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Coral Reefs of the Fiji Islands: Current Issues.

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Abstract

Coral reefs are one of the world's most spectacularly ecosystems. They have the highest densities of animals found anywhere on earth. They also are a critical resource for millions of people. At the same time they are vulnerable to natural impacts and the human - induced impacts of sedimentation, pollution, overfishing and climate change.

This paper examines the current status of the coral reefs in Fiji. Although a majority of reefs are considered to be in a healthy status, the number and intensity of the threats to this healthy status are increasing and these are described in the paper.

At the same time there is a growing response to these perceived threats through research and especially community-based marine management and monitoring. The coalition involved in this work, called the Fiji Locally-managed Marine Area Network, was recently recognized at the World Summit for Sustainable Development for its outstanding work in poverty alleviation and sustainable development. It is hoped that such work will reverse the trend of declining coral reefs and ensure future generations continue to enjoy the multiple benefits from them.

Coral Reefs of the Fiji Islands: Current Issues

Geography and Distribution

Fiji is a large and scattered archipelago of about 330 islands and 500 islets and cays, lying between 15-22°S and 177°E-179°W (Fig. 1), plus Rotuma Island at 12.5° S, 177.1° E, 386 km to the north. Fiji lies two-thirds of the way between Hawaii and New Zealand and has a land area of 18,376 km².

The approximately 1000 coral reefs in Fiji are well developed and diverse in their structure and origin, with particularly well developed fringing and barrier reefs. Fringing reefs surround almost all high islands. The most spectacular reef system is the Great Sea Reef /Yasawas/Mamanucas system, a 370 km long chain of reefs and islands (Fig. 1). Geographically isolated in the South-West Pacific, Fiji shares species with the high-diversity Indo-West Pacific but has lower diversity, for example 166 species of reef-building corals (EL unpublished data) versus greater than 400 species further west.

The population of Fiji in July 2001 was about 844,330, with a growth rate of 1.41% (CIA 2001). Ninety percent of the people live on the two large islands of Viti Levu and Vanua Levu and less than half (about 104) of the other islands are inhabited (Vuki et al. 2000). The next largest islands, Taveuni and Kadavu, are important tourist dive destinations. The major island groups are the Mamanucas, home to the majority of tourist resorts, the Yasawas, a popular destination for tourist boats, and the Lau Group which supports almost no tourism.

Threats

Fiji's reefs are considered to be in relatively good condition. Coral bleaching has had widespread impact in recent years, and reefs near large urban centres are subject to urban pollutants, heavy gleaning, coastal development and siltation. Destructive fishing practices cause locally serious damage in some parts, and include dynamiting and poisoning with the root of a local plant, *Derris* sp.

Overfishing

Most reefs in Fiji are moderately to heavily fished. Reefs closest to villages and urban areas are subject to heavy fishing pressure because of commercial fishing (Vuki et al. 2000). Reefs near villages are subject to subsistence and artisanal fishing, which can reduce the absolute and relative abundance of piscivorous fish (Jennings and Polunin 1996). Stocks of invertebrates such as giant clams, trochus and beche-de-mer have been reduced. The highly targeted reef fish species such as *Lethrinus harak*, *Lethrinus xanthurus*, *Lethrinus nebulosus*, *Bolbometopon muricatum* and all the mugilid species have been overfished in Fiji. *B. muricatum* has been fished to local extinction in most areas.

Crown-of-Thorns Starfish (COTs)

A major COT outbreak affected the group in 1965-70, followed by outbreaks in 1978-1982, 1983-1985 (Zann et al. 1990) and 1993-present (Zann and Vuki unpublished data). Chronic high densities and outbreaks have degraded coral reefs off Suva (Zann et al. 1990). Since 1996, new outbreaks have been reported annually at widely dispersed sites in Fiji, including the Mamanucas, Wakaya, Lau, Taveuni, southern Viti Levu, Kadavu and Gau (Jennings 1998; South and Skelton 2000; Cumming et al. in press; HS unpublished data). An outbreak has recently been observed at the Great Astrolabe Reef, Kadavu (Obura and Mangubhai 2002).

Pollution

In urban areas, sewage pollution, reclamation and poor land use contribute to high sedimentation and eutrophication (Vuki et al. 2000). Most urban areas lack sewage treatment and proper waste disposal. High levels of nitrates and phosphates have been found in long-term studies in Laucala Bay, off Suva (Naidu et al. 1991; Tamata and Thaman 2001).

Litter is common around all urban areas in Fiji. Most rubbish dumps are located in mangrove areas and they pose serious health risks to the public. Suva Harbour has been shown to be contaminated by toxins leaching into the marine environment from the Suva dump (Naidu and Morrison, 1994).

Outside urban centres, water quality can be high. Pollution can occur in the immediate vicinity of tourist resorts and villages. Some reefs in the Mamanuca Group have had problems with

macroalgal blooms (Zann and Lovell 1992). High levels of nutrients have recently been reported along the Coral Coast, a major Viti Levu tourist destination (Mosley and Aalbersberg, 2002).

Coral Bleaching and Cyclones

Coral bleaching has been an annual event in summer (December-April) for at least five consecutive years, 1998-2002. Minor bleaching (involving a small proportion of colonies and/or mainly partial bleaching) occurred in 1998 and 1999. Mass bleaching occurred in 2000 throughout Fiji except north of Vanua Levu, affecting 64% of coral colonies. More than 40% of colonies died from bleaching at Savusavu and Vuya Reef in Vatu-i-Ra Passage (Cumming et al. in press). In southern Viti Levu and Kadavu, 82% of surveyed colonies were affected by bleaching. Severe mortality of *Acropora* at Beqa outer reef slopes (99%) and Pacific Harbour lagoonal patch reefs (80%) near Beqa occurred between April 2000 and April 2001, and 65% mortality of *Acropora* colonies was recorded on Nukubuco Reef crest off Suva (Cumming et al. in press).

By early March 2001, minor bleaching was again widespread and some sites were on the verge of major bleaching. Cyclone Paula passed to the south at this time, and in its wake seawater cooled by more than 1°C and bleaching remained minor in most parts, with mass bleaching reported only at Verata, eastern Viti Levu. Cyclone Paula impacted reefs on the south coasts of Viti Levu, Beqa and Kadavu that were already impacted by bleaching in 2000. It overturned corals and removed many of the dead standing colonies.

Mass bleaching occurred again in 2002, concurrent with reports of severe mass bleaching on the Great Barrier Reef. The 2002 event in Fiji differed from that of 2000 in that the hot water was a surface layer above a thermocline at 2-3m. Mass bleaching was largely restricted to above the thermocline and therefore appeared restricted in most areas to shallow inshore reefs and reef tops. In this respect it was not as severe as the event of 2000.

The Seawater Temperature Monitoring Programme at the University of the South Pacific (USP) has been recording seawater temperature at numerous sites throughout Fiji since 1996. Seawater in Fiji tends to cool during El Niño and warm during La Niña, and was highest during the strong La Niña in 2000 (Cumming et al. in press).

Coral Harvesting and the Aquarium Trade

Corals are harvested in Fiji for: (a) septic systems, (b) the curio trade and (c) the marine aquarium trade. Occasionally, massive corals of the genera *Goniopora* and *Alveopora* are also exported for medical use in bone replacement. All harvested corals are exported except those for septic systems.

Septic systems

Live colonies of the genus *Porites* have historically been harvested from reefs near Suva for use in septic tanks, and the practice is ongoing. They are sold on the roadside for construction of drains and soakage pits for septic tanks, as required by Suva City Council regulations. This practice is based on the mis-assumption that the smell of wastewater overflow from sewage systems will be removed by the presence of coral, and that only corals can perform this function. The average age of collected colonies is 40-80 years and reef degradation is apparent, though no environmental impact assessment has been carried out (Lovell 2001).

The curio trade – the trade in bleached coral skeletons

This involves export of dead coral skeletons. It began in 1984 and was the principal reef product exported from Fiji until the growth of the marine aquarium trade in the mid 1990s. Fiji is the only regular supplier of curio coral from the Pacific and the chief market is the USA where they are sold as ornaments or for use in aquaria. The USA bans curio collecting from its own reefs, and selling ornamental corals to tourists is also banned in Fiji, although it does occur on a small scale in local unregulated handicrafts stalls. The fishery is under review by the Fisheries Division which is seeking to confine the harvest to sustainable levels through prohibition and limitation. Over 124,000 pieces (mostly whole colonies) are currently exported annually (Lovell 2001).

The marine aquarium trade – the trade in live reef products

Fiji is the world's second largest exporter of live reef products for the marine aquarium trade (after Indonesia), and the Pacific's largest exporter. The trade includes corals (hard, soft, gorgonians), other invertebrates (anemones, zooanthids, corallimorphs, molluscs, echinoderms), reef fish, "live rock" (calcium carbonate reef rock covered with coralline algae and associated fauna and flora) and "live sand" (reef sand with resident interstitial fauna and flora). Live rock is used for substrate and

bio-filtration in aquaria. Live sand aids in water filtration and provides a substrate for microorganisms. The market is primarily the USA and includes Japan and Europe.

Currently seven companies export live reef organisms from Fiji. Collection is contracted out to villages with an *i qoliqoli* (customary reef rights area) from which collectors fill orders for species and quantities. The market is expanding and many villages are keen to become involved for the cash income. At the same time many villages have banned these kind of collections in their *i qoliqoli* due to perceived negative environmental effects.

Live rock is removed as blocks of reef rock 15-35cm diameter. These are either packed on the beach and taken directly to the airport, or taken to holding facilities for “curing”. Curing involves being kept moist by a fine spray of seawater so the coralline algae survives while less hardy associated organisms die. Cured product is considered higher quality and has a higher value because associated organisms are less likely to die in aquaria and affect water quality.

No export limits or formal management plans exist. The only limiting factors are restricted freight space on airplanes and market demand. For corals, the size is limited to <15 cm diameter to fit in aquaria. The lack of a national coral reef management plan has resulted in conflict between the coral trade and tourism sectors.

In 1998 Fiji became a CITES (Convention on International Trade in Endangered Species) signatory, obliging it to control trade in endangered species, or species that may become endangered if trade is unregulated. This requires setting quotas, but by January 2002 required legislation had not been passed, annual reports had not been filed, and quotas had not been set so that Fiji defaulted on the terms of the Treaty. The CITES Secretariat in Geneva recommended that all signatory countries, including the USA, cease trade with Fiji in CITES-listed species from 14 January 2002. Also suspended were Yemen and Vietnam. The suspension includes giant clams (*Tridacna* spp.) and all hard corals: stony corals (Scleractinia), organ pipe corals (*Tubipora* spp.), black corals (Antipatharia), fire corals (*Millepora* spp.) and lace corals (Stylasteridae). Export continues to the USA and Japan. Trade with Europe has stopped. Aquarium fish and other benthos are as yet unlisted under CITES and therefore are not affected by the recommended ban (which also includes iguanas, parrots and flora such as timber species). A delegation was sent to the CITES standing

committee meeting in Geneva in March 2002 to seek a lifting of the suspension. It was agreed that for the ban to be lifted a quota of 50% of the 2001 permitted exports was to be imposed and the CITES legislation must be ratified by Fiji's Parliament. Fiji is currently in the process of formulating legislation.

Scientific research of harvesting impact has been inadequate, but recently Reef Check, the International Marine Alliance (IMA), the World Wildlife Fund (WWF) South Pacific Programme and the South Pacific Regional Environment Programme (SPREP) have begun organizing scientific research, capacity building and monitoring. The Marine Aquarium Council (MAC) has commissioned Reef Check to develop an assessment and monitoring strategy for evaluating sustainability and collection impacts, and pilot field testing is being carried out in Fiji. SPREP is coordinating coral identification workshops in Fiji and throughout the region to build capacity within Government in anticipation of the larger role of Customs Departments and Fisheries Department personnel in CITES compliance. Postgraduate research projects at USP are also addressing harvesting impact. Mariculture of live coral and other aquaria products is in the research phase, and some products are already being marketed by Walt Smith International.

Research and Monitoring

Historically, coral reef research in Fiji has been confined largely to Suva, where the Marine Studies Programme (MSP) of USP is situated, and the Great Astrolabe Reef, Kadavu, the site of the MSP field station. MSP is a 10 minute boat ride from Suva's barrier reefs and is equipped with SCUBA equipment, boats, drivers and laboratories. Current postgraduate and staff research projects include: impacts of fishing, mass coral bleaching, marine protected areas and aquarium harvesting, remote sensing, ecology of reef organisms and soft-sediment benthos, aquaculture of corals, algae, corallimorphs and fish, taxonomy, social aspects of subsistence fishing and marine law.

The Global Coral Reef Monitoring Network (GCRMN) and Reef Check

The mass coral bleaching event of 2000 triggered the first major activity of the incipient GCRMN in Fiji, when eight independently operating research groups made contact. They collaborated on a country-wide quantitative assessment of intensity and impact of the bleaching event that

included 19 sites covering a large geographic area (Cumming et al. in press). Monitoring is continuing at most of these sites.

The logistics and costs of coral reef monitoring in Fiji currently preclude a single research group surveying such a large area, and the GCRMN relies on the activities of various research groups, NGOs, reef-based tourist operations such as the Fiji Dive Operators Association, Greenforce and Coral Cay Conservation, and resorts. These organizations are spread throughout Fiji. The GCRMN recently mounted a campaign to involve tourist resorts in monitoring their local reefs using Reef Check and GCRMN methodology. The GCRMN is also establishing monitoring sites around Suva and collaborating with the WWF South Pacific Programme on monitoring a newly established marine protected area (MPA) at Ono Island, Kadavu (Cumming and Lovell 2001).

Reef Check is a reef monitoring programme that is simple enough to allow non-scientific personnel to contribute reproducible data to a large survey, and therefore forms an integral part of the GCRMN. Permanent sites are being established in many regions of Fiji, and training workshops for the local community and courses for resort staff are being conducted to form a network of monitors.

SeagrassNet – Global Seagrass Monitoring Programme

Kosrae, Pohnpei, Palau, The Philippines, Malaysia, Papua New Guinea, Fiji and Australia are participating in this programme to monitor changes in seagrass beds. Fiji's monitoring site was established in July 2001 on Nukubuco Reef off Suva, to be monitored every three months for two years. There is a community-based component, involving training communities to do monitoring, modeled after Seagrass Watch, the Australian community seagrass monitoring programme.

Management and Conservation

Community-based marine protected areas (MPAs)

No established system of national MPAs exists to date in Fiji. However, a growing network of village-owned and managed MPAs is in place and is based on Fiji's strong tradition of customary marine tenure. As early as 1992 traditional Fijian chiefs in the Macuata area of northern Vanua Levu closed their fishing grounds in an attempt to counter a perceived decline due to overharvesting. The

intervention was based on the Fijian tradition of closing fishing grounds in times of mourning, such as the death of a chief. The Macuata closure was not monitored.

In 1996, work began in Verata *tikina* (shire, incorporating 6-10 villages) of eastern Viti Levu with the Institute of Applied Sciences (IAS) at USP, and local group South Pacific Action Committee for Human Ecology and the Environment (SPACHEE), supported by the Biodiversity Conservation Network of the USA government. A series of environmental awareness activities were held at both the village and *tikina* levels, resulting in the following actions being approved:

- suspend issuing commercial fishing licenses to outsiders
- ban turtle and coral harvesting
- limit size of gill nets used (minimum 3 inches)
- ban use of poison from the plant *Derris* sp.
- consider declaring *tabu* (no take zone) marine areas

A subsequent two-week workshop resulted in declaration of a seagrass and coral reef *tabu* area in one village. Participants were trained to monitor indicator species identified by the community, the mangrove lobster in mangrove communities and *kaikoso* clams (*Anadara* sp.) in seagrass beds. The villagers estimated a 300% annual increase in *kaikoso* in the *tabu* area and 100% annual increase in nearby harvested areas, which encouraged other villages to establish *tabu* areas. There are now nine *tabu* areas for several important marine species in Verata.

In 1997 villagers in Ono, Kadavu declared a *tabu* area on a portion of their reef that contained two deep "blue holes". In 1999 they began work with WWF South Pacific Programme to carry out scientific surveys (Obura and Mangubhai 2002) and seek formal governmental declaration of an MPA.

In April 1998, Waitabu village on Taveuni declared a reef *tabu* area in collaboration with Resort Support, a Suva-based tourism and training company, and funded by the New Zealand Overseas Development Agency via Tourism Resource Consultants. The impetus was to develop a tourism snorkelling area and to train locals as snorkelling guides. Since 2000 it has been self-supporting and now draws an average of 22 tourists/month, with an average income of F\$700/month. The

tabu area covers 1 km of shoreline and the full width of the fringing reef, about 300m from beach to deepwater drop-off. Previously, the reef flat in particular was heavily gleaned for subsistence food items (fish and invertebrates). Surveys were begun with establishment in 1998 and have documented increases in fish species and abundance and invertebrate abundance, and improved fishing in adjacent areas (Sykes 2002).

In 1999, the Foundation for the Peoples of the South Pacific (FSP) introduced the Coral Gardens project to help communities in Fiji rehabilitate degraded coral reef habitats. They assisted Cuvu *tikina* of southern Viti Levu to develop an environmental committee that resulted in three coral reef *tabu* areas and one mangrove MPA. They work with the major local resort, Shangri-La Fijian, on sewage management and mitigation of freshwater and pollution impacts around the resort. The tourism industry is an important factor in marine protection in Fiji. The Fiji Dive Operators Association and resorts, such as the Cousteau Resort and Namenalala, seek to work with nearby communities to establish protected areas.

SPREP has funded development of an MPA at Ono-I-Lau, the southern-most and most isolated island group in Fiji. It is a collaborative effort between USP, The Women in Fisheries Network and Southern Cross University in Australia. Preliminary scientific surveys and discussions with stakeholders have been carried out, and this site may be nominated as a UNESCO Man and the Biosphere (MAB) reserve.

The Women in Fisheries Network, a regional agency, IAS and WWF hold workshops on marine conservation that are leading to the development of more *tabu* areas. Reports of the successes of these projects have attracted interest in government departments. The Fisheries Department has recently established a conservation unit that has started work with a *tikina* in Gau to promote village-level management of their marine resources. Fisheries manages an MPA around its research station at Makogai Island, east of Viti Levu.

A new initiative to encourage the different agencies to work together towards locally-managed marine areas (LMMAs) is being facilitated by USP with the establishment in 2001 of a discussion/action group called Fiji-LMMA, which includes the above-mentioned groups plus the Marine Aquarium Council (MAC) and the International Marine Alliance (IMA). Management

and conservation of reefs and their resources in Fiji is largely up to the traditional owners, and this organized network is intended to assist village, *tikina* and provincial authorities to make responsible marine resource utilization decisions.

Figure 1. Map of Fiji, excluding Rotuma in the north (12.5° S, 177.1° E) and Ono-i-Lau (20.7° S, 178.7° W) and Ceva-i-Ra (21.77° S, 174.52° E) in the south. Adapted from Cumming et al. (in press).

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