The status of marine resources and coral reefs of Nauru

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Introduction

Nauru is a single island country situated in the middle of the vast Pacific ocean, about 60 km south of the equator, at latitude 0°31'S and longitude 166° 55'E (Figure 1). Its nearest neighbour is Banaba also known as Ocean Island in the Republic of Kiribati, about 300 km to the east. Sydney is about 4000 km to the south, Tokyo, some 4800 km to the north west and Honolulu about 4200 km to the north east.

Nauru is an ancient submerged volcano with a karstified limestone cap of coral origin about 550m thick (Hill and Jacobson 1989), measuring 6 km long by 4 km wide with a circumference of 18 km and a total land area of 21 km^2. The central plateau forms about 80% of the island with the highest point to 70 m above sea level. The remaining land area is composed of a flat coastal terrace measuring 300-1000 m wide and with a mean elevation of about 3m above sea level. The shallow intertidal fringing reef measures 110-320 m in width, and sloping 45° angle to the ocean floor to a 4000 m depth. Dalzell & Debao (1994) estimated that the total intertidal reef area down to the 200 m isobath measures 7.4 km^2.

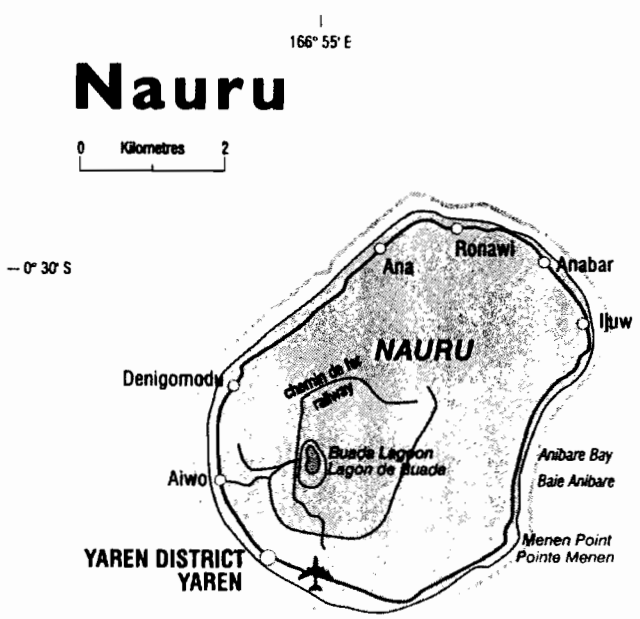

Figure 1
Map of Nauru.

The climate is tropical and humid with temperatures ranging from 24-34° Celsius, however, it is kept cool by the south east trade winds from April to October and by the westerly from November to March. While the trade winds are associated with periods of dry spells and calm seas, the westerly season on the other hand are associated with periods of heavy rainfall and stormy seas.

The population of Nauru at the last official census undertaken in 1992 was 9919 (Pitcher 1993). Estimates for this year is 12 460 based on the 1992 population growth rate. The population density is 593 km^2, which is the highest in the Pacific island countries.

Extensive phosphate deposits found on the plateau led to its mining in 1906. This resulted in the plateau's appearance being drastically altered, largely due to the open-cast mining method that removed vegetation, soil and rocks. Phosphate income, until recently, provided Nauruans with a comfortable lifestyle with most food requirements imported from overseas. The exploitation of the living marine resources was undertaken primarily on an artisanal level, on a moderate basis (Dalzell 1993). Its contribution to the nutritional requirements of the Nauruans is very important. Over the past three years the financial contribution of the fisheries sector has gained significance, particularly in terms of license fees received from distant water fishing nations. The revenue from fisheries now accounts for around 30% of the gross domestic product.

Coral reef biodiversity

The coral reef fauna and flora are among the richest ecosystems in the world containing a great diversity of species. The marine fauna and flora of Nauru are poorly documented. The earliest known information regarding the marine fauna was documented by North *et al.* (1903) and by Whitley & Colefax (1938). Petit-Skinner (1995) provided information on the common finfishes of Nauru. The benthic marine algae were documented by South and Yen (1992), while the coastal fisheries resources and a scientific checklist on finfish species are discussed by Dalzell and Debao (1994).

The lack of information is attributed to a range of factors including the orientation of the Nauru economy on phosphate mining and the smallness of the island. Previous research on coral reefs and marine resources of Nauru had been undertaken by overseas scientists, including a documentary film made by the Cousteau Society in 1992. Their results have not been made available to Nauruans.

Fauna

Finfish

Finfishes are the most commonly documented marine organisms on Nauru. The earliest accounts of finfish species were recorded by North *et al.* (1903), and by Whitley & Colefax (1938). Their lists were brief and only covered a few species. The most recent scientific checklist is compiled by Dalzell and Debao (1994). updating previous reports. The most fished species are pelagic fishes including tunas (*Katsuwonus pelamis* and *Thunnus albacares*) and rainbow runners (*Elagatis bipinnulata*). These species are abundant all year round accounting for 80% of landed catches. They are caught by trolling and through mid-water hand-lining often associated with fish aggregation devices (FADs) or in the open sea within sight of the island. Fish Aggregating Devices were first deployed in the early 1900s. Although they were initially deployed as mooring buoys for phosphate cargo ships, they soon became aggregators for tuna and rainbow runners. Cusack (1987) discussed the significant fishery that

was borne from the deployment of these buoys. The identification of the finfishes and other fish species associated with the coral reefs of Nauru can be in taxonomic publications of notable authors such as Collette and Nauen (1983), Kobayashi (1994), Allen and Steene (1996) and Randall *et al.* (1997).

Corals

Corals are among the least understood and poorly documented marine organisms on Nauru, although identification of the different species of corals can be easily undertaken from taxonomic publications provided by authors such as Carpenter and Niem (1998) and Veron (1986). Dalzell and Debao (1994) stated that the hermatypic zone of the reef slope descends to between 15 m and 30 m, beyond which there is a transition zone with coral outcrops that descends to about 60 m.

Results undertaken from a snorkelling dive and manta towing survey in March 2000 covering about 50 % of the reefs, by the author and a Fisheries Officer (David Uera) showed that coral diversity was impoverished. The dominant coral species covering around 80% of growth belong to the genera *Pocillopora*, *Monitipora* and *Acropora*. Healthy coral growth on the western side was patchy with algae growing in places devoid of corals. Estimates of coral densities within a 2 metre quadrat varies from 20-60 %, with species diversity estimated at less than seven. Coral growth on the northern side of the island was greater with densities (in 2 metre quadrat) ranging from 60-80% and diversity of less than four. The north-east side, which is subject to heavy waves, was assessed and found to be limited in coral growth. Coral fragments and rubble were the main substratum. The density assessed from a 2 metre quadrat was less than five percent.

Invertebrates

There are no known publications describing the invertebrates of Nauru, however, species can be identified from taxonomic works by authors such as Allen and Steene (1996), Ryan (1994) and Wright and Hill (1993). The most harvested invertebrates are turban shells (*Turbo setosus* and *Turbo argyrostomus*), lobsters and variety of crabs.

Flora

The marine flora has been studied by Thaman *et al.* (1981) and South and Yen. The flora is impoverished with no seagrasses and only one mangrove species is known (Thaman *et al.*, 1981). The vascular plants, including littoral species, have been documented by Thaman *et al.* (1981). The benthic marine algae have been documented by South and Yen (1992). Forty species were found with *Valonia aegagropila* and *Padina tenuis* being the dominant algae in the intertidal area. *Jania adhaerens* was found to be the dominant algae on the reef flat. The diversity of Nauru's flora is small compared to other equatorial islands of the central Pacific. This is possibly attributed to reduce habitats and the great distance from the Indo-Pacific centre of marine biodiversity (Thaman pers comm.).

Endemic, rare or endangered species

The smallness of the coastal area means that resources are susceptible to over-exploitation, especially intertidal benthic organisms such as turban shells and octopi, which are easily gleaned during low tides. According to Dalzell *et al.* (1992), anecdotal information suggests that certain reef fish species

are becoming scarce. Furthermore, the average size of fishes caught are decreasing. Jimwereiy (1999) observed that the finfish species that are becoming rare include mullets (Mugilidae), Topsail Drummer (*Kyphosus cinerascens*), Coral Cod (*Cephalopholis miniata*) and the Humpheaded Maori Wrasse (*Cheilinus undulatus*).

The spiny lobsters (Palinuridae) are rare, while giant clams (Tridacnidae) are most probably extirpated from Nauru. Today, giant clam shells are only seen outside peoples homes, although they were once commonly used in traditional customs (Petit-Skinner (1995). North *et al.* (1903) documented the existence of *Tridacna maxima* (as *Tridacna elongata*).

There are no known endemic species from Nauru, however, Alefaio (1999) mentioned that a new echinoderm species was discovered by an American scientist in 1998. It is important that surveys of neighbouring islands must be carried out to verify the endemism of this echinoderm from Nauru.

Threats to coral reef biodiversity

Anthropogenic factors

Threats to the coral reef biodiversity are largely of anthropogenic origin. These include overfishing, pollution and environmental degradation.

Fishing

Overfishing has been blamed for the decline in the number of demersal finfish species. As mentioned earlier, anecdotal information showed that some species are becoming scarce. The old generation remembered the days when fish was available in abundance. Currently, there is no regulation on fishing equipment. The fishing gears currently used are very efficient at catching fishes. Many seine and cast nets used on the intertidal zone and on the reef front have small mesh size which prevents smaller fishes to escape. The availability of self contained underwater breathing apparatus (SCUBA) equipment, enables spear fishers to probe deeper habitats for snappers (Lutjanidae), groupers (Serranidae) and squirrel fish (Holocentridae). A fishing apparatus developed by the Nauruans around the 1930s, which was described as a 'Christmas tree' by Dalzell and Debao (1993), and 'Enape Fishing Apparatus' by Whitley and Colefax (1938) is efficient to catch snappers at 50-150 m depths. The device is a T-shaped or cruciform wire frame attached to which are between 18-50 hooks. A reel with a length of mono-filament is used to lower and bring up the gear. It was estimated that at around three hours of fishing using this gear can land at least 60-70 kg of snappers.

Pollution

Pollution of the marine environment is mainly from sewage discharge. This is considered minimal and will be rectified in the near future when the waste is recycled to provide soil and agriculture manure as part of the rehabilitation plan of Nauru. Other pollutants include small oil spills in the boat harbour from barges. Pollution from ballast water is not known although, the introduction of dangerous and non-indigenous organisms without predators to control them could create a big problem for the marine ecosystem. Investigation into this area needs to be undertaken in the future.

Human pollution by way of disposing rubbish on the beaches is a very serious problem that needs to be addressed, holistically involving all stakeholders such as the government, NGOs and the people. It

is common to find disposable diapers, plastics, corrugated iron, cans, shoes, pieces of clothing *inter alia*, on the intertidal reef flat and the reef slope.

Reef blasting

The lack of deep lagoons and natural passage hinder boat movements in Nauru. This has resulted in reef being blasted to create artificial boat passages and channels. There are currently three blasted reefs: the boat harbour and two small channels one located on the west, and the other on the eastern side of the island. The channels permit the launching and retrieval of 4-5 metre aluminium boats. The eastern channel has recently been upgraded into a second boat harbour. The upgrading project, which involves reef blasting, drilling, excavation, erecting concrete retaining walls, and reclamation have resulted in massive disturbances to the reef area. Some materials used have been scattered by wave actions. The project, which is expected to be completed by May 2000 is a major environmental concern since it is located in a pristine area. This site is perhaps the most suitable site for a marine protected area.

Sedimentation

Sedimentation is not a problem on Nauru due to the absence of rivers and creeks. The soil is highly porous therefore rainwater is drained directly into the ground water table.

Tourism

Nauru is not developed as a tourist destination. The impact of tourism related developments is considered minimal.

Mining

Nauru is best known for its phosphate mine which commenced operation in 1906. Primary mining is expected to last another year with secondary mining currently being discussed and trials undertaken in the past. The mining operation, which is an open-cast method, has resulted in the removal of trees and other plants leaving behind limestone pinnacles all over the plateau rendering the place unsuitable for human habitation.

Loss of traditional environmental knowledge

Loss of traditional environmental knowledge (TEK) is a major problem with regard to traditional resource management in Nauru. Connel (1983) stated that Nauruans have occupied their land for a period of around 3500 years. Weeramantry (1992) added that Nauruans once had a customary law governing the use of the land and the marine tenure. Thaman (1992) stressed that TEK is very important in the sustainable management of natural resources on islands. The loss of TEK occurred with the advent of the mining industry and it resulted in the loss of the traditional marine tenure system. As a result the coastal area became a free for all, resulting in over-harvesting.

Environmental factors

Information and reports on non-anthropogenic environmental causes on Nauru is not available. Nauru plays a major role in regional environmental issues and is an active member of the South Pacific

Regional Environment Programme (SPREP). The Department of Island Development and Industry takes a lead role on environmental matters on Nauru.

The United States National Oceanic and Atmospheric Administration (NOAA) has set up a weather monitoring station on Nauru. It is a ten year project that commenced in 1998 with its primary role to study the El Niño Southern Oscillation (ENSO) event. Nauru is chosen because the island is located on the eastern edge of the warm water pool, which is a region that is very significant in terms of generating weather patterns that affect the whole world.

Climate Change

There is no known report available on the impacts of climate change on Nauru, however, micro climatic changes seem to be taking place on the island. Nauru has not experienced any significant rainfall over the past two years. Past ENSO events greatly affected the climate on the island. For instance, during an ENSO event, very heavy rainfalls were experienced (>3000 mm per annum) while droughts occur during La Niña periods. According to data received from the Nauru Phosphate Corporation laboratory, rainfall for 1999 was only 359 mm. This is the second lowest rainfall since 1915, when data were first recorded.

The La Niña period from 1998 to 2000 aggravated the current drought conditions on the island. Exposed pinnacle rocks were heated up and heat radiation or the up-draft of hot air have been observed to disperse clouds over the island. As a result, as much as 40% of the ubiquitous coconut tree may have died with many other plants either dead or dying. The conditions of the flora on the island are in a very poor and dying state.

Sea level rise

No information on sea level rise is available. About 20 per cent of Nauru is low lying, therefore sea level rise will inundate these areas. Relocation to higher ground will be necessary, however, there is a need to rehabilitate the mined fields if it is to be used for human occupation. The sea level rise will also affect the salinity levels in brackish water wells, as well as the coastal plants distribution.

Coral bleaching

There are no information available on coral bleaching occurrences in Nauru. It is not known whether the 1997-98 bleaching occurrence affected Nauru. The survey that was carried in March 2000 by the author, showed no evidence of coral bleaching.

Conservation and monitoring programmes

Conservation and marine protected areas

No conservation or marine protected area (MPA) has been established. The most environmentally appealing area is the Anibare Bay area located on the eastern part of the island. Thaman and Hassall (1996) called for the establishment of a conservation area at Anibare, which is also supported by the locals.

Monitoring programmes

The monitoring programmes currently in place, are undertaken by the Nauru Fisheries and Marine Resources Authority. These cover finfish creel census, ciguatera outbreaks, and occasionally seawater salinity levels. Future plans call for the monitoring of the reef through the establishment of quadrats and other monitoring methods useful to compare changes over time.

Legislation

Nauru's fisheries legislation underwent reviews within the last few years and relevant provisions of regional and international laws and conventions were incorporated. The *Nauru Fisheries and Marine Resources Authority Act 1997*, calls for the Authority to manage and sustainably utilise the fisheries and marine resources of Nauru. The *Nauru Fisheries Act 1997* calls for the management, development, protection and conservation of the fisheries and marine resources of Nauru. The two legislation did mention the requirements for management and conservation of the marine resources but are not adequate to address conservation programmes in more detail. It has been proposed that a marine conservation bill be tabled in parliament. A draft bill has been documented but widespread consultation with stakeholders needs to be undertaken first before it becomes law.

Conclusion

The coral reefs and marine resources of Nauru are poorly documented and understood. The marine fauna and flora appear to be impoverished in terms of species diversity, due to the smallness of the island and its remoteness from the Indo-Pacific centre of marine biodiversity. Nauru is an island that has experienced great disturbances to its terrestrial and marine environments with mining being the greatest environmental impact on the marine biota. Other human induced changes also play role in the disturbance of the environment, with rubbish disposal on beaches being a serious environmental concern. This poses significant impacts to marine organisms. Non-anthropogenic induced changes, such as coral bleaching, have a major impact on the integrity of the marine ecosystem. Although these are beyond the capability of Nauruans to control, there are other changes that can be managed, such as the utilisation of certain fishing gear. The declaration of conservation areas or marine protected areas do have their merits and this may be the next approach in the management of the marine resources of Nauru. This will ensure that the integrity of the marine ecosystem is maintained, which will allow for Nauru's future generations to have access to a pristine marine environment.

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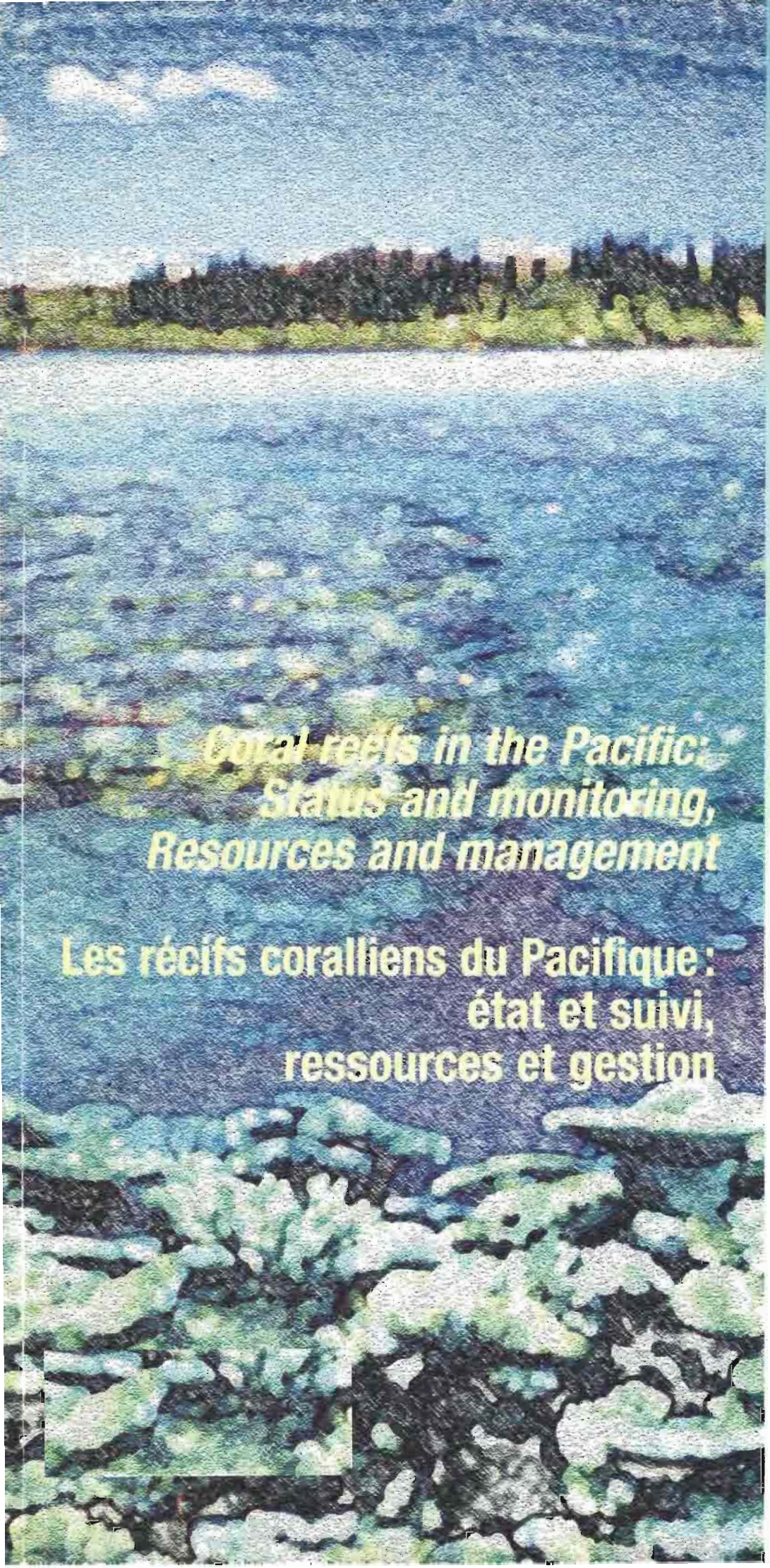

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