for the foregone fishing revenues. The management plan permits subsistence fishing by resident communities and other sustainable economic development in designated zones. Kiribati first declared their intention at the 2006 Conference of the Parties to the Convention on Biological Diversity in Brazil. On 30 January 2008, the Government of Kiribati adopted formal regulations for PIPA to double the original size and make it the largest MPA in the world. The development of PIPA was a partnership between Kiribati and the New England Aquarium including joint scientific research, with funding and technical assistance from the CI Global Conservation Fund and Pacific Islands Program, which is part of the Coral Reef InitiativeS in the Pacific (CRISP) program.





This pie chart (or ‘camembert’ in French) presents the economic goods and services (in US\$) provided by the coral reefs and lagoons of Moorea, French Polynesia. An assessment was made of the possible economic contributions, but these 9 (of the total 20) represent most of the value. Of particular note are the non-extractive value of tourism and aesthetics which reinforce the need for effective management of damaging impacts (pollution, over-fishing, and possibly control of COTS plagues) to sustain these values (from Charles, M. 2005, Masters Thesis).

In the Cook Islands, the Takitumu Lagoon Pilot Program is a component within the Cook Islands Marine Resources Institutional Strengthening (CIMRIS) project. This aims to enhance the management of sustainable marine resources for Cook Islanders. The Takitumu Vaka Council (TVC) provides supervision over the Takitumu Lagoon Management Plan and conducted a series of surveys focusing upon households, tourism accommodation owners and managers, to identify and channel local support to help management of their lagoon. Some of the results were as follows:

- Overall, 61% of households ticked the ‘very strongly’ box when asked if they support the TVC to lead the Lagoon Management Plan;
- The health of the Lagoon was perceived to have deteriorated over the past 10 years in the 3 villages, falling from average scores of 3.77–4.09 down to 1.59 – 2.33 (1=much polluted, 5=very healthy);
- Important uses of the lagoon for households were recreation, a source of food, ‘identity’ and pride, health, tourism and livelihoods. The tourism operators response was 99% in terms of importance for guests and business;
- When asked about work needed to be done for the lagoon project, overall 6% of the household participants considered enough was done, 99% of tourism operators felt insufficient resources had been committed to the project; and
- Pig effluent was perceived to be the major cause of deteriorating lagoon health by 3 villages, followed by septic tanks and sediment runoff. Climate change threats rated the lowest in all villages.

CONCLUSIONS

The 6733 km² of coral reefs in Polynesia Mana are mostly healthy and under low threat levels (3% regarded as destroyed, 2% at critically threatened stage, 5% moderately threatened, and 90% at low or no threat level), unless global warming threats become more severe in the next few years. The main reasons for this healthy status is the low human populations living in the area, thereby resulting in very low pressures on most coral reefs and associated fisheries, as well as the isolation of these archipelagos in the Central and East Pacific far removed from continental influences.

Despite this general healthy status, reefs have been destroyed or degraded during the last 4 years through natural events such as cyclones in Niue and the Cook Islands, COTS outbreaks in French Polynesia and bleaching in Kiribati. Human activities are putting an ever increasing pressure on reefs around populated islands, such as Rarotonga, the Society Archipelago (Tahiti and Moorea) of French Polynesia or Tarawa, Kiribati. These reefs are clearly being degraded with evidence of reduced coral cover and water quality, overgrowth by algae, reduced and changed fish populations and the presence of solid wastes, especially plastics. On most reefs the poor water quality due to unsustainable land management and sanitation are the main threats. Over-fishing is a localised threat around these populated areas but many no-take zones and other fishing regulations, such as PGEM in Moorea, have been implemented to mitigate it; success of these measures has been demonstrated at many sites. The high prevalence of ciguatera fish poisoning in populated area such as Rarotonga acts as a great mitigation measure in reducing the catch of large, potentially toxic fish species.

One positive example is the Taiaro Biosphère Reserve in the Tumaotu Archipelago, which was established in 1977 by the Man and Biosphere Programme. A small uninhabited atoll was created as a strict nature reserve and was extended in 2007 to include neighbouring atolls, such that the new Biosphere Reserve now includes 7 atolls (Aratika, Fakarava, Kauehi, Niau, Raraka, Taiaro and Toau).

RECOMMENDATIONS

- There is a need to better integrate watersheds in the coastal management of populated islands because the main sources of coral reef degradation come from the land as increased sediments, nutrients and solid wastes;
- Coral reef monitoring needs to include both ecological and socioeconomic aspects and should be included in government service program activities in order to be sustainable and not project based;
- Coral reef monitoring should be closely associated with management plans, for example in the designation of protected areas, to assess the effectiveness of management activities, and to demonstrate the direct benefits of effective management to stakeholders and adjacent islands and countries; and
- Parallel ecological and socioeconomic monitoring should be implemented in all countries to assist resource management agencies make balanced decisions on conservation and sustainable exploitation.

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