

Review of critical marine habitats and species in the Pacific islands region

By Chris Bleakley

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Abbreviation and Acronyms

| | |
|----------------|---|
| CBD | Convention on Biological Diversity |
| CITES | Convention on International Trade in Endangered Species of Wild Flora and Fauna |
| COP | Conference of Parties |
| EEZ | Exclusive Economic Zone |
| FFA | Forum Fisheries Agency |
| GPA | Global Program of Action |
| ICM | Integrated Coastal Management |
| ICRI | International Coral Reef Initiative (Pacific Regional Strategy) |
| IUCN | International Union for Conservation of Nature Resources |
| LME | Large Marine Ecosystem |
| MARPOL | International Conservation for the Prevention of Pollution from Ships |
| MMCS | Marine Mammals Conservation Strategy |
| MPAs | Marine Protected Areas |
| NEMS | National Environmental Management Strategies |
| NGOs | Non Governmental Organisations |
| RMMCP | Regional Marine Mammals Conservation Program |
| RMTCP | Regional Marine Turtle Conservation Program |
| RWAP | Regional Wetlands Action Plan |
| SAP | Strategic Action Program |
| SIDS | Small Island Developing States |
| SOPAC | South Pacific Applied Geoscience Commission |
| SPBCP | South Pacific Biodiversity Conservation Program |
| SPC | Secretariat of Pacific Community |
| SPREP | South Pacific Regional Programme |
| SSC | Species Survival Commission |
| ToR | Terms of Reference |
| TRAFFIC | Wildlife Trade Monitoring Network |
| UN | United Nations |
| UNCLOS | United Nations Conventions on the Law of the Sea |
| USP | University of the South Pacific |
| WEP | Western Equatorial Pacific |
| WPWP | Western Pacific Warm Pool |

Executive Summary

Obligations for the Conservation and Sustainable use of Critical Marine Habitats and Species

Pacific island nations have obligations for the conservation and sustainable use of critical marine habitats and species under a number of legally and non-legally binding international instruments. Foremost among these are the Convention on Biological Diversity, the UN Convention on the Law of the Sea (UNCLOS), the Framework Convention on Climate Change and the South Pacific Regional Environment Programme (SPREP) and Apia Conventions. These instruments emphasise the linkages between the protection of the marine environment, sustainable management of coastal and marine resources and human development. It is not possible to consider the conservation and sustainable use of critical marine habitats and species separately from wider social and economic issues.

Trans-boundary Issues

Pacific island nations share common issues, problems and priorities for management of critical marine habitats and species. Although separated by vast distances, the Pacific islands are linked by the marine environment. Larvae, pollutants and other substances can travel long distances on ocean currents. In the case of highly-migratory species such as marine turtles, mammals and oceanic fishery resources the large-scale trans-boundary linkages are clearly apparent.

The Large Marine Ecosystem (LME) concept aims to provide a practical framework to overcome a narrow sectoral approach to management and research by addressing all the factors affecting the health of marine systems. Longhurst (1995) and Lehodey (1996) present evidence which supports the definition of an oceanic LME in the region. Lehodey (1996) summarises this as:

- uniformly high temperatures throughout the surface layers, with seasonal variation;
- identifiable physical or bio-oceanographic boundaries which may however be dynamic in nature;
- unique productivity enhancement mechanisms which allow an otherwise unproductive area to support and oceanic tuna fishery of global significance;
- distribution of tunas and probably other associated species largely restricted to within the area, despite their migratory potential; and
- a relatively diverse macrofauna can probably be defined.

Much remains unknown about the elements of the Western Equatorial Pacific (WEP) which are not the prime focus of commercial exploitation, e.g. phyto, zoo and ichthyoplankton, marine birds, marine mammals, marine reptiles and a wide variety of non-tuna fish and shark species; many of which are taken incidentally or as by-catch of the tuna fishery. There is also limited information on the interaction between the coastal and pelagic environments. An ecosystem basis to research could help to provide the basic information required as a foundation for more holistic management of issues affecting critical marine habitats and species. There exist in the region well-accepted regional organisations, e.g. Forum Fisheries Agency (FFA), Secretariat of the Pacific Community (SPC), SPREP which could assist in promoting ecosystem-based research and management programmes.

At the island-level strong linkages exist between the land and the sea. Almost all the Pacific islands are entirely coastal in character, and for most coral atolls, even the furthest point of land is close to the sea. Coral reefs, mangroves and seagrass (where they occur) and other coastal ecosystems form interdependent systems. Each habitat-type plays a role in maintaining the overall function of the ecosystem. Management of critical habitats and species need to be considered within the broader context of coastal management.

Pacific island nations share a reliance on marine resources to support economic development and maintain a 'Pacific' way of life. Fisheries provide a key source of subsistence protein. Only 20% of the fish and invertebrate catch from coastal fisheries enters the cash economy (Dalzell et al., 1996). Oceanic fisheries are an important source of export revenue and appear to be a resource sector with major opportunities for further development.

Tourism is another sector which is seen by many countries as having significant potential for future economic development. Tourism depends on the maintenance of environmental quality of not only the features which attract tourists (e.g. beaches, coral reefs) but also on a wide range of supporting resources and infrastructure (e.g. water quality, fisheries, sewage treatment facilities).

Critical marine habitats and species, and the resources they represent, are threatened by pollution, physical destruction and over-exploitation. Pollution of the marine environment, primarily from land-based sources, is identified as an issue by most Pacific island nations. Sewage disposal, sediment and nutrient runoff, disposal of domestic and industrial waste are common problems.

Destruction of coastal wetlands, removal of mangrove areas and alteration of the coastline for coastal development continue to occur in a largely uncoordinated and disintegrated fashion. The ecological and economic costs of these piecemeal decisions are rarely taken into account in government approval processes.

Available evidence from catch rates, yield comparisons and species compositions suggest that Pacific island reef fisheries can sustain local protein nutritional demands at least for the immediate future (Adams, 1996). However, fish stocks around urban centres and densely populated islands are under increasing stress. Over-exploitation is also an issue for species which are vulnerable or commercially valuable such as *bêche-de-mer*, coconut crab, giant clam, live grouper, marine turtles, pearl oyster, sharks and trochus.

Traditional Ownership and Use of Marine Resources

Pacific island people have strong cultural links to the sea. Traditional ownership and management practices in the use of coastal marine areas are characteristic of many parts of the region. These systems help to reinforce traditional authority and contribute to a custodian ethic, particularly where they emphasise systems of sharing and communal use. Traditional tenure and management systems have greatly eroded since the times of western colonisation. The expanding influence of the western cash economy and its profit motive has had a major impact. Resources traditionally managed as communal property are increasingly exploited and traded for individual profit. Urbanisation and the adoption of more western lifestyles have separated people from their traditional roots and customary knowledge. Cultural affiliations and attitudes towards custodianship of the sea are weakening.

Despite their decline traditional tenure and management controls are still enforced to varying degrees in many areas. In comparison to other parts of the world, Pacific islanders retain relatively strong cultural links to their marine environment. The success of conservation and management methods will depend on the support and involvement of customary right holders and their ability to satisfy their social and economic aspirations.

Critical Habitats and Species of the Pacific Islands Region

Critical Habitats

Coral reefs are one of the most important and extensive coastal ecosystems found in the region. The diversity of Pacific island coral reefs is high in global terms (ranging from around 70 reef-building coral genera in the west to about 10 in the east). Reefs also underpin the productivity and stability of the coast and are vital to social, cultural and economic prosperity. Reefs throughout the region face chronic threats from the effects of human activities. The International Coral Reef Initiative (ICRI) Pacific Regional Strategy emphasises the need for integrated coastal management, capacity-building and research and monitoring for the region's coral reefs.

Mangroves occur naturally in the western part of the Pacific and have been introduced to some eastern areas. They are an important buffer between the land and the sea and in maintaining the stability and productivity of the coastal environment. Mangroves are critical habitat for many marine species, including those targeted for fisheries. They are increasingly under pressure through clearing, reclamation and pollution, and have historically had a low profile in most conservation programmes. A Regional Wetlands Action Plan (RWAP) seeks to redress this imbalance.

Seagrass beds are common in the west of the region, declining in abundance and diversity from west to east across the Pacific. They contribute to coastal productivity and provide food and habitat for endangered species (e.g. green turtles and dugong). There is very limited information on the values, status and threats to seagrass beds in the region.

Lagoons (and estuaries which are found on larger islands) are a primary location for subsistence fishing. Their location close to population centres places them at risk from over-exploitation and pollution.

Beaches are important in protecting coastal land from wave erosion, particularly for atolls which may only be a few metres above sea level. They also provide nesting areas for marine turtles and are a feature which attracts tourists and foreign exchange. In many Pacific island countries sand from beaches is mined to make concrete for construction. Beaches are also affected by coastal construction (e.g. breakwaters and jetties) which can change currents and greatly alter sand deposition and erosion regimes.

Critical Species

The region has globally-significant populations of marine turtles, with six of the world's seven species present. Populations have severely declined as a result of over-exploitation. A Regional Marine Turtle Conservation Programme (RMTCP) is underway and provides a basic level of support for a variety of turtle conservation activities. Further commitments will be necessary to build on the progress achieved to date.

Saltwater crocodiles are found in the west of the region (Palau, PNG, Solomon Islands and Vanuatu). It is reported that populations are threatened in some countries. There is limited information on the status and threats to this species.

A significant proportion of the world's marine mammal species are found in the Pacific region (in the vicinity of 25%) and these include whales and dugongs, to name a few. With the increasing interest in whale-watching in many areas, and the limited information on the status and threats to these species in the region, a Marine Mammals Conservation Strategy (MMCS) has been developed and is now being implemented in the Conservation of these marine mammal species

At least 3,392 species of reef and shore fish occur in the Pacific islands region. Coastal fisheries are a vital

source of subsistence protein. While coastal fisheries may be able to meet current nutritional demands, there is anecdotal evidence of overfishing near urban centres and around densely populated islands. There is also concern about the impacts of live collection of species such as grouper for markets in Southeast Asia.

The increase in fishing pressure on oceanic shark populations (as a bycatch of tuna long lining) is a major cause for concern. Examples of collapsed shark fisheries around the world emphasise their susceptibility to overfishing.

Invertebrate marine resources are important to Pacific islanders as a source of food and as source of cash income. Export-driven demand (mainly from Southeast Asia) is a primary factor behind their exploitation. The comparatively high prices which can be obtained for some of these products, leads to typical "boom-bust" cycles. Those with commercial value include trochus, green snail, pearl oyster, bêche-de-mer, giant clams, and crustaceans (e.g. coconut crab and spiny lobster). It is difficult to develop an overview of their status due to limited information on the quantities of subsistence use and incomplete and inconsistent trade data. However, there is sufficient information to highlight serious concerns about the sustainability of exploitation.

Seabird populations in the region are affected by habitat loss and degradation (e.g. wetland areas), harvest, and predators, e.g. rats. Little is known about the potentially significant impacts of bycatch of seabirds from longline fishing.

Approaches to Management of Critical Habitats and Species

Integrated Coastal Management

For most Pacific islands all parts of the island are influenced by, or influence coastal processes. Conservation efforts for critical marine habitats and species should preferably be part of integrated management regimes. Attempts to protect individual species or establish conservation areas may prove futile in the long-term unless they are part of the overall management of uses within the coastal zone. Pacific island governments lack the capacity to implement ICM. Key issues are the limited human, technical and financial resources, and the sectoral emphasis and lack of experience with integrated decision-making. Despite these problems there are also positive features which include the high level of community involvement and interest in coastal resource use and the existence of traditional management and participative decision-making structures.

The challenge for the region is to develop ICM processes which are appropriate to community and cultural needs. Participatory and local community decision-making is paramount. Where customary tenure systems are dominant, the customary systems, structures and processes should form the basis of ICM. Even where they don't exist it is important that ICM seek to assist and complement existing decision-making structures rather than try to introduce new ones. This will require the initial development and implementation of ICM to be at the scale of the most effective management unit, be it the village, district or whole island level.

There are common threads to the problems, issues and requirements to implement ICM in the Pacific islands which point to the potential benefits of a regional approach to addressing the issues outlined above. While the implementation of ICM solutions is a national responsibility, it would be greatly assisted by regional assistance with coordination, technical advice, training, human resources development, sharing basic resources and networking.

Traditional Management Practices

Pacific islanders traditionally employed many practices to control their use of marine resources. These traditions are maintained to varying degrees in different areas, and can provide an effective foundation for management

and conservation. Community-based forms of management are likely to be more culturally appropriate in the region. There is a need to link management with locally-based structures and to empower local communities.

Fisheries Management

Fisheries management represents a different (but often overlapping) point on a continuum of activities to maintain marine ecosystem integrity. Pacific island countries have adopted fisheries management legislation for key coastal resources, ranging from size limitations to closed seasons and gear restrictions for certain species. The limited capacity of national agencies to enforce controls and lack of information are major constraints to the implementation of coastal fisheries management measures. There seems to be little likelihood that these problems will be solved in the immediate future. Given this situation it may be preferable to focus on developing and enforcing effective management measures for known critical areas and species and to promote extension and collaborative management arrangements.

Given that it is a comparatively less complex fishery and economically important it is not surprising that the amount of available information for tuna is greater than for other fish groups. In contrast, for a range of epipelagic species (fish, sharks and others) taken in association with tunas, their role in the pelagic ecosystem and the impacts of fishing on them, remain to be understood.

Issues relating to coastal and oceanic fisheries are more comprehensively addressed in the 'Review of Fisheries Management Issues and Regimes in the Pacific Islands Region'.

Marine Protected Areas (MPAs)

MPAs are not well established in the Pacific islands as an effective conservation tool. The term 'protected area' is viewed with suspicion by many communities who fear imposition of unreasonable constraints on their behaviour and threats to their livelihoods.

There are a number of activities underway which address this situation. One of the lessons is that effective management is largely dependant on voluntary acceptance by the community. In traditional communities where there is continuing ownership or custody over terrestrial and marine environmental resources there is little possibility of establishing effective protected areas and regimes unless this is done in partnership with the traditional owners or custodians. Providing opportunities for sustainable development, such as through fisheries or tourism, and demonstrating that benefits will flow from management of resources are a means to achieve cooperation.

MPAs can contribute to increased fishery yields through dispersal of larvae produced at higher rates from within the reserve, through emigration of larger and greater numbers of catchable fish across reserve boundaries, and by protecting critical areas such as nursery or breeding areas. Traditional communities have long recognised the value of setting aside areas from exploitation and fishery managers are increasingly recognising that the creation of MPAs is a positive step.

MPAs are used extensively in the Caribbean and elsewhere in association with the tourism industry. This remains a potential avenue to be explored as a means to protect critical marine habitats and species in the Pacific region.

Partnerships between local people, interest groups (e.g. fisheries and tourism), and government are the key to establishing the management of MPAs. Such partnerships need to build on, rather than replace, existing institutional structures and decision-making processes at both the government and community levels. In many cases the customary tenure systems and traditional practices may provide the most effective basis for establishment of MPAs.

Species Conservation Initiatives

Programmes targeted at specific groups of species have proved to be an important means of capturing community attention and support for marine conservation. Examples are the marine turtle and marine mammal programmes, the Regional Avifauna Programme, the work of TRAFFIC related to endangered species, the SPC Coastal Fisheries Programme and others.

While such programmes can effectively capture and focus public imagination and attention, they must be adequately resourced and set within the framework of wider management programmes in order to successfully deal with the broad range of coastal management issues and threats, and to provide continuity and follow-up.

Recommendations

The following are recommendations for protection and conservation of critical marine habitats and species in the Pacific region:

- **To develop and implement a Pacific island regional programme that will support the national application of Integrated Coastal Management (ICM);**
- **To support the use of community-based Marine Protected Areas (MPAs) as a tool for the protection and management of critical marine habitats and species;**
- **To support implementation of the International Coral Reef Initiative (ICRI) Pacific Regional Strategy;**
- **To support implementation of the Regional Wetlands Action Plan (RWAP) for the Pacific Islands;**
- **To promote regional cooperation to identify and apply management options for coastal fishery species which are subject to export-based demand;**
- **To have a regional assessment of the conservation status of the dugong and saltwater crocodile;**
- **To have a regional assessment of the impacts of the international tuna fishery on non-target or bycatch species;**
- **To support regional and national campaigns to gain public support for the protection and management of critical marine habitats and species.**

1 Introduction

The Pacific is the world's largest ocean and one of the global centres of marine biodiversity. Coral reefs, mangroves, seagrass beds and other marine habitats form an extensive and complex system which is fundamental to the social, economic and cultural prosperity of Pacific island people. The region is home to globally significant populations of rare and endangered species such as marine turtles, dugongs, seabirds and others, as well as significant stocks of important fishery species. Conservation of the marine habitats and species of the region is a priority for the maintenance of global marine biodiversity.

Pacific island communities depend on the continued good health of its marine environment. The productivity and biological diversity of the sea provide the natural resource base for fisheries and tourism which are major sources of food and other subsistence resources, employment and foreign exchange. Pacific island people have very strong cultural affinities with the sea. Coastal and inshore marine areas are often held in local community tenure. Traditional rights to, and ownership of resources within these areas is common throughout much of the region. For some Pacific island countries exploitation of marine resources represents the primary opportunity for economic development.

Marine ecosystems in the Pacific are increasingly threatened by coastal development and over-exploitation. Coastal areas are the principal locations of human settlement and the target of most forms of economic development. Pollution, physical alteration of the seabed or coastline and overexploitation of these resources are resulting in the degradation of marine habitats and the biological diversity which they support.

These problems are becoming more widespread and in some areas urgent, as the potential for sustainable development of coastal areas and resources and the conservation of marine biological diversity are increasingly compromised.

1.1 Terms of reference (ToR)

The terms of reference of this report specify for this review to include:

- an analysis of the trans-boundary dimensions of issues identified in the review;
- analyses of the impact of traditional ownership and customary use rights to marine resources, particularly in coastal and atoll areas and how these may be changing as a result of settlement patterns, community and economic development;
- identify the root causes of trans-boundary problems, potential solutions, any knowledge gaps and what should be done to address these gaps;
- identify current attempts to address the issues and suggest new approaches;
- suggest priorities for action, including sectoral interventions and national and regional institutional mechanisms for their implementation.

1.2 Definition of 'Pacific islands region'

For the purpose of this paper the 'Pacific islands region' is defined as the region served by the SPREP, which includes the following countries and territories: American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna.

2 International, regional and national obligations relating to the conservation of critical habitats and species

Pacific island countries have obligations for the conservation and sustainable use of critical marine habitats and species under legally-binding international agreements. There is also a large number of non-binding instruments which outline strategies, recommendations and priorities for action.

The Convention on Biological Diversity (CBD) aims to ensure the long-term survival of the full range of biological diversity. The CBD also emphasises the need to provide for human needs through the sustainable use of biological resources and the fair and equitable sharing of the benefits arising out of such use. The CBD places a range of obligations on Contracting Parties for the conservation and sustainable use of biological diversity. Further guidance on their implications for coastal and marine environments is provided by Conference of Parties (COP) to the Convention¹.

Pacific Island Party Status (independent nations) for selected International Agreements relevant to Critical Marine Habitats and Species

| Country | CBD | SIDS | GPA | Agenda 21 | UNCLOS | FCCC | Apia | (Noumea) SPREP |
|------------------|-----|------|-----|-----------|--------|------|------|----------------|
| Cook Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| FSM | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Fiji | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Kiribati | ✓ | ✓ | ✓ | ✓ | | | | |
| Marshall Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Nauru | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Niue | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| Palau | | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| PNG | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Solomon Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Tokelau | | | | | | | | |
| Tonga | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| Tuvalu | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Vanuatu | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Samoa | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

¹ For more information see COP decision II/10 and also the relevant deliberations of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA).

The United Nations Convention on the Law of the Sea (UNCLOS) outlines obligations for the conservation of the living resources of the Exclusive Economic Zone (EEZ). These include ensuring that living resources are not endangered by over-exploitation and maintaining populations of harvested and dependant species at levels which can produce maximum sustainable yield. The obligations are expanded upon through the Implementing Agreement on the conservation and management of straddling fish stocks and highly migratory fish stocks, the FAO Code of Conduct for Sustainable Fisheries, MARPOL, the London Dumping Convention and other instruments.

Other international treaties also impose obligations relating to the conservation and sustainable use of critical habitats and species. Prominent amongst these are the Framework Convention on Climate Change, and the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)². A more complete list is provided at Annex 1. At the regional level the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention) and Convention on the Conservation of Nature in the South Pacific (Apia Convention) contain complementary provisions relating to the conservation of terrestrial and marine biodiversity in the region.

There is also a substantial body of non-legally binding material which contains strategies, recommendations or targets relating to biodiversity conservation and sustainable use. These include such instruments as the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), the Programme of Action for Small Island Developing States (SIDS) and Chapter 17 of Agenda 21.

The concept of critical habitats and species is central to most of these instruments. For instance, the CBD requires Contracting Parties to identify "important components" of biodiversity, and provides an indicative list of categories. There is an obligation to monitor these and take regulatory or management action where a significant adverse effect has been determined. The in-situ conservation measures required by the CBD include systems of protected areas and promoting the protection of ecosystems, habitats and species.

2.1 Important Components' of Biological Diversity, as Defined by the CBD

1. Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes;
2. Species and communities which are: threatened; wild relatives of domesticated or cultivated species; of medicinal, agricultural or other economic value; or social, scientific or cultural importance; or importance for research into the conservation and sustainable use of biological diversity, such as indicator species; and
3. Described genomes and genes of social, scientific or economic importance.

Similarly, the identification and conservation of critical habitats and species is also part of the GPA, SIDS

² Although few Pacific island countries are parties (only PNG and Vanuatu) many countries to which exports are destined have obligations as parties which need to be met when trading with non-parties.

and Chapter 17 of Agenda 21. As with the CBD, these instruments emphasise the linkages between the protection of the marine environment, sustainable management of coastal and marine resources and human development. There is strong recognition of the need to address social and economic needs as well as environmental priorities. To fulfil the obligations of these instruments it is not possible to separate conservation objectives from wider social and economic considerations. The notion of what is 'critical' must be considered in the light of all these issues.

In many cases Pacific island nations are well advanced in the process of determining national priorities for sustainable development. The National Environmental Management Strategies (NEMS) prepared for many countries outline priority actions which give effect to obligations summarised above in accordance with national development priorities. These often clearly articulate issues, needs and priorities for initiatives in the coastal marine environment.

3 Overview of Trans-boundary Issues

3.1 Ecological Scale and Linkages of Marine and Coastal Systems

Marine areas and resources are connected over very large scales. Although separated by vast distances, the Pacific islands are linked by the marine environment through ocean currents and the supporting properties of water. Larvae, pollutants and other substances are carried long distances, linking marine areas which may be far apart. The larvae of some species may be viable for many days or weeks and during this time can travel vast distances, in some cases hundreds or even thousands of kilometres (Kenchington, 1990). Some areas act as important "sources" of recruits, while others are excellent "sinks" (i.e. receiving a good supply of recruits). Although the precise nature of these connections is generally not well known in the Pacific islands, it is clear that marine biological diversity and productivity are linked and to a degree shared across national boundaries. National issues and problems affecting the health of coastal and marine environments have potentially significant trans-boundary dimensions.

In the case of highly migratory species such as marine turtles, marine mammals and some birds, the large-scale linkages and trans-boundary dimensions are more clearly apparent. These species roam across wide areas of the region. In many cases they return to quite specific areas to breed or nurse their young. They are a shared regional resource because of their highly migratory nature, yet their survival may be very strongly influenced by dependence on a specific site for one stage of their life cycle.

The pelagic fishery resources of the region are another shared regional resource which has assumed vital importance to the economic development of Pacific island countries, particularly as a source of foreign exchange. The migratory nature of oceanic fisheries dictates that management issues are by their nature trans-boundary.

Linkages are much stronger at the island-system level, where coral reefs, mangroves, seagrass (where they occur) and other coastal ecosystems form interdependent systems. Each habitat-type plays a role in maintaining the overall function of the ecosystem, and this balance can be disturbed when one or more elements of the system are stressed. Tropical marine systems can be remarkably robust in recovering from catastrophic occurrences such as cyclones and crown-of-thorns infestation. However, their robustness may be weakened in the face of chronic threats like overfishing, loss of water quality through pollution, elevated nutrients and increased sedimentation (Done, 1995). These types of pressures are increasing throughout the region as a result of expanding urban populations and economic development. There are now many examples of areas where marine biological diversity and productivity are significantly compromised (SPREP, 1995).

At the island-level strong linkages exist between the land and the sea. Almost all the Pacific islands are entirely coastal in character, and for most coral atolls, even the furthest point of land is close to the sea. The islands influence, or are influenced by processes and activities occurring on coastal lands and in coastal waters. The economies of the Pacific islands region depend a lot on coastal resources, with a concurrent lack of an inland economic base and with their population concentrated along the coast (Holthus & Maragos, 1992). It is impossible to separate management of marine resources, particularly in near shore areas, from activities and issues on the land.

3.2 Application of the Large Marine Ecosystem Concept

Large Marine Ecosystems (LME's) are relatively large regions, of the order of 200,000 square kilometres or larger, characterised by distinct bathymetry, hydrography, productivity and trophically dependent populations (Sherman & Alexander, 1986). The LME approach is based on the concept that critical processes controlling the structure and functioning of biological communities can best be addressed on a regional basis. This was partly a response to the realisation that isolated investigations in limited areas of the sea were of little value and that cooperation in the international field was highly desirable (Went, 1972). The LME concept aims to provide a practical framework to overcome a narrow sectoral approach to management and research by addressing all the factors affecting the health of marine systems.

The 49 LMEs identified by Sherman (1994) are primarily coastal bodies of water. Longhurst (1995) has recently defined ecological domains and biogeochemical provinces in the pelagic ecosystem, based on biotic and physical oceanographic criteria. The Western Pacific Warm Pool (WPWP) is one such province. Lehodey (1996) proposes the Western Equatorial Pacific (WEP), a slight modification of the Warm Pool, as a LME. The Western Equatorial Pacific is described as the area of primarily open ocean lying approximately between 10°N and 15°S and 130°E and 150°W. To the west it is bounded by the land masses of PNG, Indonesia and the Philippines. The eastern boundary lies at the convergence of two water masses and a well defined salinity front; a boundary which is displaced eastwards during *El Niño* events and westwards during *La Nina* events (shifting through more than 20° of longitude). It has an area of about 15 million square kilometres and includes part or all of the EEZs of 19 coastal states. Lehodey (1996) summarises the evidence which supports definition of the Western Equatorial Pacific as a LME:

- uniformly high temperatures throughout the surface layers, with seasonal variation;
- identifiable physical or bio-oceanographic boundaries which may however be dynamic in nature;
- unique productivity enhancement mechanisms which allow an otherwise unproductive area to support and oceanic tuna fishery of global significance;
- distribution of tunas and probably other associated species largely restricted to within the area, despite their migratory potential; and
- a relatively diverse macrofauna can probably be defined.

While the concept of LMEs is undoubtedly sound from a biological perspective, there remain significant scientific and political issues for practical application of the LME approach for critical marine habitats and species. Some of the characteristics of the WEP are reasonably well known, particularly as they relate to the commercially valuable tuna fishery. However, far more remains unknown about the other elements of the system such as phyto, zoo and ichthyoplankton, marine birds, marine mammals, marine reptiles and a wide variety of non-tuna fish and shark species (many of which are taken incidentally or as by-catch of the tuna fishery). Lehodey (1996) notes that “very little is known of these other components of the ecosystem, and even less of the system dynamics, most information on this vast area of ocean coming from commercial fishing activity”. There is also limited information on the interaction between the coastal and pelagic environments. Although land comprises a very small proportion of the area its impacts are likely to be significant, such as through inputs of nutrients through runoff and local up welling. An ecosystem basis to research could help to provide the basic information required as a foundation for

more holistic management of issues affecting critical marine habitats and species.

The WEP includes waters (EEZ's) under the jurisdiction of many Pacific island countries, and extends beyond each country's EEZ as well. This raises an issue of the sharing states (including distant water fishing nations) reaching agreements on the approach to research and management of the resources of the LME. Optimum management of the LME requires that political decisions be made on the allocation of resources (Christy, 1986). It is fortunate in such cases that the regional organisations such as FFA, SPC, and SPREP assist with making decisions and also promote ecosystem-based research and management programmes.

3.3 The Importance of Coastal and Marine Resources for Economic and Social Development

Pacific island countries depend on marine resources to support economic development and maintain a Pacific' way of life. While some of the larger Melanesian countries (e.g. Fiji, PNG, Vanuatu) have substantial terrestrial resources and a more diverse economic base, many of the smaller atoll nations depend on exploitation of marine resources as the primary opportunity for economic activity.

3.3.1 Fisheries

At one end of the scale, fish from reefs and lagoons are a key source of subsistence protein. Pacific islands rank among the highest in the world for the per capita consumption of fish with some atoll nations consuming up to 250 kg per year (Wright, 1993). Inshore fisheries are the targets of small- to medium-scale fishing operations which provide resources principally for domestic consumption and local trading. It has been estimated that only 20% of fish and invertebrates taken enter the cash economy, emphasising that inshore fisheries are primarily subsistence-based (Dalzell et al., 1996). There is some evidence that this situation is changing due to increased commercialisation of the catch at both the village and national levels and decreasing consumption of seafood in favour of cheaper imported products such as canned fish and meat (Bettencourt et al., 1995). Nevertheless, it is important that the worth of near shore fisheries is not measured solely by their contribution to the cash economy but also by their significant benefits to local communities in guaranteeing food security and supporting the subsistence economy.

Historically women have played an important role in marine resource use in the Pacific islands. Women's involvement is primarily directed at supplying protein for the family meal, as opposed to fishing for commercial gain (Tuara, 1995). Their role as a source of information on the status of the coastal marine environment, and involvement in management programmes is critical. Any attempt by governments to achieve the sustainable management of inshore fisheries resources must acknowledge the role played by women in coastal fisheries.

At the other end of the spectrum are the large-scale commercial tuna and billfish fishing operations which operate throughout the tropical Pacific Ocean. Some Pacific island countries derive substantial foreign exchange earnings through foreign vessel licensing. Available scientific evidence suggests that these fishery resources are not yet fully developed (SPREP, 1992).

3.3.2 Tourism

Tourism is a growing sector in the Pacific islands, with tourism receipts averaging about 25% of export earnings (SPREP, 1992). Tourism also has significance for domestic employment and wealth creation. Development of a tourism destination can bring substantial economic and other benefits to local communities. The fostering of appropriate tourism development in an area may allow or facilitate the protection and enhancement of natural and cultural features, as well as providing a means of generating economic growth.

However, poor planning and control characterise much of the tourism development in the region. The degree of on-site environment and policy control which government agencies have been able to exert is generally quite restricted (Fuavao, 1992). All too often this leads to impacts on coastal areas which are usually the target of tourism activities.

Part of the attraction of the region as a tourist destination is the image of pristine coastlines, clear tropical waters and abundant marine life. It is in the interests of countries to maintain these characteristics in order to maximise potential tourism receipts. The maintenance of environmental quality applies not just to features which attract tourists directly, but also to a wide range of supporting resources and infrastructure (e.g. fresh-water supplies, fisheries, sewage treatment facilities) and to the cultural systems and values which are so important to Pacific island people.

3.4 Summary of Threats to Critical Habitats and Species

As part of the Strategic Action Programme (SAP) process a separate review is to be prepared dealing with threats ('Review of Nonliving Resources and Threats in the Pacific Region'). The purpose of this section is to briefly summarise the issues as they relate to critical habitats and species. Those issues most prominently reported by Pacific island countries include:

- pollution, especially due to improper disposal of sewage and domestic solid waste and mismanagement of non-domestic waste;
- increased sedimentation and destruction of coastal habitats such as fringing reefs, mangroves and seagrass due to coastal development; and
- overexploitation of living marine resources.

3.4.1 Pollution

Pollution of the marine environment takes many forms and is an issue which is identified by most Pacific island countries (refs: list relevant NEMS/SOE documents). Kelleher (1993) provides an overview of pollution issues in the coastal marine environment, noting that by far the greatest source of pollution of the sea is land-based human activity. Not surprisingly, the degree of marine pollution at different parts of a coastline is often closely related to the size of the adjacent human population.

Forms of human-induced pollution include nutrients (mainly nitrogen and phosphorus), herbicides and pesticides and their derivatives and toxic chemicals and heavy metals, most of which are created in industrial processes including mining. Outfall sewers cause local eutrophication, loss of seagrass beds, build-up of toxic metal levels in sediments and organisms and loss of public amenity. Stormwater drains also contribute pollutants.

Nutrients in sewage, combined with contribution of nutrients from other sources, particularly affect coral reef ecosystems adversely, resulting in reductions in strength of calcium carbonate skeletons and smothering of corals by algae. Methods of sewage disposal in the Pacific islands are increasingly inadequate in the face of expanding populations especially in urban areas. These methods include direct disposal into lagoons, piping to the outer edge of the fringing reef, evaporation ponds and others. Pre-treatment is necessary for safe disposal of wastes but is an expensive option for Pacific island countries. In some instances where sewage systems are established there are problems with maintenance (ref: Kiribati NEMS). Increased algae growth, eutrophication, contamination with fecal coliform and other bacteria have been recorded in coastal waters and are testimony to the growing problems throughout the region.

Mainland environmental problems are usually reflected in marine problems. Soil erosion results in suspended sediments being conveyed to the sea. Nutrients in the form of ions are often attached to the soil particles, leading to nutrient enrichment. This is usually greatly increased where the clearing of native forests is followed by agricultural activities which involve the application of fertilisers. The effects can include degradation

of coral reefs and the destruction of seagrass beds.

Disposal of waste is an acute problem in atoll countries and in heavily populated low-lying coastal areas. As urbanisation increases and lifestyles and consumption patterns change, these problems are exacerbated. Traditional goods were largely biodegradable but these have been replaced by modern packaging and materials, many of which do not readily break down. The sea is a convenient dumping ground for such wastes and is also indirectly affected by runoff from contaminated areas on land. Industrial waste also finds its way into the sea, leading to elevated nutrient levels and contamination with dangerous chemicals.

With increasing severity of pollution problems there is the ever present risk of disease and toxic substances entering the food chain. Given the reliance of the people on coastal resources for food any potential health effects are cause for serious concerns.

3.4.2 Physical Alteration of the Seabed or Coastline

Destruction of coastal wetlands, removal of mangrove areas and alteration of the coastline for coastal development continue to occur in a largely unplanned, uncoordinated and disintegrated fashion (Kelleher, 1993).

Decisions are made without taking into account adverse ecological and economic consequences of the destruction of natural coastal environments. Activities such as dredging harbour construction etc change water patterns and sediment regimes, often with ecologically undesirable results.

Mangroves play vital roles in retaining sediments eroded from the mainland and islands, taking up toxic chemicals, preventing erosion and providing vital habitat to various marine species. Wetlands are important areas for the preservation of biological diversity and as habitats for many migratory and domestic species. These and other coastal features are commonly sacrificed for tourist developments, mariculture and agriculture. The ecological and economic costs of these piecemeal decisions are rarely taken into account in government approval processes.

3.4.3 Overexploitation

The typical evidence of fisheries overexploitation - decreasing catch/effort ratios followed by stock collapse – are not yet in evidence for most Pacific inshore fishery species, although information is extremely limited. There are anecdotal references which suggest declining size and abundance of inshore fisheries (King et al., 1995). In general terms it is difficult to determine the status of fisheries on Pacific island coral reefs. The region is economically undeveloped, sparsely populated and coral reefs are widely scattered. Constraints on monitoring and investigation mean that quantitative information is rare. Available evidence from catch rates, yield comparisons and species compositions suggests that Pacific island reef fisheries as a whole do not exert an excessive pressure on reefs and that local protein nutritional demands can be sustained at least for the immediate future.

An exception is around densely populated islands where nearby fish stocks come under stronger exploitative pressure, coupled with the influence of pollution and habitat loss. In these instances although stock collapse does not yet appear to have occurred overfishing and overall ecosystem change are likely to be in evidence (Adams et al., 1996).

Another exception are species such as *bêche-de-mer*, coconut crab, crocodile, giant clams, live grouper, marine turtles, pearl oysters, sharks and trochus and which are vulnerable or have become commercially valuable, particularly as exports. Species which are relatively rare, slow growing, slow to reach sexual maturity, have fewer number of offspring, sedentary and easy to collect or catch, or at the upper end of the food chain can be particularly vulnerable to overexploitation. The comparatively high prices which can be obtained for some of these products provide sufficient incentive to bypass traditional constraints on exploitation, where they existed. There can also be an economic incentive for intense and rapid exploitation in order to generate

commercially viable quantities of product for export, resulting in serious depletion of the stock to the point where populations have not fully recovered. Although the long-term benefits of managing these resources sustainably are clearly apparent, regulatory mechanisms are not strong enough to achieve this. Depletion of these resources is now widely reported throughout the region. Re-empowerment of community management and stronger international cooperation for monitoring of trade are seen by some as the only means to address these issues (Adams, 1996).

Reefs which are subject to overfishing are less resilient and recover less well from catastrophic events. Fish help to keep algae in check and their removal can lead to algal overgrowth of corals. Avoiding overexploitation of fishery resources is vital not just for the sake of the resources themselves but also in terms of maintaining the overall health of marine systems.

3.5 Population Growth and Increasing Urbanisation

Pacific island countries have some of the highest population growth rates in the world. For many countries populations are on track to double at the rate of every 20-25 years or less (SPREP, 1992). In some instances these high rates are offset by migration to metropolitan countries overseas. High population growth rates will place increasing demands on coastal resources (see Craig, 1995).

One of the most profound changes affecting critical habitats and species in the region is the increasing urbanisation of Pacific island life. There is a marked tendency towards population concentration in one major town, usually the national or provincial capital, with urban growth rates at least 50-100% higher than overall population growth rates (SPREP, 1992). Across the region, Pacific islanders are moving from the uplands to the coastal cities, from outlying islands to the national or provincial capitals, and from the smaller rural villages to the larger villages and towns.

Most often the larger urban centres lie on the coast. Some of the most serious marine and coastal environmental problems occur in the vicinity of these urban centres.

As Pacific islanders adopt an increasingly urbanised lifestyle their reliance on the sea for their daily life is reducing. There is a danger that their strong cultural affiliation and attitudes towards custodianship of the sea will be weakened. Education is essential as a means of reinforcing the importance of the marine environment as a foundation for the Pacific way of life.

3.6 Impacts of Traditional Ownership and Customary Use Rights

Traditional ownership and management practices in the use of near shore marine areas are commonly argued as characteristic of the Pacific islands region. Customary tenure systems may extend over substantial areas of the coastal marine environment. In some countries, marine areas are held under some form of traditional tenure, typically vested in a clan, chief or family. In many instances fishing rights are maintained from the beach to the seaward edge of the outer reefs, and in some cases further offshore (Johannes, 1978).

The basis of these systems is that resource use is controlled for the benefit of the community as a whole. In keeping with the cultural diversity across the region, the nature of traditional rights and the measures employed to enforce them vary greatly. Traditional rights may include rights to fish and collect (including the harvesting of shellfish and other products) or simply rights of access and passage. Traditional controls include strictly enforced prohibitions (tabu, tambu, taboo) on particular species, restrictions on gear and catch limits, restrictions on time, and rules to promote orderly fishing. In some cases temporary bans were imposed on fishing during breeding periods or in times of scarcity (SPREP, 1992). Johannes (1978)

records instances where fishing rights were temporarily or permanently ceded to other communities in order to redistribute resources to where they were needed.

Traditional systems provide practical management tools to ensure sustainable supply and reinforce traditional authority (Hooper, 1985). The existence of these systems contributes to a custodian ethic (Zann, 1985), particularly where traditional controls emphasise forms of communal sharing or use.

Traditional tenure and management systems have greatly eroded since the time of colonisation by western Europeans, generally in direct proportion to the degree of western influence. Customary tenure was contrary to the western coloniser's notion of the "freedom of the seas". The introduction of western legal systems has resulted in the imposition of a new system of legal rules in many areas. The authority of chiefs or traditional leaders has declined, weakening their capacity to enforce traditional law. Urbanisation and the adoption of more western lifestyles have separated people from their traditional roots and customary knowledge.

Probably the single most significant impact has been the introduction of the western cash economy and the profit motive. Resources previously viewed as communal property, shared for the good of all, have increasingly become common property (open access), exploited and traded for individual benefit. The monetary value on resources provides an incentive to catch more than is required for immediate use - income is proportional to catch and restraint is equivalent to self-denial (Johannes, 1978). It becomes difficult to convince people accustomed to few restrictions on access, of the benefits of enforcing or re-establishing reef and lagoon tenure.

Despite the weakening of traditional management systems, coastal tenures are still enforced to varying degrees in many areas; in some cases the use rights have been formally recognised in legislation (e.g. Fiji, PNG, and Vanuatu). In others countries these rights exist de facto.

Traditional ownership and customary use rights, although depleted, still have a very great impact on approaches to conservation and management of critical habitats and species. The success of conservation and management methods will depend on the support and involvement of customary right holders and their ability to satisfy both their subsistence needs and their aspirations for economic development (Connor et al., 1994).

4 Critical Habitat and Species of the Pacific Islands Region

Critical habitats and species are linked and interdependent parts of complex marine systems. Within this context the concept of critical habitat and species must be based on the maintenance of ecosystem function, biodiversity, productivity, and social and economic considerations. The primary means to achieving these aims will be through a holistic approach to maintaining the overall health and functions of the marine environment.

4.1 Patterns of Biological Diversity, Endemism and Productivity

The broad patterns of variation of biological diversity in the Pacific islands region are known. The Indo-Malaysian archipelagos on the western margin of the Pacific are the centres of the greatest species diversity in most marine organisms (see Dahl, 1979 and 1980; IUCN/UNEP, 1986; and Springer, 1982). The diversity of marine organisms decreases from the warm tropical waters to the more temperate areas to the north and south and from west to east across the Pacific Ocean. The distribution of coral genera and mangrove, seagrass and reef fish species all exemplify these gradients.

Regional patterns of coral and mangrove diversity clearly indicate the importance of the west Pacific, as the high diversity area at the regional level.

Relative to terrestrial organisms, there is much less endemism among marine flora and fauna in the Pacific islands region. This reflects the better function of sea water as a medium for the transport, dispersal and migration of organisms and the low level information available on marine biological diversity in the region. The highest levels of endemism are found around isolated islands away from the centre of diversity in the south-west, notably the Marquesas Islands (Springer, 1982)³. Some endemics are limited to a few islands or island groups within a limited area, particularly in the Cook Islands/Society Islands area, and the Pitcairn Islands/Easter Islands area (Holthus and Maragos, 1992).

The diversity of coastal marine ecosystems at any point on these gradients also depends on the size of the islands, the variety of habitats (rocky or sedimentary coastlines, fringing or barrier reefs, estuaries and lagoons) and the importance of terrestrial influences. All of this adds to the complexity of marine biogeographic patterns, in which each island is in many ways unique in spite of habitat-type and biogeographic affinities.

4.2 Critical Habitat

4.2.1 Coral Reefs

There is a substantial body of information on coral reefs, although given their importance; extent and complexity, there remain significant gaps. Smith (1996) provides a review of the issues and activities associated with coral reefs and related ecosystems.

Coral reefs are one of the most important and extensive ecosystems within the Pacific region. They are widely distributed and are a fundamental component of the complex tropical small island environment. The diversity of coral reefs in the Pacific islands declines from a maximum in the western Pacific, adjacent to the Indo-Malayan centre of coral reef evolution and diversity, to the central and eastern Pacific, and from the equator north and south to more temperate waters. The diversity of reef-building coral genera in the western Pacific is amongst the highest in the world, with up to 70 genera present in Papua New Guinea and Palau and 60 for the Solomon Islands, Vanuatu, New Caledonia and Fiji. Coral diversity progressively decreases to around 10 genera in the eastern parts of the region (Veron, 1993).

Reefs form the primary coastal protection structure on most tropical islands and provide the sand for construction of atoll islets and beaches. This is in addition to their important functions as sources of subsistence food resources, reservoirs of high biodiversity, and environmental health indicators. The social, cultural and economic prosperity of the Pacific islands region has been, and will continue to be, directly dependent on the health of coral reefs and their related ecosystems.

Human activities are the primary cause of coral reef degradation and most of these are chronic threats. Environmental conditions resulting primarily from human population growth, water pollution, resource over-exploitation, unsustainable fishing methods (e.g. use of sodium cyanide in the western Pacific for the live fish trade), and direct physical damage are causing reefs to deteriorate at an alarming rate. Increasing social and economic demands are placing new levels of stress on Pacific coral reefs.

At the individual reef level it is not always easy to pinpoint a single cause of stress on these reefs. Usually, the frequently interaction of several factors could be the cause. This must also be considered against the background

³ The Hawaiian Islands and Easter Island, outside the scope of this report, are also noted for their high levels of endemism.

of reefs as a constantly changing and evolving environment which are subject to natural perturbations and change.

The International Coral Reef Initiative (ICRI) Pacific Regional Strategy was developed by a partnership of governments, non-government organisations and other groups from the Pacific islands region. The Strategy highlights the specific issues and priorities for the Pacific for the conservation and sustainable development of coral reefs and related ecosystems (SPREP, 1996).

4.2.2 Mangroves

Ellison (in press) provides a status report on Pacific island mangroves. The state of knowledge on Pacific island mangroves is poor relative to that for other regions.

Mangroves are a common coastal ecosystem in the western part of the region but become increasingly scarce eastward and are absent in the eastern part of the region, except where introduced. They occur in close association with seagrasses and coral reefs. In the Pacific there is a total area of at least 343,735 ha (about 2.4% of the world total) with the largest areas occurring in PNG, Solomon Islands, Fiji and New Caledonia. A total of 34 mangrove species are present as well as 3 hybrids, with diversity declining from west to east.

Mangrove systems are an important buffer between the land and the sea. They act as a sink for sediments, nutrients and other contaminants to maintain coastal water quality, and so promote the growth of coral reefs and seagrass. Mangroves are important as critical breeding habitats and food sources for marine species and help to protect coastlines and support significant subsistence fisheries.

Mangroves have been traditionally used for construction, herbal medicines, and the gathering of crabs, fish and fuel wood (Ellison, in press). Despite their many values and importance, they are increasingly under pressure from reclamation for settlements and agriculture, through use as dumping grounds for waste and other forms of coastal development. Mangrove values are often not fully appreciated and they have had a generally low priority in past conservation programmes. Action is urgently needed to promote mangrove conservation. The draft Regional Wetlands Action Programme (RWAP) developed by SPREP (Idechong et al., 1996) seeks to address this imbalance. This programme is at a very early stage and needs to find funding for implementation, particularly through incorporation into coastal management programmes of Pacific island countries.

4.2.3 Seagrass Beds

The following is adapted from the review of Pacific seagrasses provided by Coles and Kuo (1996). Quantitative information on seagrasses in the Pacific islands is scarce, including their importance to coastal fisheries, and the areas that may be threatened by coastal developments.

Like mangroves, seagrass beds become less frequent and lower in species diversity from west to east across the Pacific, reaching the limit of their distribution in Kiribati, Wallis and Futuna, Samoa and Niue. Fourteen of the fifty-eight species found globally are recorded in the Pacific.

Seagrasses stabilise coastal sediments, provide food and shelter for diverse organisms (including endangered species such as dugongs and sea turtles), act as nursery areas for many shrimp and fish of commercial importance, and help to maintain coastal water quality by trapping and recycling nutrients. They make a significant contribution to coastal productivity and their primary productivity ranks among the highest recorded for marine ecosystems. Seagrass destruction results from human activities, for example, as a consequence of eutrophication or land reclamation and land-use changes. The conservation of seagrasses is also addressed under the RWAP (see above).

4.2.4 Lagoons and Estuaries

The region has a great variety of lagoons ranging from open lagoons little different from the surrounding ocean to completely closed lagoons with a variety of water salinities, or to coastal lagoons and estuaries with heavy terrestrial influences. These conditions often result in unique combinations of species and ecosystems, sometimes with a small number of species occurring in great abundance. Fisheries of lagoons are often a primary source of subsistence protein, yet these areas, particularly when close to population centres, are often most at risk from over-exploitation and pollution (Kelleher et al., 1995).

Estuaries are more common in the west of the region on the larger islands with well-developed watersheds. They are an important part of the coastal marine system, supporting mangrove and seagrass areas and acting as important feeding, breeding and nursery areas. Estuaries are amongst the richest and productive of coastal habitat types.

4.2.5 Others

The open ocean is much less well known than coastal and terrestrial habitats. Seamounts, which may be very extensive and support a large standing biomass in some areas, serve as larval refuges and even as refuges for archaic and rare species. Research by ORSTOM around the seamounts of New Caledonia, for example, has seen many new species (fish and invertebrates) described.

Upwellings, vitally important nutrient sources for the western Pacific, can be semi-permanent in nature, and may harbour unique microfaunal assemblages. Information concerning these is very limited. SPC is in the process of describing the Warm Pool of the western Pacific, the engine room of the world's weather and host to the world's largest tuna fishery, as a LME.

4.3 Critical Species

While effective conservation of biodiversity of the Pacific islands will require integrated management approaches which maintain the health and function of marine systems, there are a number of marine species which could be considered 'critical'. In some cases these are rare or endangered. In others their importance is by virtue of their significance as a potentially sustainable resource for humans.

4.3.1 Reptiles

Six of the seven species of marine turtles are found in the Pacific islands region. The three most commonly present are the green turtle, hawksbill and leatherback, while the loggerhead, flatback and olive Ridley are less common. Of these the hawksbill is listed as 'critically endangered' by the IUCN Red Data List, while four (green, leatherback and olive Ridley) are 'endangered' (the flatback is listed as 'vulnerable').

Marine turtles are typically slow to reach sexual maturity (e.g. from under one to over four decades for leatherbacks). They return to specific locations to mate and lay their eggs and are particularly vulnerable while on nesting beaches. These locations are an obvious priority for conservation action.

People in the Pacific islands region have had a long association with marine turtles (Hirth, 1993). Turtles are hunted for food and to produce jewellery, cosmetics and other products, while the eggs are also a food source. Sea turtles have played a role in religious ceremonies and figure in traditional art and legends.

Human impacts are a significant cause of turtle mortality. Accidental killing occurs in fishing nets. Sea turtle populations in the Pacific islands region have severely declined as a result of over-exploitation. SPREP has initiated a Regional Marine Turtle Conservation Programme (RMTCP) to assist fisheries and conservation

agencies in the region to conserve and sustainably use sea turtles. The RMTCP has operated under a 1994-1996 Strategic Plan developed by its country and NGO members. Recently a new Strategic Plan for the conservation and sustainable use of sea turtle resources in the Pacific Island region for 1997-2001 has been developed and requires resources for implementation.

4.3.2 Saltwater Crocodile

Saltwater crocodiles are found in Palau, Papua New Guinea, the Solomon Islands and Vanuatu. They are heavily exploited in these places, primarily for the skin trade. The population is threatened in the Solomon Islands (Messel & King, 1989) and is nearly depleted in Palau (Messel & King, 1991; Brazaitis, 1992).

4.3.3 Marine Mammals

Of the world's 120 species of marine mammals, three quarters live in the Pacific. Of the 90 or so Pacific species, perhaps a third is known to be resident in the SPREP region or at least to visit it seasonally or occasionally (Reeves et al., in press). Very little is known about marine mammals in the region.

Pelagic whaling began in the early 1800's and much of what is known about these species relies on whaling records. Many of the whale species that migrate to the SPREP region e.g. humpback whale, have had significant commercial whaling pressure in other parts of their migratory range. Little is known about the impacts from traditional/subsistence and commercial harvests of small cetacean species, or the impacts from bycatch in fisheries and vessel collisions.

Local expertise to work on marine mammal issues is virtually non-existent. There is now a growing interest in marine mammal based nature tourism (e.g. humpback whale watching, swimming with dolphins) to meet international tourism demands and to provide local income. Early training initiatives have been undertaken in Tonga for whale watch operators and guides from Tonga, Niue, Cook Islands, Fiji and American Samoa.

A Marine Mammals Conservation Strategy (MMCS) for the South Pacific has been completed and implementation has begun. This includes production of a baseline document on marine mammals in the region and a field guide for the identification of different species of whale (prepared in conjunction with the IUCN/Species Survival Commission Cetacean Group).

4.3.4 Dugong

Dugongs inhabit the shallow coastal tropical and sub-tropical waters of the Indian and western Pacific Oceans. In the Pacific islands region the dugongs are found in Papua New Guinea, the Solomon Islands, Vanuatu, New Caledonia and Palau. Information on its abundance, distribution and threats is very limited. Sirenian status and conservation efforts are reviewed by Marsh and Lefebvre (1994). Dugong reliance on seagrass beds for food limits their ability to travel between islands and thus many island populations, including those in Palau and Vanuatu are probably essentially isolated (Reeves et al., in press).

Threats to dugongs include unsustainable hunting, incidental capture in fishing nets, collision with vessels, and loss of the seagrass on which they depend for food. They are vulnerable to exploitation because they are slow to breed.

4.3.5 Fish

Information for fish in the Pacific islands Region is available from a number of sources. Wright and Hill (eds.) (1993) provide a review and assessment of near shore fisheries resources and management.

4.3.6 Overview of major fish groups of the Pacific islands region

Small Pelagic Fishes:

The small pelagic fishes (e.g. sardines, anchovies, sprats, flying fishes etc) of the Pacific islands form an important part of the total fisheries production of the region. They are fished by the indigenous populations of the region as a traditional food source and more recently, by pole-and-line tuna fishing vessels as a source of live bait. Although there are anecdotal reports of overfishing present levels of exploitation appear to be sustainable in most areas - although there is a lack of information on which to base an objective assessment (Dalzell, 1993).

Reef-associated Finfish:

Throughout the Pacific islands, reef-associated finfish form the basis of most subsistence fisheries (Wright, 1993). In many areas the resource is also fished on a commercial scale. Compounded by a poor understanding of social factors affecting fishing in coastal communities throughout the Pacific is a generally poor but increasing knowledge of the population biology and fishery dynamics of target finfish resources. There is ample, albeit largely anecdotal information to suggest that reef resources close by most urban centres suffers from overfishing (Wright & Hill, 1993).

Marine Aquarium Fish:

Over the past two decades there has been a tremendous increase in the popularity of marine fishes for aquarium. The uncertainty of reef fish population dynamics and the paucity of data concerning the effects of aquarium fish collecting on coral reefs have made the development of management regimes difficult. Most authors agree that very few species of reef fish are in danger of becoming extinct as a result of aquarium fish collecting. Of greater concern is the impact that lives collecting may have on local populations of coral reef fishes (Pyle, 1993). Although not yet widespread within the Pacific islands as in south-east Asia, the use of destructive collecting techniques, in particular sodium cyanide, and the export of live grouper are potentially important management issues.

Deepwater Demersal Fish:

Finfish catches on the deep (100-500m) slopes of the Pacific islands are dominated by a few species of snappers and groupers. These have not been a major component of the traditional subsistence fisheries in the Pacific, but in a few areas have become an important component of developing commercial fisheries.

Tuna:

Skipjack, yellow fin, big eye and albacore tuna are distributed throughout the Pacific islands region and the pelagic fishery of the Pacific islands is vital to the economies of the region. Levels of exploitation are classified by the SPC as low-moderate for skipjack, moderate for yellow fin, while for big eye suggestions are that recent catches may exceed sustainable limits, although for this species there are serious deficiencies in current knowledge which continue to hinder reliable assessment. For albacore there is no evidence that current levels of fishing are adversely affecting the stock, although this species is slower in growing and live long and therefore of less fisheries potential (SPC, 1996).

Sharks:

Nichols (1993) notes that sharks form an important role in the culture and folklore of many Pacific island nations. For example, shark worship is common in Melanesia, especially in the Solomon Island and Papua New Guinea. Traditional and small-scale commercial fisheries for sharks exist throughout the region, although they are poorly documented (Nichols, 1993). Sharks possess particular biological characteristics which make them susceptible to high fishing pressure. These include: long-lived, slow growth rates, low fecundity and reproductive rates, long gestation period, relatively large size at first spawning and strongly density dependent recruitment. They also have a low capacity to recover in the event of overfishing. On the basis of available case studies, the long-term sustainability of most commercially exploited shark fisheries is doubtful. Examples of

collapsed shark fisheries from around the world emphasise the susceptibility of shark populations to over-fishing. The dramatic increase in fishing pressure on oceanic shark populations (as bycatch of the tuna longline fishery) in the waters of the Pacific is cause for particular concern.

4.3.7 Invertebrates

Sant (1995) provides a review of the trade in marine invertebrates of the south Pacific, from which the following information is drawn. Additional information is available in Wright and Hill (eds.) (1993).

Invertebrate marine resources play a particularly significant role in the lives of Pacific islanders because they are easily collected and, in some cases, carry a high value. The increased availability of hooker and scuba gear has increased the opportunity to exploit many of these resources. Some species are in demand on the global market and therefore can be critical to the economies of Pacific island nations (Kelso, 1995). Harvest differs from some other fisheries in that it the islanders themselves who do the harvesting, indicating the potential for capturing financial benefits for local people.

There is a general lack of background biological information to allow for assessment of stocks, limited information on the quantities of subsistence use, and incomplete and inconsistent trade data. Determination of whether levels of harvest are sustainable is very difficult. Sedentary invertebrate species need to be assessed on a population by population basis making it difficult to provide an assessment for the region as a whole (Sant, 1995).

4.3.8 Commercially exploited invertebrates in the Pacific islands region

Trochus:

Trochus (*Trochus niloticus*) is a tropical marine snail which is naturally distributed on reef flats from the Indian Ocean to the islands of Fiji and Wallis in the Pacific. It has also been translocated to a number of other areas as far east as the Society Islands (Eldredge, 1993). Trochus has a long history of subsistence use and export from the region. It is generally collected by hand or by free diving and is used to produce mother-of-pearl clothing buttons, jewellery and as inlay in carvings (Sant, 1995). The high value of trochus shell on world markets has made it an important source of foreign exchange for Pacific island nations. In many instances it is a casual artisanal fishery, with collection when money is required. In others the fishery is driven by demand from button blank factories (e.g. Fiji, Solomon Islands and Vanuatu) which require a minimum supply of product to operate. There is concern that this amount may exceed the sustainable catch (Nash, 1990). Trochus is susceptible to overfishing because it occupies a well-defined and accessible habitat is relatively easy to collect, and is slow to recover when heavily depleted, probably due to limited larval dispersal (Nash, 1993). The status of trochus fisheries is difficult to determine due to inadequate or non-existent catch statistics, however there are indications of overfishing (Nash, 1993).

Green Snail:

The green snail is a gastropod which inhabits reef crests and deeper slope areas and is distributed throughout the Indo-Pacific. Its Pacific range extends as far east as Vanuatu. It is used primarily in the mother-of-pearl trade and also for jewellery and clothing buttons, historically as a by-catch of the trochus trade. In recent times the price has increased faster than that of other shells and it is now a target (Skewes 1990). The increase in fishing pressure has led to a substantial reduction in snail populations throughout its distribution (Yamaguchi, 1993). It occurs in low population densities, even when not exploited. Probable limited larval dispersal means that depleted areas may take a long time to recover. Available information is variable and imprecise although anecdotal observations suggest that the conservation status of this species is cause for serious concern (Sant, 1995).

Pearl Oyster:

Pearl oysters are found mostly on open shelf areas of continents and large islands at depths of 10 to 60m. The main commercially significant species in the south Pacific are the black-lip pearl oyster and the gold-lip or silver-lip. Pearl shells are harvested by free diving or use of SCUBA (Sims, 1993) and have been traditionally used throughout the Pacific in the production of lures for tuna fishing. The two commercial products are the shell (used for jewellery, wooden inlay and clothing buttons) and cultured pearls. Commercial exploitation has resulted in over-exploitation in some areas. In other areas population's densities are too low to support commercial industry (Sant, 1995). Cultivation through mariculture occurs in many areas.

Bêche-de-mer:

Bêche-de-mer is the name given to the dried product of the sea cucumber (a number of species are utilised). It is collected by hand in tidal flats and pools (and by free-diving and with SCUBA in deeper waters) and is gutted, boiled, smoked and then dried for export (Kelso, 1995). The product is considered a delicacy in China and South-east Asia which are the principle destinations for exports and commercial trade has been well-established since the early 19th century (Preston, 1993). Bêche-de-mer is also consumed on a subsistence basis in the Pacific. Stocks have often been over-exploited and although only two nations - Fiji and Vanuatu - have management controls in place (Sant 1995) others are in the process of developing them. These fisheries play an important role in providing income-earning opportunities, particularly in remote locations where other opportunities may be limited. A related management issue is the cutting of forests, especially mangroves, which are required for smoking bêche-de-mer (Preston, 1993).

Giant Clams:

Giant clams (Family Tridacnidae) occur with coral reef habitat in the tropical waters of the Indo-Pacific. They are harvested for their meat or adductor muscle, while shells are used as ornaments. They have been an important component of the diets of Pacific islanders for centuries, and still appear in local markets on a regular basis (Munro, 1993). Local extinctions of some species and the low numbers of some remaining populations reflect unsustainable exploitation, ranging from legal commercial and subsistence use to illegal poaching. Heavy commercial fishing reached a peak in the mid-1970's with the activities of long-range Taiwanese fishing vessels and was followed by the development of local enterprises (e.g. Fiji, PNG) which have since declined due to dramatic stock depletion (Munro, 1993). Because of this, countries have been working to monitor and regulate international trade and placing obligations on importing countries who are parties. Artificial propagation is technically feasible and there is increasing interest in giant clam mariculture operations.

Crustaceans:

Crustaceans such as spiny lobster and mangrove crabs are exploited for subsistence and commercial purposes in the Pacific islands. The spiny lobster in particular is in great international demand as a delicacy and is a high-value commodity. The coconut crab is a land-dwelling crustacean found in dense forest within a few kilometres of the coasts. Their range is reported to have declined significantly during this century due presumably to over-exploitation to the point where they may be endangered in some areas (Fletcher 1993).

4.3.9 Birds

Many Pacific Island and atoll systems have or have had until recently significant populations of nesting sea birds and coastal bird species. Land-based threats to include habitat loss and degradation, harvest (particularly of eggs and juveniles), deliberate killing without use for food, and particularly impacts from introduced predators such as rats. Many coastal wetlands areas are also important for migratory bird species, including those from the northern hemisphere. Little is known about the impact of bycatch of seabirds in fisheries in the region. However, this is a significant issue in surrounding countries e.g. New Zealand and Australia and is likely to be an issue given the amount of long-line fishing in the region.

Information on coastal wetland and shorebirds in the region can be obtained from Scott (1993). Information on seabirds in the region is available in Garnett (1984) and Harrison, Naughton, and Fefer (1984). A number of important breeding sites have been identified (see Garnett, 1984, table 5; Dahl, 1980). The South Pacific

Avifauna Programme was developed in 1990 under the auspices of SPREP. A significant number of bird population and habitat surveys in several countries of the region have received assistance under this programme, however, there has been to date little attention given to coastal and sea bird species. NGO initiatives and individual scientists have produced much useful information on avifauna in the region, e.g. Birdlife International, however, much of this information appears largely unavailable at the national and regional levels.

5 Analysis of Current Approaches to Management of Critical Habitats and Species in the Pacific Islands

5.1 Integrated Coastal Management

The following section draws on material from Smith et al. (1994), who provide an overview of coastal management issues and priorities for Small Island Developing States.

An important consequence of the large scale and linkages of coastal and marine environments is that conservation efforts should be part of integrated management regimes. Efforts to protect individual species or establish conservation areas may prove futile in the long-term unless they are part of approaches which enable overall management of uses within the coastal zone. For most Pacific islands all parts of the terrestrial environment influence or are influenced by coastal processes. From an ecological perspective, Integrated Coastal Management (ICM) thus equates to sustainable development of the entire island.

ICM may be summarised as a process which aims to maximise the benefits provided by the coastal zone and to minimise the conflicts and harmful effects of activities upon each other and the environment (see World Bank, 1993). There is an urgent need for Pacific island countries and territories to develop ICM programmes and strategies appropriate to their circumstances. ICM strategies need to be not only technically appropriate and scientifically sound, but also culturally and socially relevant. The conditions of social and economic development discussed earlier in this review have a major impact on approaches to ICM in the Pacific islands.

Although coastal management planning has been undertaken in many areas (e.g. Fiji, FSM, Palau, PNG and others) it is still a relatively recent inclusion on the agenda of many countries. There is no history of an integrated approach to decision-making. The majority of economic development targets specific sectors with little attention to integration or coordination. Most economies are strongly affected by the performance of relatively few exports, with a resulting high degree of dependence on a few external markets. This leads to uncertainty and vulnerability to boom-bust cycles, making integrated planning for sustainable development difficult. Decision-makers tend to be most concerned with the performance of key sectors, and less concerned about achieving integration across sectors.

Pacific island governments lack the capacity to implement ICM. Key institutional factors include the generally small size and limited human and technical capacity of relevant government agencies, their sectoral emphasis, and the reliance on aid programmes for staff and finances.

Subsistence is a predominant use of coastal resource of coastal land and sea. Although arrangements vary across the region, control of subsistence activities often rests primarily at the local community level. Government decision-making may have comparatively limited influence. Coastal resource development is thus frequently characterised by a large number of discrete management units along the coast. Traditional decision-makers tend to have a history of autonomy in decision-making which works against developing an integrated approach. There is often no practice of, or opportunity to coordinate long-term economic development. It is essential that the initial development and implementation of ICM to be at the scale of the most effective management unit, be

it the village, district or whole island level. The challenge for the region is to develop ICM processes which are appropriate to community and cultural needs. Participatory and local community decision-making is paramount.

Where customary tenure systems are dominant, the customary systems, structures and processes should form the basis of ICM. Even where they don't exist it is important that ICM seek to assist and complement existing decision-making structures rather than try to introduce new ones.

In considering the application of ICM to the Pacific islands it is also important to recognise the features of the region which present important opportunities for the application of ICM.

5.1.1 Opportunities for Application for ICM in the Pacific islands (Smith et al., 1994)

- High level of community involvement in resource management across the coastal zone.
- The existence of traditional and widely accepted and appropriate decision making and management mechanisms for natural resource management. These tend to have an intimate relationship with local communities and the coastal issues they face.
- A high degree of subsistence use of coastal resources, which may be translated into a strong interest in the sustainable use of these resources.
- Many cultures and communities are closely attuned to concepts of family and community which bring an understanding of the need to provide for future generations.
- The existence of cultures and structures which can provide for community debate and participation in decision-making.
- Although coastal problems are growing they are generally not yet at the level experienced by many other regions.

Implementation of ICM in the Pacific islands region will require at least four important elements:

- Education and awareness must initially target decision makers at all levels (including traditional decision-makers), particularly to develop an understanding of the consequences of policy decisions and actions in the coastal zone.
- Capacity building is required to provide the institutional, administrative and legislative basis for ICM.
- Long-term stability is required to support ICM as a long-term commitment rather than a one-off project. 5 years is probably a realistic timeframe for establishment of an ICM programme. External aid projects do not always address the need to provide sustainable financial and institutional support.
- "Island" appropriate methodologies must be developed to suit the particular situation. In the Pacific islands it is the process of implementation which will determine success, particularly in arriving at a consensus decision.

Despite the great diversity of the region there are common threads to the problems, issues and requirements to implement ICM in the Pacific islands. This points to the potential benefits of a regional approach to addressing these issues outlined above. Countries are isolated and it is difficult to exchange information and ideas. The store of technical and human resources available within the region is finite. There is a need to share these resources as well as to exchange experiences and information. This sharing and exchange is vital in order to develop ICM approaches which will be effective in the context of the Pacific islands. While the implementation of ICM solutions is a national responsibility, it would be greatly assisted by regional assistance with technical advice, training, human resources development, sharing basic resources and networking. A regional approach would also assist coordination between the numerous regional agencies that are supporting much of the existing ICM-related work across the region (e.g. SPREP, FFA, SOPAC, SPC, and The University of the South Pacific

(USP). These organisations have a history of effective regional cooperation and the appropriate mandate and status with governments to effectively promote ICM.

5.2 Traditional Approaches to Management

Johannes (1978) describes a number of customary marine conservation measures used by Pacific islanders. Most of these are based on restricting harvest from particular areas or of particular species and are often interwoven with other aspects of the life of the community (Munro & Williams, 1985). Measures employed in various places and at various times included:

- closing of fishing or crabbing areas
- closed seasons or banning of fishing during spawning periods
- allowing a portion of the catch to escape or deliberately not catching all readily available fish
- holding excess catch in enclosures until needed
- ban on taking small individuals fishing in inland lagoons or for certain easily accessible species restricted to times of poor fishing conditions
- restrictions on taking sea birds and/or their eggs
- restricting the number of fish traps in an area
- ban on taking turtle eggs
- ban on taking turtles on the beach
- ban on frequenting favourite spots on turtle nesting beach

The methods described above indicate that Pacific islanders employed many practices to control their use of marine resources. Although the degree to which these practices were successful in conserving resources is open to question there is no doubt that in many communities a relatively sound concept of resource management existed (Munro & Williams, 1985). This is not to suggest that there are no examples of traditional practices which were destructive.

As noted previously, the extent to which traditional practices have been maintained varies considerably across the region. They have been completely abandoned in some places, particularly around major towns and cities, as a result of escalating population, outside migration and colonial influences. In other areas (often more remote) they are still strictly adhered to (Munro & Fakahau, 1993).

Traditional tenure and customary management methods can provide an effective and cost-efficient foundation for management and conservation of marine resources. The owners of traditional rights have an incentive to use the resources in a sustainable manner, because the benefits will accrue. Another important feature is that controls are exerted at a local level, and not imposed from outside. This promotes self-confidence amongst the community and can help to establish good working partnerships with the government. If community-based management can be established the costs of management will be greatly reduced (Munro & Fakahau, 1993).

Community-based management and enforcement is likely to be more culturally appropriate and more effective than other approaches, particularly given the limited human, financial and technical resources available to Pacific island governments. However, with weakened local authority and changed social and economic circumstances, traditional systems, where they exist, are often not well enforced. There is a need to link modern management principles with village-based management structures, where the role of government is to empower local authorities, provide facilitation and technical advice on management issues. There are examples of where this approach has been employed and is proving successful (Bettencourt et al., 1995).

There are also examples where traditional approaches might not be appropriate, available or acceptable. In some instances traditional systems no longer exist in any real form. In others the return to a limited entry system could be viewed as unfairly constraining. In these instances stronger government intervention in management and

enforcement may be required. Even so, only where there are direct, identifiable benefits will local people support and follow management regimes (Bettencourt et al., 1995).

5.3 Fisheries Management Approaches

Fisheries management represents a different (but often overlapping) point on a continuum of activities to maintain marine ecosystem integrity. The emphasis on ecosystem management is important because the whole fishery process is dependant on the health of the marine ecosystem. Adams et al. (in press) provide a review of the status of Pacific island coral reef fisheries.

All Pacific island countries have adopted fisheries management legislation for key coastal resources, ranging from size limitations to closed seasons and gear restrictions for certain species (Bettencourt et al., 1995). Typical management options employed by fishery administrations include:

- restricted harvests through minimum or maximum size limits, catch quotas, seasonal closures and other restrictions;
- gear restrictions;
- closed areas (permanent and periodic closures);
- limited entry systems (e.g. annual or permanent licensing, exclusive access); and
- indirect methods such as taxes, subsidies, development of alternative fisheries, aquaculture, etc.

Some of the methods listed above lend themselves to management of critical habitats and species described in this review. Discussions of the applicability of these approaches are provided by Munro and Fakahau (1993) and Munro and Williams (1985). For instance, it is considered that minimum size limits could be successfully applied to invertebrates (e.g. giant clams, trochus, bêche-de-mer, green snail) and crustaceans for which the fisherman can make a judgement as to the size of the individual before catching it. This would help to ensure that only mature individuals are taken for these targetable organisms (Sant, 1995). In these instances maximum size limits might also be applied to promote greater egg production/recruitment. Quota systems might also contribute to export-based fisheries where all of the product arrives at a few centralised points for processing and can be monitored. Gear restrictions are a common means of preventing the use of destructive techniques (e.g. dynamite, cyanide, muro-ami nets and others), to exclude commercial interests such as where the primary emphasis is deemed to be subsistence, or to affect the composition of the catch. Restricted access systems could be employed to reduce the amount of fishing effort and help promote a sustainable catch. The use of closed areas has been advocated by many to serve as nuclei for breeding stocks and this concept is discussed below (see section on MPAs).

The limited capacity of national agencies to enforce controls is a major constraint to the implementation of fisheries management measures like those described above. There are very real limitations on what can be achieved in small island developing states which have limited funding and human and technical resources. The fact that most Pacific island reef fisheries can still support human subsistence nutrition is perhaps a matter more of good fortune than effective management (Adams, 1996).

Lack of information is another common problem for management of the region's complex multi-species and multi-gear coastal fisheries. There is a lack of basic information about how species interact and respond to exploitation. Levels of production are largely unknown. There is an inadequate knowledge base on which to plan management programmes and take action before resources become overexploited (Adams, 1996). Given the magnitude of the data requirements one approach would be to undertake a major effort at comparative assessment, using highly standardised species abundance methodologies at a wide range of sites. This would provide a comparative assessment of the status of areas and help to identify priorities for action (Adams, 1996).

There seems to be little likelihood that the problems of limited resources and information will be solved in the immediate future. Given this situation it seems reasonable to focus on developing and enforcing effective management measures for known critical areas and species and to promote extension and collaborative management arrangements with local communities wherever practicable (King et al., 1995). Adams (1996) suggests that this would involve:

- providing information to local communities, including through networks to allow sharing of experiences;
- defining local borders of jurisdiction;
- maintaining a basic infrastructure of resource management regulations which provides for more detailed local community action and enforcement; and
- monitoring and applying resource-specific restrictions at strategic bottlenecks (e.g. trade and export outlets).

5.3.1 Offshore Resources

The management of oceanic resources requires international and regional approaches, and is currently evolving, following the conclusion of the UN Implementing Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. The Oceanic Fisheries Programme of the South Pacific Commission prepares an annual report on the status of tuna stocks (SPC, 1996). Given that it is a comparatively less complex fishery and economically important it is not surprising that the amount of available information for tuna is greater than for other fish groups. In contrast, for a range of epipelagic species (fish, sharks and others) taken in association with tunas, their role in the pelagic ecosystem and the impacts of fishing on them, remain poorly understood. The general consensus is that offshore fisheries in the region are not yet fully developed.

Issues relating to coastal and oceanic fisheries are more comprehensively addressed in the 'Review of Fisheries Management Issues and Regimes in the Pacific Islands Region'.

5.4 Marine Protected Areas (MPAs)

The term 'Marine Protected Area (MPA)' is defined by IUCN (1992) as: "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". This definition is very broad and the term MPA thus potentially encompasses many different protected area types, including strictly protected areas (e.g. 'Scientific Reserve') multiple-use areas (e.g. 'Marine Park'), areas for fisheries enhancement (e.g. 'Fish Sanctuary'), and community-based management areas (e.g. 'Conservation Area').

A recent assessment (Kelleher et al., 1995) showed that a total of 41 MPAs have been established in the countries of the Pacific islands (as defined in this review). The level of management effectiveness is generally low. There is limited information on the habitat and species included and the threats they face. Many areas exist on paper only, lacking local support. MPAs are not well established in the Pacific islands as an effective conservation tool.

One of the reasons is that past efforts to establish MPAs in the South Pacific have been motivated largely by government, with insufficient attention given to the interests of local people. As a result the term 'protected area' is viewed with suspicion by many communities who fear imposition of unreasonable constraints on their behaviour and threats to their livelihoods.

This situation has been addressed to some extent by the South Pacific Biodiversity Conservation Programme (SPBCP), implemented by SPREP. The SPBCP has initiated the establishment and management of 'conservation areas' in the region, including a number of marine sites. The 'conservation areas' are a form of protected area which is firmly based on securing the commitment and support of local people. The SPBCP has contributed to fostering a community-based approach to management of protected areas in the region.

Community-based protected area initiatives by international NGOs such as The Nature Conservancy and the World Wide Fund for Nature are proving successful in some Pacific island countries (e.g. PNG, Solomon Islands). The SPBCP is due to conclude in the next few years and further work is needed to build on the progress achieved, especially in the marine environment.

One of the lessons of these programmes is that effective management is largely dependant on voluntary acceptance by the community. In traditional communities where there is continuing ownership or custody over terrestrial and marine environmental resources there is little possibility of establishing effective protected areas and regimes unless this is done in negotiation with the traditional owners or custodians.

Cooperation with local communities is most likely to be achieved where it can be shown that it is in the interest of local people to establish and manage MPAs. Providing opportunities for sustainable development and demonstrating that benefits will flow from management of resources are one means to achieving this cooperation.

One way of achieving this is through the use of MPAs to enhance fisheries. In theory MPAs can contribute to increased fishery yields through dispersal of larvae produced at higher rates from within the reserve (from more numerous and larger fish) and through emigration of larger and greater numbers of catchable fish across reserve boundaries (Hatcher et al., 1995). Although anecdotal evidence supports these conclusions, there are few quantitative studies which prove the existence of these effects (studies on Sumilon islands in the Philippines are an exception - see Russ, 1994). MPAs can also contribute to fisheries by protecting critical areas such as nursery or breeding areas. Traditional communities have long recognised the value of setting aside areas from exploitation. Fishery managers are increasingly recognising that the creation of MPAs is a positive step. There are efforts underway to promote these concepts - an example is the use of MPAs in conjunction with incentives to promote access to offshore fishery resources to decrease reliance on near shore sources. However, there remain relatively few examples of the application of MPAs for fisheries management in the Pacific islands.

MPAs are used extensively in the Caribbean and elsewhere in association with the tourism industry. Tourists and divers in particular like to see the large and spectacular fish and other marine life which can occur in MPAs set aside from extractive activities. Tourism operators may recognise a strong interest in preserving the environmental assets on which their operations depend. They may be in a position to provide a stronger local management and monitoring presence than government authorities and can potentially be important allies for conserving critical habitats and species. There are many practical challenges to developing marine-based tourism operations in the Pacific islands. However, this remains one potential avenue to be explored as a means to promote the use of MPAs.

Considerations such as those adopted by the SPBCP are appropriate in selecting MPAs in the Pacific⁴, e.g.:

- presence of nationally or regionally significant examples of one or more ecosystems of global conservation concern (e.g. coral reefs, mangroves, seagrass beds);
- degree of commitment and support by landowners, residents, resource users and other potential partners;
- is sufficiently large and complex to encompass a wide range of the interactions between people and natural resources;
- containing high levels of biological diversity and ecological complexity, represented by a number of major environments, diversity of ecosystems, and/or large numbers of genera and species of plants and animals;
- importance for the survival of endemic species, or of species that are rare or threatened nationally, regionally or global; and/or
- is threatened by destruction, degradation or conversion.

⁴ IUCN (1992) have developed comprehensive criteria for selection of MPAs which are consistent with those used by the SPBCP.

This review promotes partnerships as the key to establishing and managing MPAs as a means of conserving and managing critical habitats and species. The influence of key interest groups (e.g. fisheries or tourism) will vary in different situations, however, achieving local community support must be a constant priority. Clearly there is a need for partnerships between governments and local people, which recognise the role of government in providing financial, technical and other support, and in ensuring consistency with national policy objectives, and the role of local communities in providing local enforcement. Such partnerships need to build on, rather than replace, existing institutional structures and decision-making processes at both the government and community levels. In many cases the customary tenure systems and traditional practices may provide the most effective basis for establishment of MPAs.

5.5 Species Protection Initiatives

Programmes targeted at specific species have proved to be an important means of capturing community attention and support for marine conservation. An example is the Regional Marine Turtle Conservation Programme (RMTCP) developed by SPREP to assist fisheries and conservation agencies in the region to protect sea turtles. This Programme included the successful 1996 'Year of the Sea Turtle' public awareness and education campaign which helped to generate widespread interest and involvement in the conservation of marine turtles. It is hoped to emulate the effectiveness of this campaign with the 1997 'Pacific Year of the Coral Reefs Campaign'.

Other species-focussed programmes include the Regional Marine Mammals Conservation Programme (RMMCP) for the South Pacific completed by SPREP in association with the IUCN Species Survival Commission (SSC), the Regional Avifauna Programme, the work of TRAFFIC related to trade in endangered species, the SPC Coastal Fisheries Programme and a number of other programmes carried out by organisations from within the region (see Smith (1996) for a listing of key institutions in the region).

While such programmes can effectively capture and focus public imagination and attention, they must be adequately resourced and set within the framework of wider management programmes in order to successfully deal with the broad range of coastal management issues and threats, and to provide continuity and follow-up.

6 Recommendations

In outlining the following recommendations the intention is to identify a limited number of high-priority issues for critical marine habitats and species, and the actions which could be taken to address them.

It is recognised that national task teams are responsible for developing detailed priorities under the SAP. The recommendations below should be considered as suggestions to contribute to this process.

It is proposed that to the maximum extent practicable these actions be addressed through existing institutions and mechanisms. As required by the ToR for this review, an attempt has been made to suggest, where appropriate, possible lead institutions, recognising that proposals will be subject to further consideration and approval by the governments and the various organisations involved.

6.1 Develop and implement a Pacific island regional programme to support national application of Integrated Coastal Management (ICM)

The development and application of ICM approaches which are appropriate to the context of the Pacific islands are a priority. Recognising the benefits of regional collaboration and coordination in addressing this issue, this review recommends the development and implementation of a regional ICM programme.

This programme should:

- strengthen the capacity of relevant regional organisations to provide coastal management technical assistance and support to countries in the region;
- develop and promote approaches to ICM which are appropriate for the Pacific islands;
- provide training and technical assistance to strengthen national capacity to implement ICM;
- support education and awareness activities which build commitment and support for ICM at all levels; and
- establish a limited number of pilot sites to demonstrate the application of ICM concepts in differing environmental and cultural conditions.

It is suggested that the programme could be implemented by SPREP in close coordination with FFA, SOPAC, SPC, and USP and other appropriate regional and national government and non-government organisations.

A sub-element addressing Marine Protected Areas (MPAs) is proposed below. It is suggested that community-based MPA sites could provide a focus for the application and demonstration of ICM.

6.2 Support the use of community-based Marine Protected Areas (MPAs) as a tool for the protection and management of critical marine habitats and species

MPAs are potentially an important tool for the conservation and sustainable use of critical marine habitats and species. The model of the community-based ‘Conservation Area’ is suggested as a type of MPA likely to be most appropriate for the social and cultural context of the Pacific islands. This review recommends that governments, non-government organisations, donors and other groups support the establishment and management of MPAs.

This should include:

- identifying areas of priority for the conservation and sustainable use of critical marine habitats and species;
- building partnerships with local communities and other interest groups, particularly the fisheries and tourism sectors;
- supporting community-based management of these areas, based around traditional structures and practices where appropriate;
- emphasising the need for long-term management arrangements including sustainable sources of financing.

This review also recommends that a MPAs sub-element addressing the above items be included in a regional ICM programme (see above).

6.3 Support implementation of the International Coral Reef Initiative (ICRI) Pacific Regional Strategy

The ICRI Pacific Regional Strategy was developed in late-1995 by a partnership of government and non-government representatives (the latter including local community leaders, scientists, academics and the private sector). It outlines the strategies and actions for the conservation and sustainable use of coral reefs and related ecosystems. The Strategy has received wide endorsement throughout the region, and is receiving particular support through the ‘1997 Pacific Year of the Coral Reef’ campaign.

This review recommends that governments, non-government organisations, donors and other groups maintain a commitment to the objectives of the Strategy and devote resources to projects which achieve its objectives.

The goals of the strategy are as follows:

- to effectively manage coral reefs and related ecosystems through the adoption of ICM appropriate to the circumstances found within the region;
- to develop the human resource and institutional capacity and responsibility for coastal management, research, training and education that reflects the Pacific way;
- to answer key management questions for the conservation and sustainable use of coral reefs and related ecosystems through the effective use of existing research and information, and the development of appropriate future research and monitoring activities;
- coordination and review of ICRI activities at the international, regional and national levels; and
- to make efficient use of existing resources and to identify and make use of new and innovative sources of funding to support the achievement of objectives of the Strategy.

6.4 Support implementation of the Regional Wetlands Action Plan (RWAP) for the Pacific Islands

Mangroves, seagrasses and other wetland areas have historically received a relatively low conservation profile in the Pacific islands region. There is limited expertise on wetland issues available within the region. A Regional Wetlands Action Plan (RWAP) has been developed to address this need, and implementation is underway through SPREP. Current resources provide a basic level of operation which requires further strengthening. This review recommends that additional resources be sought to assist with implementation of the RWAP.

This should focus on:

- implementing mangrove and wetland-related management projects identified in Pacific island National Environmental Management Strategies (NEMS);
- developing the human resource and institutional capabilities for mangrove and wetland management, science, training and education; and
- collecting information on mangrove and wetland ecosystems that can contribute to the management process.

6.5 Promote regional cooperation to identify and apply management options for coastal fishery species which are subject to export-based demand

Export-based demand is a driving force behind the exploitation of a number of important coastal fishery species. While this trade can generate important economic and social benefits, there are indications that the exploitation of a number of groups is not sustainable. These include invertebrates such as bêche-de-mer, crustaceans (particularly coconut crab and spiny lobster), giant clam, green snail, pearl oyster and trochus. There is also an expanding trade in live reef fish which can involve destructive fishing methods.

Responding to the external forces involved in addressing these issues will require regional collaboration and coordination. This review recommends that governments in the region cooperate to identify and apply management options for coastal fishery species subject to export-based demand. This should include assessment of the potential for:

- improved monitoring of exports;
- arrangements for regulation of trade in these species; and
- application of management controls such as the establishment of sanctuary areas, size limits, and quotas.

6.6 Regional assessment of the conservation status of the dugong and saltwater crocodile

Information on the conservation status of the dugong and saltwater crocodile is limited. Both these species are present in the western parts of the region (Palau, PNG, the Solomon Islands and Vanuatu; the dugong also occurs in New Caledonia). The saltwater crocodile is heavily exploited for the skin trade and dramatic declines have been recorded. Dugong numbers have declined in some areas (e.g. Palau) and are uncertain in others.

This review recommends that a regional assessment be carried out to identify their conservation status, threats and priority management actions required for dugong and saltwater crocodile.

It is suggested that the assessments could be coordinated by SPREP in collaboration with appropriate regional and national government and non-government organisations.

6.7 Regional assessment of the impacts of the international tuna fishery on non-target or bycatch species

The international tuna fishery provides a major source of revenue to Pacific island countries. These operations employ methods such as long-lining and purse-seine nets which result in the capture of non-target species. The quantities and significance of this take are largely unknown. Species taken incidentally or as by-catch include billfish, seabirds, sharks, small cetaceans and turtles.

This review recommends that the governments in the region, in cooperation with distant water fishing nations, support a regional assessment and monitoring of the impacts of the international tuna fishery on non-target and by-catch species.

Such an assessment would be an important contribution to developing an ecosystem-based approach to research and management of the Western Equatorial Pacific as a LME. It is suggested that it could be carried out by FFA in cooperation with the SPC, SPREP and other appropriate government and non-government organisations.

6.8 Support regional and national campaigns to gain public support for the protection and management of critical marine habitats and species

Pacific island people depend on marine resources for their daily life. Recent campaigns such as those on marine turtles and coral reefs, and the ongoing efforts of a number of regional and national government and non-government organisations have helped to raise awareness of coastal management issues and the need for action to address them.

This review recommends that governments, non-government organisations, donors and other groups support further education and awareness programmes to generate public support for the protection and management of critical marine habitats and species.

The benefits in adopting a regional approach in the Pacific, particularly for sharing resources and expertise, have been clearly demonstrated. Consideration should be given to further regional education and awareness campaigns in the future.

Such activities should be closely coordinated with ongoing management programmes to ensure continuity and follow-up.

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ANNEX 1

Conventions and Instruments Relating to the Conservation of Critical Habitat and Species of the Pacific Islands.

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| Convention on Biological Diversity (CBD) | The CBD forms the basis of an international legal regime designed to ensure the long term survival of the full range of biological diversity, while at the same time providing for human needs through the sustainable use of biological resources. It places a range of obligations on Contracting Parties for the conservation and sustainable use of biological diversity. |
| Programme of Action for Small Island Developing States | The Programme of Action for Small Island States was adopted in 1994 and, like the GPA, is a non-legally binding instrument. It identifies priority areas and indicates specific actions at the national, regional and international levels that are necessary to address the special challenges faced by small island developing states. The dependence of small islands developing states on their coastal and marine resources is emphasised. The programme calls for action to ensure use of resources is ecologically and economically sustainable, including sustainable harvesting of fishery resources and the protection of coastal and marine resources. The Programme also outlines specific actions, policies and measures for the conservation and use of terrestrial and marine biodiversity. In doing so it calls on nations to identify sites of high biological significance for the conservation of biological diversity and/or for eco-tourism and other sustainable development opportunities. |
| Global Programme of Action for the Protection of the Marine Environment from Land-based Activities | The Global Programme of Action (GPA) is a non-legally binding instrument which provides conceptual and practical guidance to prevent degradation of the marine environment from land-based activities. The GPA outlines a programme of actions at the national, regional and international levels. Its main focus is on addressing particular activities and issues which may impact upon the marine environment. The identification of 'areas of concern' is a key part of the identification and assessment of problems. The GPA calls on nations to take steps to protect such areas from the effects of land-based activities. |
| Chapter 17, Agenda 21 | Chapter 17 of Agenda 21 outlines in detail the actions required to achieve protection of the oceans and the rational use and development of their living resources. The scope of the chapter is broad, ranging from integrated management, marine environmental protection, sustainable use and conservation of marine living resources, to sustainable development of small island states. As with the GPA, it is a non-legally binding instrument. The linkage between conservation and development is prominent, and management action for the maintenance of biological diversity and productivity is an explicit objective. |
| United Nations Convention on the Law of the Sea (CLOS) | The CLOS sets forth in one document the comprehensive body of principles and rules on the rights and obligations of states for control over and use of marine areas and resources (Tsamenyi et al, 1996). Article 61 of the CLOS imposes obligations for the conservation of the living resources of the EEZ. These relate primarily to ensuring that living resources are not endangered by over-exploitation and to maintaining populations of harvested and dependant species at levels which can produce maximum sustainable yield. The obligations are not onerous and are qualified by environmental and economic factors. Obligations under the CLOS for protection from maritime activities are more stringent and are expanded upon through MARPOL, the London Dumping Convention and other instruments. |
| Framework Convention on Climate Change | The 1992 United Nations Framework Convention on Climate Change sets as an ultimate objective atmosphere at a level that would prevent dangerous human-induced interference with the climate system. The Convention establishes a framework and a process through which governments can pursue action. The obligations of the convention are very broad as they relate to coastal and marine environments. There is a general requirement to promote sustainable management, integrated coastal management and to cooperate in the conservation of oceans, coastal and marine ecosystems as sinks and reservoirs of greenhouse gases. |
| Apia Convention | The Apia convention focuses on the protection of primarily terrestrial plants, animals, and areas of historic and cultural significance. It is focussed on nature conservation and provides for the designation of protected areas (national parks and reserves). Parties to the Convention are obliged to notify SPREP of the status of protected areas and of the flora and fauna protected, including endangered species. The Convention allows for appropriate arrangements to be made for the customary use of species and areas in accordance with traditional cultural practices. |
| SPREP Convention | The SPREP convention and its protocols focus on the prevention and control of pollution of marine And coastal environments. The provisions of the Convention cover only those terrestrial areas that |

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| | are essential to the protection of marine and coastal environments. Thus, the Apia and SPREP Conventions are complementary. In addition to provisions for control of various forms of marine pollution the Convention calls on parties to preserve marine species and habitats, particularly those which are rare or endangered. |
| The SPREP Action Plan | The SPREP Action Plan provides a framework for a regional approach to environmental issues addressing the unique needs and concerns of the countries and people in the South Pacific, and enhancing their environmental capabilities. The Action Plan is currently being reshaped, and a new plan being developed for the period 1996-2000. |
| Action Strategy for Nature Conservation in the South Pacific Region | The Action Strategy grew from the 3rd South Pacific Conference on Nature Conservation and Protected Areas held in Vanuatu in 1985 and was most recently revised following the 5th Conference held in Tonga in 1993. The Strategy recognises the importance of the human dimension in natural resource conservation in a region where much of the population is directly dependent on the sustainable use of natural resources. Strong emphasis is given to encouraging non-governmental and local community participation in all facets of natural resource conservation and management. Similarly, the strategy recognises the strong potential of traditional knowledge and custom to assist in developing sustainable resource use practices appropriate for the special circumstances of Pacific Island countries. |
| ICRI Pacific Regional Strategy | The International Coral Reef Initiative (ICRI) is a partnership of governments, non-government organisations and other groups seeking to increase the capacity of countries and local people to effectively conserve and sustainably use coral reefs and related ecosystems. The ICRI Pacific Region Strategy was developed and adopted by participants at an ICRI regional workshop. The Strategy highlights the specific issues and priorities for the Pacific region for the conservation and sustainable development of coral reefs and related ecosystems. |
| FAO Code of Conduct for Sustainable Fishing | The Code provides a necessary framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment. It provides principles and standards applicable to the conservation, management and development of all fisheries. The Code aims to promote sustainable use of fisheries resources and emphasises the need for protection of the biodiversity of aquatic habitats and species and endangered species. |
| Convention on International Trade in Endangered Species of Wild Flora and Fauna | CITES aims to protect wildlife against over-exploitation through international trade and to prevent international trade from threatening with extinction. CITES has established a world-wide system required for trade in threatened wildlife and wildlife products. No permits are issued for the most endangered species listed in Annex I. Other species considered at serious risk are listed in Annex II. International trade is permitted subject to proper controls and documentation from the government of the exporting country. |
| Ramsar | The Ramsar Convention was established with the primary purpose of protecting wetlands. As defined these include areas of marine water up to a depth of 6 m. Parties to the Convention are required to promote the conservation of listed sites and to ensure their wise use. |
| World Heritage | The World Heritage Convention aims to promote co-operation among nations to protect worldwide heritage which is of such universal value that its conservation is a concern of all people. It is intended that properties on the World Heritage List, established under the Convention, will be conserved for all time. Member countries commit themselves to ensuring the identification, protection, conservation, presentation and transmission to future generations of World Heritage properties. |

