

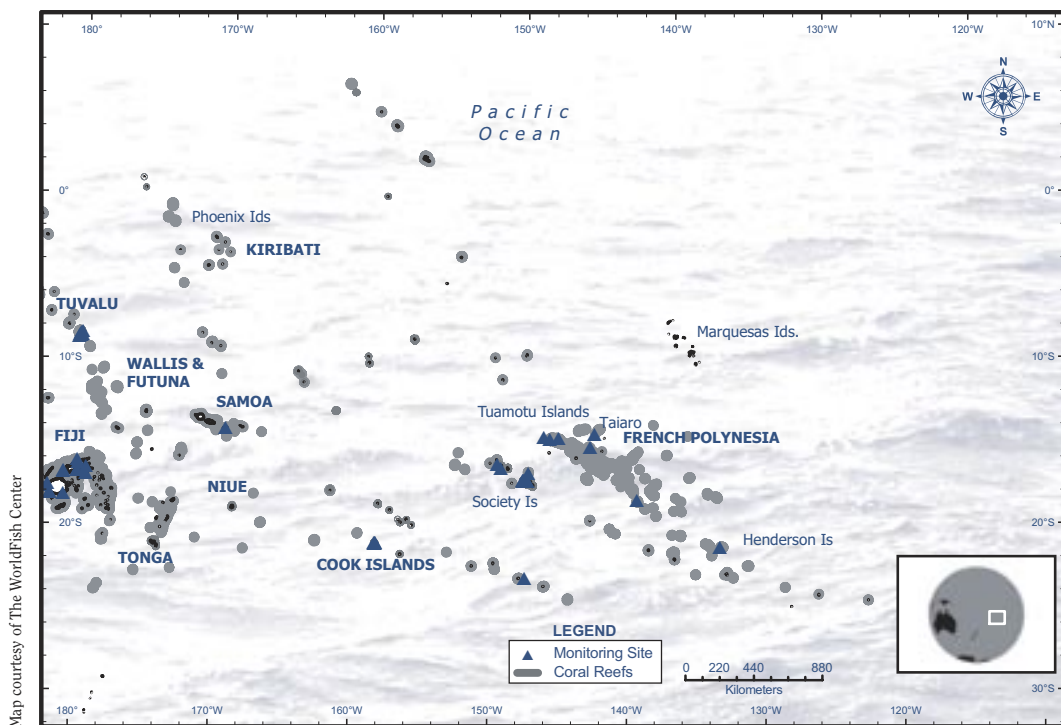
13. A CENTURY OF CHANGE IN CORAL REEF STATUS IN SOUTHEAST AND CENTRAL PACIFIC: POLYNESIA MANA NODE, COOK ISLANDS, FRENCH POLYNESIA, KIRIBATI, NIUE, TOKELAU, TONGA, WALLIS AND FUTUNA

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ABSTRACT

The Polynesia Mana Node of the southeast and central Pacific contains 7 independent or autonomous countries or territories with only 6,000 km² of land on 347 islands, but surrounded by 12 million km² of EEZ. These seas contain 13,000 km² of coral reefs as the main natural ecosystem providing food resources and opportunities for development, especially for tourism and pearl culture for 500,000 inhabitants. During the 19th and first half of the 20th centuries, there was major exploitation by the colonial powers of mother-of-pearl oysters for the button industry, as well as guano, sandalwood and trepang. The Polynesian people were largely involved in a subsistence economy and all coral reefs and lagoons were healthy. During the last two decades of the 20th, all countries experienced rapid development and urbanization, rising populations, and some increased agriculture. These developments were limited to a few islands of each country (i.e. 15 islands amongst the 347) with resulting degradation of the coral reefs around these sites. The other islands remained mostly uninhabited and pristine, and continued with a subsistence economy. Generally, there was more damage to the coral reefs through natural events such as cyclones and coral bleaching, than by human activities. There is however, an urgent need to combat the threats on some islands from increased sedimentation, over-fishing, dredging and nutrient pollution.

The coral reefs of Polynesia Mana are predominantly healthy and at low threat risk in the immediate future. These coral reefs are probably the least degraded and endangered in the world as they are remote from continents and in the middle of the largest ocean. The largest threat is still controversial; predicted global climate change threats of more frequent and intense cyclones, and rising sea surface temperatures causing more coral bleaching mortality. Monitoring programs are developing in each country, with some having regular programs running for decades whereas others are just starting. The Node is now a functional reality with countries signing on as partners and authors contributing to status reports. The optimistic predictions are based on increased involvement of national authorities in coral reef protection and resource management. There are many MPAs currently being planned as awareness is



raised and monitoring progresses. Local populations are participating more and reviving their culture and traditions as a basis for sustainable reef management. The pessimistic predictions will apply if governments fail in their efforts towards coral reef resource management for these coastal communities, and if they do not remedy the causes of human stresses to the reefs around the heavily populated islands.

100 Years ago: Virtually all coral reefs were healthy with normal fish populations, although pearl shell and trepang were heavily exploited from some lagoons.

In 1994: Only French Polynesia had a monitoring program and there was little awareness for coral reef management and few MPAs. The reefs were largely healthy, but there were warning signs of degradation on reefs near populated areas.

In 2004: All countries have monitoring in progress or planned and all are developing plans for stronger reef management based on raised awareness of the need for sustainable development of their resources. Reefs are damaged near centres of population, whereas remote reefs remain healthy. Climate change effects are the major threat on the horizon.

Predictions for 2014: Most reefs will remain healthy, unless the adverse predictions for global climate change of more cyclones and bleaching come to pass. Human stresses around populated islands will continue but most countries will have active programs of harm minimisation and MPA development.

INTRODUCTION

The coral reefs of Polynesia Mana (Cook Islands, French Polynesia, Kiribati, Niue, Tokelau, Tonga, and Wallis and Futuna) are remote from most of the damaging human stresses to reefs closer to large land masses. Thus, most are in generally good condition with a few near the expanding urban centres and heavily used lagoons showing signs of damage with low fish populations, low coral cover and algal overgrowth. Another supporting feature of Polynesian countries is that traditional management practices away from the capital cities are still strong, as expressed in the term 'Mana' which symbolises the stewardship relationship between the Pacific peoples and their resources. Most of the people in this Node are of Polynesian origin, although some of the islands of Kiribati are populated by Micronesians.

These countries have vast areas of coral reefs, surrounded by deep oceanic waters, which provide ideal conditions for coral growth. There are also small human populations (< 0.5 million) on 347 islands with a total land area of 6,000 km², scattered over 12 million km² of EEZ. Coral reefs grow around the many mountainous islands, atolls, uplifted atolls and low coral cays, but because they are remote from the centres of coral reef diversity, they usually have only half to a third the number of hard coral species found in Southeast Asia e.g. 115 on Kiribati, 192 on Tonga. Politically, Kiribati, Niue, and Tonga are independent countries, whereas the Cook Islands and Tokelau are associated with New Zealand, and French Polynesia, and Wallis and Futuna are French Overseas Territories. Kiribati, Niue, Tokelau, Tonga, and Wallis and Futuna have small, developing economies, whereas the economies in the Cook Islands, and French Polynesia reflect more tourism and black pearl oyster income, as well as the funds contributed by their family members overseas. Foreign aid often contributes more than 50% of GNP in some Pacific countries.

Since the last report in 2002 there has been considerable progress in coral reef monitoring and conservation, but capacity building for monitoring and management is still needed. Many of the trained staff are drawn away from the tasks of environmental conservation to comply with the requirements of the many international and regional Multilateral Environmental Agreements designed to assist these countries conserve their natural resources. Therefore support is needed to train people to conserve natural resources through field activities and manage their field staff, as well as negotiate their way through the UN Conventions to gain maximal benefits in minimal time.

This report is based on national Coral Reef Status Reports produced by most of the countries in 2004. The many experts on the region listed above provided additional information. Some of these national reports are available on www.reefbase.org. The theme for this chapter was to determine how the reefs have changed over the past century or more, specifically focusing on recent decades. This coincides with an increased global awareness of the need for coral reef conservation and management and the formation of the International Coral Reef Initiative (ICRI) in 1994. In many parts of the world, there is considerable pessimism about the immediate future for coral reefs, thus the Chapter ends with both pessimistic and optimistic scenarios for the coral reefs of Polynesia Mana and recommendations to move towards an optimistic scenario.

POLYNESIAN REEF STATUS PRIOR TO 1994

During the 19th and early 20th centuries, the colonial powers exploited the once flourishing mother-of-pearl oyster populations in Pacific coral reef lagoons. Vessels sailed from Sydney to cross the Pacific through the Cook Islands and French Polynesia and arrived in Europe carrying large cargos of the black-lipped pearl oyster, *Pinctada margaritifera*, to be made into buttons. As early as 1865, there were reports of depleted stocks and calls for regulations to conserve the resource. From the earliest times, most Pacific Islands were governed under ‘Customary Marine Tenure’, which had largely been developed as a marine conservation mechanism to ensure that the harvest of resources, especially fish and giant clams was sustainable. Those mechanisms now form the foundation for many Pacific Island fishing regulations. In Kiribati for example, this system “underpinned villagers’ resource management, providing them with the incentive to look after their marine resources by ensuring that they could retain for themselves the future benefits of doing so” (from Johannes and Yeeting, 1995). In French Polynesia and Cook Islands, *Rahui* or *Ra’ui* (a system of taboos) was imposed by chiefs on some marine areas, in a bid to turn them into temporary no-take zones to protect fish spawning, or to ensure that there was suitable food for upcoming celebrations.

In Tokelau, *inati* was the traditional communal resource distribution system. The *taupulega* (village council) controlled the harvesting and distribution of all resources and each family would receive the same amount of fish, irrespective of the amount of land they owned. This *inati* system was an important form of resource management because it generally avoided waste, enhanced food security, and conserved energy because not all villagers needed to fish.

When traditional management prevailed on Niue, the elders reported that reef resources were more plentiful, and less effort was required to catch sufficient for the needs of the community. Now they report that there has been a reduction of 70% in hard coral cover on the reef flats in the last 30 years, and that key target species of invertebrates and fishes have declined along with the corals on the slopes. These stories of the elders over the past 60 years, confirm the measured decline in status of the reefs and their fisheries resources, and illustrates a breakdown in the management systems.

In the 1950s, major changes in the status of key marine resources became apparent, even though colonization had been on these islands for many decades. Initially the British colonial leaders in Kiribati accepted customary sea tenure “to prevail and ensure that the long-term fishing interests of the Kiribati people were protected from outside interests”; however, in the 1950s, the colonial administration introduced the European principle of open access fishing, ‘anywhere and at any time’, thereby over-ruling traditional norms. In Tonga, the end of the customary marine tenure and the beginning of open access to marine resources dates from 1875. Despite these rule changes, community resource management continued to play a key role mostly through transmission of traditional knowledge between generations, but this has slowly faded and there is now open access to marine resources. Furthermore, the introduction of cash economies in the 1950s removed the sacred and protected status from some species so that they became just another source of food and income for the community, irrespective of past traditions.

Economic development is starting to impact on the marine habitat, not only because of open access to the resources. In French Polynesia, the 1960s represented the beginning of economic

development linked to nuclear testing in the atolls of Mururoa and Fangataufa. Building development and urban growth also lead to modification of the coastline and massive habitat degradation and loss around the main town Papeete on Tahiti. French Polynesia was only just ahead of other Pacific countries with the development of large population centres in the following decades in Tonga, Kiribati and Cook Islands.

The major threats to coral reefs of Polynesia Mana countries prior to the mid 20th century were through mother-of pearl exploitation, as well as guano mining, sandalwood deforestation, and trepang collection. Most islands had subsistence economies with a reasonable balance between natural resource generation and human exploitation because their cultures and traditions were closely linked to coral reefs. The major factors degrading reefs were natural, such as tsunamis (which have left only geomorphological evidence) and cyclones such as those in 1903-1906, which claimed hundreds of lives in French Polynesia. The other 'natural' disturbances such as crown-of-thorns starfish (COTS) plagues and coral bleaching have only been recorded since the 1950s. These coincided with the first examples of local commercialisation of coral reef products (fish, shells for curios), followed by pearl culture and tourism development.

In the decades prior to 1994, reefs in Polynesia Mana countries were predominantly healthy, because of the relatively low populations on most islands and the use of traditional management systems. Then increases in commercialisation put more pressure on the resources. These increases were to have more serious consequences in the following decades as increasing urbanization put heavy pressures on reef resources without any measures being taken to find alternatives to traditional management practices.

POLYNESIAN REEF STATUS AND MANAGEMENT IN THE 1990s

In 1994 the coral reefs were coming under increasing pressures from rapidly rising human populations, urbanization, and agricultural and industrial development. These human impacts varied from virtually nil or minimal on remote outer islands and reefs, to intense pressures around urban areas. Marine environmental management was minimal in all Polynesia Mana countries in the early 1990s, and there was little awareness about threats to coral reefs, both among local populations and other stakeholders. Although there were usually sound regulations, no efforts were made to enforce the rules.

Tonga

The most disturbed areas in Tonga now are: Faga'uta lagoon in Tongatapu (eutrophication, major coral mortality and collapse of fisheries); and Nuku'alofa and adjacent northern Tongatapu (physical disturbance, loss of habitat, eutrophication, over-fishing, coral mortality); inner Neiafu harbour in Vava'u (sedimentation, COTS, over-fishing, coral mortality); and Pangae harbour on Lifuka Island in Ha'apai (eutrophication, high coral mortality) are locally disturbed. There were 9 MPAs off Tongatapu in the 1990s, but these had no management, education or enforcement programs. Tonga, like French Polynesia, Kiribati and Niue, had limits on catch sizes for fishes, invertebrates and shellfishes, but enforcement was usually poor.

Kiribati

The problems are similar in Tarawa (Gilbert Group, Kiribati), where the dense population of the atoll affected the lagoon through intense fishing pressure and the construction of causeways that closed the small passages between islands in the southern and eastern sides of the atoll. Another effect in Tarawa is poor human health due to very poor sanitation e.g. more than 90%

of the population have contracted hepatitis. Reefs around the concentrations of people show clear signs of eutrophication with little live coral remaining, whereas reefs in the north and west of the lagoon appear healthier.

French Polynesia

A decade after the first big natural disturbances of the El Niño years in the early 1980s when there were 5 cyclones and a major COTS outbreak, many of the outer slopes have recovered with near normal coral and fish populations returning. However, fish populations were clearly depleted in the lagoons, which had not been affected by the natural disturbances. There were significant coral reef population changes between 1971 and 1992 on Moorea, which were closely linked to human pressures. In 1995, the outer slope reefs were still dominated by hard corals due to a lack of human disturbances; the top of the barrier reef was an intermediate case where corals were less abundant compared to the past but still dominant and were able to compete for space with macro-algae; whereas the fringing reefs, which had been dominated by corals, changed into a macro-algal dominated community, especially near the sources of human disturbance. At that time, Moorea was not typical of French Polynesia as a whole, but this example demonstrated the growing concern about the status of lagoons of the major populated islands of Tahiti, Moorea and Bora-Bora; these were only 3 islands out of 118.

As early as the 1970s, the Government of French Polynesia started working towards better planning and focused on the high biodiversity and threatened ecosystems, especially on Tahiti, Raiatea, Moorea, and Huahine of the Society Archipelago. They were aware that establishing MPAs in lagoons adjacent to high levels of human activity was futile, but still they wanted regulations to ensure a sustainable use of the resources. Thus in 1971, 6 MPAs were established in the uninhabited atolls of Scilly and Bellinghausen and in 4 islands of the Marquesas (Eiao, Hatutu, Sable and Motane) after a regional conference in Noumea suggested that 39 islands of the Pacific should become special reserves. The Taiaro atoll in the Tuamotu Archipelago was declared as a UNESCO 'Man and Biosphere' reserve in 1977 (Box p 380). These MPAs were launched before the development of strong economic and political pressures to exploit coral reef resources. These protective measures for the future were effective, even though there were no management plans and some conflicts occurred such as in the Scilly Atoll which contained the only protected natural mother-of pearl oyster stocks.

Tokelau

News of the declining status of some reefs in the Pacific in 1994 had no effect on Tokelau as the problems did not seem relevant. At this time there was a report on the status of the environment which warned the population to be careful not to over-exploit the resources. The main concern was the use of modern fishing methods which increased fish capture while reducing effort. There were also reports of decreasing numbers of turtles, giant clams, black pearl oysters and coconut crabs. The use of modern fishing techniques (introduction of aluminium boats with outboard motors, monofilament gill nets, steel fishing hooks, fish aggregation devices) was disturbing as it contributed to non-sustainable harvesting of specific species. In addition, the authority of the Elders to impose effective management methods had been reduced. More recently, rusting old shipwrecks on the reef flats may be poisoning fish, and there have been calls for assistance to remove these wrecks.

Niue

The reefs were still recovering from the large 1990 cyclone 'Ofa' when in 1994 it became apparent that some highly prized species of invertebrates had been significantly over-fished

(clams, lobsters, some shellfish). Furthermore, some of the previously plentiful ornamental shells were quite rare. The people all reported reduced catches of shellfish, and there were growing perceptions that many reef resources were declining. However, as the human population on Niue was also declining due to out-migration to New Zealand, it was believed that the resources would recover as fishing pressures reduced. The Government's mission statement and objectives aimed for sustainable management of the resources, but these initiatives and plans were not publicised, enforced or effective.

MONITORING AND MANAGEMENT OF MPAs IN 1994 AND NOW

When the International Coral Reef Initiative was launched in 1994, there were very few MPAs in Polynesia Mana countries and these were predominantly 'paper parks'. Some were effective, but mostly because they were on uninhabited and remote islands. A Kiribati fishery officer explained: "a *paper park* means that it is known only to the people in the environment and fisheries departments who are interested in conserving their resources. The general attitude of the locals was - go out fishing at any desirable place, take whatever you catch and be a real fisherman".

Ten years later, things have improved as many MPAs have been established or planned in all countries; although, the level of management, monitoring and effectiveness varies considerably from one country to another. Very few of the established MPAs are monitored, thus, it is difficult to evaluate their effectiveness and use them to demonstrate the benefits of protecting these areas to the local communities.

An exception is Kiribati, where there are no MPAs, not even 'paper parks' despite many attempts since the late 1980s to introduce them. According to the Fisheries Department, this lack of MPAs is due a lack of funds. There is, however, a *de facto* MPA on Kiritimati (Christmas Island) since the islands are government owned and people found poaching before 1994 were sent back to the Gilbert Group. Now there is no incentive to poach resources from Kiritimati.

In Niue, the first MPA was established by the Fisheries Department in 1998, as a precautionary approach as no declines in resource stocks had been demonstrated. A baseline resource survey was conducted via the Secretariat for the Pacific Community (SPC) in 1998 with the view towards regular monitoring every two years. Due to a lack of resources and staff, the first follow up survey was conducted in 2004 following cyclone 'Heta'. Additional MPA assistance is being provided by the International Waters Project.

In Tokelau, MPAs were set up by the Council of Elders in the 3 atolls a few years ago. However enforcement is not effective, despite very strict traditional rules, these areas are still harvested for occasional celebrations. ICRAN started a program in Tokelau in 2003 to attempt to improve the effectiveness of their marine conservation.

In Tonga, efforts are now under way to conduct baseline and monitoring studies in a number of areas and analyse all existing data. Similar efforts are in progress to implement MPAs that were planned by the Environment Department. However, there are considerable constraints due to poor capacity for monitoring, surveillance and enforcement.

In the Cooks Islands, there are 13 MPAs around Rarotonga which are managed by village chiefs using the traditional *Ra'ui* system. Monitoring in 2002 showed that fish stocks have recovered

TOWARDS BETTER COASTAL RESOURCE MANAGEMENT IN NIUE

Little has been published about the coral reefs of the small raised coral island of Niue or the people who live there. Two major cyclones in 1990 and 2004 battered the island and reefs causing major damage. A 7-year GEF International Waters Project (IWP) has been implemented to assist the communities develop sustainable coastal fisheries and establish MPAs, because there has been destruction of fisheries habitats and over-fishing. National activities have included: establishing a National Task Committee with key stakeholder representatives from fisheries and government; a project development team to work with communities to find solutions; in-depth consultations on the key fisheries problems and causes; selection of Alofi North and Makefu as target communities for fisheries management; assessing the status of fisheries in these two host communities; and developing an awareness-raising campaign. Potential solutions to fisheries problems include the establishment of local rules and penalties to protect fisheries (possibly via new by-laws) and a series of MPAs, as well as introducing new income-generating activities to support reductions in fishing. Similar activities are underway in other Pacific island countries to address the root causes of environmental degradation.

in the protected areas. The remaining issue is the absence of sewage treatment, which has resulted in high nutrient levels in the lagoon that prevented the recovery of corals in the MPAs. This problem remains in 2004 but the Government is drafting regulations to ensure that effective sewage treatment is implemented for commercial businesses and private dwellings.

In Wallis and Futuna, the traditional chiefs approached the environment administrators in 1999 and requested the creation of MPAs. Three areas were chosen to include varied ecosystems (seagrass beds, barrier reefs, reef slopes). Mooring buoys were installed in 2002 to make the boundaries clear but there has been no monitoring.

In French Polynesia, the 'Marine Area Management Plan' (called the PGEM) was based on strong community consultation and launched in Bora-Bora and Moorea in 1998. The Plan aims to: involve all lagoon users in determining the regulations; ensure that the marine resources are sustainably exploited; preserve the high value and threatened ecosystems; and ensure that all lagoon users maintain harmonious relations. The biggest problem has been the conflict between the local user community and the tourism industry that is important for the economy of French Polynesia. The Plan was launched 6 years ago and there are still no clear zone boundaries in the lagoons of Moorea and Bora-Bora, but there is a strong political will to finalise these plans, at least for Moorea. A monitoring program in the 8 MPAs in Moorea started in 2004 following BACIPS protocols (Before After Control Impact Paired Series), in which islands with an MPA (the 'Impact' site) are compared with islands without an MPA (the 'Control' site) at least several times 'Before' and 'After' establishment of the MPAs. Comparison of islands with and without MPAs may estimate regional effects of MPAs, while comparison inside and outside of MPAs may estimate local effects. Such a design has never been fully tested; the islands of French Polynesia provide an outstanding opportunity to scientifically evaluate the concept through a research project. Fish, invertebrate and coral samples are currently monitored inside and outside the proposed reserves under the Moorea PGEM. Similar

A MARINE RESOURCE MANAGEMENT PLAN FOR TOKELAU

The 3 atolls of Tokelau are virtually unknown, except to the Tokelauans. The 2001 'World Atlas of Coral Reefs' includes only a brief reference of Tokelau. In 2004, a multi-disciplinary assessment team assembled under the ICRAN program and SPREP visited Tokelau to assist its government develop a program of MPAs. They completed a rapid assessment of the significant marine resources, surveyed fishing activity, conducted workshops with the community and traditional leaders to identify their requirements and wishes for the marine environment. They also canvassed actions needed to ensure the sustainable use of their marine resources, and recommended measures to be included in the Marine Resource Management Plans for each atoll. There were clear signs of overfishing and over-exploitation in the 3 lagoons, with many species being rare, and other species in low abundance and reaching maturity at smaller sizes. Although there is less subsistence fishing, the marine resources are under greater pressures because of more efficient fishing gear, motorised fishing vessels, and increased fishing for 'export'. Until recently, Tokelau was particularly isolated, but there are new market forces, as fish are being sent to family members overseas, especially in New Zealand, because there is regular transport connecting Tokelau to the wider Pacific. The communities were aware of the decline of their marine resources but did not recognise that their fishing methods, including the use of fine mesh nets, were responsible for this decline. The community leaders welcomed assistance to set up MPAs and acknowledged that the existing MPA was largely unsuccessful. The ICRAN team suggested new Conservation Areas building on the results of the ecological assessment. The Tokelauans showed strong interest and concern for their resource sustainability during consultations at community meetings. A report on the findings, and recommendations for potential new locations for MPAs, and the establishment of a long-term monitoring program will be presented in Tokelau in 2005.

data from other islands without MPAs will be used as controls. This program is expected to significantly advance our understanding of the effectiveness of MPAs.

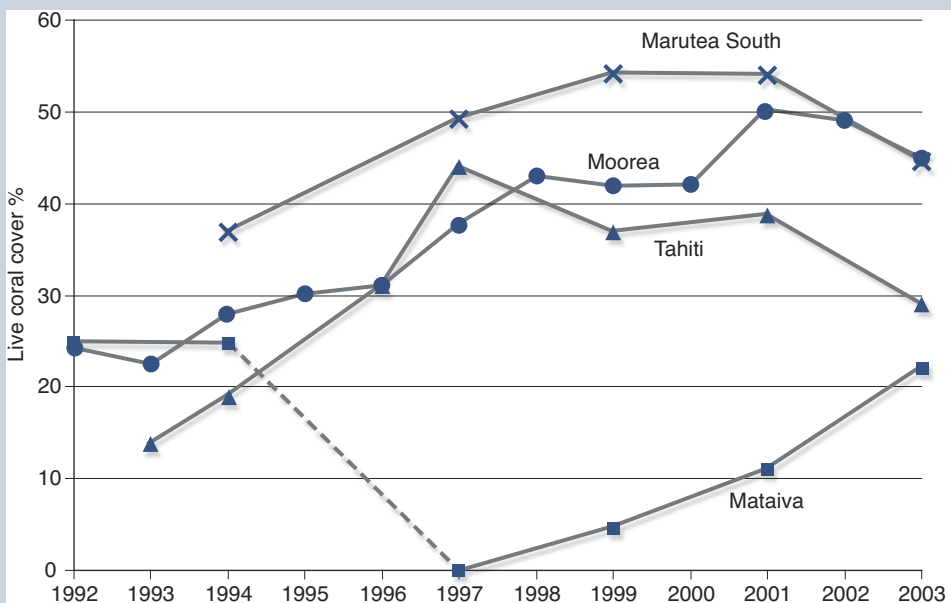
STATUS OF POLYNESIA MANA REEFS IN 2004

Niue

Cyclone 'Heta' battered the island in early 2004 with disastrous impacts on both the island and coral reefs on the western side. About 20 to 90% of the reefs were flattened on this coast where most of the economic activities occur, especially reef fisheries and tourism ventures, including diving. There is only one dive shop and all of its dive spots were destroyed. Prior to that, the reefs were in good condition as it had been almost 14 years since cyclone 'Ofa' and the coral cover had recovered to be very healthy in previously impacted areas. Cyclones are the major threat to the small island of Niue and the reefs have suffered considerably in the last 30 years from 6 large cyclones in 1959, 1960, 1968, 1979, 1990 and 2004. The last 3 were the most severe and all impacting on the same sites.

LONG-TERM MONITORING PROGRAMS IN FRENCH POLYNESIA

Long-term monitoring programs of outer reef slopes in French Polynesia have shown that: coral cover is relatively stable on Moorea at about 50% cover; there have been new bleaching events in Marutea South and Tahiti between 2001 and 2003; there is almost complete recovery of Mataiva reefs since the devastating cyclone in 1998 (25% cover in 1994, 22% in 2003); and coral cover on Tahiti has dropped from 40% to less than 30% in 6 years. The monitoring network of French Polynesia is upgrading to assess fish populations as well as the substrate on the 14 islands.



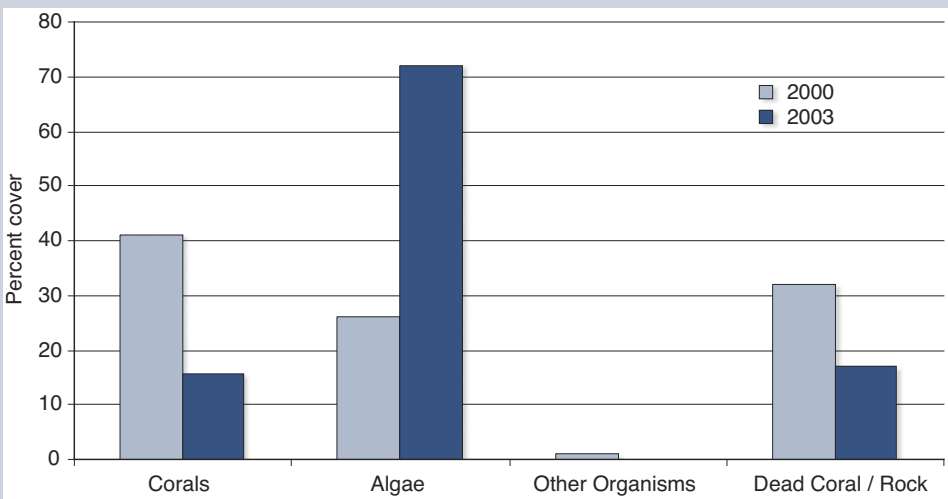
Live coral cover on 4 French Polynesian reefs shows a contrasting pattern since 1991, with sudden declines from major stress events, followed by long periods of recovery. Coral bleaching in 1991 resulted in major losses on Moorea and possibly on some of the other reefs, and another bleaching bout in 1994 combined with a cyclone reduced cover on Mataiva. A localised bleaching event on Tahiti in 1997 reversed some of the earlier recovery.

Wallis and Futuna

The outer slopes were first monitored in 1999, but only one set of repeat data were collected in 2002. These 2 surveys show a decrease in live coral cover on Futuna West from 16% to 12% in 2002, and Alofi dropping from 19% to 9% in 2002. By contrast, coral cover increased in Wallis West from 22% in 1999 to 38% in 2002. The first status report in 1999 warned that anthropogenic threats of massive sediment inputs, dredging, land reclamation, blast fishing etc. were damaging the reefs and recommended specific conservation measures. But 3 years later, no conservation measures have been implemented and the coral cover continues to decrease. The increase in coral cover on Wallis is probably due to the large lagoon that buffers the outer slopes from the polluted island waters (there is no lagoon on Futuna). Coral bleaching was observed in early 2003 down to 20 m but there has been no assessment of coral mortality.

STATUS OF REEF SLOPES AROUND RAROTONGA, COOK ISLANDS

There was a decrease in coral cover on the fringing reefs of Rarotonga between 2000 and 2003. This decline was not due to polluting industries as there was no significant nutrient loading stress on these outer slope reefs. Therefore the likely causes are global stresses such as seawater temperature increases and predation by crown-of-thorns starfish. Currently, the coral cover at 10 m is relatively stable with no evidence of recent mortality, however the coral cover and diversity are low. There is some evidence of unusually slow recovery and echinoderm numbers are significantly higher, possibly due to increased algal cover. There are few crown-of-thorns starfish, probably due to a lack of suitable coral food for them. From S. Lyon.



Coral cover has decreased in parallel with increases in macro-algal cover on the fringing reefs of Rarotonga. It is suspected that a combination of bleaching and predators has killed some corals.

French Polynesia

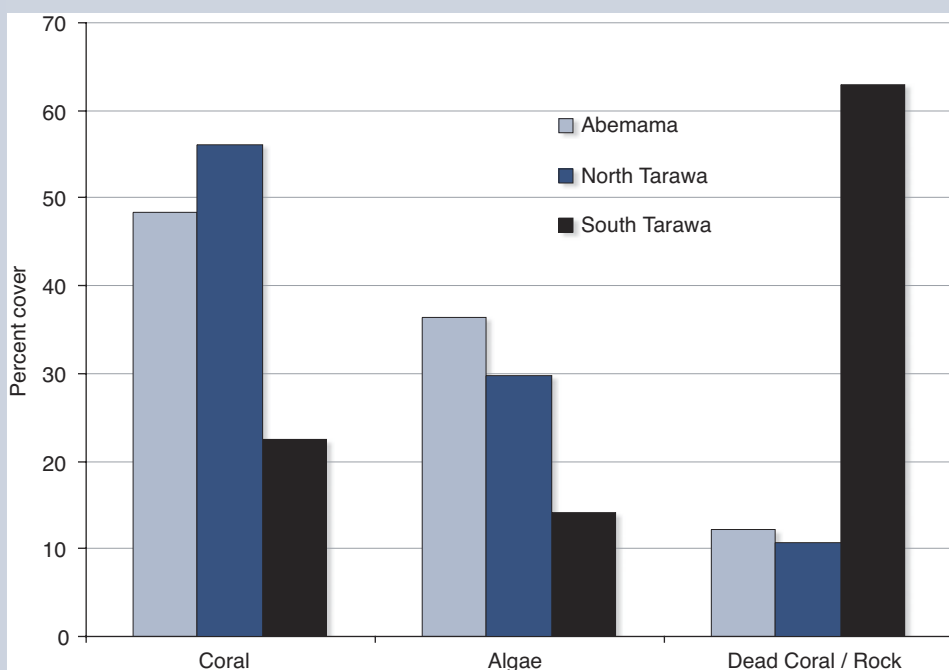
The reefs are generally in very good condition, especially the outer reef slopes of the high volcanic islands and atolls, as there have been no major natural disturbances during the past decade. Some of the lagoons of the more developed Society Islands are under increasing pressure with evidence of degradation near urban concentrations and excessive tourist resort development. The French Polynesian government is particularly concerned about the pearl industry, which is expanding in the lagoons of Tuamotu atolls. Monitoring programs have been implemented to follow water quality and the health of the environment and the pearl oysters.

Cook Islands and Tokelau

Rarotonga has experienced several COTS outbreaks and there is recent evidence of bleaching damage on Tokelau. Fish poisoning is a growing concern in Tokelau with a rusting old shipwreck suspected of poisoning fishes in the atoll of Fakaofu. Locals have requested assistance to remove it, however, a clear relationship between this wreck and fish poisoning has not been established.

CORAL MONITORING DATA NOW COMING FROM KIRIBATI

Six long-term sites were set up for annual monitoring in the Gilbert Group of Kiribati in May 2004, by the Fisheries Department and the 'Polynesia Mana' coordinator in collaboration with the Procfish program of the South Pacific Community. The sites on the outer slopes at 6 m will be surveyed annually as part of training in data collection and analysis. The first results show significant differences in the coral cover around Tarawa, with the North reef slopes having up to 50% cover including 30% cover of the blue coral, *Heliopora*. The slopes of South Tarawa have a substantial amount of dead coral cover (60%) and virtually no cover of calcareous coralline algae. This difference is probably linked to the much higher human population on South Tarawa, compared to the North. Coral cover is close to 50% on Abemama, an outer island, and similar to North Tarawa but with less blue coral and very few dead corals. On the nearby island of Kuria, there is lower coral cover (13 to 30%).



Coral cover on South Tarawa is much reduced compared to other areas, probably reflecting the direct pressures from the larger concentration of people.

Fish poisoning is also recorded in the two neighbouring atolls of Nukunonu and Atafu where there are no shipwrecks.

Kiribati

There was massive fish mortality in some atolls of the Gilbert Islands in November 2003. Various species of fish were killed, including small herbivores and larger carnivores, moray eels and even some dolphins. A toxic algal outbreak was suspected but this was not confirmed

as there was no follow up analysis. Live coral cover appears to be negatively influenced by the proximity of the massive urban sprawl of Tarawa, but some of the low populated outer islands also show low coral cover.

The countries of Polynesia Mana have not been involved in any major export or import of coral reef resources (excepting pearls). The harvesting of live fish, especially groupers for the restaurant trade in East Asia (especially Hong Kong), is presently limited to countries of the Southwest Pacific.

PREDICTIONS FOR POLYNESIA MANA REEFS

Optimistic

Optimistic predictions arise from the motivation of Fisheries and Environment authorities to seek involvement in monitoring networks and conservation programs, and from the increasing awareness of local communities about the decline in their marine resources. It is hoped that such increased motivation will attract more donors to support management programs, so that by 2014, there will be many more trained staff in all Polynesia Mana countries managing an effective network of MPAs. The optimistic position includes regular monitoring programs that are producing data to assist managers assess the effectiveness of protected areas, and used in adapting management measures to ensure resource sustainability. Enforcement is currently a major issue in Polynesia Mana countries, and it is hoped that punishment, which is becoming necessary in many islands, will not be required, as people will realise the benefits of protecting the resources. Natural disturbances will have fewer consequences for the reefs because effective management will mitigate damaging human stresses. Coral bleaching events

CLIPPERTON ATOLL INTEGRATED INTO POLYNESIA MANA

The 'Polynesia Mana' node and the French Coral Reef Initiative (IFRECOR) will expand to include Clipperton - one of the most remote and strange 'atolls' in the world. There is a 30 m high basaltic rock rim that is 12 km long and totally encloses a 30 m deep lagoon that smells strongly of hydrogen sulphide. The first visitor was the English pirate, Clipperton and the next real exploration was by Jacques-Yves Cousteau. The atoll is 1100 km to the west of Acapulco, Mexico, 4018 km from the Marquesas of French Polynesia, 4940 km from Hawaii, and 2390 km from the Galapagos Islands. It is so remote that the only inhabitants are numerous birds and red crabs. Ownership was disputed between France and Mexico until 1931 because of the 200 mile exclusive economic zone, which is rich with tuna. However, it is impossible to control exploitation due to the remoteness of this uninhabited island. Although there is much information on the flora and fauna, there have been no systematic assessments and no monitoring. Monitoring will now be conducted by the French explorer and documentary maker, Jean Louis Etienne and WWF France, and will commence in early 2005. An expedition of 40 specialists from Mexico and the Moorea Research Center will rotate on the island and monitor 2 sites at 12 m on the outer slope to assess corals, fishes and other prominent organisms. The Clipperton reefs have no anthropogenic impacts with the only threats being cyclones and possible bleaching events, although these have not been recorded.

NEW INITIATIVES IN FRENCH POLYNESIA AND WALLIS AND FUTUNA

There has been increased emphasis on coral reef ecology, social science and management initiated in French Polynesia and Wallis and Futuna through the French Coral Reef Initiative (IFRECOR) since 1999. A guide for restoration of degraded coral reefs in French Polynesia has been published in French and English after field studies on Bora Bora and Tahiti. All old coral mining sites around Moorea have been surveyed, and projects have commenced to rehabilitate landscapes for the benefit of fishermen and tourists. Management plans have been developed to include protected areas that are being monitored in Moorea, Bora Bora and Fakarava. There have been no declines in fish catches by the local communities on Moorea over a 10-year period (49 tons per year in 1992 vs 78 in 2002). Fishing is the main activity for about 20 families amongst 13,000 with most of the fish sold by the roadside. The environmental impacts of hotel sea bungalows have been studied (lagoon ecology and landscapes), to assist in determining carrying capacity by local authorities.

Reef fishing is an important activity on Wallis, with 34% taken for home consumption, 21% for exchange and 42% for sale. Coral reef protected areas covering 50 ha have been planned and are currently being considered for ratification within local and customary laws. Human pressure on these islands is high with 34 km of the 52 km coastline altered with human constructions (including low wall and rocks to protect private property and roads). Only 18 km of coastline is uninhabited. The Polynesia Mana node is now conducting coral reef monitoring.

will cause less damage to healthy corals and there will be better recovery of reefs after events such as COTS outbreaks or cyclones, because effective management systems will avoid other damaging pressures.

Pessimistic

The pessimistic position is based on a projected failure of countries in the region to establish effective management systems by 2014. Reef resources will be insufficient to provide sufficient food for coastal communities of the region. When the alarm is raised, it will be too late because the reefs will have declined to such a poor state that it will be impossible to reverse due to the accumulated effects of pollution and fishing pressures, combined with bleaching events, cyclones etc.

CONCLUSIONS

100 Years ago: The only pressures on the coral reefs were natural and through exploitation of pearl shell and trepang by colonial seamen in many lagoons. The reefs were predominantly healthy with normal fish populations supporting subsistence livelihoods of small populations of predominantly Polynesian, and some Micronesian, people.

In 1994: There were clear signs of damage to coral reefs around the main islands in all countries from sediment runoff, nutrient pollution, over-fishing, and shoreline modification and dredging. The remote reefs were predominantly healthy although there had been recent

damage from cyclones and some coral bleaching. The only coral reef monitoring was on a few reefs in French Polynesia, and there was generally little awareness within governments and local populations of the need for coral reef management or the establishment of MPAs. Traditional and customary knowledge and management practices were being eroded and largely ignored, except on the remote islands.

In 2004: Damage to coral reefs near populated centres continues and there have been major warnings of potential global climate change impacts with recent strong cyclones and several bouts of coral bleaching. The GCRMN Node is now functional with all countries undertaking some coral reef monitoring and all have plans for more monitoring to support stronger reef management. There is increased awareness within governments and island communities of the rising levels of damage to their coral reefs, and the need for sustainable management of their resources. Efforts are being made to reverse the damage near centres of population by removing the causative stresses. The remote reefs continue to remain healthy, but there are repeated signs of coral bleaching.

Predictions for 2014: Most reefs will remain healthy, unless the adverse predictions for global climate change or more cyclones and bleaching come to pass. Human stresses around populated islands will continue but most countries will have active programs of harm minimisation and MPA development.

RECOMMENDATIONS FOR AN OPTIMISTIC OUTCOME IN 2014

People with many years of experience in Polynesia Mana countries have formulated the following recommendations to move towards the optimistic scenario in the next 10 years. They recommend:

- Stronger cooperation between countries, especially in formulating inter-governmental environmental decisions and seeking regional funding to solve shared environmental problems;
- Establishing stronger political and public recognition of the important value of coral reefs in the lives of the people who rely on them for food security and income, as well as the contribution of reefs towards protecting fragile shorelines of the islands;
- Convincing all sectors of the population of the current and future threats to reefs and their resources and the roles that the population can play to ensure they are well managed and conserved;
- Ensuring that adequate resources and technical assistance are provided to assist Pacific Island countries in effective assessment and monitoring of coral reefs and associated marine resources;
- Incorporating traditional and modern resource management practices to form a comprehensive and integrated community-based Resource Management Plan;
- Training local agency staff (e.g. in Fisheries Departments) to effectively manage the reefs and their resources thus forming the basis for long-term sustainability of management and monitoring programs; and
- Making sure that sufficient capacity and resources are available to support community-based management initiatives and programs.

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WHS

HENDERSON ISLAND, UNITED KINGDOM - WORLD HERITAGE SITE

Henderson Island is one of the few raised atolls in the world that remains virtually unaltered by man. It has an area of 37 km², a maximum height of 33 m, and is part of the particularly remote Pitcairn Islands in the southeast Pacific. There are fringing reefs around half of the islands, although live coral cover is low, ranging from 5-30% on the fore-reef slopes. There have been scientific missions to record species on Henderson's reefs, however many species remain unidentified. Approximately 1% of the total French Polynesian green turtle population uses the island for nesting. Although home to 183 species of fish and 305 species of marine molluscs, there are few endemic species.

The island is uninhabited, but Pitcairn Islanders visit Henderson Island occasionally to collect timber for curio making. The only other visitors to the island are scientists and cruise ship visitors. Its pristine state and isolated location are suited to the study of the dynamics of island biological evolution and natural selection. The Pitcairn Island group is a dependant Overseas Territory of the United Kingdom and Henderson Island is Crown Land. Access to Henderson requires a licence issued by the Governor, following approval by the Pitcairn Island Council. Henderson Island has not been declared a protected area, although it receives *de facto* protection due to its isolation. The island was inscribed as a World Heritage Site under the World Heritage Convention in 1988. The UK Joint Nature Conservation Committee has published a management plan recently to establish a management committee, investigate feasibility of a permanent ranger, and stimulate scientific research.

Ecological Monitoring: There are plans to encourage research activities and to develop a monitoring program for native species of conservation importance as well as threatening alien species. There are ongoing discussions between the French Research Center on Moorea and the UK Joint Nature Conservation Committee to establish monitoring sites on fore-reefs of the island, with the results to be integrated in the Polynesia Mana node of the GCRMN.

Socio-economic Monitoring: There is no current monitoring, as the island is uninhabited, but management is focused on long-term sustainability of forestry operations and the tourism industry.

Contact: www.ukotcf.org or admin@pitcairn.gov.pn

Coral reefs are 20% of the natural resources:

Ecological Monitoring is occasional with more planned.

Socio-economic Monitoring: is planned.

MAB

ATOLL DE TAIARO, FRANCE - MAB SITE

Atoll de Taiaro, Tuamotu Archipelago, French Polynesia, was declared a Man and Biosphere reserve in 1977, and is now considered a core area for the future Tuamotu Biosphere Reserve. This enlarged reserve will include 6 other atolls (Aratika, Kauehi, Niau, Raraka, Toau and Fakarava), all belonging to the Fakarava community, and the adjacent ocean to 1,000 m. Taiaro is an almost circular, completely closed and uninhabited atoll, with a raised coral reef rim enclosing a 5 km-wide, 15 m deep sandy lagoon. Outside, the bottom drops to 500 m within 700 m from the shore. There is a well-developed algal crest on the windward side of Taiaro, but the coral and mollusc communities are richer and more diverse on the leeward sides. There are also whales, dolphins, and 3 turtle species (green, hawksbill and leatherback) in the reserve.

Fakarava is the largest atoll (1220 km², 700 inhabitants) and management plans will focus on the land and lagoon resources, especially the community's traditional activities e.g. support the re-establishment of management tools such as 'rahui' or seasonal taboos to manage fish stocks. Monitoring on the Aratika outer slope since 1997 shows slight changes in coral cover: 28% in 1997; 20% in 1999; 24% in 2001; and 28% in 2003. Monitoring will start on Fakarava when the management plans are adopted, and socio-economic monitoring on Aratika and Fakarava will focus on fish exports to Tahiti and pearl aquaculture. Other human activities include fishing, black pearl cultivation, and minimal tourism. Pearl cultivation is authorised by the Consultative Commission of Public Affairs.

The earliest science on Taiaro was by the U.S. Exploring Expedition in 1839, and in 1972, the Muséum National d'Histoire Naturelle (Paris) and Ecole Pratique des Hautes Etudes assessed the ecology, geomorphology, and hydrology of the reef and lagoon. There were also scientific expeditions in 1992, 1994 and 1996. There is close cooperation between the traditional owners, the sanctuary administrative committee, the High Commissioner of France and the Government of French Polynesia to protect the atoll, lagoon and buffer zone. Access to the reserve is restricted to scientific researchers who have a permit from the committee. Harvesting turtles, tritons, other molluscs and black coral is prohibited.

Ecological monitoring: The Atoll de Taiaro continues to be a focal point for biological and physical research. Long-term monitoring is planned.

Socio-economic monitoring: Fakarava, Niau, Aratika and Kahuei atolls have small resident communities. Socio-economic monitoring is in the management plan.

Contact: Miri Tatarata, Délégation à l'Environnement, Papeete, Tahiti, delegation@environnement.gov.pf.

Coral reefs are 80% of the natural resources.

Ecological Monitoring is occasional.

Socio-economic Monitoring is planned on adjacent atolls.