SUSTAINABLE MANAGEMENT OF THE MARINE AQUARIUM TRADE

S.P.R.E.P.

PACIFIC REGIONAL WORKSHOP

PROCEEDINGS

4-8 FEBRUARY
NANDI, FIJI

Editors : Mary C Power and David A Fisk

AGENDA

Welcoming Address by the Minister for Agriculture, Fisheries and Forestry, Government of Fiji

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- Status of Coral Reefs – Value to the Region — Dr Robin South
- Coral Reefs and Sustainability — Dr David Fisk

Session 2 : Overview of the Marine Ornamentals Trade in Region

- Nature, Scale, and History of Marine Ornamentals Trade — Paul Holthus

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- MAC and Draft Certification Scheme — Peter Scott / David Vosser

<u>Session 6</u> : Action Strategy for Pacific Island Countries

- Group Discussion : **Constraints and Opportunities – Towards Sustainable Management of Coral Reefs and the Industry in Pacific Island Countries Action Plan : Initiatives Required to assist PIC to Sustainably Manage Marine Ornamental Trade**

<u>Focus of the workshop</u>

Foster Sustainable Use of Marine Resources – taking into consideration not only stresses from extractive activities such a s the marine ornamentals trade but also the compounding effect of other stresses/activities

Fulfilling CITES requirements and obligations for signatory and reporting countries

Role of government, local communities and trade industry in ensuring ecosystem sustainability management – Ban or Manage?

Capacity of National Governments to manage and monitor the industry – current capacity and future needs.

Outcomes : Determine capacity in Pacific Island Countries to sustainably manage the Marine Ornamentals Trade and identify areas for capacity building and support from Regional Bodies.

Welcoming Address

Opening Statement by Dr. Ken Cokanasiga
Deputy Secretary (Operations)

Please allow me to extend to you all the sincere apologies of the Minister of Agriculture, Fisheries, Forests and ALTA, Mr. Apisai Tora, who was invited and had agreed to deliver the opening statement this morning.

He has however, due to an urgent national commitment, been summoned to Cabinet for an important meeting.

He sincerely regrets not being here and has however directed that I convey to you all his sincere apologies and his well wishes for a very successful workshop.

He shall eagerly await the outcome and recommendations of your deliberation for the development of appropriate policies on managing this sector.

It is against that backdrop that I, on behalf of the Fiji Government, would first of all like to formally welcome you all to Fiji and to thank the South Pacific Regional Environment Programme (SPREP) for the invitation extended to our Minister to officially open this Regional Workshop on Marine Ornamentals. Thank you for choosing Fiji as the venue for this important meeting. I am told that 7 countries within the region are represented here today namely Tonga, Fiji, Cook Islands, Solomon Islands, Samoa, Vanuatu and Marshall Island.

I have been informed that Fiji when compared to other small island nations is assumed to be more advanced in terms of marine ornamentals development. Our Ministry is responsible for the development, utilization and sustainable management of our marine ornamental resources. Our marine ornamentals industry is currently worth approximately F$20 million annually in terms of export earnings. It is therefore an important industry for Fiji and considering the size of the reefs surrounding the Fiji archipelago, our Ministry believes that our marine ornamentals resource could be further developed to increase export earnings without compromising the long term sustainability of our resources.

We fully believe in sustainable resource development and the Ministry of Agriculture, Fisheries, Forests and ALTA is committed to putting in place resource management plans that would ensure the sustainability of our resources and our marine ornamentals industry. On this score, our Ministry would like to work closely with the three organisations namely the Marine Aquarium Council (MAC), SPREP, and the Forum Secretariat, in addressing our concerns in terms of resource management and sustainable harvesting systems. Our Ministry recognizes the importance of what is trying to be achieved and we are optimistic that the proposed MAC certification and labeling program would put in place certification standards and codes of practice that would protect our resources. We are also happy about the MAC/Forum Secretariat goal in trying to use market forces to transform the marine ornamentals industry in at least three Forum Island Countries (FICs) into one based on quality and sustainable use of coral reefs.

I believe the Marine Aquarium Council (MAC) will take the lead role in implementing activities to develop a third party marine ornamentals certification system for FICs. I understand that the MAC is focused specifically on addressing the range of negative environmental impacts that are occurring, or may occur, in conjunction with the existing marine ornamentals industry. We would appreciate initiatives to introduce a market driven certification and labeling system for marine ornamental industries that will assist countries achieve a balance between developing profitable reef-based industries, maintaining reef health and minimising negative environmental impacts.

It is clear the marine aquarium industry can provide high quality, healthy aquarium organisms with minimal mortality harvested from a sustainably managed reef environment, as well as good, equitably distributed returns to village communities. This is exemplified by successful industry operations that operate in this manner and are ready to provide information to back their claims. However, there is currently no system in place to identify and document quality products and sustainable practices and allow the consumer to reward those in the industry operating on such basis.

Government agencies, the industry, and NGOs have made isolated attempts in the past to address the impacts of the marine aquarium trade. Such efforts have included monitoring and testing for cyanide in aquarium fish, training collectors in non-destructive practices, and providing nets to collectors. Yet, while these activities are important, they have not been able to transform the industry because they have only addressed limited aspects of the commerce in marine aquarium organisms. No single government or other party has been positioned to work with the full "chain of custody", the range of other stakeholders, the global consumer demand for marine aquarium organisms, and coral reef conservation issues.

Finally, we are optimistic that the scientific support from SPREP and the political influence from the Forum Secretariat will support the Marine Aquarium Council, as an international multi-stakeholder institution, to address the situation comprehensively and achieve market-driven quality and sustainability in this industry, by developing an international system of certification and labeling for quality and sustainability in the marine ornamentals trade here in Fiji and our friends in nearby island nations.

With those words, I wish you all a very successful meeting, and I have much pleasure in declaring your workshop open.

Vinaka vaka levu.

Session 1 : Overview of Coral Reefs in the Pacific Region

STATUS OF CORAL REEFS IN THE PACIFIC ISLANDS

G. Robin South & Posa A. Skelton,

IOI-Pacific Islands, GCRMN Node for the Southwest Pacific, Suva, Republic of Fiji

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The following notes were taken from a Powerpoint presentation by the authors.

1. GCRMN-Reef Check Nodes for the Pacific Islands :

<u>IOI-Pacific Islands Node Includes :</u>
- Fiji
- Nauru
- New Caledonia
- Samoa
- Solomon Islands
- Tuvalu
- Vanuatu

<u>IOI-American Samoa & Micronesia Node Includes :</u>
- America Samoa
- Northern Marianas
- Federated States of Micronesia
- Guam
- Palau

<u>IOI-Hawaiian Archipelago Node Includes :</u>
- 8 large islands and 124 small islands over a distance of 2,400 km.
- Main Hawaiian Islands - large high islands, heavily populated
- Northwestern Hawaiian Islands - mainly uninhabited atolls & banks comprising 60% of the US coral reefs.

<u>IOI-Polynesia Mana - Se And Central Pacific Node Includes :</u>
- Cook Islands
- French Polynesia
- Kiribati
- Niue
- Tokelau
- Tonga
- Wallis & Futuna

<u>IOI-Australasia Node Includes :</u>
- Papua New Guinea

- Australia

2. Status of Reefs

Status Of Reefs

- Majority in good condition
- Increasing pressures from anthropogenic impacts in urban centres
- Main source of protein for people
- Some of the highest biodiversity in the world
- High Importance for economic development

Causes Of Reef Degradation – Regional

Anthropogenic

- Over-fishing
- Destructive fishing
- Increased sedimentation
- Physical alteration
- Eutrophication
- Ship groundings

Natural Phenomena

- Cyclones
- Coral bleaching
- Crown of Thorns Starfish
- Volcanism
- El Niño - La Niña
- Sea level rise

3. Causes of Degradation – National

Fiji

- Eutrophication
- Over-fishing & destructive fishing
- Mining, forestry & agriculture
- COTS
- Mass bleaching

Nauru

- Overfishing
- Blasting of reef channels
- Lack of MPAs

New Caledonia

- Mining runoff (Noumea)
- Loss of up to 28% of mangroves
- Coastal development

Samoa

- Overfishing & destructive fishing
- Eutrophication
- Poor land-based activities

Solomon Islands

- Rapid population growth ➔ overfishing
- Industrial pollution in Honiara causing extensive damage
- Logging & effects on catchments

Tuvalu

- Sand mining
- Cyclones
- Sea level rise
- Coral Bleaching

Vanuatu

- 50% of reefs considered degraded
- Poor land use practices
- Cyclones

Australia

- Pollution from river run-off
- Chronic fishing pressures (line fishing and trawlers)

Kiribati

- Sand extraction (past practice)
- Construction of causeways
- Mangrove destruction
- Over-fishing
- Sea-level rise

French Polynesia

- Coral bleaching
- Over-fishing
- Localised eutrophication (urban & pearl culture)
- Nuclear testing & fall-out

Tonga

- Over-fishing
- Destructive fishing
- Sand extraction
- Eutrophication
- Sedimentation

Wallis & Futuna

- Over-fishing
- Coral mining
- Sand extraction
- Eutrophication
- Sedimentation

Hawaiian Archipelago

- Alien introductions
- Destructive fishing
- Eutrophication
- Solid waste disposal
- Military uses (Kaho'olawe)
- Oil spills
- Sediments & run-off
- Urbanisation
- Tourism & leisure uses
- Ship groundings

American Samoa

- Over-fishing
- Coastal development
- Oil & hazardous wastes
- Sedimentation
- Alien species
- COTS
- Aquarium trade

Northern Marianas

- Over-fishing
- Land use practices
- Sedimentation
- Land-based eutrophication
- Tourism
- Military uses

Federated States Micronesia

- Coastal development
- Increased population & urbanisation
- Over-fishing
- Destructive fishing
- Grounded & abandoned ships

Palau

- Road building (Babeldaob)
- Eutrophication from fishing vessels (Malakai Harbour)
- Poaching fishing practices by DWFNs

4. Economic Issues

<u>Sectors most vulnerable are:</u>

- Artisanal and subsistence fisheries
- Aquaculture (subsistence and commercial)
- Tourism & ecotourism
- Coastal communities, infrastructure & development
- Traditional life-styles
- Food security

5. Economic Solutions?

In PINS little is known of the economic value of coral reef ecosystems, hence need to:

- Assess the value of coral reef and associated ecosystems
- Assess the socio-economic impacts of known and projected changes on coral reef ecosystems
- Develop strategies and scenarios that address these projected socio-economic impactsIssues & Priorities
- Build monitoring capacity
- Establish Community-based MPAs
- Develop National CZM plans
- Incorporate coral reef issues in UNFCCC
- Documentation of biodiversity & training of marine systematists
- Protection of intellectual property rights
- Development of legislation & regulations

6. Recommended Actions

<u>Subsistence & Artisanal Fishery</u>
- Develop fishery plans that are complicit with sustainable development
- Incorporate fisheries planning with CZM
- Improve on enforcement of regulations (gain assistance of communities wherever possible)
- Develop strategies to respond to crises caused naturally & anthropogenically

Tourism
- Tourism development should be part of national CZM plans
- Tourism industry should adopt ecologically sound practices
- Benefits of dive-tourism should filter down to resource owners
- Development of MPAs to be encouraged

<u>Marine Conservation</u>
- Development of community-based MPAs should be facilitated, and appropriate legislation developed
- Regular monitoring of MPAs should be integral to national Coral Reef Strategies
- Maintenance of national CR databases should be encouraged

<u>Marine Biodiversity</u>

- Marine biodiversity research & training a priority
- Legislation for bio-prospecting and biodiversity research should be developed
- The regional marine biodiversity collections at the USP should be strengthened
- Preservation of gene pool is essential

Acknowledgements

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CORAL REEFS AND SUSTAINABILITY

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1. Overview

This discussion will cover the topics listed below, with the aim of explaining, in simple terms, the complex organisation of coral reef ecosystems. The central theme is the inter-relationship between various components of the coral reef ecosystem and the way in which a change in one component may manifest changes in other components. Specifically, inter-relationships are explained in terms of a selective extractive activity such as that associated with the marine ornamental trade. Where possible, examples are drawn from organisms that are currently collected for the trade.

There is no single approach that will yield an adequate understanding of coral reefs such as using a single model to explain cause and effect. This is because a certain process may be better described and understood by the application of one type of model but a different model may be more amenable to an alternative model.

This presentation is divided into 4 major headings :

- Characteristics of Reefs
- Keys to Understanding Coral Reef Ecosystems - Paradigms, Processes
- Functions & Inter-Relationships
- Data Requirements for Sustainable Extractive Activities - Some Thoughts & Suggestions

2. Characteristics of Reefs

There are certain characteristics of reefs that apply to most locations. These characteristics have to be taken into consideration whenever issues of sustainability of an extractive activity are considered. These characteristics must be properly addressed in monitoring and assessment programs.

2.1. High Diversity

There is generally high species diversity within coral reef ecosystems globally, but a number of Bio-Regions can be recognized which vary in their level of species and community diversity. Diversity is a multi-level and can include genetic, taxonomic, community, functional, and ecosystem levels.

An important point to remember is that species with small distribution ranges generally have small populations and therefore are more susceptible to adverse conditions that can severely impact on the whole population. Similarly, species with a large distribution range but with locally small population sizes can also be vulnerable to intensive harvesting efforts. It also is important to keep in mind that for some regions, relatively few individuals make up a number of coral species' presence records, and it can't be assumed that a particular species occurs in every location across its whole distribution range.

2.2 "Hotspots" of Diversity

It is recognized that there are areas within an individual coral reef (or within a biogeographic area) that are relatively richer in numbers of species (or even in numbers of categories of species) in comparison to other reefs or areas. However, some species can be vulnerable to local exploitation even though they have large distribution ranges. This is the case where the "fringes" of a species range is clearly demarcated, eg, in Figi, some coral species are at present at the eastern edge of their distribution range.

As a general rule, if high species diversity is used as a measure of importance when considering sustainability issues, it should be considered within but not among different biogeographic regions (Norse 1993).

2.3. Spatial and Temporal Variability in Survival and Recruitment

Recruitment and survival rates are the two key population parameters that are needed for estimates of sustainable management of extractive industries such as the marine ornamental trade. The role of recruitment is sometimes referred to as "supply side ecology" and for many coral reef fish species, recruitment and survival rates are closely tied in with specific settlement and habitat requirements. For example, damsel fish (Family Pomacentridae) often have two or three years of good recruitment on a reef which is then followed by a period of relatively lower recruitment (Myers 1999).

Habitat requirements often differ between juveniles and adults of the same species, eg, the juvenile Emperor Angel fish (*Pomacanthus imperator*), a highly sought after aquarium fish, is solitary and occur under ledges, in holes of outer lagoon patch reefs, or in semi-protected areas of exposed channels and outer reef flats, but move to other habitats when sub adults and adults (Myers 1999). In another example, the clown trigger fish (*Balistoides conspicillum*) settles as a juvenile in or near caves and ledges on steep drop offs below 20m depth (or at depths where the habitat requirements are suitable, Myers 1999).

Populations of reef organisms that exhibit low recruitment rates are particularly vulnerable to over exploitation and to disturbances that reduce their population size. It is also important to recognize that patterns of recruitment may not be the same within an individual species across its full distribution range. This is because low recruitment can be a consequence of low fecundity or high juvenile mortality. In heavily fished reefs, very few fish survive long enough to spawn and so recruitment depends on larvae drifting in from other areas. Even relatively unfished areas downstream from heavily fished areas exhibit major variations in stock size and substantial reductions in numbers of targeted fish species due to upstream impacts.

2.4. Complex Inter-dependence of Organisms including Symbiosis

Coral reefs and the organisms that make up the system, display complex interactions and inter-dependencies that often result in a range of facultative to obligate associations. In fact, species interactions (eg predation, symbiosis) are one of the main driving forces in coral reef ecosystems. For example, certain butterfly fish species (Family Chaetodontidae) are obligate coral polyp feeders and consequently the presence of suitable coral prey is a prerequisite for the survival of these chaetodontid species.

In obligate association cases, the presence of one species is essential to the survival of the other organism. A good example of this is the variety of endo-symbiont algae or cyanobacteria associations with hard and soft corals, anemones, giant clams, sponges, tunicates and other invertebrates.

2.5. Dynamic Changes at many Spatial and Temporal Scales, produce a Multitude of Patch Sizes at Different Successional Stages

The distribution of areas of reefs, or patch sizes, at different successional stages produces a mosaic of species distributions that is characteristic of reef systems. It is this variability in community development that helps maintain the variety and diversity of species on a coral reef. This has to be kept in mind when designing monitoring programs that will accurately follow the sustainability of an industry that selectively extracts certain elements from the system.

2.6. High Primary Production Rates with Light Energy driving the System

Although some reefs and reef patches may produce a yield of excess biomass (whether it be in the form of high predator numbers or high plant or algal biomass), other reefs may be consuming more biomass than is being produced. In general, however, coral reefs have the greatest gross productivity of any ecosystem in the sea but the net system productivity is very low (eg in terms of net fishery yield or biomass).

Coral reefs are systems that exist in relatively nutrient deficient seas, and the high productivity found on reefs is due to symbioses between single celled algae within the tissues of animals, and to marine plants and algae that are part of the coral reef community. The recycling of nutrients within coral reef systems is very rapid and it is the rapid recycling mechanisms that produce the significant coral reef characteristic of multiple trophic levels. As a consequence of this rapid recycling, much of the assimilated energy is lost in respiration at each step in the food web so it would appear likely that there is very little excess net production in coral reef systems.

2.7. Complex Food Webs and Predator - Prey Relationships, and Rapid Significant Responsiveness to Disturbances

In coral reef ecosystems, the resident population of fish at a site can affect the recruitment of fish and corals and therefore the community structure of the reef at that site. For example, on Jamaican coral reefs the live coral cover has been substantially reduced due to over fishing of herbivorous fish and triggerfish, and to a consequent mass mortality of relatively high sea urchin population. The mechanism for coral cover reduction in this example was the replacement of much of the reef biomass by macro algae that shaded corals. Macro algae was initially controlled by grazing from high sea urchin populations which expanded due to the increased algal food availability when fish grazers and urchin predators were severely reduced in abundance.

2.8. Very Efficient Recycling of Nutrients and Essential Elements (Pathogens, Microbes, Boring Organisms)

The very efficient recycling of nutrients on coral reefs is based on detritus recycling. Coals have been observed to feed on fish faeces, and another study has reported that up to five fish species may cycle the same fecal material before it settles on to the bottom where it is again consumed by corals and invertebrates.

The high standing stock of animals, the low net yield of coral reefs, and the intensity of predation suggests that a natural coral reef system is operating at close to maximum sustainable yield, just to support the normal level of biomass that is on a reef.

2.9. Life History Characteristics of Key Groups make them especially Vulnerable to the Targeting of Large Individuals

The life history of dominant coral reef animals (eg fish) vary but can generally be described as having a majority of the following characteristics :

- they exhibit variable recruitment rates,
- high juveniles mortality,
- slow growth, low natural adult mortality,
- first reproduction is often postponed with an increased fecundity correlated with age,
- there are usually sedentary post settlement stages,
- adults have a long life, and
- multiple reproduction phases are common (eg, many reef fish are sequential hermaphrodites).

These life history characteristics make successful reproduction in these populations especially vulnerable to extractive activities that target large individuals.

3. Keys To Understanding Coral Reef Ecosystems

There are a number of approaches to help understand the way coral reefs function, however, any one approach does not fully encapsulate the full functional complexity of a coral reef. Four approaches are outlined here : (i) Coral reefs are under the influence of a buoyant liquid medium that is in constant motion, (ii) Aspects of coral reefs can be best understood by focusing on the link between tiny producers and larger consumers, (iii) Coral reefs are not homogeneous structures, and (iv) Coral reefs can be viewed as being made up of multiple community types and can demonstrate multiple dominance characteristics (adapted from Norse 1999).

3.1. Coral Reefs are under the Influence of Variable Water Movements

The motion of water around and within a coral reef influences feeding, reproduction, the growth forms of plants and animals, and animal movements. Currents influence species evolution and distribution patterns as they are the primary mechanism for dispersal of reproductive products and for the successful sexual reproduction of new genetic combinations. That is, organisms occur in a place only if they can get there and can survive there. For example, there is an observed decrease in diversity of a wide range of reef organisms from west to east across the Pacific Ocean that is correlated with western flowing ocean currents within the tropical latitudes.

Boundaries of species distributions are determined by factors such as depth, salinity, temperature, light gradients, as well as by differences in prevailing winds, currents, and areas of upwelling.

The dominant features of the water medium that act as major controlling mechanisms on reef structure and function are :

- Thermal and light absorption properties of water restricts optimal growing conditions for organisms dependent on light and high productivity to the uppermost levels in the water column,
- Oxygen is rapidly depleted in the very warm waters of the tropics so proximity to water turbulence zones (wave breaks and areas of rapid water movement where water is oxygenated) is an advantage, and
- As a consequence, optimal living conditions vary over the whole area of a coral reef and in any one location over time.

3.2. The Tiny Producer and Larger Consumer Model

Coral reef ecosystems contain many food web configurations. As mentioned above, the role of detrital pathways through coral reefs is very significant, but there may be a many steps in that process. For example, a typical food web structure on a coral reef may be represented by one or both of the following :

- (Plankton) ⇔ Zooplankton (which are predominantly detritus feeders) ⇔ Planktivorous Fish (eg Damsel Fish) ⇔ Carnivorous Fish ⇔ Birds, or by
- (b) Microbial ⇔ Algae ⇔ Sea Urchin ⇔ Trigger Fish.

In the latter case, the removal of relatively few trigger fish from a location can result in an increase in sea urchins, which in turn can lead to a highly eroded reef platform (and to the reduction in recruitment of many benthic organisms).

On coral reefs it has been estimated that up to six trophic levels may be present in any community, which is probably the most complex organisation of any marine ecosystem. Generally, as the level of nutrient input to a system increases, the number of trophic levels in the communities become fewer. This is because efficient recycling of essential elements is not as important compared to locations with constantly low nutrient environments.

The dominant features of a reef are can be described in terms of producers and consumers in some of the following ways :

- There is often high turnover rates of species (though not necessarily of trophic groups) in one location over time,

- Species can respond quickly to certain environmental changes or to changes in the abundance of species that normally interact with them,
- Food web relations can be broken and dominance can change in small areas, and
- Recycling organisms can be prolific at times because they can rapidly respond to conditions that are favorable to their increase in abundance.

3.3. Coral Reefs are Not Homogeneous Structures

Corals reefs display an array of habitats due to variations in slope, substrate type, degree of consolidation, and to different combinations within these factors. Diversity on coral reefs can therefore be understood by considering the influence of variations in the physical features mentioned above.

There is a definite relationship between reef structure and species distribution, where the key structural component is often hard coral (though in some habitats hard coral may be replaced by macro algae or soft coral). At small spatial scales, there are some good examples of the inter-dependence of fish and coral growth forms, eg, Damsel fish - Staghorn coral relationship, with the primary function of the coral is protection for the damsel fish from predators.

Topography can dictate what community types will dominate. For example, at Heron Island on the Great Barrier Reef, there were two separate breaches in the outer reef crest a few years apart that lead to dramatic changes in the immediate coral communities. One breach in the level of the crest was caused by a small ship grounding, and the second by physical removal of crest material during a cyclone. Both incidences resulted in an altered low tide flow pattern and a lower mean low water level which resulted in extensive death of all benthos over 100's of meters and a lowered reef profile in the area.

3.4. Coral reefs Show Temporally Variable Multiple Community Types and/or Multiple Species Dominance

There can be a sudden change in community type or in relative species abundance as a result of a sudden environmental change. For example, on the Great Barrier Reef (Myrmidon Reef), as a result of the grounding of a ship containing fertiliser, there was a switch from a coral dominated community to an algae dominated one. This was thought to be due to the initial fertiliser spill, causing death to most organisms in that area, and the maintenance of the algal community over a long period of time due to continual input of dissolved iron from the boat breakup. This alternate community state has persisted for greater than 20 years in the vicinity of ship grounding.

Other natural examples of multiple community shifts in organism dominance are :

- On reefs with a high wave action, there is a gradation from crustose coralline algae (CCA) in the surf zone, to a turf algae community on otherwise unoccupied substrate that can be correlated with the change in water turbulance that occurs across reef flat,
- Tabulate *Acropora* spp often dominate upper reef slopes after severe physical disturbance (eg from cyclones or major crown of thorns (COTS) infestations), and
- Where there has been a major outbreak of COTS, it often leads to extensive stands of dead standing coral which is quickly covered with turf algae and other micro

organisms, this in turn leads to an increase in food for herbivorous animals (fish and urchins for example), and often as a consequence of the increase in micro organisms, there is an increase in the incidence of ciguatera poisoning in humans from the consumption of carnivorous fish. At same time there is often a reduction in coral dependent fish such as certain butterfly and damsel fish species.

4. Functions & Inter-Relationships

4.1. Water Medium Effects

The behaviour of water can have an effect on reproduction which is reflected in the diverse life history strategies that can be seen on coral reefs, for example, all of the following can be present on a normal coral reef :

- Seasonal verses intermittent continual breeding,
- Sexual verses asexual propagation eg in *Acropora vs Pocillopora* coral species,
- Hermaphroditism verses separate sexes in certain coral species,
- Sex changes in fish groups (with either a dominant male or the largest being female).

Variability in the recruitment of reef organisms with pelagic stages in their life cycle can be a result of differences in water motion and the subsequent dispersal of reproductive propagules. This has lead to life history differences that range from short verses long drifting phases, the latter often showing a progression of developmental phases while in the drifting pelagic phase. Differences can be seen between similar organisms showing either a large number of small eggs verses organisms exhibiting a small number of large eggs.

To presumably enhance fertilisation rates, fish often congregate in distinct and predictable spawning aggregations, and at predictable times of the year. This is an important consideration for the marine ornamental industry looking at the sustainable collection of fish.

4.1.1. Spatial Arrangements - Competition for Space and Non-Shade

Because light energy is driving the system, and the majority of primary production is occurring intracellularly, there is a strong forcing function (or organisational force) that can be best described as high competition for space in sunlit positions. There is also a limitation with respect to depth due to the rapid attenuation of light as it passes through water. As a secondary factor, the degree of water clarity (or the amount of suspended particles and turbidity) will also be limiting the vertical range where competition will be at its most extreme.

Many organisms have adopted strategies to give them a competitive advantage. These include the ability of many hard corals to kill neighboring coral tissue through extrusion of tentacles and digestive filaments. Soft corals and sponges have developed powerful chemical retardants that repel or kill potential competitive neighbors. A variety of growth forms and growth strategies also convey a competitive advantage in the most suitable habitats.

The combination of all these factors act to produce the diversity and variation in reef structure that is characteristic of coral reefs.

4.1.2. Energetic Requirements and High Oxygen Demand in a Nutrient-Limited Environment

Because of the intensity of competition, there is strong pressure on organisms to maintain high energetic levels for fast growth. Due to the general limitation of nutrient inputs into reef systems (the exception is where major terrestrial input is present), the development of partnerships and mutual associations is common. Rapid growth requires energy as well as high oxygen demand. Warm water temperatures limit the absorption potential of gases such as oxygen, so locations where there is constant and significant water agitation is where the highest dissolved oxygen levels are to be found. Such locations are exposed reef fronts where strong wave action is present, and in passes and channels where strong tidalcurrents are experienced.

4.1.3. Shape and Form - Growth and Least Resistant Shapes

Water motion adaptations result in the clear distinction of reef zones with characteristic communities. In the most acceptable locations for growth, there is a small suite of growth forms that generally comply with the necessity to have shapes that are the least resistant to the strong water motion characteristics and can maximise the utilisation of growth factors.

Zonation is often highly predictable on normal healthyreefs, and within regions, many of the common community types and species growth forms are also located in predictable zones, though the precise composition of such communities do vary.

4.1.4. Feeding Methods - Filter, Detritus, Omnivore, Carnivore

Water motion dymanics also influence the ability of sessile organisms (in particular) to feed from the water column. The flow of water past any point on the reef, together with the suspended sediment and particulate load present, will significantly influence the distribution of organisms with different feeding methods, including filter feeding, detritus feeding, omnivorous or carnivorous feeding.

4.1.5. Optimal Primary Production - Photosynthetic Requirements Determine Competition "Rules" and Growth Forms

To gain an understanding of the role of water motion in the functioning of coral reefs we can integrate a number of the above points from this section of the presentation. That is, it should now be appreciated that photosynthetic requirements determine the competition "rules" and the force that ultimately determines the organisational arrangement of reef components

To optimise primary production via intracellular photosynthesis, growth forms that maximise the capture of light will be favored. Conversely, growth forms that effectively shade competitive neighbors will also be an advantage for an individual organism.

4.2. Some Species Attract Special Concern and/or Interest

4.2.1. Unique or Rare Species

A unique (or rare) species can be acknowledged as a feature of a location. Though some species will be rare everywhere or rare in certain geographic regions, species that are common on many coral reefs can be rare at the boundaries of their distribution. These factors should be taken into consideration when deciding on the relative importance of a species in a location with respect to a particular aquarium fishery.

4.2.2. Species Associations and Inter-dependence

Species that are usually or always found together eg Goby fish and burrowing shrimp, free living corals and sipunculan worm, anemone fish and anemones, other symbiotic and mutualistic associations, are expressions of the competition pressure that exists on reefs. Aquarium collecting activities that separate the members of an association usually compromise the ability of the other partner to survive in the system because of the degree of dependence that has developed between the associates. An example is the anemone and its anemone fish where the removal of the fish exposes the anemone to increased predation (as does the reverse situation).

4.2.3. Key Ecological Species

The role of some species is thought to be very significant for the health and functioning of coral reefs. Often the presence of a species with a certain key role is disproportionate to its biomass or size in that community eg the critical role of cleaner fish and cleaner shrimp in maintaining the health of a wide range of fish species and fish trophic groups cannot be underestimated.

Certain species can respond quickly to a reduction in the abundance of competitors or predators. Therefore, species that keep the population size of a competitor or prey species in check can be viewed as key ecological species. There are dramatic examples that have been documented in the scientific literature where a series of factors conspired to produce a large phase shift in the status of a reef community. Often the significant shift in community type has been a result of natural and anthropogenic factors that combined to produce the outcome.

4.2.4. Keystone Species that Characterise Whole Communities

Keystone species can be either common or rare. Common species that characterise a whole community are probably not very susceptible to sustainable levels of exploitation. However, the presence of endangered or threatened species (either on a global or regional scale) are important to consider with respect to sustainable use, as these species are in high demand for the aquarium trade yet they can have significant key roles in those locations. The fact that they may be rare or endangered suggests that there are life history features that have caused the species to become rare or endangered. The same life history features probably mean that these species can be extremely vulnerable to over exploitation despite the fact that their presence can indicate or characterise a whole community type.

4.3. Some Areas are Especially Important

Spatial scale is an issue when considering if an area is important for the long term health or long term sustainability of a reef system. Such areas may be where unique (endemic) species may be found. An important area may be one that can be defined by the presence of an unusually high number of species, categories of species, or communities ("Hotspots").

An important area may not be defined by either of the above two criteria yet it may have an important human dimension. The importance of a location and the communities contained within it can be defined because of its relative accessibility with respect to conservation, tourism, scientific study value, or as an essential food resource.

4.4. Risk is Higher for Certain Species and Ecosystems

A number of general ecological principles can be applied to gain an understanding of coral reefs and to use as tools to assess sustainability. One approach looks at species with respect to their potential risk or vulnerability to exploitation. Some relevant principals would include the following :

- **Small Populations** have a higher risk of extinction as there is reduced adaptability to natural or man-made catastrophic disturbances that result in variations in population structure, environmental parameters, and genetic recombination;

- Populations or species with **low recruitment** rates are vulnerable to over exploitation and disturbance as there are low numbers of young and/or high juvenile mortality; common traits of low recruiting populations are long adult life and extended reproductive life;

- Species with very **specialised requirements** for habitat, diet, reproduction, or relationships with other species are vulnerable to environmental changes because they possess limited ability to switch to other resources (eg Cleaner Fish / Shrimp);

- Populations or species with **limited ranges** are vulnerable to disturbances within that small range because of their lack of ability to move away from unfavorable situations;

- Species **valued by humans as commodities** follow the basic principle of supply and demand; and cultural preferences and traditions for certain species can be a driving force;

- **Large sized species** usually are less abundant as adults and species whose juvenile phases are in demand by an extractive industry can be vulnerable (eg Juvenile angel fish);

- Ecosystems in that are in **proximity to human populations** can be vulnerable or sensitive to disturbance because other factors are reducing the resilience of the system to withstand further impacts (eg as a result of coastal alteration, pollution, higher exploitation rates.

5. Requirements For Sustainable Extractive Activities

5.1. Major Facts and Issues to be considered when attempting to make Extractive Industries Sustainable

A number of facts and issues can be viewed as frames of reference for the assessment of sustainability. These include :

- Trends in **demand will change** over time due to relative availability, uniqueness, curiosity value, which can be described as having a sensitivity to changes in a species' "commonness" value;

- Extractive industries **superimpose disturbances** on top of natural and other man-made disturbances resulting in cumulative or synergistic effects, which can only be addressed by Environmental Impact Statements and effective Management Plans;

- **Population structure changes** can result in reef organisms due to specific industry demands for certain sizes (especially small sizes) or certain development phases, can be significant eg *Fungia* corals have been found to have highly skewed sex ratios in Australian GBR populations with a dominance of males;

- Reef organisms display **location-specific differences** in growth rates, recruitment, mortality, so care has to be taken when applying estimates of these key population parameters to calculations of sustainable yields;

- There can be **significant "by catch" mortality** rates associated with certain catch methods, and with certain target products (eg the live rock trade).

5.2. Monitoring for Sustainability

Monitoring for sustainability will require a sound knowledge of the biology of target species, or at a minimum, sound predictive information on similar closely related species. A caveat for the above point is that there are often significant local and regional differences in key population parameters that will have to be taken into account when estimating maximum sustainable levels of harvesting.

Specific values of population parameters that are applicable to a specific location are desirable for assessing sustainability. In lieu of this information, a categorisation scheme with broad conservative estimates from similar species, will be needed to accommodate the variability in population characteristics of the current range of organisms that are exploited by the industry.

Some examples of test categories and best practice essential information are given below in the table. This is not an exhaustive list but serves only as possible examples of the relationship between ranges in key variables.

CATEGORY	ESSENTIAL INFORMATION
1. (a) Rare, endangered, very low abundance species (b) Locally common species and Widespread within a region	1. (a) Species specific Life History (b) Specific or Related Species Life History
2. (a) Recruitment & Sexual Reprodn (Exclusive) (b) Asexual Reproduction (Common)	2. (a) Distribution Patterns and Connectivity Processes (b) Broad Distribution Patterns
3. (a) Growth Slow (b) Growth Relatively Fast	3. (a) Specific Recruitment & Mortality Rates (b) Broad Distribution Patterns

3.3. Data to Estimate Sustainable Yields

Data for calculations of sustainable yields will include a conservative estimate for each key population parameter as a minimum requirement until location specific data are available. The key population parameters will be :

- Distribution and Abundance of the organism at each location and at greater spatial scales (regions);
- Growth Rate;
- Mortality Rate;
- Recruitment Rate;
- Age / Size at reproductive Maturity;

A major aim in marine conservation and sustainable industries is to be able to **predict, maintain, and enhance recruitment** (to mature size) of the target organism in specific locations where the activities are carried out. This is because the majority of fish and invertebrates that are principal targets for the aquarium industry maintain their populations via larval recruitment rather than migration or other means.

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Session 2 : Overview of the Marine Ornamentals Trade in the Region

NATURE, SCALE, AND HISTORY OF MARINE ORNAMENTALS TRADE

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1. The Marine Aquarium Trade and Market: Background

1.1. The Marine Ornamentals Hobby and Market

The number of marine aquarium hobbyists has been growing steadily in the last 10 years, based on new aquarium technology and better understanding of the biology and ecology of reef and aquarium animals and systems. The market for ornamental fish is dominated by the United States, with an estimated 60 per cent of the demand. Western Europe, Japan, Taiwan and Australia are responsible for most of the rest, although the hobby is expanding into other areas. Over 11 per cent of about 86 million homes in the United States keep fish, the number of households with fish having increased 43 per cent between 1988 and 1992 (Walton, 1994). This represents some 95 million fish in 12 million aquariums, however over 90 per cent of this is freshwater fish (NFO Research, Inc., 1992: in Walton, 1994). In the United Kingdom and the Netherlands the rate of aquarium keeping is even greater, at 14 per cent and 20 per cent, respectively (Andrews, 1990).

There are estimated to be almost 1 million home aquarium hobbyists in the United States and perhaps another 0.5 million elsewhere. One in ten aquarium hobbyists in the United States is thought to have a marine aquarium, representing over 700,000 households. Much of the hobby growth is in the marine component, with a 60 per cent rise in the number of American homes with a marine aquarium reported from 1990-1992 (Walton, 1994).

Over 38 per cent of retail pet sales in the United States are due to aquarists, representing the single largest component of pet-related retail. Of this, marine livestock, products and goods accounted for over 23 per cent of the US$ 900 million in United States aquarium retail sales in 1992. The 10 per cent of aquarists with marine aquariums purchase 25 per cent of aquarium products and 22 per cent of fish livestock (Anon., 1992; Anon., 1994: in Walton, 1994). General estimates indicate that each hobbyist spends an estimated US$ 200/year on fish and associated goods (e.g. fish food, aquariums, pumps, etc), adding up to $300 million/year.

Aquarium hobbyists have a variety of approaches to setting up a marine aquarium. The 'fish tank' aquarium, where fish are the only inhabitants, continues to be the preferred approach for the majority of hobbyists, especially beginners, because it is less expensive to set up and easier to maintain. Due to advances in ecology and technology, the 'mini-reef' aquarium is now possible and is the fastest growing component of the hobby. The 'mini-reef' aquariums require live rock and sand, stony corals, soft corals, clams and other reef invertebrates and can be expensive, depending on the size of the aquarium.

1.2. The Global Trade in Marine Ornamentals

1.2.1. Trade Volume and Value

In 1975 the world trade in ornamental fish and associated goods was estimated at US$ 4 billion a year (Axelrod, 1971), of which only 1 per cent of the volume of fish were marine species (Conroy, 1975). By 1986, the value of the global ornamental trade had risen to US$ 7.2 billion (Andrews, 1990) and it is difficult to obtain more current data. About 10 per cent of the estimated total 350 million aquarium fish involved in the trade, i.e. 35 million fish are currently thought to be marine species. Other estimates put the volume of the marine aquarium fish trade to be 60-100 tons, or 10-15 million fish. Although it is difficult to obtain consistent, hard data on the trade, the growth and significance of the marine component of the aquarium industry is clear from the statistics available.

Marine aquarium organisms are being collected and exported from most of the world's coral reef areas (Philipson, 1989). Approximately 85 per cent of the marine aquarium fish exported to the United States and Europe are captured on the reefs of the Philippines and Indonesia alone. This trade is thought to be worth US$ 200 million annually in retail sales and a more specific study indicated the aquarium fish trade from Indonesia to be worth US$ 32 million/year (Cesar, 1996). The remaining 15 per cent of marine fish come from many other coral reef areas around the world - Sri Lanka, Pacific Island countries, Hawaii, Florida, the Caribbean, the Red Sea countries, and Indian Ocean Island/East Africa countries. Live coral and “live rock” are being exported primarily from Indonesia and Fiji, as their export is banned in the Philippines.

The “chain of custody” for the trade in marine aquarium products includes collectors, exporters, importers/wholesalers, and retailers. There are variations on this in some source areas, e.g. in larger source countries there are middlemen between collectors and exporters; in smaller areas, many collectors are often also exporters. Sustainability issues in the marine aquarium industry are a direct result of the practices employed at each link in the chain of custody.

1.2.2. Marine Aquarium Organisms in the Trade

Numerous groups of reef fish are part of the ornamentals trade, i.e. butterflyfish, anemonefish damselfish, surgeonfish (tangs), Moorish idols, wrasse, angelfish, triggerfish, gobies, blennies, basslets, small groupers, pufferfish, rabbitfish, hawkfish, cardinalfish, boxfish, and leatherjackets (Pyle, 1993). Clams, sea anemones, sea stars, sea cucumbers, sea urchins and a few other invertebrates are also a growing part of the trade. Small specimens of “giant clams” have become particularly popular because of the beautiful colors and patterns of their fleshy mantles. They are now relatively abundant in sizes appropriate for home aquariums due to the success in spawning and rearing them.

Live coral is collected and exported for the marine aquarium trade, including both hard corals (order Scleractinia) and soft corals (order Alcyonaria). Hard, or stony, corals have become popular and important parts of the home 'mini reef' due to their physical structure and beauty. Large polyp hard coral species are the most sought after. The principal source areas for live coral are Indonesia, Fiji and Sri Lanka. The United States comprises 70-90 per cent of the live coral market.

Live rock has also become an important part of the home aquarium due to its function both as structural/decorative material for the 'mini reef' and as bioactive material for the recycling of nutrients and waste products. Live rock refers to coral rubble/reef rock or reef sand coated or permeated with living organic material, especially encrusting algae.

2. The Marine Aquarium Trade: Costs And Benefits

2.1. Environmental Issues and Impacts

2.1.1. Destructive Fishing

Destructive aquarium fishery collecting practices include the use of sodium cyanide and other chemicals to stun and catch fish and the breaking of corals. Fishing on coral reefs with dynamite and other explosives has not been part of the marine aquarium trade. However it is an alarmingly common method of food fishing on coral reefs, and may be more of problem than cyanide use (Mous *et al*, 2000).

Fishing with cyanide has become particularly notorious - and has been well publicized by conservation groups in the media. Although cyanide use is widely used in the live food fish trade, there is no denying that it's use unfortunately did begin - and continues to some extent - in aquarium fish collection. Cyanide was first used to stun and capture aquarium fish in the 1960s in Taiwan and/or the Philippines (McAllister *et al*, 1999). Since the late 1970s, cyanide has also been used to capture larger live reef fish for sale to specialty restaurants in Asian cities with large Chinese populations (Johannes and Riepen, 1995). Despite the fact that cyanide fishing is nominally illegal in most countries, the high premium paid for live reef fish, weak enforcement capacities, and corruption have spread the use of the poison across the Asia-Pacific region (Barber and Pratt, 1997).

The use of cyanide involves dissolving tablets of the chemical in a bottle of seawater and then squirting the solution at the target fish, which is usually hidden in a coral crevice. The stunned fish can then be caught, sometimes after divers pry the reef apart to collect their prey, and is revived in uncontaminated seawater. It is obviously very difficult to know how many targeted fish are killed directly by cyanide use. The effects of the chemical also affect how well the fish survive the additional stress of handling and transport and many cyanide caught fish die before or soon after they have been sold, with mortality figures ranging up to 80% (Hanawa *et al*, 1998).

Cyanide also kills or damages corals and non-target fish and invertebrates, although there is only limited field research and data on this (Jones and Steven, 1997). In addition, cyanide use is a health risk for fishermen, through accidental exposure to the poison and careless use of often shoddy compressed-air diving gear by untrained divers (Barber and Pratt, 1997).

Although cyanide use has now spread to many coral reef countries, considerable efforts are being made on the cyanide issue. For example, in the Philippines, the International Marinelife Alliance (IMA) has teamed up with the government to form the Cyanide Fishing Reform Program. The program, along with previous efforts by the Haribon Foundation and other groups, has trained thousands of fishermen to use barrier nets, with the nets often provided by the industry. There is also a public awareness campaign in the media and public schools that is helping to educate Filipinos about the value of coral reefs. The government has also stepped up enforcement of anti-cyanide fishing laws by establishing a network of cyanide detection laboratories, operated by IMA, that randomly sample fish exports at shipment points throughout the country.

There is considerable debate about how widespread cyanide use is and whether it is increasing or decreasing. Cyanide fishing has not ceased in the Philippines, but it has been reduced as a result of the efforts there. Recently released figures from the cyanide detection laboratories show a drop in the number of aquarium fish testing positive with cyanide from over 80 % in 1993, to 47 % in 1996, to 20 % in 1998 (Rubec *et al*, 2000). The monitoring of cyanide presence in the Philippines is a valuable step towards addressing the cyanide use, however there is no law or industry requirement for mandatory screening and verification of "cyanide-free" status for exports.

Some aquarium fish importers and retailers claim that their fish are "net caught only" or "cyanide free". Some of them may believe this to true to the best of their knowledge. Others may be blatantly making claims that cannot be substantiated in order to attract customers. However there is that there no independent system to verify these claims and therefore no way for aquarists to know whether they are buying "net caught" or "cyanide free" fish.

2.1.2. Overfishing

There is the possibility that the harvest of reef aquarium animals (including live coal and live rock) has gone beyond what is reasonable or sustainable. The intense collection of the same fish species from limited areas may create the potential for overfishing. Also, with the growing popularity of home 'mini-reef' aquariums, live coal and live rock have become the fastest growing components of the trade, raising fears that reefs are being physically dismantled to supply the aquarium trade.

Reef fish scientists believe the depletion of fish stocks due to collection of marine ornamentals is unlikely (Randall, 1987), but there may be rare species that are the exception to this (Lubbock and Polunin, 1975). Overfishing seemed especially improbable for abundant species with pelagic eggs, i.e. eggs that drift in the open ocean before settling out on reefs if and when the currents bring them back to a reef. This creates tremendous natural spatial and temporal variation in these reef fish populations and complicates the ability to determine the effects of fishing effort on the fish populations (Doherty, 1991).

There is a growing amount of qualitative evidence of aquarium fish populations in fished areas. This comes from underwater surveys and observations by reef scientists and fisheries experts and the information from these is mixed. Some indicate there may by some reductions in fish populations, at least temporarily, among heavily fished species. Others report that there is no noticeable decline in fish diversity and abundance. Clearly there is a need for improved information on fishing effort, catch and location - and for more research on the effects of aquarium fishing.

The only systematic study on aquarium fish harvesting effects was undertaken in Hawaii and found declines in six of the seven most abundantly collected fishes (Tissot, 1999). The study also showed that there is no evidence of habitat destruction due to fishing practices and no increase in algae growth where herbivore populations were being collected.

Since live coral and live rock form part of the reef structure, their collection and export create additional concerns that high levels of harvesting from limited areas may affect the ability of the reef to maintain itself and its ecosystem functions. The trade in all hard (stony) corals is regulated under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as are all species of giant clams (Tridacnidae).

The most comprehensive review of the coral trade has been based on CITES data and concluded that globally the trade in coral is not a high impact industry (Green and Shirley, 1999). In Indonesia, coral harvesting for the aquarium trade is managed by a fairly broad quota system and the harvest of coral is considered to be a relatively minor risk to the overall health of the coral reef ecosystem (Bentley, 1998). Due to the importance of live coral to the reef ecosystem, specific, area based fishery management for coral harvesting is needed for this and for the growing live rock collection in some countries (Grigg, 1984; Wells *et al*, 1994).

For the harvest of marine aquarium fish, corals, other invertebrates, and live rock - as with any fishery - it is critical to determine the sustainable levels of harvest. For most coral reef fisheries, this is very difficult due to the large numbers of species involved, but best possible efforts must be made. Aquarium fishery management should also be backed by monitoring programs and independently verified, so that the industry and market can know that they are purchasing fish and corals from sustainably managed fisheries.

2.1.3. Post Harvest Health and Mortality

Even when collected in an environmentally sound manner, aquarium organisms often suffer from poor husbandry and transport practices resulting in stress, reduced health and increased mortality. This creates added pressure on coral reefs, as more organisms are collected to make up for those that die. There are wide variations in the estimated levels of post capture fish mortality - from a few percent for net caught fish that are handled by high quality operations to 80% or more for cyanide caught fish.

There are many variables that affect post harvest health and mortality, such as collection method, characteristics of the species involved, and the level of experience of the collector and others handling the animal. The quality of the husbandry, handling, holding and transport facilities and practices are particularly critical to the health of the fish, e.g., water quality and packing densities. Fortunately, most of the quality controls that are needed to maintain the health of aquarium animals and minimize mortality are known.

Many aquarium industry operators have excellent facilities and high quality practices and some retailers and importers in a few countries adhere to a "code of practice". Unfortunately there is no system to independently verify which companies have high quality practices and facilities. There is also no way for the consumer to know through whose hands the fish has passed and how good a job they have done. To be effective in ensuring high quality and health in marine ornamentals a quality control system must extend from "reef to retail" and be independently verified.

For those fish that do make it to the home aquarium, survey data are quoted that indicate the vast majority of fish don't survive for very long. The implication, which is sometimes explicitly stated - and is unfortunately sometimes true - is that aquarists regard tropical fish as "throw away pets" to be bought for the cheapest price, and when they die, there is always another one there to be bought.

It is also important to recognize that some marine ornamental species do not survive well in the trade or in the home aquarium (Hutchins *et al*, 1994). This obviously depends on the skill of the aquarist - and will change with developments in technology and information. Nonetheless, unnecessary mortality could be reduced if the responsible industry wholesaler or retailer would not deal in species unable to survive in captivity and the responsible aquarists should recognize their limits to their skill.

2.1.4. Other Issues: Species Introductions and Conflicts in Use

In general, species introductions - intentional and unintentional - have caused some of the most serious human impacts on natural systems, including in the marine environment and coral reefs (Eldredge, 1987). Most tropical marine aquarium organisms are sent to temperate areas that are far from the sea, limiting the possibilities for introductions to occur. Although to date there are no documented populations of non-native reef animals that have become established as a result of introduction by the marine aquarium trade or hobby, the possibility exists.

One of the most vocal complaints against the marine aquarium trade is that it reduces fish populations in areas that are important for marine tourism, especially for scuba divers, but also for snorkelers and glass bottom boat tours. This has particularly been an issue in Australia and Hawaii. In the latter, the government decided to close off 30 % of the coast on west side of the Island of Hawaii (the principle collecting area in Hawaii) after a study showed aquarium collecting to be reducing fish populations for several species (Tissot, 1999). These kinds of conflicts in use will undoubtedly increase with the growth of coastal tourism, scuba diving and marine recreation. The marine aquarium industry must be able to show that it is sustainable and brings benefits to the community if it is to be able to negotiate its continued presence in these areas.

2.2. Benefits of a Sustainable Marine Aquarium Trade

2.2.1. Socio-Economic Benefits

Collecting and exporting marine aquarium organisms in developing countries creates jobs and income in rural low-income coastal areas that have limited resources and economic options (Forum Secretariat, 1999). Collecting marine aquarium organisms provides one of the few possibilities for a sustainable local industry. For example, there are an estimated 7,000 aquarium fish collectors in the Philippines, many of them supporting families. A UNESCO report estimates the number of people in Sri Lanka directly involved in the export of reef animals as high as 50,000 (Kenchington, 1985).

Marine ornamentals are in fact one of the highest value added products possible to harvest sustainably from coral reefs, bringing a higher economic return than most other reef uses. For example, live coral in trade is estimated to be worth about US$ 7,000 per tonne, while the use of harvested coral for lime production yielded only about US$ 60 per tonne (Green and Shirley, 1999). The figures for reef fish are even more striking. Reef fish harvested for food from one island country were valued at US$ 6,000 per tonne. Aquarium fish from the same county realized a return of over US$ 496,000 per tonne (FA0, 2000).

2.2.2. Reef Conservation Benefits

Because of the important socio-economic benefits the aquarium trade brings to rural, coastal communities in developing countries, fishermen and their families have an incentive to ensure their reefs are healthy, protected and continue to produce aquarium fish. As a result, collectors of marine ornamentals, and their communities, often become active reef stewards. They guard these valuable resources against destructive uses and sometimes create informal management systems or de facto conservation areas.

This is often in areas that are far from the reach of government capability to provide resource management or law enforcement, and many government agencies in developing countries admit that they will never have the staff or funds to adequately manage or police most coral reefs. Nor are there going to be outside investments, such as beach hotels, dive tours or eco-tourism, for the vast majority of the world's "working" reefs. These coral reefs and the adjacent coastal communities depend on each other for their survival.

On the other hand, without sustainable uses of coral reefs - such as the responsible collection of aquarium animals and the incentives that this creates for local resource stewardship - reefs would quite probably become open to more destructive uses. This could be in the form of destructive fishing by outsiders that have no stake in the future of the local reefs. Or it could possibly be by the local fishers themselves. Without a sustainable income from aquarium fisheries or other sustainable use, they could be forced into poverty-driven use of destructive fishing practices in order to get food for their families. Or, without an income generation options in the rural areas, they would be forced to migrate to over-populated urban areas, adding to social issues in the country.

2.2.3. Nature Appreciation and Advances in Reef Science

On the other side of the world from most coral reefs, humans have become more and more removed from nature and seek to find ways to reconnect with it. For the modern, urban dweller in an industrialized nation, an aquarium - especially a reef aquarium - brings the chance to experience a complete natural system in the home in a way that no other hobby can. There is undeniably something both appealing comforting in an aquarium, as evidenced by the continued growth of aquarium keeping and new public aquariums. In fact, researchers have found that aquarium viewing reduces blood pressure and anxiety - undoubtedly contributing to the popularity of aquariums in doctor and dentist waiting rooms (Katcher *et al*, 1984).

Aquarium keeping thus creates an opportunity to know and experience nature where none exists. This can but only contribute to the ability for us to perceive the need to conserve and protect nature. So by helping instill the love of nature in general - and for otherwise inaccessible coral reefs in particular - home aquariums contribute to the conservation of coral reefs. In fact, some authors have suggested that the popular appeal of aquarium keeping could be used to raise public awareness of aquatic environmental problems, noting that some aquarium industry associations are funding conservation efforts (Andrews, 1990).

There is much that is not known about coral reefs. In part, this is because scientific observation or experiments with reef animals and their interaction in nature is difficult, time consuming, costly and complicated. But rigorous, regular observation and trial and error experimentation of reef animals and systems is exactly what so many aquarists do best.

Many aquarium keepers have made significant contributions to reef science through their efforts to study, observe and record what is occurring in their tanks. To give just a few examples, this has included important advances in the understanding of fish behavior, reproduction, feeding and growth; the propagation and growth of corals, soft corals and other invertebrates; the balance of nutrients, light, and water motion needed to maintain a reef ecosystem.

3. A Market Based Approach To Sustainability

3.1. The Need and Opportunity for Certification

Most aquarium hobbyists want to support an industry that produces quality products using sustainable practices - both for ethical/environmental reasons and for personal reasons (i.e. these products are better value - they are healthier and live longer). Responsible aquarium industry operators want minimal mortality, healthy animals and healthy bottom line (there is no profit in a dead fish), a sustainable supply (i.e. healthy, productive reefs) and standards that codify "best practice" and create a "level the playing field".

Conservation organizations want a sustainable, environmentally sound trade that provides incentives for reef stewardship, conservation and management. Governments and coastal communities in export countries want a sustainable, environmentally sound trade that provides jobs and support for reef stewardship, conservation and management. Governments in import countries want their consumers, policies and legislation to support a sustainable, environmentally sound trade that provides incentives for reef stewardship, conservation and management.

With proper management, reef resources and habitat can be conserved in balance with their ability to provide for local sustenance, the collection of aquarium organisms, and other benefits.
The collection and export of marine aquarium organisms can be based on sustainability and achieve a balance between reef health, aquarium animal collection, and the numerous benefits described above. This is proved by the many successful industry operations and aquarists that provide and maintain high quality, healthy aquarium organisms with minimal mortality. Most aquarists would prefer to support this kind of industry.

The demand from informed consumers for environmentally sound products provide incentives for industries to adopt and adhere to standards for sustainability, and this applies to marine goods and services (Holthus, 1999). The single most important market force in the marine aquarium industry is the purchasing power of hobbyists. Market assessments show that there is a strong demand for responsibility in the collection and trade in marine aquarium organisms. However, there has been no system to identify and verify sustainability and allow the consumer to reward those in the industry operating on this basis.

Although government agencies, industry, and NGOs have made important efforts to address the impacts of the marine aquarium trade in some areas, these have not been able to transform the industry because they have been undertaken in isolation and only addressed limited aspects of the marine aquarium industry. Certification and labeling are a useful means to ensure that the market requires and supports sustainable practices in the marine ornamentals industry. However, no single government or other party has been positioned to work with the industry's full "chain of custody", the international range of other stakeholders, the global consumer demand for marine aquarium organisms, and the trans-boundary aspect of marine conservation issues.

3.2. The Results of Certification

By creating credible, international, multi-stakeholder standards of practice where none exist, certification will ensure the marine aquarium trade is responsible and sustainable, at no cost to governments. This will create market incentives for industry to comply with standards of practice by allowing consumers to vote with their dollars. The standards will be based on what industry, conservation, consumers and government work together to agree is needed for the trade to be responsible and sustainable.

Certification will allow the industry and market to reject unsustainable, sub-standard practices and products. Sub-standard operators will be forced by the market to either adjust their practices "upward" or lose market support and leave the trade. Certification will require proof of compliance with domestic law, e.g. no destructive fishing practices, and with international law, e.g. CITES permit conditions.

Going further, certification will lead to sustainable industry financing for conservation. Certification will require, among other things: monitoring of reefs and stocks for compliance with sustainability standards; industry documentation of compliance with standards and providing data to an international trade information system; and management plans and conservation areas for harvested reefs. This means the industry will be required to support monitoring, documentation and conservation and management of reefs as the way it does business - i.e. sustainable self-financing of reef conservation.

Developing countries with most reefs, and even developed countries, do not have enough funds to create, implement and enforce enough laws and management plans to protect all reefs all the time. Coastal communities with incentives to manage and conserve reefs are the only hope for widespread, ongoing, effective and financially sustainable reef conservation and management.
With market incentives and independent certification, coastal communities involved in the aquarium trade will have motives for becoming the guardians, stewards and enforcers of management and conservation, often in remote areas rarely visited by government.

4. The Marine Aquarium Council

4.1. Marine Aquarium Council: Background, Objectives and Structure

4.1.1. Background and Role

The Marine Aquarium Council (MAC) was established as an international multi-stakeholder institution to address the situation comprehensively and achieve market-driven quality and sustainability in the marine aquarium industry. The Council began as an initiative of a cross section of organizations representing aquarium keepers, the aquarium industry, conservation groups, international organizations, government agencies, public aquariums, and scientists. From the broad network of stakeholders that constitutes MAC, the15 person Board of Directors is required to have a majority of non-industry members.

Following incorporation in 1998, MAC is now established as an independent, third party institution whose goal is to transform the marine aquarium industry into one that is based on quality and sustainability. MAC is making this happen by:
Developing standards for quality products and sustainable practices;
Establishing a system to certify compliance with these standards and label the results; and
Creating consumer demand and confidence for certification and labeling.

In addition, MAC is:

- Raising public awareness of the role of the marine aquarium industry and hobby in conserving coral reefs and other marine ecosystems;
- Assembling and disseminating accurate data relevant to the collection and care of ornamental marine life; and
- Encouraging responsible husbandry by the industry and hobby through education and training.

4.1.2. MAC Global Network and Partnerships

MAC is now fully established and recognized as the lead organization and global voice for developing and coordinating efforts to ensure sustainability in the international trade of marine ornamentals. MAC has made rapid progress in creating a global network for raising awareness of the needs and opportunities for certification, and initiating certification system development. As of early 2001, the network included 2,200 stakeholders in over 60 countries and territories.

MAC is also forming key partnerships to meet strategic needs in developing a market based approach to sustainability for the marine aquarium trade. To ensure that there is consistent, comprehensive, quality information on the marine ornamentals trade, MAC is collaborating with the World Conservation Monitoring Center (WCMC) to develop an international data recording and reporting system. To ensure that reef habitat and resources are sustained in the long run, we are partnering with the Global Coral Reef Monitoring Network/Reef Check programs to develop aquarium collection area monitoring based on internationally accepted methods and expertise.

4.2. Certification System Development

Developing the standards of practice and certification system is at the core of MAC's efforts. In late 2000, most effort was being put into developing the MAC Certification Standards and an initial set of "Core Standards" to address critical urgent issues affecting sustainability is rapidly moving to completion. The Standards Advisory Group, an international, multi-stakeholder committee, is reviewing the draft standards into early 2001, following which the standards will be available for public review.

The Core standards cover:

- Ecosystem Management Practices: in-situ habitat, stock, species management and conservation;
- Collection and Fishing Practices: fish, coral, live rock and other harvesting and related activities, e.g. field handling and holding practices; and,
- Handling, and Transport Practices: holding, husbandry, packing, transport etc. at wholesale and retail.

During the first half of 2001, MAC will undertake a major outreach effort to widely inform the marine aquarium industry and hobby of the standards and certification system and provide materials on how to participate. There will be training to ensure that the industry in developing countries (especially collectors) has the skills and capacity to supply certifiable marine ornamentals. The standards of practice are to be tested and then put to work in pilot areas. Pilot certification will seek to include operations in at least the Philippines, Fiji, Australia, Indonesia, and Hawaii that will be linked to numerous importers and retailers in the US and Europe who are waiting to participate in the pilot phase of certification. Following the pilot phase, the certification system will formally be launched and become operational in 2001, and certified marine ornamentals will be available.

Over the two years following the implementation of the Core Standards, a more comprehensive set of "Full Standards" will be developed to address the broader more complex range of issues and approached to ensuring sustainability for the marine aquarium trade. The Full Standards will expand on the Core Standards and also include a set of standards for Maricuture and Aquaculture Practices.

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Session 3 : Country Reports – Status Reports & Needs Assessment for Each Country

FIJI CORAL TRADE

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1. Introduction

1.1. Defining the Industry

The definition of coral harvesting in Fiji previously referred to the exclusive collection of hard corals for their decorative skeletons but this definition has been broadened to refer to the removal of wide variety of plants, animals and reef materials for commercial benefit (Lovell & Tumuri, 1999).

The coral harvest in Fiji can be divided into the collection of material for:

- **Curio or Ornamental Coral** which involves removal of whole hard coral colonies **for the purpose of selling their cleaned skeletons as decorative items;**
- **Live Aquarium Products** is the collection of reef organisms which are amenable to aquarium life which includes hard and soft coral and mobile invertebrates such as gastropods, crustaceans and starfish;
- **Live rock** that is the collection of reef rock covered with coralline algae which is used as a partially living substrate in creating relief or seascape in aquaria; and,
- Other coral products such as **live sand** extracted from lagoon waters, which is composed of carbonate materials and is also used in aquaria.

1.2. Commencement of Trade

Coral harvesting for export started in Fiji in 1984 and a current list of traders and companies involved in Fiji include the following :

- Ocean 2000 Ltd – currently collecting in Kubuna waters (Kaba & Moturiki) and Nadroga waters (Malomalo). Export corals, live rocks and aquarium fish;
- Tropical Fish Ltd – Export aquarium fish and corals. Collection is from Suvavou waters and Kubuna waters and Komave (Nadroga);
- Walt Smith International Ltd – Export live rocks, aquarium fish and other marine organisms including Tridacna clams. Collection is done in the Yasawa waters and Nadroga. The company also import corals from other Pacific Islands for re-export purpose;
- Waterlife Ltd – collect live rocks, aquarium fish and corals from Suvavou waters and Muaivuso for export purpose;

- Aquarium Fish (Fiji) Ltd – export aquarium fish collected from Beqa, Yanuca and Deuba waters. It is reported that they export small range of invertebrate species and corals;
- Seaking Trading Co – export coral mostly. Began operating in Bauan waters and moved to Dawasamu and Viti Levu Bay (Ra); and,
- Acropora International Ltd – export corals collected mostly from Bauan waters.

2. Issue of Licenses and Export Permits

The Director of Lands and Surveyor General is responsible for the issue of licenses to extract sand, gravel and dead corals.

The Fisheries Department issues licenses for the extraction of live coral and any living organism that lives within the aquatic ecosystems. This is similar to the fishing license to take finfish for commercial purpose under the provision of section 5 of the Fisheries Act (Cap 158). Fishing licenses to collect live coral and aquarium fish are granted to individuals, who in most cases are villagers. Coral Traders or Companies are not issued with collecting licenses since they are not directly involved in collection of the resources.

The Fishery Department issues export permits when requested by an exporting company in line with the provision of section 64 of the Customs Act of 1986.

CITES Permits are also required for traded products that are listed in CITES appendices such as Hard coral and *Tridacna* clams.

3. Volume of Live Corals Extracted by Villagers

Ra Village – Villagers were being paid an average income of F$130/week and at 7c/piece of coral, indicating an extraction rate of 1,857 pieces per week. It is not known how long this activity has been in operation in that particular area of Viti Levu.

Malomalo village (Nadroga) – Villagers are paid F$0.65 per kilogram of "corals". The village headman confirmed to us that the village gets F$3000 per week. They normally collect "corals" 2 days/week. If they collect "corals" 4 days/week, then they get F$6000 per week. This calculates to about 4616 kg – 9231 kg/week. The village headman reported that Malomalo villagers had been selling "corals" to this company for the last 7 years.

Total volume of "corals" sold by Malomalo villagers in the last 7 years was between 1,260,168 kg and 2,520,336 kg (1260mt – 2521mt).

Naiborebore & Naimasimasi (Tailevu) – Divers are paid F$800 to collect enough corals to fill a container. Packers are paid F$500 per week. Each week, 1 – 2 containers have been packed, for the last 4 years.

Four (4) companies exported **live rock material** in 2000 and live rock exports have been operating for a total of 26 years. The volume of corals sold to exporters was between 3,120,416 kg and 12,480,312 kg (3120 mt – 12480 mt).

4. Concerns about the Impacts of the Industry

The **volume of corals extracted** and sold by villagers is alarming as the total estimated volume of exports is approximate and there is considerable wastage. The volume of coral material that is wasted is not known but is thought to be high. As well, guidelines for extraction (Zann, 1984) have never been monitored.

The impact of **extraction methods** has never been studied properly, for example the use of bullocks and sledges to transport material in certain areas (refer to Lovell & Tumuri 1999) on coral reef and its inhabitants.

Another concern is that actual **volumes of coral exported** and recorded in export permits are not being checked or verified. The Fishery Department should provide personnel to check and verify such figures, and Customs Officials should likewise verify products and volumes imported (as trans shipment aquarium goods from other Pacific Island countries) and exported.

The commodity **price paid to villagers or resource owners** who are mostly indigenous people needs to be discussed at a "high government level". The price being paid to villagers indicates a clear trend of exploitation for a long time. It is not known what kinds of contract/agreement/MOU exist between Traders and License Holders and between License Holders and Villagers. The Government is not party to these agreements nor is it not known if such agreements really exist. The Fiji Fishery Department is not aware of any such agreements

Villagers of Malomalo complained to us that there have been **illnesses related to the effect of years of diving** on the lives of individuals and are wondering what kind of compensation can they get. They reported to us that when approached, the company agent did not wish to hear their grievances. The number of villagers affected by diving related illnesses over all the years that the trade has existed is not known.

5. Outstanding Issues

(i) The **volume of aquarium products** exported each year seems unclear. A lot has gone out of the country. A thorough check with the Customs database and Fishery's records will be needed to ascertain the total volume of products exported since 1982 or 1985.

(ii) We will **need to know what species of corals and aquarium fish are exported** and **the volume of each species** to ascertain likely impact of continuous removal of each species from the wild. This should also help in deciding on a quota system to be used each year as required by the Convention on International Trade in Endangered Species (CITES) to which Fiji is a signatory.

(iii) **Proper economic analysis of the industry** needs to be made to ensure that there is equity between the percentage of revenue paid to resource owners and the government as compared to financial returns to the traders.

(iv) We **do not know at this stage whether formal contracts exist between such individuals and exporters**. The license to extract is awarded to villagers or individuals that apply for it as it is a requirement of the Fishery Act. The licenses are renewed at the end of the year. The Solicitor General's Office is still to respond to our enquiry on the issue of whether the state should be held responsible for losses incurred by traders if a ban on exports is to be enforced. The uncertainty exists because the extract licenses are not issued to the exporters but to villagers or individuals. Permits to export aquarium products are granted to the companies when they make a request for it. If there are no products to export, then the companies will not make applications. As such, the Government is not a party to any agreement with any exporter regarding the issuance of permits to export aquarium products for a year or so. Therefore, it is not certain if government liability exists on losses incurred by companies if a ban to extract corals and live fish is instituted.

6. Recommendations

It is recommended that :

1. High level discussions should take place regarding the state of the industry.

2. The issue of Fiji's **CITES obligations** should be discussed with the authorities. The Solicitor General's Office should (if required) conduct talks on the merit of enforcing CITES requirements since Fiji is a party to this International Convention. In other words, can we and should we put a ban on "Coral Extraction" for a certain period until all companies comply with CITES requirements. The CITES Secretariat have informed us that we have to comply with requirements. If not, all Managing Authorities and Customs World-Wide could ban any coral imports from Fiji.

COOK ISLANDS AQUARIUM FISHERY

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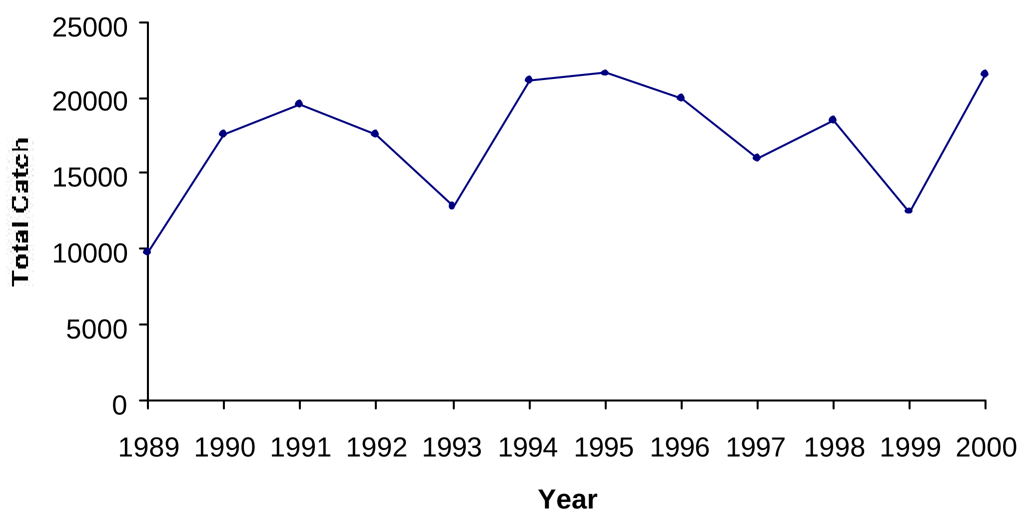
1. History

The Cook Islands Aquarium Fishery trade commenced in late 1988, through permission granted by the Cook Islands Government to the foreign-owned company, Cook Islands Aquarium Fish (CIAF). Presently CIAF is the sole aquarium fishery exporter in the Cook Islands and their operations are limited to marine ornamental fish[1] collected from Rarotongan reefs of depths 8 – 70 m. The total catch of aquarium fish has remained relatively stable since the origination of operations (Figure 1).

Figure 1. Total annual catches of marine ornamental fishes for the Cook Islands 1989 – 2000 (collected from Rarotonga reefs).



2. Nature of Aquarium Trade

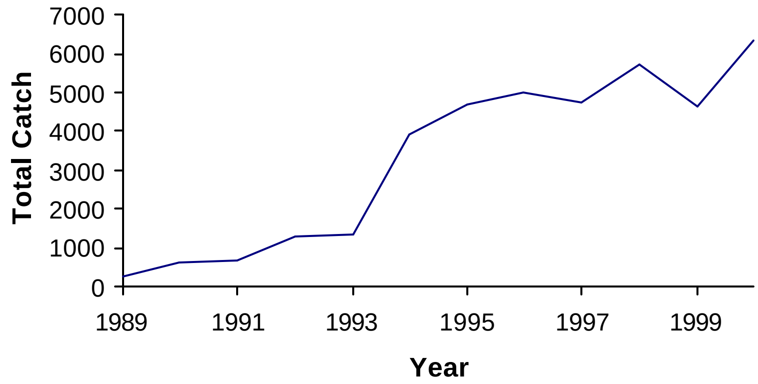
As many as 36 fish species have been collected from Rarotongan reefs for the aquarium trade, a list of the more recently caught species is attached as Appendix 1. The catch of aquarium fish has been dominated by five species of fish identified as:

- *Pseudanthias ventralis* (Long-finned anthias)
- *Centropyge flavissimus* (Lemon peel angel)
- *Centropyge loriculus* (Flame angel)
- *Cirrhilabrus scottorum* (Scotts wrasse)
- *Neocirrhites armatus* (Red hawk).

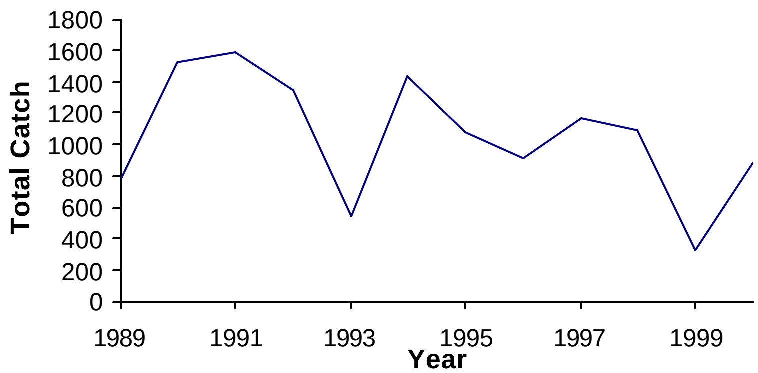
[1] Fish only, no invertebrates or coral are collected.

Figure 2. Annual catch of marine ornamental fish 1988– 2000

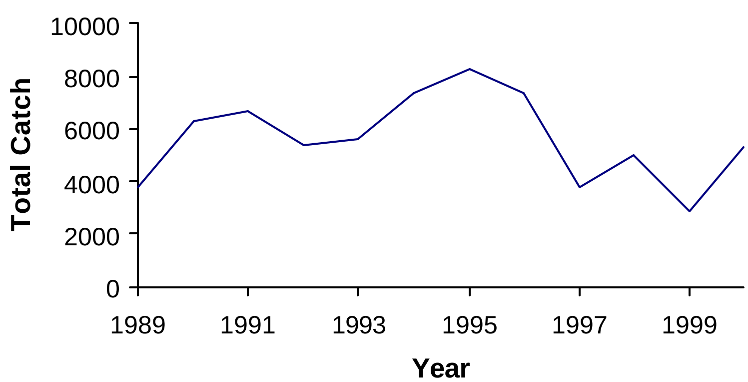
Pseudanthias ventralis
(Long-finned anthias)

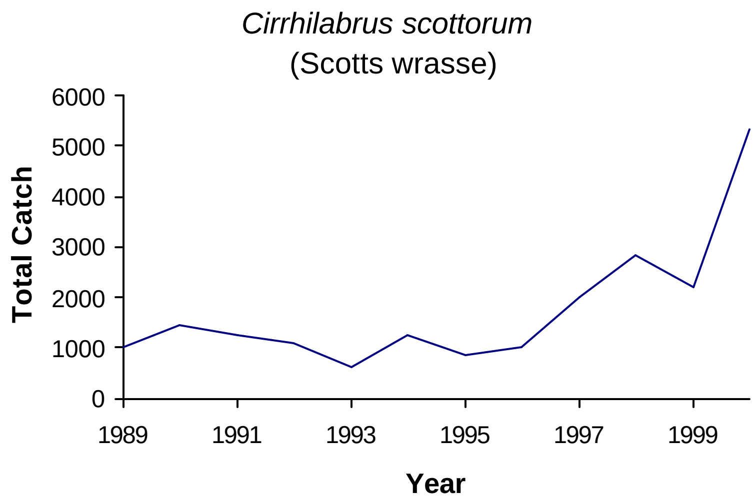


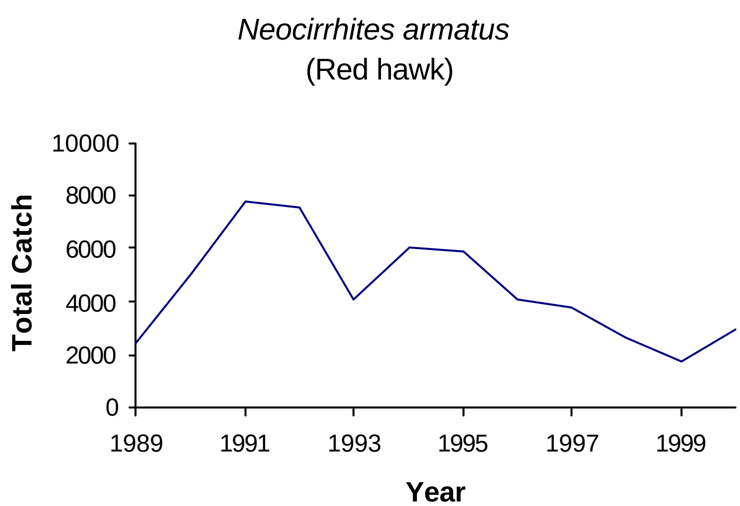
Centropyge flavissimus
(Lemon peel angel)

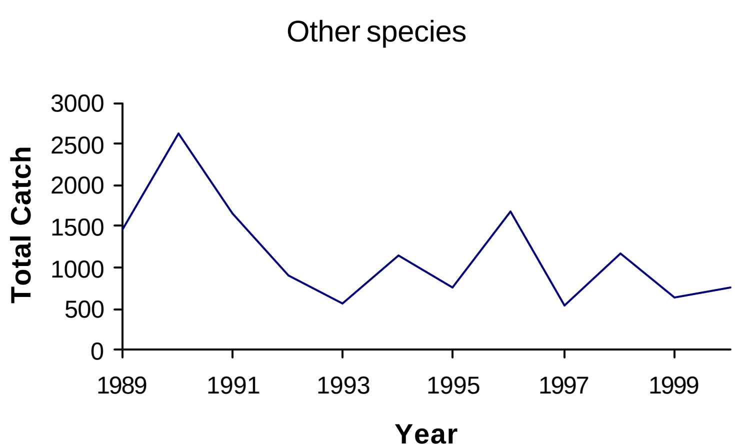


Centropyge loricuclus
(Flame angel)




Cirrhilabrus scottorum
(Scotts wrasse)
Total Catch
6000
5000
4000
3000
2000
1000
0
1989
1991
1993
1995
1997
1999
Year


Neocirrhites armatus
(Red hawk)
Total Catch
10000
8000
6000
4000
2000
0
1989
1991
1993
1995
1997
1999
Year


Other species
Total Catch
3000
2500
2000
1500
1000
500
0
1989
1991
1993
1995
1997
1999
Year

These five species of fish together constitute over 90% of annual catch. However, the relative proportion of each of these five species has changed through time, for example catches of *P. ventralis* and *C. scottorum* have increased, and catches of *N. armatus* have decreased (Figure 2). These changes are described by the company as reflecting changes in competitiveness of prices relative to other suppliers of aquarium fish and the skill of collectors per year, rather than changes in the stocks of these aquarium fishes (Anon, 1998).

3. Value of Aquarium Trade

The value of the Cook Islands Aquarium Fishery trade for the year ended 1999, was NZ$200,000. Exports over the ten years of operation have averaged 18,250 fish per annum, worth an average value of NZ$190, 000. In comparison with other Cook Islands export commodities[2] over the same period, the export of aquarium fish comprises an average value of 3% of total exports or 4.5% of exports from the fisheries sector.

The aquarium fishery trade now enjoys little conflict over its operations, though previously the public perceived the aquarium fishery operations as excessively damaging coral and significantly depleting both ornamental and reef food fish stocks (Anon, 1998). Collecting did lead to some damage to coral reef habitat. For example, the removal of some branches[3] (notching) of *Pocillopora verrucosa* is required to collect *N. armatus*, and CIAF did accept that some of their collectors caused unnecessary damage to the reef during capture of this species (Bertram and Tatuava, 1992; Passfield and Evans, 1991). Consequently, CIAF dismissed collectors with frequent destructive fishing practices, and now conduct monitoring of their collectors, as well as having instigated a system where inexperienced collectors are not permitted to collect *N. armatus*. There is a preference to notch coral colonies previously notched, and to transplant those coral branches that are removed(Anon, 1998; Bertram and Tatuava, 1992; Passfield and Evans, 1991).

The question of the depletion of human food fish stocks due to aquarium fish collection only is relevant to one species (of the 35 harvested) that is, *Variola louti* (Oka). However, *V. louti* has not been collected since 1993 and prior to this, an average of 7 per year were collected (Anon, 1998). Preliminary estimates of sustainable yield for total catches within the aquarium fishery suggest it is operating at 30% below maximum sustainable yield, using total catch per unit effort data (Anon, 1998; Bertram, 1996). In addition, the harvesting of aquarium fish is possible on only approximately 33.3% of Rarotonga's coastline[4] (10.66 km) for most of the year. This is a result of weather-related accessibility and the establishment of temporary marine

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[2] In the context of this paper export commodities include, pearls, pearl shell, fish, papaws, taro, maire etc.

[3] The capture of Neocirrhites armatus sometimes requires the notching of the coral Pocillopora verrucosa (the removal of 10 – 15% of branches). However, Hunter and Meier (1992) concluded that re-growth is relatively rapid and the replanting of branches compensates for the short-term damage.

[4] Through agreement with two of the three recreational dive operators, CIAF has agreed not to fish in 5 sites (1.4% of the entire reef slope), and the recent introduction of raui has closed off a total of 18% of the reef slope to fish collection. Coupled with this, 45% of the coastline is unsuitable for fish collection because of rough conditions.

reserves (Raui) around Rarotonga, thus impacts from the collection of marine aquarium fish are thought to be insignificant (Anon, 1998).

4. Overview of CIAF Operations

Since the origination of its operations, Cook Islands Aquarium Fish (CIAF) has collected 35 marine ornamental fish species, of sizes 40 – 150 mm in length, from the reef slopes of Rarotonga. The majority of aquarium fish are collected on the reef slope at depths ranging from 8 – 35 m; occasional specimens are taken at depths in excess of 50 m[5]. Divers collect fish using self-contained underwater breathing apparatus (SCUBA) and either small-meshed barrier nets or hand-held scoop nets; most fish are captured individually (one fish at each set) with nets of 1.5 m by 1 m high. However, schooling species (eg *Cirrhilabrus scottorum*) are driven into retaining nets where the quantity and desired sizes are chosen according to the supply order. Chemicals are not used to collect fish, therefore the collection methods used are primarily non-destructive except for the minimal notching damage used to collect *Neocirrhites armatus*[6]. A recent list of aquarium fish species collected by CIAF is included as Appendix 1. Fish are collected on a catch to order basis, and on average each shipment is dominated by the species *Pseudanthias ventralis*, *Centropyge flavissimus*, *Centropyge loriculus*, *C. scottorum*, and *Neocirrhites armatus*. Other species that comprise the catch have either been requested or are there to add variety to each shipment.

Fish caught at depth are decompressed using either by staging their descent or by air bladder piercing procedures, depending on the species. Once fish are at the surface they are placed into tanks with circulating fresh salt water on board medium size vessels (5 – 7 m), prior to transfer into the warehouse holding facility. The warehouse holding facility consists of a series of perforated compartmentalised plexiglass tanks that constantly receive flow of re-circulated filtered sea water that has temperature and oxygen content controlled. All fish are held for a minimum of three days prior to airfreight shipping, to ensure that only high quality fish are sent for export. High quality fish are those that are healthy and have undamaged fins, with all reject fish returned to the sea. To minimise mortality in transit as a result of waste build-up, fish are not fed for three days prior to shipping. In preparation for shipping, fish are individually packaged in doubled polyethylene bags separated by a liner of newspaper. The bags are inflated with pure oxygen, sealed and packed tightly in lined cardboard boxes. Shipments are exported once a week to markets in the United States, Europe and Japan.

5. Management and Regulation

The aquarium fishery trade in the Cook Islands is limited to one operator, Cook Islands Aquarium Fish (CIAF). While the export value (present and potential) for this fishery is large, the operations of CIAF are largely self-managed. The taking of marine aquarium fish falls under Part 8, Section 50 of the Marine Resources

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[5] Local collectors do not catch fish in excess of 40 m.

[6] The capture of *Neocirrhites armatus* sometimes requires the notching of the coral *Pocillopora verrucosa* (the removal of 10 – 15% of branches). However, Hunter and Meier (1992) concluded that re-growth is relatively rapid and the replanting of branches compensates the short-term damage.

(Licensing and Regulations of Fishing Vessels) Regulations 1994, that came into force on 1 January 1995, and states that…

> *' No person shall engage in fishing for any aquarium fish except with the written permission of the Minister and in accordance with such condition that he may specify.'*

Consequently CIAF follows the terms of the initial agreement set out by the Minister of Marine Resources at the time. This agreement restricts the activities of CIAF to the outer reef slope areas of Rarotonga (not within the lagoons or reef flats), and requires that they allow the Ministry of Marine Resources to monitor their catch information (annual catch reports). It also requires that local divers are trained so that they may be able to independently supply CIAF with specimens. Although the Ministry of Marine Resources maintains close contact with CIAF, the company is self-regulating. To date the Ministry of Marine Resources has not licensed CIAF. The presence of a sole operator who has made a significant capital commitment, and who has conducted business over a period of 11 years, has made government intervention by way of regulation unnecessary, except for a ban on fishing within the lagoon. Presently, the Marine Resources Act 1989 is under revision and it is intended that aquarium fisheries will be managed as a designated fishery through a specific management plan.

Aquarium collection activities are limited to fish, and no invertebrates or coral are harvested for export, thus the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) does not apply.

Further monitoring of the collection sites is intended when resources permit this. Monitoring will include methods such as an underwater visual census of target species of aquarium fishes and their surrounding coral habitats, so as to more reliably assess the impact of aquarium fishery operations.

6. Benefits

6.1. Economic Benefits

Economic benefits of the aquarium trade include :

- Taxes on earnings,
- Country export earnings,
- Wages to local persons – collectors and warehouse staff (on average, 5 collectors and 2 warehouse staff are employed at one time, and who earn between NZD80 to NZD500 per week depending on their catch and experience), and,
- Expenditure within the Cook Islands – airfills, electricity, other utilities, fuel, rent, import customs levies on equipment and parts, local servicing of vehicles and transport services.

6.2. Socio-economic Benefits

Socio-economic benefits include :

- Encouragement of training local people in the aquarium trade (approximately 34 local persons were trained as collectors, and 17 as warehouse staff in 1992-2000).

7. Future Prospects for the Fishery

Islands other than Rarotonga in the Cook Islands have the potential for commercial exploitation of aquarium fish, particularly those islands with frequent air links and reasonable freight rates to and out of Rarotonga. However, there is often a lack of interest, experience, knowledge, and investment capital for the establishment of aquarium fisheries in these islands. To have a successful aquarium fishery it is important to ensure a consistent supply of high quality aquarium fish by practicing careful handling and allowing adequate recuperation time to avoid high mortality of fish for export.

A possible way of spreading aquarium fish development throughout the Cook Islands may be for smaller outer-island based operators to supply fish either into the established operation on Rarotonga or set up additional warehouse facilities (Anon, 1998). However, the fish that are collected and consequently exported must still be sold at a competitive price relative to other suppliers (fish can be collected from Rarotonga without the extra freighting costs, as Rarotonga is the port for export). At present, the additional freight costs for fish collected from other islands do not make aquarium fish ventures in these areas worthwhile.

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Thanks to Chip and Claire, from Cook Islands Aquarium Fish, for giving their time to show me their facility, and for allowing me to experience ornamental fish collection, and for answering my questions. Thanks also to Ian Bertram for his comments and editing of drafts, and also to Josh Mitchell and Ben Ponia for their comments.

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Appendix 1: Aquarium fish species collected 1998 – 2000
(Bold: dominant species (in total they represent >90% of annual catch))

Family: Acanthuridae (Surgeonfishes)
Acanthurus pyroferus (Mimic tang)
Ctenochaetus hawaiiensis (Chevon tang)
Ctenochaetus tominiensis (Kole)
Genicanthus watanabei
Genicanthus spinus
Pomacanthus imperator

Family: Cirrhitidae (Hawfishes)
***Neocirrhites armatus* (Red hawk)**

Family: Labridae (Wrasses)
***Cirrhilabrus scottorum* (Scotts wrasse)**
Coris aygula
Gomphorus varius
Halichoeres biocellatus (Red-lined wrasse)
Labroides rubrolabiatus
Macropharyngodon meleagris
Pseudojuloides atavai
Thalassoma lutescen
Thalassoma quinquevittatum

Family: Microdesimidae (Dartfishes)
Nemateleotris helfrichi

Family: Ostraciidae (Boxfishes)
Ostracion cubicus

Family: Pomacanthidae (Angelfishes)
Centropyge bispinosus (Coral beauty)
Centropyge boylei
***Centropyge flavissimus* (Lemon peel angel)**
Centropyge heraldi (Golden angel)
***Centropyge loriculus* (Flame angel)**
Centropyge multicolour (Pastel angel)
Centropyge narcosis

Family: Pomacentridae (Damselfishes)
Chrysiptera galba

Family: Scorpaenidae (Scorpionfishes)
Taenianotus triacanthus

Family: Serranidae (Groupers)
Pseudanthias lori
Pseudanthias privaterai
***Pseudanthias ventralis* (Long-finned anthias)**

SOLOMON ISLANDS AQUARIUM INDUSTRY

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1. Introduction

Like many Pacific Islanders, Solomon Islanders have been dependent on marine resources for ages. Prior to the advent of a foreign resource-demand style of civilisation, these marine resources were exploited merely for dear life's daily sustenance and other cultural purposes. These days, marine resources are being exploited not merely for life's direct daily sustenance but also for cash to meet the cronic demands of a foreign style of civilisation that is being glorified today as modern development.

For most rural subsistence dwellers in the Solomon Islands, the knowledge of the effects of heavy exploitation of their marine resources is poor. Most realise that there is something wrong when they cannot get the harvest they used to, or when the resources are no longer there. Efforts to address declining resources or over exploitation is hampered by the lack of information on the stocks and sustainability of harvested reef species, and the ecological consequences that follow. Socio-economic factors with high population growth further complicate efforts to effectively manage the use of marine resources.

The exploitation of marine resources for the aquarium trade actually came as a surprise for many in the Solomon Islands as they regard the resources currently exploited as having no commercial value. Many also regard the exploitation of marine species used in the trade as a low kind of entrepreneurial activity. The trade however has produced economic returns for resource owners, fishermen and the government. The trade also provides opportunities for promoting the sustainable management of coral reef resources.

2. Background on the History of the Trade

An American marine biologist and ichthyologist by the name of Dr Walter Stack, suggested way back in 1975 that selling fish for the American aquarium trade would bring economic returns to the national purse. He even commented that these fish which reproduce and grow fast can fetch the same price as food fish which are up to a 100 times their size. Twenty years later, in 1996, the aquarium trade started. The ICLARM hatchery at Aruligo on West Guadalcanal also added much impetus for the trade as they diverted their failed clam program to raising juvenile clams for the aquarium trade. When the trade started it was enabled under the Fisheries Act and therefore managed by the Fisheries Division. The Environment and Conservation Division which is the CITES Management Authority, was not aware of the trade until the exporters start requesting CITES-equivalent permits as they were required by the importing countries.

A total of 224 coral reef species are currently exploited for the trade. Around 79% of these are fish and 17% are corals (Table 1). The remaining 4% are invertebrates and comprise mostly juvenile clams, starfish and sea horses. The annual export production of the trade since it started in 1996 is shown in the table below. Between 1996 and 1999 a total of 226,768 individual aquarium fish were exported. This represents 43.6% of the total export for that period. The export for corals for the same period was 220,606 pieces. This represents 42.4 % of total export for the period. The total for the invertebrates was 72,3777 pieces, which is 13.9% of total export for the same period.

Table 1. Numbers and estimated value of aquarium organisms exported between 1996 and 1999.

	1996	1997	1998	1999
Aquarium fish -pcs	84,935	3606	58188	80039
-value(SBD)	221001	10818	174098	239721
Coral - pcs	175203	2467	84755	58181
-value (SBD)	587584	289970	203628	211785
Invertebrates -pcs	37826	5396	13944	15211
-value(SBD)	176917	132500	126852	98041

3. Numbers of Collectors Present in Country and How They Operate in Country

There are currently two exporting entities involved in this trade in the Solomon Islands. These are the Solomon Islands Marine Exports and Aquarium Arts who are based in Honiara and are under a single management group. The companies do not have their own collectors. The collectors are the reef owners who collect the resources from their own reefs and sell them to the above companies. Current legislation and applicable policies do not require these collectors who are traditional subsistence dwellers to have collecting permits. This means that the collectors are operating freely without much management control. Whatever control they may exercise are those that could be required by the exporter.

Due to the nature of the trade, collecting occurs on areas that are closer to the exporting site, which is Honiara. Collecting also occurs on areas that have good transport access to Honiara. Collecting therefore concentrates on the Florida Islands (Ngella) which is north of Honiara, East Guadalcanal at Marau Sound, Malaita, mostly in the Auki and Langalanga areas. Some collection also occurs in the Western Province from the Gizo, Munda and Marovo areas, and from some areas of Isabel Province. It is estimated that a total of around 200 traditional subsistence dwellers are involved in the collections from all these areas.

When the items are collected, they are placed in large buckets and transported immediately to Honiara via outboard motor canoes. The fishermen have to replenish the water en route to Honiara. The fish, which are caught using nets, are usually placed individually in perforated containers like plastic bottles to avoid them fighting. Those that are further from Honiara have to use inter-island vessels to transport their goods and therefore have to use oxygen to keep the organisms alive. In Honiara the exporters pay the fishermen for the export quality items and reject what is regarded as low quality. What is rejected is taken back to the reefs where they come from. What is accepted and paid for is placed in large fiberglass holding tanks before being prepared for export. The fish are fed until 3 days before the due exporting date. When the items are exported they are airfreighted in plastic bags with oxygenated water and are packed in Styrofoam boxes.

4. Management Measures Currently in Place

The management of this trade is currently adhoc as there is currently no specific regulation, policies or management plan in place. Even though there is a permitting system in place, this system is mainly for facilitating export and is not adequate as an effective management system for the trade.

The current permit system involves acquiring a fisheries permit from the Fisheries Division of the Ministry of Fisheries and Marine Resources for SBD$50.00. A Wildlife Export Permit (SBD$50.00) from the CITES Management Authority (Environment and Conservation Division of the Ministry of Forests, Environment and Conservation) is also required for every consignment. Quarantine and vet certificates are also required for every consignment sent. All other normal Customs requirements also apply. Most of the fees charged are still not enough to cover the management of the trade.

Existing regulations do not cover the management of this trade and therefore the market determines specimens that are currently collected. Quotas for the trade are yet to be established. Collecting areas are not defined but are influenced by the point of export. The Fisheries division compiles all statistics relating to the trade and files all copies of export documents. These however do not cover mortality during holding. All holding facilities are currently not regulated.

5. Socio-Economic Benefits to the Communities

Resource owners from the subsistence communities collect the tradable items from their own reefs and sell them to the exporters in Honiara. The exporters pay for the items and also train the subsistence fishermen on collecting quality items. It seems that the trade provides the subsistence fishermen with income generating opportunities that otherwise would have to come from products such as trochus, beche-der-mer, shark fins and copra. The returns that the subsistence fishermen get from the aquarium products hopefully benefit the communities the fishermen represent. In the long term, when the fishermen realise that there is economic value to the coral reefs, better management can be initiated for the sustainable exploitation of these marine resources.

6. Economic Benefits to the Country

Normal foreign exchange earnings are the most significant economic benefit that the country has from the trade. Other commercial activities benefit from the trade and provide other economic benefits. Normal custom tariffs apply to all aquarium exports and provide direct economic benefits to the government treasury.

One other major benefit of the trade is in terms of employment, which in the Solomon Islands, is around twenty on full time and another twenty on casual basis. The value of the trade compared to tourism is small and the trade may not be too conducive to tourism development in Solomon Islands as most tourists to the country are ecotourists (divers). (There is no tourist coming to the country at present though).

7. Export Controls

The export controls placed on this trade are through the permit system and the normal customs and quarantine export controls. The only animals that are currently controlled are the giant clams where wild caught clams are not allowed for export. The present Solomon Islands trader exports juveniles produced from an ICLARM hatchery west of Honiara (this hatchery is now closed). Fisheries officers from the Ministry of Fisheries and Marine Resources carry out periodic inspection of the export consignments.

8. Status of Cites Responsibilities/Obligations (For Corals)

Solomon Islands is not yet a party to CITES but is intending to join. The Environment and Conservation Division of the Ministry of Forests, Environment and Conservation, which is the CITES Management Authority, ensures that all exporters adhere to CITES requirements. The issue of Scleractinian corals and how they are detailed in the current permits need to be sorted out with CITES.

9. Needs Assessments

Solomon Islands has already passed the necessary domestic legislation required to effect CITES at the domestic level. However, further regulations still need to be done. In terms of the sustainable management of coral reef resources, Solomon Islands needs to develop Marine Protected areas and Integrated Coastal Zone Management Plans. Existing legislation is enough to initiate and implement such plans. For the aquarium trade, a national management plan that would guide all aspects of this trade could be an immediate activity.

10. Lessons Learned

Current national law puts the ownership of everything below the high water mark as crown property. This is exactly opposite to the existing tenure system of the traditional communities who claim ownership of coral reefs as they are extensions of their land. Traditional resource owners and or fishermen therefore collect the resources for the aquarium trade as part of their subsistence activity. It is not a full time activity.

The fact that the exporters buy the goods from the fishermen eliminates the chances for land disputes involving them and the fishermen or reef owners. However, disputes amongst the communities may surface. In most of Solomon Islands, coral reef resources are regarded as common property and their use is usually open to all community members who reside in the area or who claim ownership of the reef. The trade therefore integrates into the existing traditional tenure system of the communities. Doing otherwise will create problems.

Collecting from the wild is a concern as there is no data available to ensure sustainable exploitation of the resources. Banning the export of wild caught clams has been a good approach for the Solomon Islands as this promotes the export of the hatchery produced juveniles. Farming the corals has also been a good practice that has now been developed and could be developed further.

Export volumes from Solomon Islands depends on aircraft space as there is only one plane. This is a kind of hidden control that limits the exporter on what is bought from the fishermen and what the fishermen collects or harvests from the coral reef.

PALAU AQUARIUM TRADE

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1. Background on the History of the Aquarium Trade in the Republic of Palau.

1.1. History of the Aquarium Trade in Palau.

The aquarium trade officially began in Palau in 1990 with the construction of a facility which was a fairly low tech system, drawing water from Malakal Bay and running it through a homemade biological filter and then back out to the ocean.

Several problems were encountered by this first operation in its efforts to collect and export aquarium species from Palau. At this time Palau had no regulations in place to monitor or regulate the trade. The government tried to use its regulations for food fishing for the aquarium fishery. The first problem encountered was a law stating the minimum mesh size for fishing in Palau must be 3” or larger. This regulation was only enforced in Koror State. Koror was the closest state and had the largest reef. In the four years Palau Aquatics operated they were arrested and fined several times for violation of this law.

Special permits were obtained from Melekeok State and other states in Eastern Babeldaub (Palau’s big island). These permits allowed Palau Aquatics to operate without incident. During certain times of the year bad weather made it difficult to collect in these states and fish were still being collected in Koror State illegally. In addition, it was illegal to collect fish using compressed air devices. Again this was a law specific to the reef food fish trade and this law was only enforced in Koror State. Palau Aquatics used hookah type diving compressors like those used in the Philippines.

Besides problems relating to the actual collection of fish, other problems having to do with exports were encountered. Continental Airlines was the sole carrier that serviced Palau. Flights were much less frequent then they are today and space was difficult to obtain on the aircraft for live aquarium products.

In late November of 1990 the first aquarium shipment went out from Palau to Los Angeles. Eventually regular shipments were being made to the U.S. At their peak, Palau Aquatics was able to export some 250 boxes of live aquarium products per week. Some weeks PA was exporting 5 out of 7 days. There are no written records available of the exact amount of species exported from Palau Aquatics. Their offices were located on the second floor of the Hardware Store that was destroyed in a fire in 1996. Most of this information has been obtained from conversations with the Manager, Larry Sharron who is still living in Palau. He estimates that annual sales from Palau Aquatics ranged from 300 to 400 thousand a year.

It should also be noted that at the time Palau was still a U.S. territory and shipments from Palau were not subject to inspection by customs or U.S. Fish and Wildlife. They were considered as domestic cargo. Because of this, Palau Aquatics was allowed to collect virtually any marine animal it deemed marketable for the aquarium trade. These included fish, invertebrates, wild giant clams, hard and soft corals and some live rock. It is estimated that a total of about 400 species in all were exported at one time or another.

In mid 1994, Palau decided to completely revise it's marine regulations and an embargo was put in place for all reef fish until such regulations were in place. This was later to be known as "The Marine Protection Act of 1994.

Palau Aquatics changed hands and became Palau Biotech. This was the second aquarium export business to operate in Palau. Even with the Marine Protection Act in place the parts pertaining to the aquarium trade were not clear. It was decided to create a set of regulations under the act specific to the trade. Also of importance at this time, Palau became independent and the shipment of live aquarium products were now subject to inspection by customs and USFW. But since no local regulations existed as to what species could be exported, Palau Biotech was still free to export any aquarium product they deemed marketable. Live rock was an extremely lucrative aquarium product and Palau Biotech relied on this as their mainstay. In addition, fish, invertebrates, hard and soft corals, as well as giant clams, were exported. Once Palau had aquarium regulations in place it was decided that live rock, hard coral and wild clams would be illegal to export. After 3 years Palau Biotech began to have internal problems as well as government problems and the company eventually closed. For the next 2 years there were no aquarium exports from Palau even though regulations and permits were now in place.

In 1998 Belau Aquaculture commenced operations, experimenting with coral and other invertebrate cultivation. Belau Aquaculture's goal was to only export maricultured species, specific to the aquarium trade and not collect any wild marine animals. Soft corals, giant clams and anemones were reared and exported. Shipments were small, totaling about 30 boxes a week to a handful of US customers. But the El Nino of 1998-99 killed off 90% of Belau Aquaculture coral farms and so it shifted to the export of aquarium fish. By 2000 Belau Aquaculture at its new location was making regular shipments of live aquarium fish, invertebrates, maricultured corals and maricultured clams were being sent to the U.S. At the present time this company is the sole aquarium exporter in Palau. During 2000 Belau Aquaculture had just over $220,000 in sales including freight, exporting an average of 40 boxes a week to a single US customer.

1.2. Species Collected

At the present time, a total of about 300 different species of marine fish and invertebrates are collected. During an average week, about 50 different species of fish and invertebrates are exported. About 6 species are from mariculture. The variety of species depends on various factors such as weather, tides, and customer demands. Some rare species are only encountered occasionally. A complete species list is on record at Palau's Division of Marine Resources. It should be noted that Palau has about 1300 known species of fish (R.F.Myers, 1999). Of these just over 200 are collected for the aquarium trade.

2. Present Number of Collectors and How they Operate

At the present time there is only one aquarium exporter in the Republic of Palau. This exporter employs 3 collectors.

Under the current regulations two types of permits are required. A permit from the National government is divided into two parts which refer to the **permit owner**, who must be a Palauan citizen, and the **permit holders**, who are the collectors in the water.

A permit must be obtained from one or more of the 16 states of Palau where collecting is to take place. Collection may not take place without national and state(s) permits.

The Republic of Palau allows up to 10 aquarium collecting permits to be issued by the national government at any given time. Individual states do not have regulations restricting the number of permits, but a state permit cannot be obtained without a national permit being obtained first. No more than 10 permits can exist in a given year. It should be noted that in the entire history of the Palau aquarium trade there has never been more than one operator at any given time even though permits are available for several to operate.

Aquarium specimen collection takes place wherever the operator can obtain state permits from. Because Palau is a dive destination, it is prohibited to collect aquarium species from known dive sites. The existing operator is carrying out aquarium specimen collection in 2 of the 16 states of Palau.

The current operator uses one assistant per collector and collectors are required to be listed on the national permit. State permits vary from state to state.

The current operator has a state of the art holding facility that uses modern filtration systems such as fluidized beds and protein skimmer technologies, and can recycle the same water. This single facility uses acrylic tanks for holding fish. It also has a separate filtration system to prepare shipping water.

Holding periods vary depending on species. Larger herbivorous fish are held the longest, usually one week to 10 days. Holding periods for smaller fish range from 2 to 4 days. Holding periods for many invertebrates can be as little as one day. No wild caught specimens are shipped less than 24 hours following collection.

3. Management Measures Currently in Place

Palau has a specific permitting process in place for the aquarium fishery. Subject to approval by the Division of Marine Resources, a permit application must be filled out by the permit owner prior to obtaining a national aquarium collection permit. A permit application must be re-filed each year. The annual fee for each permit is US$300.

State permits work differently to the national permit system. The aquarium operator must make their case to the governor of each state in writing before a permit is considered. Each State has different regulations for the aquarium fishery. To date it has been done on a case by case basis. State fees vary and permits must also be renewed annually.

4. Management Controls

Since all of Palau's reefs are government owned, permission from local communities is not required for collecting. All arrangements for collecting are made with National and State governments.

Aquarium collection may take place in any state where the operator holds a permit with the exception that known dive sites and designated marine preserves are not to be used. Koror State has comprehensive regulations as to where any type of fishing is permitted. Other states have some areas designated as marine preserves where all fishing is prohibited. All reefs in Palau are state and government owned and no individual or clan has jurisdiction over reefs.

5. Cost Recovery

Since there has never been more than a single aquarium operator in Palau, managing the fishery has been relatively easy. The current annual fee probably covers the expense of preparing documents for the current relatively small operator. The current operator also shoulders the expense for inspections during off hours (overtime).

Of the 16 states in Palau, only Koror State carries out actual formal reef management. This covers every aspect of the marine fishery and the aquarium fishery is a small part of it. Since state governments do not have to prepare export documents for the aquarium fishery their costs are low. Other states may carry out spot checks of aquarium collecting from time to time.

At present there are no regulations limiting the amount of specimens collected though there is a list of species that has been designated as "aquarium species" that must be followed. There are also species that are prohibited for collection. State permits use national guidelines for species collected for the aquarium fishery.

Since there has never been more than a single operator in Palau it has not been necessary to define collecting areas among collectors.

The Palau Division of Marine Resources (DMR) requires annual reports of species that are exported. There are no laws that require the exporter to report on collecting sites or mortality rates. Lists of species intended for export must be submitted prior to each shipment. Each shipment must be inspected by a DMR inspector just prior to export.

There are no regulations or requirements for holding facilities though holding facilities are regularly inspected by DMR officials.

6. Socio-Economic Benefits to the Communities from the Trade

In the case of the sole aquarium exporter in Palau, 6 locals are employed at the facility. The total number of persons who directly benefit from this exporter is 11. They are as follows: Palauan – 6, Philippino - 3, Bangladesh -1, American - 1.

Under current regulations fish used for food are not listed as suitable aquarium species. The current operator does not compete with locals for species used for food or any other purpose.

Aside from direct employment benefits resulting from locals working at the facility, many of the materials needed to operate the facility are purchased from local merchants. In addition the facility has educational value by allowing local schools to come and tour the facility and learn something about the marine species in their own country.

7. Economic Benefits to the Country.

Besides direct employment to locals, the operator must pay taxes on all revenues from exports. Taxes are imposed quarterly like all other income for profit businesses in Palau, and since the product is exported overseas it brings money into the country.

Originally, the aquarium trade was seen as a threat to the tourism trade in Palau. Palau is a world class dive destination and almost all tourists coming to Palau do so for diving. But to date the aquarium fishery in Palau has probably had less impact on the reefs than the thousands of tourists who dive on them every year. This is due to the fact that the aquarium fishery has always been very small. Today it is has been accepted and is no longer seen as something that competes with dive tourism. Palau has come to believe that it needs to diversify into other areas and to not rely solely on tourism.

8. Export Controls in Place

Before any marine product can be exported from the Republic of Palau proper documentation must be obtained from DMR in advance. DMR officials must inspect all export aquarium products before documents are signed. These documents must accompany each shipment and are required by USFW before any live aquarium product originating from Palau is allowed to enter the U.S. The laws and documentation required for aquarium exports are strictly enforced by the government of Palau (Division of Marine Resources).

9. Status of Meeting CITES Responsibilities and Obligations (for Corals)

The Republic of Palau is not a member of CITES, however, Palau aquarium regulations prohibit the export of wild corals. Any operator attempting to export wild corals would be fined and would risk losing their permit. In addition, any corals exported illegally from Palau to the US would be in violation of the Lacey Act.

10. Lessons Learned

Palau has been fortunate that most of the operators have been conscientious in the short history of its aquarium fishery. Prior to aquarium regulations being in place there were some problems. We believe that the current operator is a conscientious one. He has a high standing in the community and holds ideals about the fishery that are in line with those that wish to conserve the resource.

Future operators that may open in Palau should be scrutinized closely. Facilities should meet high standards and marine resources personnel should go beyond inspecting exports and should monitor facilities and the collecting methods closely. Export operators and DMR should work closely together to gather more data on the aquarium fishery.

COUNTRY REPORT OF THE KINGDOM OF TONGA: STATUS OF THE TRADE IN STONY CORALS

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Editors Note: This paper not presented at this meeting but at a subsequent meeting on the International Trade in Stony Corals on Jakarta in April 2001. It is included here for completeness of status update for the Pacific

A. BACKGROUND INFORMATION ON THE TRADE IN STONY CORALS

The trade of stony corals in Tonga started in 1988 by one tropical aquarium fish operator and exporter called the Exotic Tropic of Tonga. Stony corals, ornamental fish and invertebrates were harvested and exported to the United States of America for aquarium purposes only. The beginning of the aquarium industry in Tonga can be dubbed as an American-and-Tongan view initiated by a party consisted of Americans and Tongans. The first company ceased operation in a few years then another operator was established called the Walt Smith International. Thus, from 1988 to 1992 harvesting of corals for aquarium trade was undertaken by only one operator/ exporter. After 1993, three additional operators joined the industry; Intra-Pacific, Sea of Colour, and the Dateline Aquarium Fish. In 1995 the Ministry of Fisheries set up a policy that only 5 aquarium operators per year be allowed to conduct aquarium activities in the Tongatapu group, the main island group of the Kingdom of Tonga (refer the attached map). By the end of 1996 two operators stopped operation, then two companies Mele D. Vaha'i and Topac Marine filled up the vacancies. Both operations stopped after less than 12 months. In 1999 there were only two players in the industry, the Walt Smith International (Tonga) and the Dateline Aquarium Fish Co. Ltd., then the Vanisi International joined in the year 2000. At present, three operators are currently active on the stony coral trade. The coral harvesting, activity mainly confines to Tongatapu and is yet to be extended to other groups, such as Ha'apai and Vava'u.

Two major types of stony coral exported from Tonga, the dead rock (hereinafter referred as aquarium rock, live rock or dead coral) and live coral. The aquarium rock are mainly *Scleractinia* sp. of which each aquarium operator/ exporter is allowed to export no more than 100 metric tons per annum. This quota was set in 1995. Regarding. live coral harvest, each operator is allowed to harvest 300 pieces per week.

The harvest of live coral started in mid-1997 following survey on aquarium fish and coral conducted by the South Pacific Commission, now the: Secretariat of the Pacific

Community. The species harvested include: *Acropora sp, Alveopora sp., Caulastrea sp., Euphyllia sp., Favia sp., Favites sp., Fungia sp., Galaxea sp., Goniopora sp., Goniastrea sp., Lobophyllia sp., Millepora sp. Montipora sp., Oxypora sp., Pachyseries sp., Pavona sp., Platygyra sp., Plerogyra sp., Pocillopora sp. Seriatopora sp., Stylaphora sp., Stylaster sp., Stylophora sp., Tubastrea sp., Tubipora sp., Turbinaria sp., etc.*

Almost all corals are exported. to the United States, of America with very small amount being exported to Europe. Table 1 shows the quantity of aquarium rock and live coral exported from Tonga in 1997 - 2000 with corresponding fob (free on board) values. This figure is believed to be ‘under valued' and it does not reflect the true value of the industry. Table 1 shows a decrease on quantity of aquarium rock exported in 1998 (decreased by 10.5 metric ton) and 1999 (12.3 MT) compared to 1997 (40.5MT). In the year 2000, the aquarium rock export quantity increased to 137.5MT, a 339% increase compared to 1997. On the other hand, the live coral harvest depends on the number of pieces. The data shows a slight increase of the live coral quantity in 2000 compared to 1997.

Furthermore, the annual trends in the trade poses a high demand from the market in October to April and low demand from May to September according to one operator. That high demand is shown on the graphs for live and aquarium rock/ dead corals export from 1998 - 2000. The trend in coral trade in Tonga primarily depends on the international market as well as the freight capacity. On freight, the aquarium industry competes with fresh tunas, snappers and groupers for airline space. The monthly trend in coral trade (live coral and aquarium rock) is shown in Figures 1 & 2. Again, the degree of increase and decrease depends on the market and freight capacity.

Table 1: Live coral and aquarium rock exported from Tonga in 1997 - 2000 taken in its essential from the Ministry of Fisheries Annual Reports 1997 - 2000

Coral	1997			1998		
	PCS	W	TOPS	PCS	W	TOP$
Aquarium Rock *(branched, slap and solid)*		40531. 00	121593. 00		30, 314. 09	90, 944. 70
Live Coral	6, 494		28, 397. 25	13, 178. 00		79, 068. 00
TOTAL	**6, 494**	**40, 531**	**149, 990. 00**		**4, 560. 9**	**170, 012. 70**
	1999			**2000**		
	PCS	W	TOPS	PCS	W	TOP$
Aquarium Rock *(branched, slap and solid)*		27779. 0	83337.6		137, 459. 07	412, 377.20
Live Coral	24, 975		113, 141. 00	26, 053		159, 018. 00
TOTAL	24, 975		**196, 478. 60**		137, 459. 07	**571, 395. 20**

Live Coral: Pieces = PCS= Number of Pieces ranges from 5cm to 20 cm; Weight in kilogram = W , FOB Value for Aquarium Rock $3.00 Tongan Pa'anga per kilogram , FOB Values for Live Coral depends on the species and size of coral. The live coral size ranges from 5 to 20 cm.

The current operators were requested to comment on the ten popular generas/ species of coral they have exported. Two operators responded, one gave the percentage proportion while the other prioritize by number all the corals its company has exported. The former indicated the percentage proportion: *Acropora 40%*, *Pocilliapora 5%, Stylophora 5%, Monlipora 5%, Lobophillia 5%, Turbinaria 5%, Seriatopora, Euphillia, Tubastrea , Favites and Favia 20%, other 15 X.* The latter showed the order ranging from the most to the least as follows: (1) Mushrooms *(Rhodactis inchoata, Discosonia sp. & many* other types of mushrooms) (2) Brown, Green, Yellow Polyps such as *Pachyclavidaria violacea* and *asbestinum,* (3) *Alcyonium* sp. or commonly called colt coral (4) Leather corals such as *Sarchophyton* sp. and *Sinularia* (4) *Acropora sp* - acro being the common name (5) *Montipora sp. - name* used by the aquarium trade (6) *Caulastrea sp.* or trumpet coral (7) *Lobophyllia* sp. or brain/ meat coral, (8) *Pocillopora* sp. or Birdnest Coral, and,(9) Live Rock, or *Scleractinia.*

In essence, the overall harvest of stony corals in Tonga (Tongatapu group only) at present is believed to be undertaken in a sustainable manner. The method being used for collection of aquarium rock and live coral complies with the code of practice being set for this industry (refer Appendix). The dead coral or rubble are picked by hands while the live corals are strictly harvested on a rotational basis from certain locations of the Tongatapu reefs. Noteworthy to mention, an earlier comment from the South Pacific Regional Environment Programme (SPREP) suggested that in order to know the sustainability of the aquarium collection activities one must allow collection to be undertaken with appropriate data/ statistics to be collected (by operator and the Ministry of Fisheries) for onward monitoring and assessment. Subsequent reports on the aquarium industry by SPREP 1994 and SPC 1996 indicated that the current exploitation for both aquarium fish and coral harvest in Tonga is sustainable and should be sustainable with the 5 operators being set for the Tongaatapu

Figure 1: MONTHLY TRENDS OF LIVE CORAL TRADE IN TONGA 1997 - 2000

The graphs present the number of pieces of live coral export on a monthly basis with corresponding fob value in Tongan Pa'anga (TOP)
(The length of a live coral piece ranges from 5 - 20cm depending on the species harvested. TOP$1.00 ranges from USD$0.57 to $0.61 depending on the daily rate)

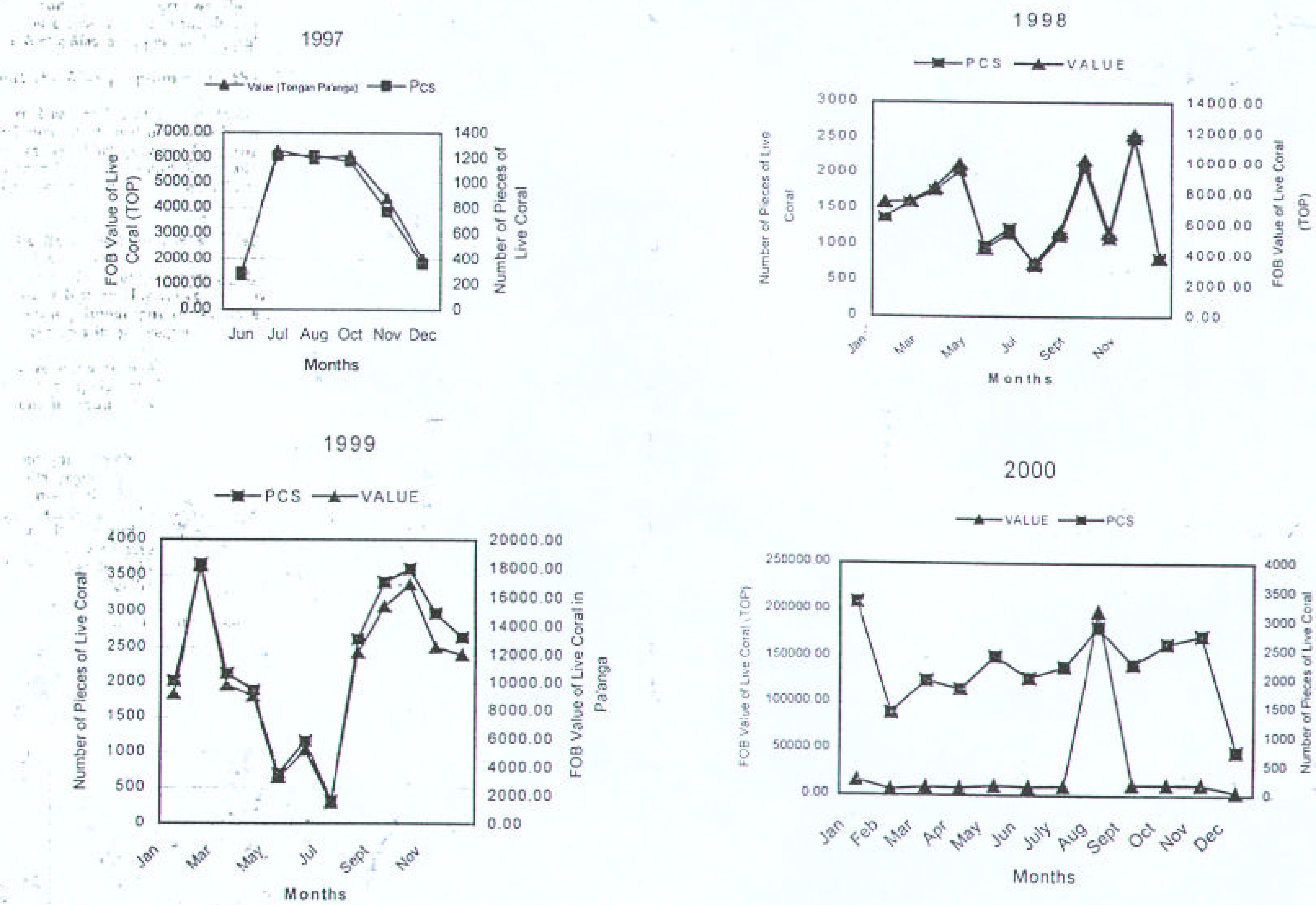
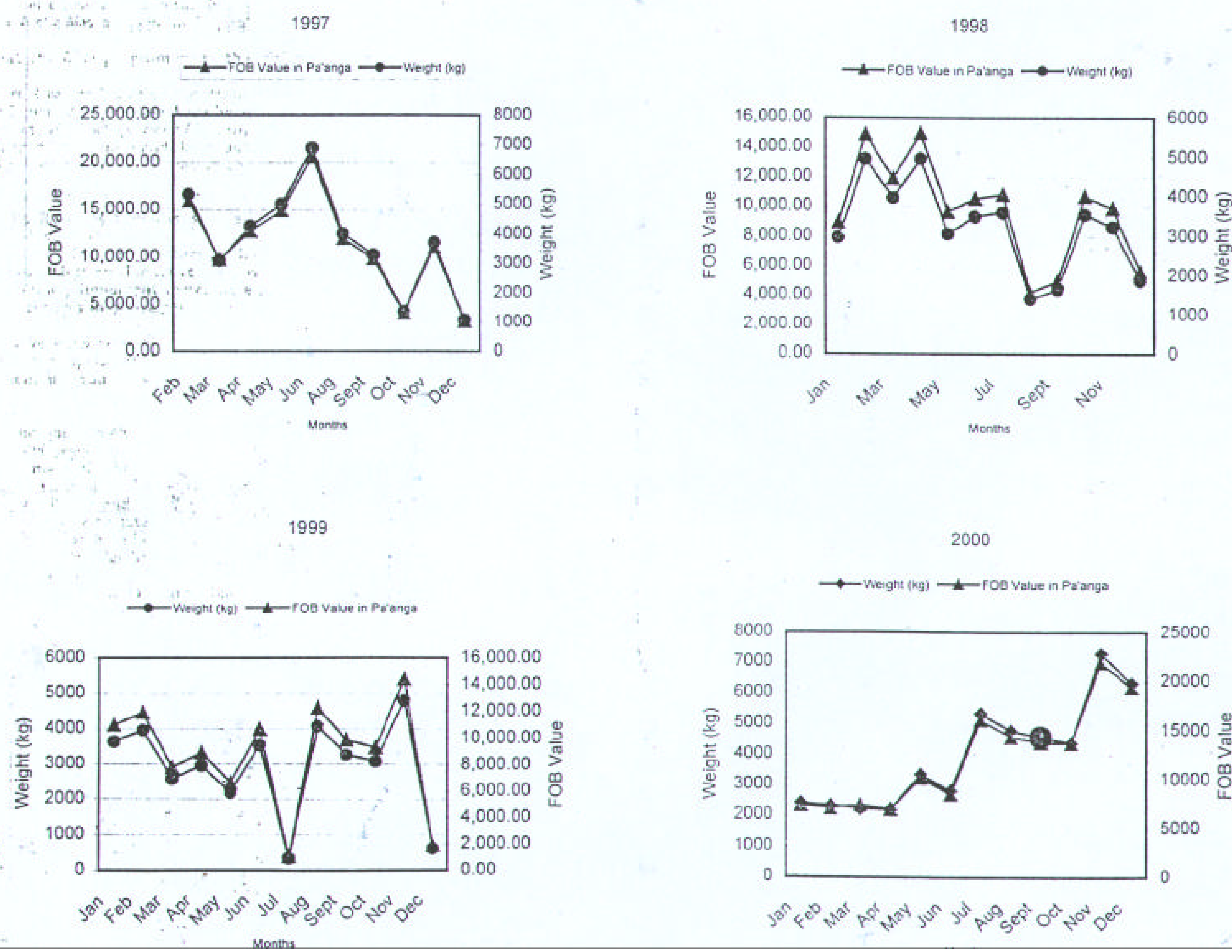


Figure 2: MONTHLY TRENDS OF AQUARIUM ROCK EXPORT FROM TONGA 1997 – 2000

The graphs represent the monthly weight (kilogram) of aquarium rock export with corresponding TOP$1.00 ranges from USD$0.57 to $0.61 depending on the daily rate)



B. CORAL COLLECTORS

The number of people involved on coral collection in Tonga is very small and is currently ranging from 12 - 15 for all the three current operators. All collectors are certified divers and well trained on sustainable practice for coral collection. A collector must be an employee for an operator and he will work in accordance with the code of practice (refer Appendix) which can be reviewed from time to time should needs arise. During collection time, each operator has a supervisor to ensure that the code of practice is observed. In addition, a fisheries inspector/ observer do often accompany collectors to the reef for coral collection.

Aquarium rock collection is done on the outer reefs while live coral is strictly harvested on a rotational basis from certain locations directed by the code of practice.

The common gear used for coral collection is snorkel while the hookah and scuba are sometimes used on at least 10 metre depth. Collectors confine their collection to market requirement and freight capacity. They record the weight of the dead rock/ live rock harvested while the live coral harvest is recorded in a logbook. All information are submitted to the Ministry of Fisheries prior to export shipment authorisation. The logbook is to be submitted on a monthly basis for inspection by the fisheries inspector which he signs and dates to confirm that the logbook data complies with the collection activity being undertaken.

Regarding the question of whether or not the collectors have information on mortality associate with collection and handling, all collectors commented that hardly any mortality occurred during the course of collection and handling. Therefore they do not have any information on coral mortality.

C. MANAGEMENT OF CORAL RESOURCES IN TONGA

The current management regime for the harvest of stony corals in Tonga emanated from the SPREP 1994 Report to the Prime Minister's Office on the collection of corals and aquarium fish from the Kingdom of Tonga by Jamie Oliver & Andrew Smith (1994) and another follow up report by SPC entitled: "The aquarium fish fishery in Tongatapu, Tonga: status and recommendations for management by S. Matoto, E. Ledua, G. Mou-tham, M. Kulbicki & P. DaIzell (1996)". Both reports were noted by His Majesty's Cabinet.

Hard coral is any coral with a stony skeleton belonging to the Order Scleractinia, Coenothecalia, Athecata, and Stolonifera. This group contains all common hard or stony reef corals including the. Genera Acropora and Goniopora. It also includes blue coral, organpipe coral and fire coral.

It is noteworthy to mention that hard coral (live coral harvesting) harvest was banned by Cabinet in December 1993 and re-confirmed by Cabinet Decision in April 1994 after the report by Jamie & Oliver (1994). The latter decision recommended that a field survey must be done to consider whether or not the live coral harvest is sustainable. Although the live coral harvest affected the industry the ability to control its ban opened the door for some of the operators to consider extending to other countries in the South Pacific. Coral harvest has been a subject of many discussions and heated debates in Tonga.. However, it is the view of the Ministry of Fisheries that every marine resource should be subject to exploitation/ use, so long it is carried out in a sustainable way employing total allowable catch, best practice, etc.

Thus, live coral harvest resumed in 1997 following assistance of the South Pacific Commission (SPC) Resource Assessment Section. At the second quarter of 1996 a team of research scientists conducted a survey of the aquarium fish stock and hard corals in Tongatapu. In essence, both the above reports (SPREP & SPC) concluded that the current state of exploitation in the aquarium industry is sustainable though the first report make precautionary approach to live coral harvest due to recommendation of the Ministry of Fisheries.

In 1997 the Ministry of Fisheries prepared the code of practice for harvesting of live corals in Tonga. Fisheries (Conservation and Management) Regulations 1994 make provisions for coral as follows: (1) No person shall remove or take any coral from within the fishery waters except with the written permission of the Secretary for Fisheries. (2) The Secretary may impose such conditions as he may specify, including, but not limited to, conditions relating to: (a) the quantities that may be removed or taken; (b) the location or locations from which it may be removed or taken; (c) the duration of any permission granted; (d) the method of removal or taking; (e) measures necessary or desirable to conserve and protect the marine environment; (f) the fees, royalties or compensation to be paid in respect of the permitted operations.

At present, Tonga employs good collection practices that are stipulated by the code of practice. The areas for collection are inspected for damage and abundance. The operator always attempts not to collect more than 2 weeks of shipping. The collection is planned ahead as per market order. The size of coral collected is determined by the Ministry of Fisheries following consultation with the operator on best practice to be adopted.

As a guide for best collection practice one operator has been working on fraging corals and attempt is made to make them popular in the coral community. Some areas have been designated as no take areas such as the fringing reefs adjacent to Tongatapu, marine parks and other locations (refer Appendix A). Inspectors always attend to make on-site inspection, and also present at the packing to ensure compliance.

D. HANDLING OF WILD-HARVESTED CORALS

Handling of wild-harvested corals is important to minimize or eliminate injury and mortality during transport. To ensure good handling a fisheries inspector always inspect the export facilities and attend packing. A guidance for best practice on handling to minimize coral injury and coral mortality will be incorporated into the current code of practice. At present only one operator treats broken coral during collection, i.e. by turning it into a frag (when a coral is glued to a piece of rock using underwater putty) while the other operators do not make any precautions.

Transporting of the corals from collection site takes 1 - 2 hours depending on the distance from the collection site to the shore and another hour to the operator's establishment. The corals are then kept on facilities using- the best and latest, technology available (i.e. protein skimmers, ultraviolet sterilizers, filtration system, etc.). One operator keeps live coral on saltwater tanks and store rocks in the ocean to help the curing, when excess matters such as sponges and certain algae are removed. The holding time is no more than 2 weeks prior to air-transport to the market. On export to the USA all operators try to ship on 20 hour flights or less in order to minimize coral injury.

E. MONITORING, ASSESSMENT AND RESEARCH

The condition and abundance of the coral resource within a particular area is always assessed by the Ministry of Fisheries and collection supervisors from aquarium operators before collection is undertaken. In this assessment the sustainability of the area for collection is considered. This is particularly important for live coral.. In addition, the current protocol being used to monitor the status of the resource and any impacts associated with coral extraction is the using of harvest logbooks and inspection of sites. This provides specific information such as types, sizes, weight, location, dates, quantities, name of divers, and operators.

Regarding scientific research there is currently no activity to examine life history features of corals in trade that may be relevant to management such as growth rates and recruitment in specific collection sites. However, research program is now being done to explore alternatives to wild harvest, such as coral mariculture. One operator indicated that some mariculture corals are now being harvested by its company.

Notwithstanding the above, the Ministry of Fisheries plans to seek assistance for a review of the aquarium fish and coral harvest by June 2002, i.e. the completion of the first five years of the live coral code of practice (management plan).

F. LEGAL OBLIGATIONS

The legal obligations for the stony coral trade in Tonga is vested specifically with three ministries. The,Ministry of Fisheries prepares the management plan and gives authorisation for collection actitivities *vide* the Fisheries Act 1989 (Fisheries Amendment Act 1993) and the Fisheries (Conservation and Management) 1994. The Ministry of Fisheries issues the permit for coral export as per list of species submitted by the operator/ exporter prior to shipment. Although Tonga is not a party to CITES all matters relating to export of corals are dealt with in accordance with the CITES guidelines. At present every shipment from Tonga is attended and inspected by a fisheries inspector.

Although each of the three operators and the Fisheries Inspector use CITES guidelines, none of the personnel involved has attended a workshop, short term training or attachment on how to implement CITES obligations. Most of the personnel involved have learnt coral identification from coral textbooks such as the book entitled "Coral of Australia and the Indo-Pacific (1986) authored by JEN Vernon. Therefore, additional assistance to manage coral resources in a sustainable manner, coral identification training for law enforcement to verify the accuracy of permits and prevent illegal coral shipments and other related issues are required as soon as possible.

The only other government departments involved are the Ministry of Labour, Commerce and Industries which issues the commercial licence for exports and the Customs Department, Ministry of Finance, which involves on export inspection in accordance with the provision of the Customs and Excise Act. This Act prohibits export of raw unprocessed coral and live coral without the consent of the Collector of Customs.

REFERENCE

1. Ministry of Fisheries Annual Report 1997 – 2000

2. Legislation: Fisheries Act 1989, Fisheries Amendment Act 1993, Fisheries (Conservation & Management) Regulations 1994; Customs & Excise Act, Parks & Reserves Act

3. SPREP 1994 Report to the Prime Minister's Office on the collection of corals and aquarium fish from the Kingdom of Tonga by Jamie Oliver & Andrew Smith

4. SPC 1996 Report entitled "The aquarium-fish fishery in Tongatapu, Tonga: status and recommendations for management by S. Matoto, E. Ledua, G. Mou-tham, M. Kulbicki & P. DaIzell".

APPENDIX A

GUIDELINES TO ISSUING OF LICENCE FOR COLLECTING AND EXPORTING LIVE (HARD) CORAL FOR AQUARIUM PURPOSES 1997

1. There should be no more than 5 operators permitted to collect and export live (hard) coral in Tongatapu

2. A new aquarium operator must have had sufficient proven experience that ensure safe, less hazard and sustainable harvesting techniques before the issue of a licence.

3. The aquarium operator wishes to harvest and export live (hard) coral must submit a proposal to the Ministry of Fisheries, including but not limited to, the market which it intends to export, the likely international prices of the specific coral generas/ species, the likely cos t insurance freight value of the coral to be exported and any other conditions designated *vide* section 17 of the Fisheries Conservation & Management Regulations 1994.

4. That harvest and export of live (hard) coral be allowed to resume with a maximum allowable catch of no more than 300 pieces per week collected in total by any exporter. No more than 14, 000 pieces of live coral should be exported per year per collector.

5. That the maximum size in length of hard (live) coral to be harvested as per following genera: *Montipora* (20cm), *Acropora* (12cm), *Alveopora* (10cm), *Caulastrea* (10cm), *Euphyllia* (15cm), *Favia* (12cm), *Favites* (15cm), *Galaxea* (15cm), *Golliastrea* (15cm), *Gonippora* (15cm), *Lopophyllia* (20cm), *Millipora* (15cm), *Platygyra* (12cm), *Pocillopora* (12cm), *Tubastrea* (15cm), and *Tubipora* (15cm) *Turbinaria* (20cm). Any additional generas will be approved by the Ministry of Fisheries.

6. The entry of any new foreign company or Tongan registered company involving non-Tongan nationals into the industry should involve 50% Tongan national equity participation.

7. That a resource rent (fees) shall be paid to the Ministry of Fisheries. The levy is 10% proportion of the

8. The licence/ permit fee for the harvest of live (hard) coral shall be $300 per operator which shall be val

9. That a company involving full Tongan nationals as shareholders shall be subject to only 1 % resource

CODES OF PRACTICE FOR HARD (LIVE) CORAL HARVESTING

1 . Harvest must be undertaken on the areas specified on the Table and the attached Mao.

2. Harvesters should be employees of the aquarium fish operator/ exporting company that has been regi

3. Coral must be cut by hands or any other techniques recommended from time to time by the Secretary

4. Harvest Logs, designated from time to time by the Registrar must be filled by companies showing are

5. Separate records should be kept on the number of pieces per species and total weight and dollar value

6. Destructive fishing techniques such as using of hammers and crow-bars are prohibited.

7. Management officers (fisheries inspectors) should accompany harvesters on harvesting trips at least 4

8. Unless directed by the Secretary for Fisheries, Fisheries inspectors should carry out a spot check, of tl

9. If any application to relax these restrictions is made, it should be justified (at the proponents expense)

10. The Government review this policy in 1-2 years time in the light of the data collected by exporters and any other studies which may have been conducted.

<u>COLLECTING SITES FOR LIVE CORAL (HARD CORAL)</u>

Note:

a) Collection should be refrained from the marine parks and adjacent reefs surrounding the mainland To Minister of Fisheries. Most of the above areas are spawning grounds for coastal marine lives and fishing grounds for coastal communities/ local fishermen. The reef areas and marine parks can be used for "underwater ecotourism". In essence, these reefs support local consumption and easy access to Tongans who cannot afford boats.

b) Collection should be restricted at the present time to the northern reefs of Tongatapu (see Table belov

c) All aquarium boats should be registered and licensed immediately for case of monitoring and keeping

d) Future expansion on sites can be done on outer islands, Ha'apai & Vava'u Reefs

c) The harvest of live corals should be rotational harvest, following instructions from the Ministry of Fis

Table : Coral Harvest Site Locations and the duration of harvest (see attached Map for reference).

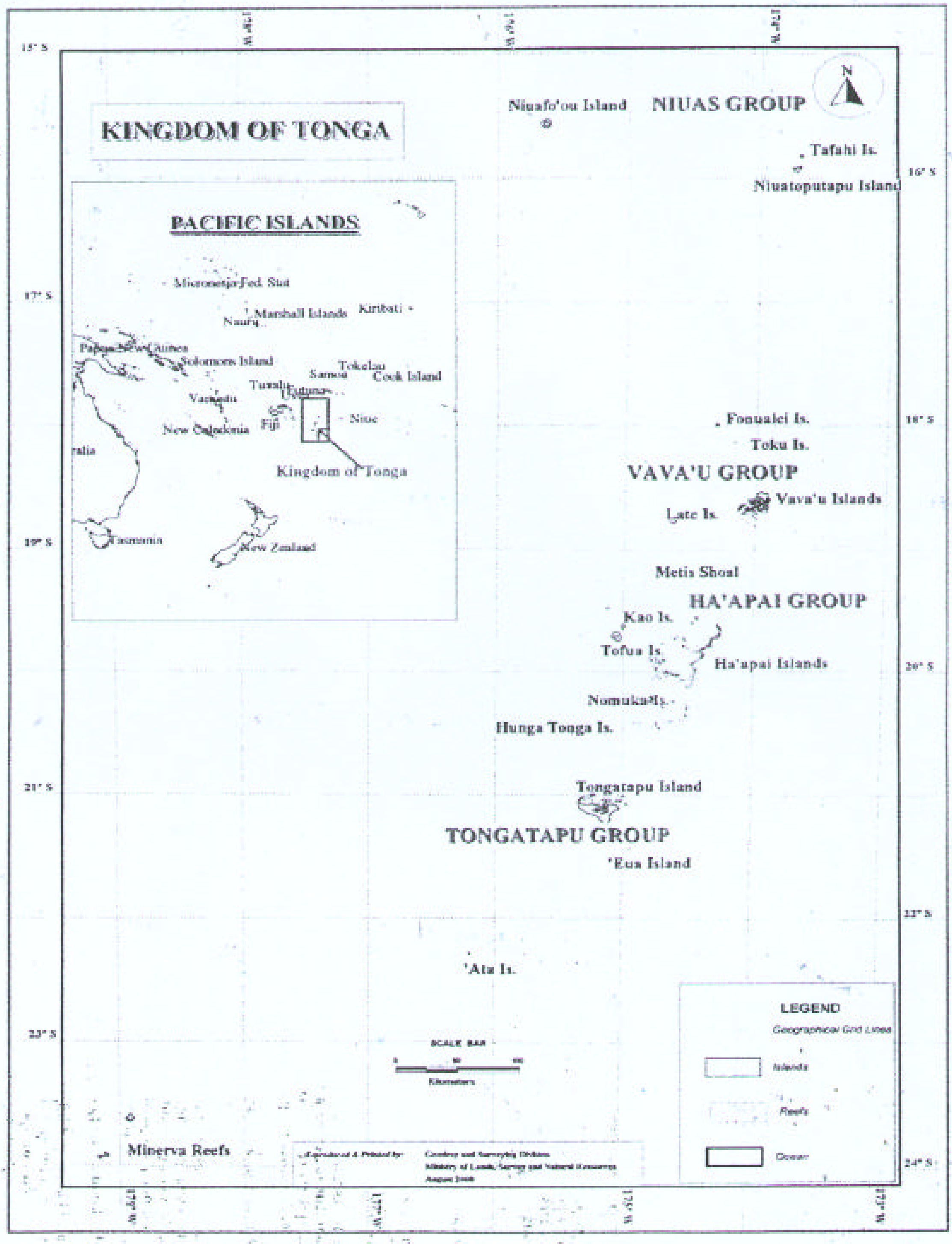
Sites Number	**Name of Site Locations as per small islands on the north of Tongatapu**	**Duration of Harvest (month)**
AREA 1	North & East of 'Atata (same as no. 3)	2
AREA 2	Ualanga Lalo Ualanga 'Uta Mounu.	(1 month on each surrounding reefs)
AREA 3	Northern edge of Fafa (to avoid the resort) 'Onevai 'Onevao Velitoa (Hihifo & Hahake)	2
AREA 4	Reefs stretch from Motutapu islet to Tau islet (a big area)	5

Marine Parks: Hakaumama'o Reefs, Reefs surrounding Malinoa island, Reefs surrounding Mounuafe, Pangaimotu, Makaha'a, Ha'atafu Reefs

Hard (Live) Coral Logbook
Company Name

Species	Common Name	Weight (kg)	Size/length (cm)	Area/ Location	Estimated Depth (metres)	Date	No. Divers
Boat Skippers Signature:				Date: ……………………			
Company's Director/Agent:				Date: ……………………			

APPENDIX B: MAP OF THE KINGDOM OF TONGA



VANUATU MARINE ORNAMENTALS TRADE

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1. Background on the History of the Trade

The ornamental export trade began in Vanuatu around the mid-80s. At that time the Fisheries Department hadn't been properly established. Therefore details pertaining to the statistics and information relating to this period are not available. The trade really took off in 1992, though the level of trade is low compared with other Pacific island countries.

Species collected for the trade involve fish species of the families, Acanthuridae (surgeonfishes and tangs), Balistidae and Monacanthidae (triggerfishes and filefishes), Blennidae and Gobiidae (blennies and gobies), Chaetodontidae (butterflyfishes), Cirrhitidae (hawkfishes), Labridae (wrasses), Pomacentridae (damelselfishes) and Serranidae (groupers and basslets). Also collected and exported are giant clams of the species *Tridacna*, various cultured corals species namely *Acropora, Porites*, Live rocks, *Cypraea* sea shell species, and numerous other smaller invertebrates.

In 2000 it was estimated that products exported from Vanuatu was worth approximately US$100,000 with live giant clams making up at least two thirds of the quantity as well as in terms of monetary value (see table 1).

Table 1. 2000 marine ornamental exports

Product	Quantity	Value (US$)
Giant clams	18,000 pieces	77,000
Live rocks	8 tons	8,000
Fish	3,000 pieces	20,000
		105,000

2. Number of Collectors, and how Collectors Operate in the Country

Any operator of the trade needs to have a license to collect, process and export products. Fisher folk can collect at will, particularly those owning reefs. Operators need to also obtain approval for access from both Provincial authorities and reef custodians before they can collect. There are currently 3 licensed operators working in the country and as a matter of policy, there is no desire yet to increase this number. All are based in Port Vila on the island of Efate. The island of Efate has been the main area of operation for operators but they are slowly moving out to the outer islands to obtain products. Efate collection sites are becoming more competitive and more restrictions have been placed on harvesting by the Shefa Provincial Government and by local custodians. All operators are foreigners but they employ locals to do the collection and with species like giant clams, actually buy the clams from fisher folk.

Operators usually employ about 5 – 10 people. There is no restriction on the number of local employees an operator can employ but there are restrictions on foreign labor.

Holding facilities for the ornamental trade are either concrete or reinforced plastic tanks. Most are situated on waterfronts for convenience in terms of operating a seawater system. All operators have installed open water systems (with additional aeration), with the exception of one operator whose fish holding facility is a closed system. All incoming seawater is filtered and the outgoing water flows straight back into the sea. Specimens are held for at least 1 to 2 weeks before they are actually exported. The organisms are given time to acclimatize before they are shipped overseas.

3. Management Measures Currently in Place

Vanuatu does not have any specific management plan for the ornamental fishery. There are no restrictions as to where collections can or cannot take place, or what species can or cannot be collected, and there are no quotas. Collectors have no defined area within which they operate. They collect anywhere where they want, provided they obtain prior approval from the relevant Provincial Governments and from the reef owners. Sometimes the operators end up competing for products from the same area. This usually pushes the price of the products higher, or one or all operators leave the area. As far as holding facilities are concerned the Fisheries Department does not have any criteria or guidelines that the facility must meet, apart from adequate clean sea water, aeration and treatment.

The use of poison or other harmful chemicals is prohibited by law (Fisheries Act Cap 158 regulation section 19). As a result, all fin fish (for example) are caught using barrier or scoop nets.

4. Socio-economic Benefits to the Communities from the Trade

One collector or operator would normally hire at least 2 permanent staff to carry out supervisory, administrative, and management roles. An operator would also employ a variable number of casual employees (usually between 5 and 10) to collect specimens, and to maintain the facility. It is also common for an operator to employ locals on a wage to assist in the collection of specimens from their own area.

Apart from fin fish, fisher folk can bring in specimens to sell to the operator as well. However, this usually involves the collector initially going out and advising the community on how to collect, what species to collect, and how to care for specimens prior to sale. This has been especially true for giant clam and for farmed coral. For new products like farmed coral for example, an experienced person was brought in from overseas over a period of one year to facilitate the transfer of the farming knowledge and skills, then the communities continued with the concept. The operator is then left to rely on the community to supply the farmed product.

In areas where a particular product(s) (that is also a food item) becomes scarce, it has been usual for the communities to refuse access. This is challenging because in some cases the need for quick money overrides other legitimate but less pressing concerns. In some areas where collection has taken place, the communities have benefited from the new trade in their area, particularly when it means staying in a remote rural community and earning some money from a resource(s) that one wouldn't especially use directly for subsistence.

All reefs in Vanuatu are traditionally owned and therefore it is obligatory for any outsider to seek permission from the owner(s) before one can obtain access rights to the resources of interest. Compensation is by way of royalty either in cash or in some cases in-kind. Two collectors have each obtained a small plot of land on the waterfront where they have established their facilities and pay an agreed monthly rent to the landowners.

5. Economic Benefits to the Country

Apart from permitting fees, the country also receives revenue from licensing through the Fisheries Department and the Department of Inland Revenue. Some money is also made from permits issued under CITES by the designated CITES section situated in the Environment Unit. Vanuatu does not impose any taxes on any export items including ornamental products. Obviously some foreign earnings is made by the operators which is injected back into the local economy but it is doubtful that it is all the earnings that was made. There has been no study carried to date in order to compare the benefits of the ornamental trade to benefits from other uses of reefs.

Vanuatu ornamental products are also advertised overseas by operators as an industry that is operated in an environmentally sound manner. Operators are now sending their products directly to overseas markets unlike before where a middleman was being used. The Fisheries Department still receives requests now and again to supply potential markets with the addresses of existing operators in country, particularly for products that have been cultured or harvested in an environmentally friendly manner.

Products are currently being exported to the United States, Canada and France. One operator is looking at establishing a marketing outlet in UK where all products can be sent there and re-distributed elsewhere. A business partner there will be responsible for the marketing side of the business.

6. Export Controls in Place

Any operator who wishes to export ornamental products must obtain permission from the Minster of Fisheries, by way of licensing (Fisheries Act Cap 158, section 21 (3), which includes a permit for every export consignment. Fisheries Department, Dept. Customs & Inland Revenue, and the Environment Unit have always worked closely to monitor the export of products.

All intended ornamental export consignment requires an export permit from the Fisheries Department for any one shipment. Prior to making an export, the operator would need to supply the Fisheries Department with the necessary details of the intended consignment. Details include data showing what species were collected, the quantity, the value to the reef custodians, the name of the area where the collection was made, and the name of the island. If there is no fish collection data then there is no export permit issued. Discarded fish are still unaccounted for in all cases. Due to the fact that there exists only three operators, and that all are based in Port Vila, export consignments are small and occur twice a week on average. Therefore it has been possible for all consignments to be inspected by the Fisheries Inspector during the packaging process of the products.

7. Status of Meeting CITES Responsibilities and Obligations

Vanuatu became a party to CITES in October 1989. Since then, Vanuatu has put into place a law which regulates the movements of threatened or endangered species of wild animals and plants from and into Vanuatu. The International Trade (Fauna and Flora) Act of 1991 for Vanuatu deals specifically with the import and export of species for trading purposes that originate from Vanuatu or are transshipped from other countries.

Since Vanuatu joined CITES, the Environment Unit (which is the CITES Management Authority for CITES in Vanuatu) has been working closely with other Government Departments such as Customs, Fisheries, Forestry and Agriculture, to regulate or control the trading of endangered species of fauna and flora that have been listed under CITES appendices.

As a contracting party to CITES, Vanuatu pays an annual contribution to the CITES Trust Fund. In return, the Environment Unit collects fees upon issuing CITES export permits to individuals who wish to take items of threatened or endangered species out of or into Vanuatu. These fees go into Government revenue.

Since Vanuatu joined CITES in 1989 it has not added any species to the CITES appendices. However, a number of species occurring in Vanuatu are already on Appendices I and II.

Corals

The trading of corals from Vanuatu with other countries is closely managed and monitored jointly by the Fisheries Department and the Environment Unit. Currently, there are three licensed Aquarium businesses in Vanuatu. Apart from exporting live corals, the three aquarium companies also export other marine species such as clams, fish, and live rocks. The Fisheries Department is responsible for issuing licenses to aquarium companies, while the Environment Unit issues CITES export permits.

To meet CITES obligations, the country needs to do a detailed assessment of the status of coral reefs on the islands. This study should highlight the availability of different types of coral, their distribution and habitat, and their abundance. Currently, no quota has being set by the management authorities to control the harvesting and export of commercial species. The results of such a study therefore can be used as a basis to determine a quota system for the quantity of each commercial coral species that can be harvested or exported in a given period of time. This is a stock management control system which should complement the work of CITES in controlling or regulating the trading of coral through the issue of permits and from imposing CITES export fees.

The country also needs a lot of awareness raising especially among local communities to properly manage their coral reefs. Local communities should be made aware that coral reefs are living systems that house a lot of marine animals important for their livelihood. Monitoring techniques should be taught to local communities in order for them to do regular reef checks for any damages done by particularly ornamental operators.

Coral trade started in Vanuatu in the mid 1990s on a very small scale with only one operating aquarium company. However, since 1998 two other companies have began operating. This has also increased the level of export of coral from Vanuatu. However, it is important to note here that the export of live coral collected straight from the wild has been prohibited since 1999 and that all coral exports have to be cultured or farmed.

The collection of species by the three companies included various coral species as well as clams and fish. The coral genera that were collected for export included *Acropora*, *Turbinaria*, *Montipora*, *Porites*, *Heliofungia* , *Fungia*, *Lobophyllia*, *Pachyseris*, and *Pocillopora* . Collections of these genera came from several islands but mostly from Efate, Aneitym, Santo, and Epi.

Giant Clams

All giant clams are currently collected from the wild, with *Tridacna crocea* being fished the most. There is currently no specific regulation for giant clams, but the Fisheries Department endeavors to have this in place this year. The regulations should include the banning of the export of *Tridacna crocea*, and the imposition of quotas that can be phased out slowly once the operators establish the capacity to produce culture clams. Advice should also be provided to communities to close off some areas were giant clams populations have dwindled.

The operators require a CITES permit for every export shipment of these species. At the moment there is no limitation to the number of permits issued by the Environment Unit. CITES permit fees vary according to the quantity of specimens exported and the type of export item. For commercial purposes, each 10 items (even of the same species) cost 250 vatu. Anything less than 10 items costs [7]200 vatu for the whole lot. For personal effects like souvenirs or gifts, the CITES fee charge is 200 vatu per species. The Environment Unit receives CITES customers almost daily for requests for permits. The Environment Unit has advised hotels, motels, restaurants, airline and shipping authorities about CITES requirements and has provided information so they in turn can advise their customers accordingly. The fees collected for CITES permits does not cover the expense of managing them. All CITES fees collected from the Environment Unit go into the general revenue basket of the Vanuatu Government which assists with in-country CITES administration.

9. Needs Assessment

The assessment of current needs include the following :

- To immediately develop and establish simple but effective guidelines for operators to follow when carrying out their work.

[7] 100vt ~US$1.39

- ❖ To establish Fisheries Management Plan in the medium to long term, which will direct the sustainable development and management for each particular fishery.
- ❖ Establish more effective methods for collection of data.
- ❖ The need for better/regular monitoring of resource (stock) assessments and for auditing, particularly at the community level.
- ❖ Good databases.
- ❖ More networking between different agencies in terms of sharing information and experiences that can be of practical application.

10. Lessons Learned

Vanuatu's experiences with the ornamental trade include the following advice :

- ❖ Build a close working relationship with the operators but do not let them abuse that relationship for their own gain.
- ❖ Don't trust or take for granted/operators/collectors information of trade figures.
- ❖ Always stick to your guns.
- ❖ Always keep them on their toes.
- ❖ Learn and familiarize yourself with the trade and the processes or systems involved. It will help you carry out your job effectively.
- ❖ New operators must be genuine and have international credentials as proof. Double-check their background if you can, to validate their claims.

Experiences with managing reef resources:

- ❖ Need to have a genuine interest in managing reef resources.
- ❖ Need to know what you're talking about.
- ❖ Don't act as a Mr. 'Know-everything'; Need to respect and accept local knowledge.
- ❖ Don't be a resource manager 24hrs behind a desk. Take time out in the field to experience and appreciate the reality of situations.
- ❖ Dedicated staff are a bonus.
- ❖ Must be able to make the most out of the limited tools or resources available to do the job and to produce the expected outputs.
- ❖ Don't always wait around for science if a situation calls for immediate action.
- ❖ Must possess good communication skills to work effectively with people.
- ❖ Need to have a focus otherwise one will never produce the expected results.
- ❖ Promote and encourage community involvement and ownership of any initiative.

U.S. TERRITORY OF AMERICAN SAMOA ORNAMENTAL TRADE

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1. Background of Trade History

Since 1987, there has been one small company exporting marine ornamental organisms to the United States mainland through Hawaii. The company has had a succession of owners from the United States and Australia. The company (Sea Tropical Fish Samoa) is currently owned by a U. S. citizen of Samoan extraction. The company apparently does not operate on a continuous basis and has not exported fish for several past months.

2. Number of Collectors and how they Operate

When in operation, the owner employs two Samoans/American Samoans to assist in collection. Fish and invertebrate specimens are gathered at various sites around the island of Tutuila, with no apparent limitation of collection sites imposed by the Department of Marine and Wildlife Resources (DMWR). Specimens were held at the DMWR clam hatchery raceways adjacent to the airport prior to shipping, which enabled potential monitoring at the convenience of any DMWR biologist assigned to monitor this activity. However, this facility is inadequate as a longer term holding facility due to high water temperatures caused by low water flow rates and direct sun exposure. Sea Tropical Fish Samoa is currently constructing a holding facility with a re-circulating salt water system.

From December 1998 through November 1999, live rock from (Independent) Samoa was trans shipped through American Samoa. These shipments totalled 2,336 boxes weighing an estimated 60,737 kg. Each shipment exported from the Territory had a document signed by the Director of DMWR that described the contents, and stated that the trans shipment was in accordance with American Samoa territorial laws and regulations.

3. Management Measures Currently in Place

DMWR issue permits for commercial fishermen and a special permit is required for aquarium fish collection. Permit applications are reviewed by the DMWR director prior to approval. An annual fee of US$20 is required for each permit. The general terms and conditions for collection and exportation of aquarium fish are shown in Appendix 1. Additional special conditions may be added at the discretion of the director. No quotas or area restrictions for aquarium fish collection have been documented. While reporting requirements exist as a condition of the permit, the conditions of the permit may not have been enforced, since no reports were currently available from the DMVR files.

There is some jurisdictional overlap between DMWR and the Department of Commerce with its Coastal Management Program. A recent dispute over live rock exports resulted in the American Samoa Governor issuing an executive order to stop the export of live rock.

4. Socio-Economic Benefits to the Communities from the Trade

The benefits to communities owning reefs exploited by the ornamental trade fishers appear to be minimal. There is no formalized payment to villages for use of these resources. Many residents are suspicious of the local operator's using SCUBA equipment, as commercial SCUBA fishing (for food fish) is seen as having negative effects on reef fisheries.

5. Export controls

While there are export controls in place concerning inspection and verification of ornamental trade shipments, there is no available documentation that confirms such inspections by the government have taken place.

6. Needs Assessment

DMWR currently does not have the funding to adequately monitor the activities in the marine ornamental trade, as most funding is restricted to non-commercial fisheries. Close cooperation with the inspection of shipments by US Fish and Wildlife Enforcement personnel in Honolulu may help compliance with CITES obligations.

Appendix 1: Terms and Conditions for the Collection and Exportation of Aquarium Fish, September, 19991. These terms and conditions may need to be revised to provide better documentation of activities and protection of marine resources.

1. The use of catching methods detrimental to the environment is prohibited. Thus the application of poison, chemicals of any type, breaking up and removal of corals to extract fish specimens is not allowed.

2. Fish species utilized in the capture fisheries for consumption, including their juveniles, shall not be collected for export in the aquarium trade. This includes but is not limited to the following: *Acanthurus* species (surgeonfish-alogo, manini, palangi, etc.), *Ctenochaetus* species (surgeonfish-pone), *Naso* species (unicorn-ume, iffilia, etc.), the larger species of *Scarus* (parrot fish-fuga) and *Cheilinus* (wrasses-lalafi).

3. The Department of Marine and Wildlife Resources may set a limit on the amount of fish specimens and species that can be exported and will notify the operators accordingly.

4. The operator shall ensure that their catching activities will be spread out so as to minimise localising harvests to specific areas.

5. No other marine organism apart from fin-fish is allowed to be collected and exported.

6. The Department of Marine and Wildlife Resources shall conduct inspection of the fish holding premises and catching operation from time to time. Accordingly, the operator shall notify the Department of Marine and Wildlife Resources of details pertaining to the collection so that field inspection can be arranged.

7. Every shipment shall be inspected by DMWR during the packaging process. It is the responsibility of the operator to notify DMWR 21 hours prior to packaging so that arrangement for inspection can be made.

8. The operator shall duly fill in details of all catching operations on forms (Form: Aquarium 1) provided by DMWR. These are to be submitted to DMWR whenever applying for a certification to export aquarium fish.

9. An export certification will be required each time a shipment is to be made. On application for the export certification, the operator will provide DMWR with details of the shipment, including fish species, number of specimens of each species, estimated value, destination, etc. on the form (Form Aquarium 2) to be provided by DMWR. The details provided on this form shall reflect exactly what will be exported.

10. The operator shall submit to DMWR any other information pertaining to the operation, including but not limited to, mortality during shipment, etc. as may be required.

11. The Department of Marine and Wildlife Resources reserves the right to make changes to these conditions. Changes may include the withdrawal of the license anytime it determines that any of the conditions have not been adhered to or for any other reason concerning the conservation and management of the concerned or related marine resources.

MARSHALL ISLANDS MARINE ORNAMENTAL TRADE

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1. Introduction

The Republic of the Marshall Islands (RMI) is a nation of 29 coral atolls and 5 islands which form two vast parallel chains scattered over 822,779 square miles of the Central Pacific. The Marshall Islands' 29 atolls and 5 individual islands make up a total of 70 square miles of land. There are over 1,225 islands and 870 reef systems in the Marshall Islands with over 800 species of fish and 160 species of coral.

The Marshall Islands Marine Resources Authority (MIMRA) was established in 1988 (MIMRA Act 1988) and is responsible for managing all marine resources, living and non-living in the EEZ. The 1988 Act was revised in 1997. The revised MIMRA Act 1997 does not have specific provisions addressing the regulation and control of the aquarium trade. The Act focuses more on issues regarding (a) fisheries conservation, management and development, (b) management and development of local fisheries, (c) trade, commercial sale, (d) export of marine species and products, (e) foreign and domestic based fishing and related activities, (f) licenses and registration (of foreign fishing vessels), (g) monitoring, control and surveillance.

The provisions in the management and development of local fisheries of the MIMRA Act 1997, however, empowers local governments (there are 32) to develop their own fisheries management plans with the assistance and advice of MIMRA for any fisheries activity in their municipal waters. The local governments therefore will be responsible for the management of their fishery to 5 miles out from the land.

In respective management plans, local governments could develop and enforce regulations on various types of fishery activities including aquarium activities. Currently, the Majuro Atoll Local Government is the only local government that has a Fisheries Ordinance pending in the Parliament. The ordinance covers some aspects of management and control of aquarium activities, however it is still limited.

2. Background

The aquarium trade started around 1968. At that time there was only one collector for ornamental fish. It was not until 1970 that another company started its business collecting ornamental fish as well. Since the 1970's the average number of operators for the aquarium trade in the Marshall Islands has been fluctuating between 5 to 10 collectors. Currently there are a total of five (5) operators, four locals and one foreign operator. Most of the operators harvest their marine species in the surrounding waters of Majuro, which is the capital of the Marshall Islands. The foreign operator, Catalina Water International Ltd., operates both in the Capital and in nearby atolls such as Arno, Mili, and Aur atolls. Most of the collectors choose to base their operations in

Majuro because of the existing infrastructure, easy procurement of equipment and access to airfreight links to oversea markets. There are at least 50 species of aquarium fish, several invertebrates and vertebrates such as hermit crabs, brittle stars, star fishes, and juvenile moray eels, juvenile giant clams, both wild and farmed corals and sponges, and live rocks (Table 1) collected and exported to oversea markets. The main importers are from Hawaii, California, and Japan. Buyers from Hawaii trans ship these organisms to countries in Europe and Asia.

3. Number of Collectors and how they Operate

All operators harvest in Majuro atoll usually on the ocean side. On windy days, most will harvest in the lagoon side. However, fish caught in the lagoon side have recently began to disappear, which has compelled divers to dive as deep as 200 ft to catch other fish species (particularly flame angel fish, multicolor angel fish and firefish goby). The cause as one operator notes is because Majuro over the years has become very populated and construction activities such mining and dredging in the lagoon side has become very intensive. This has had a negative impact on fish populations and habitats close to the shore. Butterfly fishes and blue strip clown fish are difficult to harvest in Majuro lagoon now.

Operators are required in the MIMRA Act 1997 to obtain what is called a “Certificate of Origin and Health” document. The document or permit is equivalent in authority to, and issued in lieu of, any permits required to be issued pursuant to CITES to which the Marshall Islands is not a party. Each permit is valid for one shipment and could only be issued by MIMRA.

MIMRA issues permits only during working hours and days. Operators call in to the officer in charge of permit issuing, and request for a permit for various marine organisms. There is currently one person in charge of issuing permits and for the monitoring of exported marine organisms.

MIMRA has permits for shipment of giant clams, aquarium fish, corals and live rocks, invertebrates, and vertebrates. For example, shipments of three different marine species would require three separate permit documents. The cost for each permit is US$10.00. This amount would only probably cover the expense of stationary however, much more would be needed to hire more personnel for monitoring and surveillance purposes. MIMRA has experienced instances whereby operators attempt to ship out marine organisms without prior approval of MIMRA.

There are no existing laws that address the regulation of the number of permits an operator could obtain. Operators obtain permits usually a week prior to when a shipment is ready. Most of the operators are dependent on available cargo space. Shipments are usually exported at least once a month, with the exception of Catalina Water International (CWI) Ltd. This company has its own operation vessel(s) that travels around Majuro, Aur, Arno, and Mili Atolls collecting and harvesting live rocks. CWI transports its products in its own vessel all the way to California, USA.

Each operator has a maximum of 15 employees who are mostly from Laura in Majuro. Most of them dive for ornamental fish and also collect other marine organisms inshore. The Government or MIMRA does not regulate the employees of local operators. However, the Government does require that employees of Catalina Waters International are locals.

Operators have fish holding tanks that vary in size, length, width, and depth. Some operators keep their tanks in the open under the sun while others keep their tanks under tin roofs. Operator's holding tanks have either filtering systems that are open, which means that seawater is pumped from the sea and back after passing through the holding tanks. Alternatively, they have closed systems so that they can better regulate the quality and condition of water in the tanks. A new operator that has just started operations mid-last year does not have holding tanks however, they keep their captured ornamental fish in the ocean. Each fish has its own small plastic-cup container that is labeled with the initial of the diver that captured it. These containers are aggregated and covered by nylon fishing nets that are anchored in the sea. When the collector has filled their orders, the fish are brought out and prepared for shipment.

Depending on the type of marine organism, operators keep ornamental fish in tanks for at least a week to ensure that fish are properly decompressed and in good health prior to shipment. Sick fish are returned to the sea. Juvenile giant clams are packed 6-8 hours prior to shipment while live rocks and corals are kept in tanks for at least a day before packaging.

4. Management Measures Currently in Place

The only management measure in place is a permit system. There are currently no regulations or laws regarding the location and the season for collecting marine specimens. Nor are there regulations to control the numbers, sizes and types of species, and requirements for annual reports or audit and inspection of holding facilities. Each operator harvests from a particular area but not for more than three times in a month. The reason given by one operator is that fish usually become wary of divers after a while and therefore it makes it more difficult for them to capture fish. There are no well-defined collecting areas for ornamental fish though there is an area for one operator who harvests live rocks. This operator collects live rocks in the lagoon side, which is adjacent to the owner's property. This area is about a quarter mile long. The method of collecting live rocks is to choose algae coated rocks that are not attached to the reef, that is collection is not through breaking the rocks.

5. Socio-Economic Benefits to the Communities from the Trade

The socio-economic benefits from the aquarium trade to the Majuro community may be limited. Of a population of 53,000 there are at least 100 people involved in the aquarium trade in the Marshall Islands (most of them in Majuro atoll). All local collectors generate revenue that is circulated in the economy. For example, each person's salary supports at least 5-10 people in a household. Most of the collector's employees are young males that have not completed high school. Working as divers and collectors gives these young people a chance to earn a wage to support their family including their relatives (the extended family is still very strong). Most of them are mainly from Laura in Majuro.

At this point, it is also important to assess the impact of the trade on the environment and the people. For instance, some of the young divers are not trained and do not have a certified divers license. It is a concern because as some fish species become hard to collect, and divers have to dive as deep as 200 feet. It is difficult to assess the impact of this deep water diving on divers. Another concern is the supply of fish species and their habitat and environment. If divers are going out further to look for fish that used to be close to the shore, this may indicate that fish populations are declining. There are probably many factors affecting the decline in fish population. It is however important to know which factors are causing the greater impact.

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Table 1. List of species collected for the aquarium trade.

SCIENTIFIC NAME	COMMON NAME
A) <u>Ornamental Fish</u>	
Acanthurus chronixis	Mimic Surgeon Tang
Acanthurus glaupareius	Whiteface
Acanthurus lineatus	Clown Surgeon
Acanthurus nigricans	Whiteface/Whitecheek Tang
Amphiprion chrysopterus	Blue Strip Clown
Amphiprion frenatus	Cinnamon Clown
Amphiprion peridaeraion	Pink Skunk Clown
Amphiprion seabae	Three Stripe Clown
Amphiprion xanthurus	
Anampses meleagrides	Yellowtail Wrasse
Bodianus mesothorax	Eclipse Hogfish
Centropyge bicolor	Bicolor Angel
Centropyge bispinosus	Coral Beauty
Centropyge diacanthurus	
Centropyge flavissimus	Lemon Peel
Centropyge heraldi	Yellow Angel/Herald's Angelfish
Centropyge hybrid sp.	Hybrid Lemon Peel
Centropyge loriculus	Flame Angel
Centropyge multicolor	Multicolor Angel
Centropyge multifasciatus	Six Bar Angel
Centropyge vrolikii	Half Black Angel
Cetoscarus bicolor	Bicolor Parrot

Chaetodon auriga	Auriga Butterfly
Chaetodon bennetti	Bennett's Butterfly
Chaetodon citrinellus	Citron's Butterfly
Chaetodon ephippium	Saddle Back Butterfly
Chaetodon falcula	Double Saddle Butterfly
Chaetodon mertensii	Merten's Butterfly
Chaetodon meyeri	Meyer's Butterfly
Chaetodon punctatofasiatus	Spot Baned Butterfly
Chaetodon reticulatus	Reticulated Butterfly
Chaetodon sp.	Assorted Butterfly
Chrysiptera tricincta	Three Banne d Damsel
Cirrhilabrus longtudus	Velvet Wrasse
Ctenochaetus hawaiiensis	Chevron Tang
Ctenochaetus strigosus	Spotted Bristletooth
Epibulus insidiator	Slingjaw Wrasse
Epinephelus gottatus	Grouper
Forcipiger longirostris	Long Nose Butterfly
Gomphosus varius	Greenbird Wrasse
Halichoeres sp. Yellow	Yellow Wrasse
Heniosus sp	Assorted Wrasse
Labroides dimidiatus	Assorted Wrasse
Melichthys niger	Black Triggerfish
Melichthys vidua	Pinktail Trigger
Nematelotris decora	Decorated Dartfish (Goby)
Nematelotris magnifica	Fire Goby
Nemateleotris helfrichi	Helfrichs' Fire fish (Goby)
Oxymonacanthus longirostris	File Fish
Paracirrhitus arcatus	Hawk
Pomacanthus imperator	Emperor angel
Pseudocheilinus	Mystery Wrasse/Five Bar Wrasse
Pygoplites dicanthus	Regal Angel
Rhinecanthus aculeatus	Humu Humu
Thalassoma herbaicum	Golden Wrasse
Thalassoma lutescens	Bluefin Wrasse
Zebrasoma veliferum	Sailfin Tang

B) Ornamental Invertebrates

Ophiothrix sp. - Brittle Star
Dardanus sp. - Hermit Grab
Entacmea quardricolor - Bubble Sea anemone
Gymnothorax eurostus - Juvenile Moray Eel
Trochus niloticus - Trochus Snail
Cypria sp. - Green Cowry
Scleractina origin - Live Rock

C) Coral Genera

Acorpora sp.
Astreopora sp.

Fungia sp.
Fungia sp.
Goniopora sp.
Lobophyllia sp. (Soft Coral)
Merulina sp.
Montiopora sp.
Pavona sp.
Pocillopora sp.
Porites sp.
Sarcophyton sp. (Soft Coral)
Seriatopora sp.
Sinularia sp. (Soft Coral)
Symphillia sp.
Tubipora sp.

D) <u>Ornamental Clams</u>
Tridacna gigas – Giant Clam
Tridacna squamosa – Fluted Clam
Tridacna maxima – Elongated Clam
Hippopus hippopus – Horse Hoof Clam

AN ECOSYSTEM APPROACH TO MANAGING CORAL REEFS

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Abstract

Ecosystem management is an evolving approach to managing ecological systems that has the potential to improve the health of coral reef ecosystems while maximizing the benefits available to humans. It is a strategy for the integrated management of an ecosystem and the living resources contained within that ecosystem that promotes conservation and sustainable use in an equitable way. The ecosystem approach is based on the application of scientific knowledge of the structure, processes, functions and interactions among the organisms and their environment, while recognizing that humans are an integral part of the ecosystem. The ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge of ecosystem processes and functions. The ecosystem approach recognizes and seeks to incorporate other management and conservation approaches to deal with complex ecosystems such as coral reefs.

1. Introduction

Coral reef ecosystems in many locations around the world are being degraded at an accelerated rate from natural and anthropogenic threats. Many of the fisheries these reefs supported are in decline, which is affecting economic stability in communities that have historically relied on coral reef resources. Contributing to this decline has been a lack of understanding of ecosystem principles that govern fisheries and a reluctance to create a partnership where fishers, scientists and resource managers share their knowledge equally.

As living organisms marine species are an interdependent part of the physical, biological and human systems within which they exist. The concept of ecosystem-based fisheries management seeks to assess the ecological context of commercially important species in order to define truly sustainable harvest. An ecosystem approach is a strategy for integrated management of terrestrial and aquatic environments, and the living resources within those environments, through conservation and sustainable use. This approach recognizes that (1) humans and their activities are essential components of coral reef ecosystems, and (2) management is based on the application of scientific methods that focus on the structure, processes, functions and interactions among organisms and their environment, and the role that humans play in these processes.

2. An Ecosystem Approach to Management of Coral Reefs

An ecosystem approach strives for a balance between conservation, sustainable use, and equitable sharing of benefits arising from utilization of the resources contained within the ecosystem. Traditional single species fisheries management strives to maximize yields of a target species, but this inevitably leads to stresses at the ecosystem level and may result in highly unpredictable outcomes. In contrast, an ecosystem approach seeks to minimize impacts to the ecosystem while maintaining biological and economic sustainability. This is achieved by considering the effects on targeted species removed by harvest as well as indirect effects of this removal on non-targeted species and community linkages. Also, it requires that we shift the burden of proof. In traditional management of fisheries resources, the management authorities generally allow fishing activities until they determine that the resource is overfished. The ecosystem approach requires that you establish prior to harvest that activities will not jeopordize the health and sustainability of the species, interrelated organisms or the ecosystem.

The best route for improving fisheries management will involve a gradual transition to an ecosystem based approach to deal with complex, functions, processes or relationships, and the dynamic nature of coral reef ecosystems. We recognize that we do not have a complete understanding of the ecological system, and we cannot forecast weather or climate change and their effects on the ecosystem. However, there are certain ecological principles that affect the stability and resilience of coral reef ecosystems, including:

- Ecosystems have **limited carrying capacity**, and the removal of one species can and does affect others.
- Ecosystems usually have a **high buffering capacity** and are fairly resilient to stress, but once a **critical threshold** is passed major system restructuring can occur and the system may remain in an alternative stable state. A well-known example involves the long-spined sea urchin, *Diadema antillarum*, which is one of the most important herbivores found on Caribbean reefs. These urchins effectively control macroalgae and turf algae on coral reefs. In some locations of the Caribbean (e.g. Jamaiaca), urchin population densities progressively increased in the 1970s in response to overfishing. Jamaica has been reportedly overfished for decades. Fishers had removed many of the top predators and were progressively eliminating the herbivores such as parrotfish and surgeonfish. As the number of herbivorous fish declined, urchin abundance increased until some areas had 25-50 urchins per square meter. In 1982-1983, an unknown urchin pathogen swept through the Caribbean and *Diadema* populations experienced widespread mortality, with up to 95% of the urchins dying within a matter of months. The loss of this herbivore led to a progressive phase shift from a community dominated by corals to one dominated by macroalgae.
- The **diversity of the organisms affects the behavior of that ecosystem**. While the productivity of ecosystems may not drastically change when particular species are removed or added, the stability and resilience of that ecosystem may change. For instance, key predator-prey relationships sustain critical linkages within marine ecosystems.
- The **removal of a keystone species can have cascading effects** on the rest of the ecosystem and negative consequences on fisheries. One example is the trumpet triton, *Charonia* spp. This mollusc, which is in high demand for the curio trade, preys upon crown-of –thorns sea stars (COTS, *Acanthaster* sp.). Some

researchers suggest that COTS outbreaks may be at least partially due to a removal of their primary predator, *Charonia*.

Our current understanding of ecosystems is limited, and there are several political issues that must be resolved in order for ecosystem management to be most effective. First, managers must realize that boundaries between ecosystems are open. Fish and the fisheries that pursue them do not follow political or jurisdictional boundaries. Also, many coral reef species move between ecosystems and occupy different habitats during different life history stages. For instance juvenile stages of some reef fish, lobsters and other commercially important species occupy mangroves and seagrass beds, and migrate to coral reefs as adults. Thus, effective protection for coral reef species requires that we also protect associated habitats.

One difficulty in determining what is meant by a sustainable harvest is that multiple scales interact within and among ecosystems. Ecosystems cannot be understood from the perspective of a single time point, space or complexity scale and a perturbation at one scale may be magnified at larger and smaller scales. In addition, ecosystems change over time in response to anthropogenic influences and natural fluctuations. By improving our understanding of the underlying dynamics of the system we can manage the system within certain boundaries to maximize the services provided to society.

In many cases we are unable to make a determination that harvest will not be detrimental. However, there are a number of ecological and economic principles that will help us manage ecosystems for their intrinsic values, and for their benefits for humans. By conserving ecosystem structure and function, we will be able to maintain ecosystem services. In developing an ecosystem based management plan it is important to shift the burden of proof to demonstrate sustainability should be shifted to ensure that we determine that an activity will have minimal impacts before the activity is undertaken. If we do not have all needed information we must take a precautionary approach to cope with uncertainty. This means we need to err towards conservation, instead of towards overfishing.

One approach is to establish a system of insurance to guard against unforseen adverse ecosystem impacts. The most typical form of insurance is the establishment of MPAs. Another form would be a system for early warning. For instance, frequent monitoring of resources would allow managers to detect and respond to adverse impacts in a timely fashion.

When developing an ecosystem-based management plan for coral reefs, management bodies need to address all available information when making management decisions. This includes scientific data as well as the local experiences of fishers. It is important to assess factors that affect the resource that are outside the authority of the management body (such as coastal zone management) and develop coordinated strategy to address these factors. Managers must be able to adapt their management measures to address changes that occur in the ecosystem. This can include a change in management approach in response to a short-term disturbance, like a storm, long-term climate changes or the implementation of certain restrictions on a fishery, in response to a decline in a fish stock. In addition, it is critical to get buy in of the user groups.

Management decisions should involve participation by all stakeholders, with appropriate consultation with scientists and fishers at the local and national level. For management to be most effective it should occur at the lowest level possible, such as a community-based approach. We should avoid managing an ecosystem for maximum short-term benefits; we need to develop incentives that promote conservation of biodiversity and sustainable use. Finally, local incentives should be compatible with global goals.

To apply an ecosystem approach to manage coral reef resources we need information on the boundaries of that ecosystem and ecological information on the harvested species. This includes data on trophic webs, life history characteristics of harvested species, types of habitat used by different life stages of target species, and the potential effects of removal of those species on ecosystem. We also need strategies for reporting fisheries data and method to identify uncertainties associated with this information, and insurance to safeguard against these uncertainties. A key component of this approach, which can provide much of the information we need for management decisions is routine monitoring.

3. Conclusion

Ecosystem-based fishery management is likely to contribute to increased abundance of those species that have been overfished while simultaneously protecting marine biodiversity upon which fisheries depend. It will also contribute to the stability of employment and economic activity in the fishing industry. However, it is critical that stakeholders understand and adopt a precautionary approach that may include a reduced harvest of species that are of critical importance to the ecosystem.

It is important to note that there is no best way to implement the ecosystem approach, as it may depend on local, national, regional or global conditions. Furthermore, it does not preclude other management approaches, such as the establishment of marine protected areas, and single-species management programs. Instead it should integrate all conservation measures to deal with the complexities of coral reefs. Ecosystem-based management can only be completely achieved over time as new information allows management to improve.

ASSESSMENT AND MONITORING OF CORAL REEFS FOR DETERMINING SUSTAINABILITY OF COLLECTION FOR THE AQUARIUM TRADE

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1. Introduction

I have been requested to speak on the assessment and monitoring of the coral reef resources utilised by the aquarium trade. Strictly speaking, the subject is the explanation of what we know of assessment methods and how we may monitor this most valuable resource. In a country like Fiji and the other developing countries, care in how we utilize our reef resources is essential to the well being of the coastal peoples who depend on them for the subsistence and artisanal livelihood. It is important for tourism where conflicts in reef usage have resulted from an inadequate understanding of the aquarium trade and tourism needs. It is satisfying to be part of a process attempting to add value to coral reefs by meeting the market challenge that was non-existent a relatively short time ago and only recently is maturing into an acceptable industry with widespread benefits for the country, here and abroad.

How are the reefs to be surveyed, what sort of impacts will be evident, how will they be noted, and what type of data is to be used to determine sustainability of collection? Sustainability is the most important word in the title for several reasons. The most immediate concern is the legislation before the United States Congress that says that all CITES listed organisms will be banned for importation unless the sustainability of the fishery is demonstrated or that there is a sustainable management plan in place. Clearly there needs to be some effort put into defining this word in terms of criteria and the processes and elements which will be considered valid in satisfying the demonstration of a sustainable fishery. Part of the difficulty in defining this term is that coralreefs occur across temporal and spatial scales, which has precluded snapshot or short-term assessments particularly when you are dealing with a large number of organisms.

I mentioned this as a process. Assessment and monitoring is only part of this effort along with other components to insure that essential goal of sustainability of the resource as well as its best management. Important elements of this process are the specification of best practices in collection, handling, shipping and retailing. In the Pacific Islands, the subject of assesssment and monitoring is considered the central most important element. Reef resources require cautious decision making. It's very nice to know that the animals collected are given the best of care once they are removed from the reef environment but the prinicpal concern of assessment and monitoring is that they are being taken in a sustainable manner, allowing the resource to last for perpetuity. As importantly is that this new industry will not interfere with the age-old fisheries which have always provided a food source for Island's peoples.

2. How Do We Do It?

The challenge falls within the management of four fisheries: live coral and other fixed bottom-dwelling organisms, mobile invertebrates, live rock and fish. These categories are very different in the nature of their assessment. Details are now only being worked out and much needs to be done in what will be an evolving process. There are many assessment and monitoring regimes. This talk will discuss some of the studies and present an overview.

The initial task is to adopt a workable mix of methods that accounts for the existing capacity within the Country, with a focus on the level of monitoring required to satisfactorily determine sustainability. What is the nature of this understanding that is required for sustainable assessment? It must begin with the consideration of the size of the collecting area; its proximity to the coast and village; and to other reef areas; the nature and variety of the habitats that it contains, and importantly; the quantity of organisms present. From the sizes and age structure assessable from many of the organisms, we will gain an understanding of recruitment and mortality. Unfortunately, it is not so straight forward.

3. The Challenge

(a) Large collecting areas may minimise impacts but make sampling all the more difficult.

From the Figure 1 we can see an example of the extent of the areas involved. Bau Waters and larger still western area which extends to Naviti Is and back to Lautoka, an area of more than 2000km^2. How many sample sites will be required to cope with the variation within this vast area, hosting a full variety of reef habitats? Adequate manpower and logistical resources may be lacking is an understatement. Just count the number of SCUBA qualified divers with survey qualifications as an indication.

(b) What are We Trying to Assess and Monitor?

There are 135 spp of hard corals in Fiji with more than half being collected, as are 50+ species of fish and an undetermined number of other coral types and mobile invertebrates. In order to keep track of them, we must be capable in their identification. Capacity in this area needs a great deal of strengthening.

(c) The Task Requires a Sampling Program that will be able to Discern Collection Impacts from the Natural Impacts.

Natural impacts include such events as cyclone, floods, crown-of-thorns starfish infestation, and coral bleaching. Also, other physical stresses can impact on coral reefs, these include nutrient pollution, and increased sedimentation from coastal development and agriculture.

(d) Marine Tenure System: A Defined Sampling Area.

It is a positive feature in Fiji that the coastal waters are regulated by a marine tenure system. This provides a ready made system for defining the spatial limits on the collection areas. It defines our sampling area. Assessment using manta towing is useful for covering large areas, and provides us with percentages of living cover and other substrate features such as general luxuriance and species dominance. Compliment this with a varied sampling program and a good mix of observations to provide a balance of understanding of the situation on the reef and detail aspects of the fishery. Much of the most valuable information will come from the industry. It is the village collectors who know the location and extent of the resource. Their information will allow sampling at the sites of collection.

Figure 1. Location of aquarium, curio coral, and live rock extraction sites as an illustration of the large areas that are defined within a single operator area.

(e) Field Methods: Live Coral and Other Benthos.

One of the main objectives of any assessment is to determine the abundance of potentially collectible items. The sampling is straightforward though the effort becomes greater with the increase in resolution or by reducing the sample variance. The sampling method is chosen to suit the nature of the organisms and the area to be sampled. The Line Intercept Transect (LIT) may be used to characterise the habitat or survey the extent of a resource such as live rock. Belt transects are used to assess colony densities and mobile invertebrates. Quadrats are another sampling unit which provide a manageable area for assessment. Add the measurement of the colony diameters and you have the type of information which will give some idea of the population structure, its recruitment and mortality. With a good approximation of these parameters, sustainability can be calculated.

Of course for many of the organisms, the growth rates are incompletely known and hence their age classes recruitment and mortality. For some, it may be appropriate to estimate these parametes from similar species, genera or lifeforms. The usefulness of proxy organisms should not be underestimated. If numbers are all you have and the organism is uncommon to rare, then collection should be prohibited. If it is very common, then it may be appropriate to treat it as ecological equity. The question then becomes, what is a reasonable percentage of the resource to be fished, given its role in the ecosystem. Certainly if it is less than 5% of the estimated species numbers, it may be considered prudent to collect.

Live Rock

For live rock, the task should be the easiest. A simple assessment of the dimensions of the area to be collected from, coupled with the weight of the product, will tell how much material there is. Knowing the percentage of what is being exported may provide a general perspective. But what are the likely problems with collection? The detractors say that live rock is habitat and the very fabric of the reef. With that there is little argument. The coralline algae, the living surface portion of the rock, do bind the reef together. This is, however, an inter-tidal area of minimum topographic relief and, is relative to the subtidal areas of the lagoon and offshore, of low biodiversity. Many of the organisms in this zone are burrowing in nature such as Polychaete worms, small and cryptic (ophiuroids), or encrusting (algaes and zooanthids).

Assessment then becomes a question of how much is available and how much can be taken without creating some type of damage. How resilient is the resource to collection? How quickly does the coralline algae recolonize the surface? What sorts of organisms is the area habitat to? What is their role in the reef system? Live rock certainly shouldn’t be extracted from areas where gleaning takes place and be regulated so. Since we don’ t know many of the basics, the monitoring phase should be concerned with gathering data and assessing whether undesireable collection is being made. Is the elevated lagoon in danger of being broached with the reduction of ponded water levels? Is there water being newly ponded as the result of collection? What is living in these recently formed tide pools? Assessment will allow areas of preferred collection to be defined and a resource management plan developed to detail and record the systematic collection of the material.

An aerial view of the coast provides an initial assessment of the live rock resource within the fringing reef along the coral coast. 100 kilometers of coast, accessible by road, offers an abundant area for collection. The band of reef 50 –100m wide just landward of the surf zone is considered best for collection. Best practice collection precludes taking material from the lagoon as it represents a conflict with the subsistance fishery. Benefits derived from the collction of live rock are tangible and if appropriate guidelines are employed can greatly add value to the coral reefs.

Also there are areas which are more conducive to the harvest of live rock. A comparison of reef composition along the coral coast illustrates the varied nature of the reefs. In some cases, the presence of river outflow have filled in the lagoon with rubble from the annual flood killed coral. Excavation in these areas would likely improve the reef with regard to increasing the amount of intertidal pondedwater and hence the biodiversity. It would certainly increase opportunity for intertidal gleaning which is absent in an area which, due to its proximity to seasonal streams, is pavement-like with little topographic relief.

Fish

For fishes, the assessment follows the same general protocol i.e. define the area, determine the habitats and sample them. In Hawaii, there is a sampling program that has determined the impacts of collecting on species numbers. Understanding their recruitment regimes is confounding. Once again, one collector, who should prove a treasure trove of information on the fluctuations in species populations, has 17 years of export data from a defined area. This in itself should provide a good indication of sustainability. Analysis of the current export records may aid in the assessment of the influence of collecting on the populations.

(f) Sampling from Collection Records.

It is the industries “commercial sampling” which is valuable in augmenting the monitoring portion of the assessment process. Though affected by market forces, the increasing rarity of an organism will signal that it is being over-collected. As the corals are CITES listed and required by law to be documented and this is checked at the foreign port of entry, there is a ready made system for monitoring the abundance of individual organisms subject to collection. Quotas can be set based on collection data per area rather than to some arbitrary presumption. This, of course, is as long as the system is functioning properly. It certainly hasn’t in the past and to this day has caused more problems than it has attempted to solve. For the other organisms, industry records could be used. If this monitoring proves successful with coral, then there should be a requirement for similar documentation for the non-CITES listed elements. A simple computer program could be written utilizing the normal export records to keep track of the species numbers and provide an alert for declining numbers.

Though much of the past research has related to the curio trade, the methods and findings are to a large extent applicable. It should be clarified that this workshop does not involve the curio or ornamental coral trade. This trade involves the removal of whole hard coral colonies. They are collected for the purpose of selling their cleaned skeletons as decorative items. Questions of its sustainability are similar to the live coral trade but due to the collection of a much larger range of colony sizes the impacts differ.

Though the conclusions of the study relate to much larger colonies than collected by the aquarium trade, the method could be used to assess maximum sustainable yield for the small massives that are exported. It also highlights the difference in the curio and aquarium trade where the latter export mainly small size, fast growing species.

Maximum sustainable yield (Brouard and Grandperrin, 1984) can be calculated through the use of the parameters of known exploitable biomass and mortality (Gulland, 1969). This method was used to assess the Faviidae stocks being harvested in New Caledonia. This method involved the assessment of numbers, diameters and weights of colonies collected and comparing the harvested material with similar area parameters within the area of collection. It showed the stocks to be limited. "With the present rate of exploitation, which is twelve times higher than the maximum sustainable yield, there is a real danger of Faviidae becoming extinct on this reef which is the only one where the harvesting of corals is authorised" (Joannot and Bour, 1988). This family is a massive or boulder-like coral with a relatively slow growth rate. Apart for the harvest for septic systems in Suva, this type of coral is not allowed for collection in Fiji, except through special permission from the Fisheries Division.

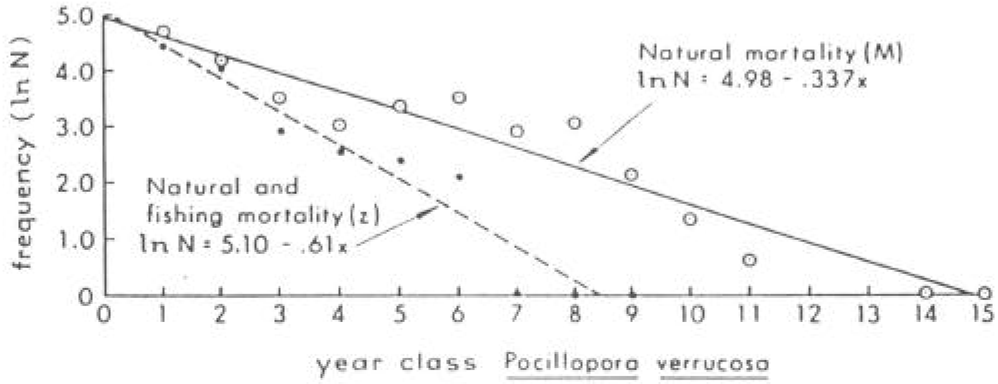
Similarly, Grigg (1984) used the classic fisheries population dynamics model of Beverton and Holt (1957) to assess the status of the deeper water precious coral fishery. Ross (1983) applied the same techniques to hard coral (Figure 2). Initially, the data was used to develop a relation between size and age. Data for size and weight was used to determine the equation for size versus weight. The instantaneous rate of natural mortality for *P. verrucosa* was calculated by regression of year class data versus time for the unfished population. The product of survival at year (x) times mean colony weight at year (x) was then calculated to produce an estimate of yield per each year. In comparison with the fished population, it was determined that the fishing of the resource was close to maximum sustainable yield with colonies less than 6 years old rarely harvested.

Another study has utilised measures of living coral surface area. In Batten Bay Indonesa, it was determined that 9% of the reef would be removed in 5 years time but fail to take into account coral recruitment and growth. This is also an area where several different operators compete for the same resource.

A more recent study in Fiji adapted a sustainable harvesting model used for natural forestry management to the assessment of the nature of coral populations, comparing them with collected and uncollected areas and providing a quantitative way to assess the nature of impact.

Cagalai reef in Bau Waters was surveyed to identify the cumulative impacts of coral collection activities conducted since operation began in 1993. Reefs areas subject to collection activities were compared to areas without collection (Vaughan, in press).

Figure 2. Worked example of a maximum sustainable yield model for the coral *Pocillopora verrucosa* (Ross 1983).



The age frequency distribution of the reef building coral *Pocillopora verrucosa* of a population off Cebu, Philippine Islands. The solid line is an estimate of natural mortality while the dashed line is an estimate of natural mortaliy plus fishing mortality.

Age, survival and yield of *Pocillopora verrucosa* in Cebu, P. I.

I Age	II Survival (1 ×)[1]	III Weight (g)[2]	(II × III) Yield (g · rec.⁻¹)
0	1.0	0	0
1	0.66	7	4.6
2	0.44	47	20.7
3	0.29	142	41.2
4	0.19	311	59.1
5	0.125	572	71.5
6	0.0837	940	78.7*)
7	0.0546	1431	78.1
8	0.0360	2059	74.1
9	0.0230	2838	65.3
10	0.0157	3782	59.4

*) Maximum sustained yield.
[1]) Based on an annual mortality rate of − 0.34.
[2]) Based on equation: y (weight) = $7.14x^{2.72}$; where x = age in years, y = weight in g.

Conclusions from the above study by Ross (1983) (Figure 2) include :

No significant differences existed in the diversity of corals or substratum composition between the areas;
The size frequency distribution of corals was significantly different;
There were indications that collection reduces coral cover; and,
Alters species richness and evenness.

Numerous comparisons have been made in the past between tropical rainforests and coral reefs due to the similarity of their disturbance regimes, ecological structure, diversity and complexity. To exploit the similarities between these two ecosystems, a sustainable harvesting model used for natural forestry management in Fiji has been adapted in an attempt to establish the sustainable level of live coral that can be harvested from a coral reef to meet international demand from the aquarium industry. This is a good attempt in developing of a model that can be used to predict historical and/or future structure and species composition of coral reefs.

Sustainable Coral Harvesting Model (after Vaughan (in press)

Vaughan's study has produced a working version of a coral reef sustainable harvesting model equivalent to a logging model (De Vletter 1995).

The model has been shown to generate a near stable coral community structure when run without coral collection. When the model is run for a ten-year period with the numbers of corals remaining in each size class each year being iterated, it becomes clear that there is no significant difference between the reductions in cover (2.3% and 2.0%) on reef areas with/without coral collection. A reduction in the numbers of *Favites abdita* on the reef after ten years when the model is run without collection demonstrates that knowledge we have pertaining to growth, recruitment and mortality rates, in addition to the effects that disturbance has upon the coral ecosystem, is inadequate. That is the existing model does not reflect a sustainable coral community. It is important to note that when the numbers of corals on the reef area are scaled up from the survey sites to the entire reef that there are $140m^2$ of reef subject to coral collection, per coral collected. This intuitively infers that the collection of corals must be sustainable since the collection rate is relatively low even if this cannot be proved empirically. This reasoning is corroborated through the analysis of the survey data, which identified no significant differences in species diversity, dominance, richness and substrate composition.

The model is useful because it enables the impact of proposed collection regimes to be predicted under different or changing environmental parameters i.e. poor recruitment events, the model also lends itself to modification as our understanding of processes occurring on coral reefs increases. The strength of a model such as this is that management action can be taken accordingly in response to the predicted scenarios rather than being purely reactionary. Indeed, as this model develops it could be used to predict past coral community compositions, or identify the effect development proposals will have on a coral reef if the disturbance regime associated with that type of development is known.

Unfortunately there are numerous weaknesses with model, not least that there has been no replication of the *Favites abdita* predictions (the model was run for *Pocillopora verrucosa* and a *Sarcophyton* sp., but there was insufficient information pertaining to these species to develop the model fully). The information required for the model was labour intensive and costly to obtain. These factors almost certainly preclude the use of this model at the moment, at least until fundamental questions have been answered with regard to recruitment, growth rates, natural mortality and natural partial mortality of individual coral species, especially with regards to soft corals (Alcyonacea). The model itself does not take into account the possibility of increased recruitment due to additional open space on the reef created by coral removal, leading ultimately to homeostasis with regards to coral removal and coral recruitment, although this is a theory that is prevalent (Connell, 1979: Karlson and Hurd, 1993). There is relatively little information within the public domain relating to the growth rates of individual species and little is known regarding differential growth rates of species as they mature. This lack of knowledge has lead to generic growth rates being used in the model, which may not be applicable. A lack of information also extends to the magnitude and effect partial and full natural mortality has on coral community structure and coral growth rates. The closest natural mortality figure applicable that could be found (and used in the model) was derived from a different species (*Montastrea annularis*), although one similar in growth and morphology to *Favites abdita*.

It is useful to remember that degraded reefs are a natural stage in succession initiated by natural disturbances (e.g. cyclones, bleaching events and crown of thorns (*Acanthaster planci*) outbreaks), therefore any discussion regarding the effect that collection of coral exerts upon a reef should take this into consideration. The effects and scale of natural degradation are especially pertinent because Connell in an extensive review (Connell, 1997) identified that a decline of less than 33% in coral cover could be regarded as ecologically insignificant. The type, scale and duration of disturbance attributable to coral collection are important when elucidating the impact upon the reef ecosystem because these factors dictate the potential for, and speed of recovery.

4. Allocation of Fishing Areas - An Essential Conservation Tool

Perhaps the most serious conservation concern is the presence of multiple operators in the same area, competing for the same resource. With the objectives of Fisheries management prioritizing sustainability through conservation and operator responsibility, the competition for marine products by multiple collectors has the potential to be devastating to the resource. With commercial concerns taking priority over the conservation and rational management of the resource, the whole concept of sustainability becomes in doubt.

With the industry in its infancy, it is appropriate to enforce the convention *of one operator, one collecting area* which has been part of the precautionary approach of Fisheries since the first coral harvesting operation by Seaking Trading Co. A recent allocation of areas by the Deputy Permanent Secretary of the Ministry has reaffirmed the practice for *live rock* areas. It is essential for the successful development of the aquarium products and curio industry, for control by Government to be consistently implemented in this area. Not to do so would compromise both management and monitoring as accountability for the resource and the reef becomes unclear.

At this stage, rights to collecting areas are being obtained by collectors, who seek only permission from the custodians. However, they are violating the Coral Harvesting Guidelines for the Industry for guideline numbers:

- concerning prior approval with the Fisheries Division;
- not conducting an environmental impact assessment;
- no demarcation of area by the Fisheries Division;
- lacking a formal strategy for collection; and,
- a lack of notification of utilising a new area.

Fortunately, there are ample collecting areas at present in Fiji. The advantages of single operator allocation of areas are:

The ability for the operator and custodian to manage the resource. With the nature of the resource known, a rational collection program can be implemented. Areas of collection may be rotated to preserve stocks.

Accountability is not possible when multiple companies use the same area. Problems of damage, over-collection or infraction of the recommended guidelines or regulation are more difficult if not impossible to deal with when there are multiple users of the same resource.

Operators who find employees culpable of poor practice or who are chronic offenders of proposed Fisheries regulations are unacceptable, but when multiple companies are operating, would have the opportunity to seek employment with the competitor. This is particularly so as they know the resource area and the strategies of the competitor.

Conservation is encouraged for an area so it will remain productive in the future rather than a strategy of encouraging over-fishing and inefficient collecting with the mentality of "get it before the other guy". With two operators, the commercial reality will minimise conservation efforts, as the product will always be threatened by the competitor.

A company that has security of operation in an area is able to provide secure employment which allows employee's to be trained in "Best Practice" and improve their standard of living, in terms of housing and family with a future in a reliable, cared for resource.

Some mechanism needs to be developed whereby the custodians are justly compensated rather than letting the financial incentive of the short-term market, where the resource is quickly exhausted or damaged by unregulated use, prevails. The Native Land and Trust Board manages the land rent, so a similar government body should officiate revenue generated from exclusive access to the Customary Fishing Rights Areas.

5. In Summary

What I have recommended is to develop the assessment and monitoring program within a management plan. This plan details the nature and dimension of the operation. It begins with a resource assessment, which defines the habitats and then it is sampled. It also reliant on a variety of information sources such as charts, aerial photography, collectors interview and sampling. Our baseline assessment relies on a quantitative assessment of those organisms that are going to be collected. Once the resource is determined, there needs to be a management plan within which the resource is utilized according to a program. This is necessary for the continued assessment of impact and the development of a monitoring regime. The objectives of assessment are to determine the abundance of the organisms being collected and to better understand their role in the reef system. The objectives of monitoring are to determine whether the resource is being depleted, in conflict with other resources or in some way detrimental to the reef.

<u>Management plan requirements:</u>

- Resource assessment;

- Define the nature of the items (Live Coral, Mobile Invertebrates, Fish and Live Rock.);

- Determine the nature of the collection area;

- Abundance of collectible items present (stock assessment);

- Decide on the best way to utilize the resource;

- Monitoring: Periodic visits to the collection sites utilising the logged information on what has been taken and where; Do random inspections;

- Assess the export data utilizing a program to graph the various species. Over-collection will reveal itself as a declining export; There may be some commercial reason for this;

- Compile a file on the area for continued assessment;

<u>Factors conducive to assessment and monitoring</u>:

- Customary Fishing Rights Area is well-defined (I qoli qoli);

- Village involvement means that there is a vested interest in the qoliqoli. Problems developing are dealt with through discussion with the common good in mind;

- Defined/Captive audience for information dissemination and awareness;

- Personnel who can become aware of the monitoring issues and methods and provide informed information on the resource.

<u>Problem areas:</u>

- Toleration of simultaneous collection in a single area.

- Lack of resolve in addressing conflicts

- Tardiness in formalising recommended regulations

- Lack of manpower

- Lack of financial resources

- Lack of political resolve to address the problems of the industry
- Lack of a program or framework for assessing the nature of the resource

Criteria for management not resolved:

- Lack of capacity;
- Scuba diving;
- Ability to identify organisms; and,
- Statistical framework.

In conclusion :

- The methodology for the assessment and monitoring of the aquarium fishery are available;
- The level of assessment is reliant on the capacity of the country;
- Capacity building is the area that needs most attention. Increasing capacity will increase the number of people involved in assessing and monitoring; This involvement will add strength to the formulation of a regulated management plan; and,
- Political will, now so lacking, will be subject to an ever increasing lobby of qualified and experienced personnel.

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APPROACHES TO MANAGEMENT OF ACTIVITIES ASSOCIATED WITH THE MARINE ORNAMENTAL TRADE

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1. Introduction

The importance of the coastal and marine environment to the sustainable livelihoods of Pacific Island peoples cannot be underestimated. Healthy reef ecosystems provide food for local communities and an increasing number of visitors and in some instances are the staple source of protein. They provide recreational opportunities for SCUBA divers and snorkellers. Coral reefs also play a major role in protecting island shores from erosion by waves and storms, an increasingly important role given the predicted impacts of climate change on storm frequency and intensity.

There are many threats to the health of coral reef ecosystems even without the impact of human activities. These ecosystems are subjected to many stresses such as cyclones, storms, crown-of thorns predation and more recently widespread coral bleaching. Forty one percent of coral reefs in the Pacific are considered already at risk from a range of human induced and natural impacts (WRI 1998), including overexploitation, coastal development, pollution and climate change.

Whilst the effects on reef populations of harvesting specimens for the aquarium trade (coral, fish, other invertebrates and live rock) are likely to be localised, nevertheless they can be profound, with a range of social, economic and environmental effects. Aquarium fish and coral harvesting operations can exert additional pressure on coral reefs by damaging the complex web of links and interdependence that characterises these ecosystems, by reducing biodiversity, and by damaging the physical framework of the reef itself. A report published this year by the World Conservation Monitoring Centre (WCMC 1999) on the Global Trade in Coral questioned whether the amount of some species of coral being collected for the aquarium trade could be sustained through reproduction, recruitment and growth.

On the other hand the industry provides economic opportunities in an environment of often limited opportunity and has the potential to support community based enterprises. Sometimes the economic benefits to a community from engaging in certain activities, or allowing other to do so however, may not be as great as is perceived if the flow-on effects are not accounted for. For instance, financial benefits may only accrue to one or two members of the community/village but reduces the quantity or quality of the resources available to the rest of the community. It is therefore essential that the socio-economic implications of any marine resource extractive activity be taken into account, as well as the ecological implications, if the full cost-benefit of engaging in the activity is to be determined.

The challenge for managers is to manage the impacts of activities associated with the marine ornamental trade, and other human interventions in the marine and nearshore environment, to minimise the potential for negative impacts to occur.

This paper focuses on ecosystem management. There is also a range of industry management initiatives such as "Best Practice" harvesting, holding and transportation methods that can further mitigate any potentially negative effects of the this activity. These generally also provide an economic advantage to operators in the longer term through reduction in stock losses and increased efficiencies. These are only briefly mentioned here.

2. Options for Management

There is a range of management mechanisms that can be used as intervention to manage not only activities associated with the aquarium trade, but other extractive or potentially harmful activities. The one thing most of these options have in common is that there is generally a need for Government intervention in the form of Policy and/or regulation by legislation and subsequently monitoring (of both the target resources and the activity) and enforcement. The extent to which the latter are required depends on the degree to which the industry/users in question supports management interventions and engages in self-regulation and adopts best practices in their operations.

(1) Prohibition

One of the simplest management approaches is the outright prohibition of an activity. The absence of data or understanding on the impact and sustainability of an activity may provide grounds for taking the precautionary approach and prohibiting the activity until more robust information becomes available. Several Pacific Island Countries such as Palau and Samoa have adopted this approach in relation to the harvesting of hard corals. Alternatively, the proposed activity might be culturally unacceptable for various reasons or might disenfranchise the local community.

This approach obviously removes the economic opportunity and possible benefits afforded to the community/individuals by the activity taking place.

(2) Designated Ecological No-Take Areas

Designated no-take or no-go areas are another form of prohibition but instead of an outright ban, an activity can be prohibited in certain areas of the reef only. This mechanism is used widely in Marine Park management globally such as in the Great Barrier Reef Marine Park. This approach is often used where an area has been identified as being of exceptional value in terms of rarity or diversity of organisms present, functional role (breeding or nursery habitat) or the need for the ecosystem service provided to the local community by that system or area.

As the potential for impact is being removed, it is not necessary to have a detailed knowledge of the ecological characteristics of these areas if it is known that certain characteristics render the area of special intrinsic value.

(3) Well Defined Collection Areas

An alternative to no-take areas, the activity can be restricted to particular areas where it might be considered that the impact would be minimal or acceptable, or that it would not conflict with other resource uses.

Establishing the location of these areas would require detailed knowledge of the ecological characteristic of the area including reef community composition and abundance of the various organisms present, including size class distributions and recruitment histories.

It is also essential that information be obtained on the other existing and even potential uses of the resources in the area, to identify the potential for conflict of interests between users.

These nominated areas can be either allocated to a particular activity, so that everyone in the industry has access, or dedicated as a special area by lease or some other form of designation to a particular individual.

(4) Restrictions on Species or Size Class of Organisms Being Harvested or Number of Organisms over a Particular Time Period

Harvesting can be restricted to species that are abundant in a location, or that are robust and survive well under the stress of handling and transportation.

Harvesting can also be restricted to certain size classes of a particular species, depending on size class at reproductive maturity or reproductive optimums.

A quota can also be placed on the number of individuals/colonies of a particular species to be removed over a time period.

Scientific knowledge is essential to specify the size classes to be collected for different species as individual fish or coral colonies of a particular size may have an important ecological role in the reef ecosystem that is not immediately obvious. This approach requires more intensive scrutiny and enforcement than most other mechanisms do, as the catch has to be examined routinely.

(5) Seasonal Restrictions

Temporal restrictions provide an alternative to spatial restrictions such as no-go or dedicated areas. This involves prohibiting access to a particular area or target species at certain times of the year.

This approach is commonly used to protect species during reproductive phases to ensure that there is sufficient recruitment to sustain the population. Many species also change their habits during this time making then more vulnerable to capture such as aggregating in large numbers for spawning or remaining out in the open when they would normally be cryptic.

Again, a reasonable level of scientific knowledge relating to life history dynamics and behavior during reproduction is essential.

(6) Licences/Permits

Requiring a licence or permit to undertake a specific activity is familiar to most people now as passports for travel between countries, driving permits etc are in common use worldwide.

The requirement to obtain a licence to extract resources, particularly marine resources which are often seen as 'common' property is not as widespread, especially in relation to inshore resources in Pacific Island Countries.

Licences can be as simple as a permit to engage in the activity, or they can contain a range of proscriptions that dictate the where, when and how an activity may take place.

(7) Effort Capping or Limited Entry Fishery

A common mechanism used in fisheries management is to cap or limit the level of effort or fishing activity by either placing a limit on the number of participants in the fishery or by restricting the types of gear to be used to limit the efficiency of capture methods. Given the small size of target resources in most Pacific Island and the nature of the capture methods, limiting the number of operators is most likely the best approach for PIC's.

Entry into the fishery by a new operator can only be gained by purchasing an existing license. The aquarium collecting industry in the Great Barrier Reef Marine Park is managed in this way.

(8) Collection Practices

<u>Rotation of Collection Area</u>

Many aquarium operators practice this mechanism when their designated areas are large enough and where there is a single operator allocated to an area. It is a good "husbandry" method that allows natural recovery and regeneration of populations. It also makes sense in terms of collection efficiencies when the return for effort spent searching and collecting target organisms increases to a point where it becomes undesirable or even unprofitable.

<u>Once Collector – One Area</u>

The adoption of a one collector – one area management approach makes good sense in that competition for resources is eliminated and therefore there is an incentive to manage an area. This mechanism should be coupled with the rotation of collection area mechanism. When one operator is involved in an area there is potential for regulating harvest effort to maintain sustainability. There is also the potential for adaptive strategies to be adopted when impacts or disturbances alter the population structure and composition.

(9) Capture-Holding and Transportation

How organisms are collected can be critical to the level of impact the activity will have on the resource area or the target species. Poor collecting methods can result in damage to other organisms in the system such as coral breakage, injury or death to other invertebrates or marine plants, physical damage to the reef structure and unwanted by-catch. Injury to the target species or mortality caused by poor collecting can mean that a lot more individuals from the target species need to be removed from the system than would otherwise be required. Similarly, stressed or injured organisms will probably die during transportation, requiring their replacement and placing further pressures on the system. Poor storing and transporting methods can have a similar effect.

Collecting, handling and transportation methods should be refined so that mortality of target species is minimised as far as possible and damage to non-target organisms and the physical reef environment is avoided or minimised.

Ensuring ecologically sustainable use of inshore marine resources will generally require the use of a combination of the approaches described above. In fact many are complimentary and work well in tandem, such as a licence system with quotas and size class restrictions or dedicated lease areas. While approaches such as seasonal restrictions or no-go areas can also be a permit condition, these restrictions should apply to the industry as a whole and not individual permit holders, due to the difficulties of enforcement.

3. Issues for Managers

3.1. Regulation and Enforcement

It would be difficult if not impossible to adopt any of these approaches in the absence of legislation and regulation, as some form of government intervention is essential. Similarly, these mechanisms are unlikely to be fully effective without adequate and effective enforcement to ensure compliance. Some approaches rely on detailed scientific knowledge, e.g. size class restrictions, coupled with a higher level of activity monitoring and enforcement, and will therefore require a high level of human and financial resourcing and expertise in the enforcement agency.

3.2. Monitoring and Adaptive Management

Other than absolute prohibition, none will work unless there is an understanding of the ecological characteristics of the target area and what levels of harvesting are sustainable over space and time. Even where this information is available, appropriate monitoring programs need to be put in place that will track the behaviour of the system over time to ensure that the activities are in fact sustainable.

Management also needs to be adaptive so that the approach being used can be altered in response to the information coming from the monitoring program, or the changes in how the industry conducts its operations. Figure 1 illustrates the responsive management approach.

3.3. Recovering Management Costs

There are several options available to assist governments and managers to meet the costs of management interventions. These include:

> Environmental Bonds – The operator is required to post a bond with the regulatory body. This is then available in the event of any major negative ecological impact to assist with recovery and restoration or compensate local communities. This type of bond is normally used where there is a potential for severe environmental degradation to occur.
>
> Competitive Financial Tenders – This approach to cost recovery can be used where there it is decided to cap effort by limiting the number of operators allowed. Only applicable to a new fishery just opening up or where the cap is set above current activity levels. Licences or access is awarded based on the highest bid.
>
> Concession systems or resource rents – An annual licence fee is charged for access. This can be permit assessment fee or a lease fee or a fee based on quarterly return accounting the stock removed during that time period. An annual licence fee/resource rent is probably the simplest of these to implement.

3.4. Managing Other Stresses

The greatest challenge to resource management agencies is to adopt a holistic management approach rather than a sectoral one, i.e. an integrated approach that manages on an ecosystem level rather than managing each activity affecting the reef ecosystem separately. This requires mechanisms to be in place to promote or require the various government agencies to communicate and cooperate in the allocation of access to marine resources or the assessment and management of the impacts on those resources from the various sectors. In the Pacific Island context, it also requires an investment in capacity building, with the assistance of the regional bodies, to help government departments meet these challenges. Figure 2 summarises the various sectoral pressures on inshore marine systems.

4. Conclusion

This paper is basically a checklist of the various management approaches that could be adopted by Pacific Island Countries to manage extractive activities in the nearshore marine environment. It does not assess the pros and cons of the various approaches in the Pacific Island context because the region is not homogenous. The government systems and cultural identities of the PICs vary enormously. The one unifying factor is that resources, both financial and human, are very limited in many PIC's.

Whatever management mechanisms are utilised, they will need to be appropriate for the skills capacity of country and the ongoing finances available, the regularity environment and the ability and willingness to utilise those regulations. Whilst a generic regional approach to the establishment of management systems for the Marine

Ornamentals Trade is useful as a starting point, National Management Plans are essential to determine the best approaches to use in each country. It is also essential to identify current management capacity and to incorporate a capacity building program to address the shortfalls.

Figure 1. Adaptive Management Model.

ADAPTIVE/RESPONSIVE MANAGEMENT PROCESS – MANAGING MARINE ECOSYSTEMS

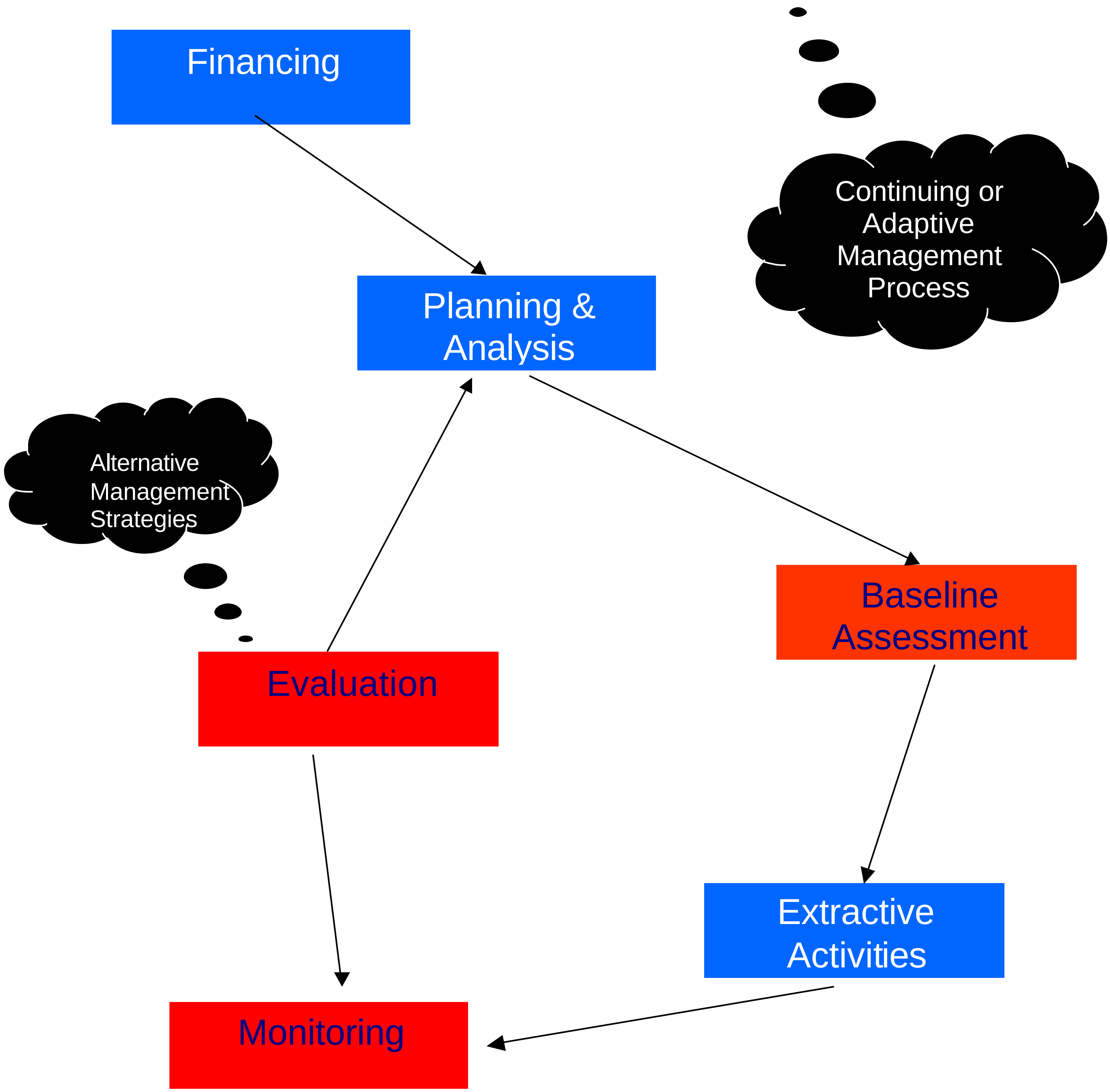
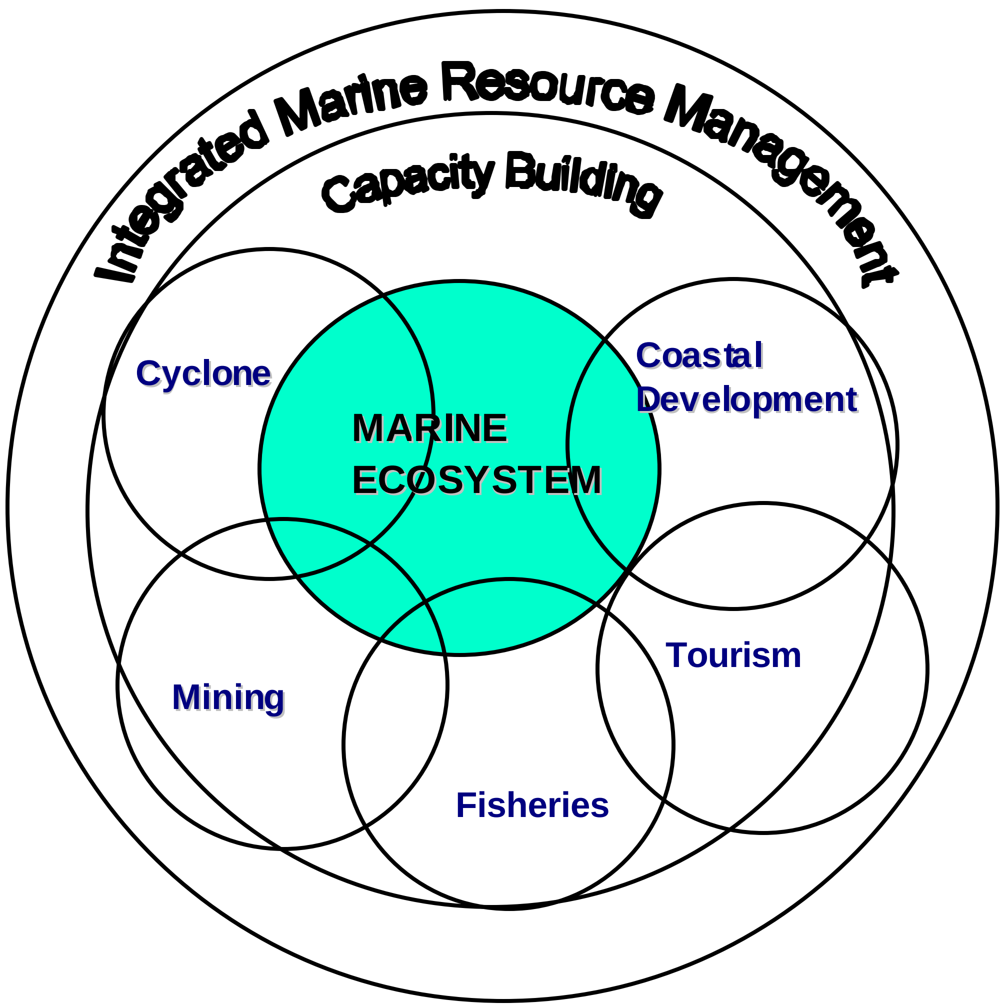


Figure 2. Stresses on Coastal Resources and Integrated Management.

INTEGRATED MANAGEMENT & STRESSES ON COASTAL RESOURCES



Session 4 : Best Management Practices – Industry Management

ENVIRONMENTALLY SOUND MARICULTURE

Simon Gower

Counterpart International, in partnership with the
Foundation for the Peoples of the South Pacific Fiji (FSP Fiji)
CORAL GARDENS INITIATIVE

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1. Coral Gardens Capacity Building & Recruitment

Since receiving funding from the John D. and Catherine T. MacArthur Foundation in July 2000, Counterpart International's Coral Gardens partner, FSP Fiji, has focused on scaling up the project. This is being done by consolidating the gains made during the initial pilot phase in the Cuvu district (located on Fiji's Coral Coast, near Sigatoka), as well as by recruiting key staff to build the capacity of FSP Fiji's Coral Gardens team.

Recruitment, orientation and training have been high priority for FSP Fiji during the last few months. Gerald Billings was hired in November 2000, and brings significant academic training and field experience, with 23 years of coral reef fisheries management and aquaculture experience at the Fiji Government Department of Fisheries. His position is supported by the MacArthur and Packard Foundations, in addition to a grant from the government of New Zealand.

The project officer is now working with Austin Bowden Kerby as the core Coral Gardens team in Fiji. It is anticipated that the team will be handling all traditional protocols, local governmental and NGO relations, community waste and land-based environmental matters, and the community "Participatory Learning and Assessment" (PLA) processes. Special area of focus however will be fisheries resources, community marine resource management plans, economic incentives such as sustainable aquaculture, coral reef monitoring, experimental data, and collaborations with the Fiji Department of Fisheries. Mr. Bowden Kerby will continue to provide on-the-ground supervision of fieldwork. The project team members provide complementary skills in the areas of community participation and science, all of which greatly enhance the effectiveness of Coral Gardens outreach.

2. Project Collaboration through a "Learning Portfolio"

In addition to focusing on building up the Coral Gardens focal site at Cuvu district, FSP Fiji is forging partnerships with other organizations to share lessons learned, increase project outreach, as well as test Coral Gardens reef restoration methods at additional sites. This collaboration is allied with the MacArthur Foundation-sponsored "Learning Portfolio" on community-managed marine protected areas, which includes FSP Fiji, as well as the University of the South Pacific (USP) and WWF South Pacific. To date, FSP Fiji and USP have just completed a formal MOU for collaboration in Verata and Cuvu, and WWF has been approached to join the agreement as well for collaborative work in the WWF Ono/Kadavu management site. After the formal MOU, the next step of this process will be to collaborate on developing appropriate strategies for sharing resources and personnel in each site, and to develop model sites for community-based management of coral reef/marine resources for national and regional training.

3. Recent Advances in the Cuvu Site

3.1. Ecotourism and MPAs

The ecotourism component of Coral Gardens has been significantly strengthened this month through cooperation and support by the Fijian Shangri-La resort in Cuvu district, where FSP Fiji has been working with communities (the customary resource owners who own the land upon which the resort is situated) on coastal/marine management. Conflicts between the customary resource owners and the resort were identified in FSP PLA workshops, and these conflicts threaten to negatively impact the site. To solve these conflicts, and to increase benefits from tourism to the customary fishing rights owners and communities, FSP is proposing the establishment of a no-fishing marine park adjacent to the Resort, both as a fisheries management measure, and as an ecotourism resource for the resort and community. This approach, was approved by the Resort, and is now dependent on final approval by the community and traditional chiefs. A marine park at the resort site would create considerable economic incentives for the community, which is already in the process of discussing the establishment of MPAs. The incentives that FSP is proposing include direct involvement by the reef owning clans in the marine park. The involvemnet will be in the form of trained reef guides and fisheries wardens, as well as through involvement in FSP's Environmental Awareness Theater project, whereby youths become trained to perform environmental dance, dramas, and puppet shows at the resort.

Another MPA site has been proposed by the community for the entire reef area in front of Yadua village (also in Cuvu district). A rapid assessment of the site indicated severe ecological imbalances resulting in algal overgrowth, low coral cover (post crown of thorns starfish (COTS) infestation), and sea urchin over abundance. Monitoring of the Cuvu reefs indicated that COTS continue to be a problem except where the corals have been completely killed, although considerably less so than before the removal activity last year. An over abundance of coral-eating *Drupella* snails was also recently identified, indicating over fishing of crabs and lobsters, while algal overgrowth indicates over fishing of herbivores. Once MPAs are established, baseline data will be obtained before the restoration activities can begin, ie,COTS removal, coral transplantation to encourage herbivorous fish recruitment, *Trochus* and *Tridacna* introductions, etc.

3.2. Work shop Activities

All of PLA workshops were completed for all villages, with fishers mapping their resources and identifying over fishing and environmental problems. Further series of workshops have also just been completed, although there was a delay caused by the death of the high Chieftess Bolou Eta, the "Ka Levu" of Nadroga Province. The hundred nights period of mourning ended in late December which then enabled the workshops to continue.

The second series of workshops have also just been completed, and involved presentation of the PLA workshop findings back to the community and identifying solutions to the problems they have identified. The development of comprehensive community-based management plans for the coral reef fisheries and land-based waste problems will be the product of these next workshops, and these plans will take several days for development in each community. A curriculum of background information in fisheries ecology needed for the management planning workshops and training is in the process of being developed by FSP.

The setting aside a number of reefs as no-fishing MPAs has already been presented by several members of the district environment committee for community consideration during the management planning workshops, at Yadua village, and one in Cuvu village. We are suggesting that the Cuvu site be shifted >1 km, to be directly in front of the Fijian Shangri-La resort as a multiple-purpose (fisheries and ecotourism) marine park. Other recommendations include the restoration of the Voua stream mouth to pre-1959 conditions, as the present location of the stream mouth is killing the reefs of Cuvu Bay each time it floods.

The third stage of the management planning process will involve approval of the tentative resource management plans at the chiefly Tikina Council, followed by community feed-back and modification before final approval at the tikina level and implementation. Approvals will also be obtained at the provincial and national levels. In addition to the management planning work, training of local fish wardens from each community will soon be conducted in collaboration with the Provincial Fisheries Officer.

3.3. Tikina Environment Committee

A Tikina (district) level environment committee was established last year by the Tikina Council and working groups under the committee have been formed. Issues addressed by the Environment Committee include:

- Presentation of community PLA workshop and experimental results;
- Consultation on waste management problems, destructive fishing, etc;
- Awareness building of the chiefs;
- Presentation of the findings and recommendations of FSP regarding erosion and reef death related to watershed deforestation and subsequent hydrological changes in the Voua stream and Yanuca Channel; and,
- Development of possible Voua River Mouth restoration plans and mangrove replanting plans.

3.4. Fast-Tracking the Community Management Process

FSP Fiji has decided to fast-track two villages in Cuvu district for Coral Gardens outreach – Yadua and Rukurukulevu villages. Yadua Village has surfaced as being in a critical up-current location, and thus important to fast track community management and restoration. Rukurukulevu village has also surfaced as a community facing resource usage conflicts and environmental degradation. Yadua has been very engaged in the project, and has already set aside a provisional marine protected area, and completed a mangrove replanting project.

3.5. Identified Ecological Problems of Cuvu Tikina

Four major reef pests and imbalances thus far have been identified from the PLA sessions, indicating ecological imbalances due to over fishing and nutrient run-off :

- An epidemic of the coral-eating *Crown of thorns* starfish is in-progress;
- *Sargassum* and other seaweed are now a dominant component of the reef, smothering corals and preventing coral reef recovery;
- *Echinometra* sea urchins are in epidemic numbers on Yadua reef, indicating over fishing of triggerfish predators; and,
- Coral eating *Drupella* snails are in great abundance on some reef areas, indicating over fishing of lobsters and crabs.

Long-term management to solve these problems and others as yet to be identified will be needed, however in the mean time the following activities have been begun :

- Crown of thorns starfish removal activity by the village communities, assisted by the Fijian Resort (providing buckets, spears, and picnic food for the youths); Some 4,000 were removed from specific areas, representing perhaps 20-40% of what was present on the Tikina's reefs, and 95% of what was on the reefs in the Yanuca area;
- Fertilizer experiment to identify an economic use for these pest species, including chemical analyses by the Fiji Department of Agriculture (indicating high N, Ca and Mg ratios for COT and very high N, K, Ca, Mg, Fe and Mn ratios for Sargassum), as well as field trials in community gardens; and,
- Initiating MPA processes as part of the long-term solution, enabling breeding populations of algal-grazing fish and predators to build up again in the Cuvu waters.

3.6. Experimental Coral Reef Restoration

FSP Fiji has initiated several experiments in Cuvu Bay, including test coral plantings for habitat enhancement, tide pool enhancement with UV and temperature tolerant corals, and coral aquaculture trials. Unfortunately, the COT infestation has interfered with most experiments, and this pest must be removed from any experimental coral culture or restoration area. The experimental aquacultured corals were attacked by coral-eating *Drupela* snails as well. These results indicate that predation is too high for effective juvenile coral survival on the Cuvu reefs, and coral predator reduction may be necessary initially within the MPAs to accelerate their recovery. Restoration work will be recommenced only once MPAs are established and underlying problems of coral survival are overcome. In addition, flooding of muddy waters into Cuvu bay killed the test plantings, indicating that restoration is impossible without a restoration of the river mouth so that the muddy freshwater does not linger inshore (see below).

3.7. Hydrological Study of Cuvu Bay

FSP Fiji carried out a hydrology survey and report for Cuvu bay and Yanuca Channel with assistance from the University of the South Pacific. Three major problems with man-altered hydrology of the Tikina were identified and all are due in part to man-made alterations in flow and runoff :

- Voua Stream mouth changed in 1959, and freshwater flooding and mud has periodically killed important reef areas surrounding this largest bay and potentially very important fisheries nursery area;
- Yanuca Channel is infilling with sand and mud, and the corals and shellfish resources have all died. The outlet to the channel has also changed, likely due to interrupted sand supply; and,
- Serious beach erosion is occurring and appears to be related to the hydrological changes.

The Yanuca Island bridge/causeway to the Fijian Shangri-La Resort, built in the 1960's, is obstructing water flow through the channel and is compounding and perhaps causing the above problems. The Fijian Resort has promised resources to help restore the hydrological situation, an essential part of the overall Cuvu restoration, yet beyond the normal capability of the communities. As part of the recent grant, the Resort has agreed to fund an independent USP study on the environmental and hydrological impact of the bridge, and this study will be carried out in February.

3.8. New Contacts and Collaborations Initiated

Contacts have been made with other organizations working on coastal/marine issues in Cuvu district, including:

- OISCA (Local Japanese Agency): mangrove replanting and reforestation;
- Provincial Fisheries Officers: fish warden training;
- Provincial Public Health Officers: waste management workshops; and,
- Provincial Agriculture Officers: Composting and watershed management.

3.9. Other Achievements in Cuvu

Yadua Village is planning to reinstate a traditional six-month *Tabu* (community marine protected area) on a large reef area, and other communities are planning to do so as well as part of their local management plans. Such traditional management measures will be strengthened, with the potential of selecting at least one of these areas per village area for upgrading to permanent reserve status.

4. Problems/Challenges and Opportunities Identified in Cuvu District

The following issues were identified as challenges that need to be addressed by Coral Gardens in Cuvu:

- COT infestation is problematic, needs special attention within the overall management framework, especially within Tabu MPA areas;
- Freshwater flooding of Cuvu Bay killed coral experiments and continues to impact the reefs negatively (necessitating Voua Stream restoration);

- Coral bleaching damaged our reef flat experiments, COT have damaged the tide pool experiment (regardless to their considerably fewer numbers);
- Piggery wastes, sewage and rubbish impact the sites;
- Aftermath of May 2000 coup, including cancelled meetings etc; and,
- Conflicts exist between the resource owners and the resort, and not enough benefits from tourism are reaching the communities.

In addition, the following opportunities were identified:

With many laid off work at the resorts (due to decreased tourism after the coup), the reef has become more important as a food source than at any point in recent history. People also have more time to attend training workshops ;

- The ecotourism potential of the site has increased with strengthened support from the Resort for a marine park;
- The Women and Fisheries Network and USP are keen to collaborate on the development and review of the community environmental management curriculum;
- SPACHEE and Women and Fisheries have a community-management site in Tailevu that we might be able to collaborate with as part of Coral Gardens; and,
- Availability of high-capacity USP students.

5. Priority Activities

The following are priority activities for Coral Gardens :

- Continue working with communities and the Tikina Environment Committee towards the development/ implementation of community-based resource management plans;
- Conduct "PLA" training of trainers workshop for Coral Gardens team and other stakeholders in Fiji;
- Conduct resource restoration and habitat recovery activities within MPA sites;
- Commence community-based and scientific monitoring activities;
- Continue working to gain support from and collaborations with the Government of Fiji at both National and Provincial levels;
- Seek additional funds to allow for a greater focus on the original Coral Aquaculture component of Coral Gardens, to replace the destructive trades and to provide a sustainable incentive for conservation;
- Establish experimental coral farms at the Makogai Island with the Fisheries Division and if possible in Kaba with USP;
- Collaborate with the marine aquarium industry and MAC regarding production specifications for sustainable CITES-compliant and MAC certified aquacultured corals;
- Investigate Vatulele Island as a potential Coral Gardens extension site;
- Work with WWF and OISCA on mangrove workshops in Cuvu;
- Encourage watershed management as a permanent solution to flooding;
- Help the resort continue with plans for at least a semi-permanent solution to the Voua Stream mouth problem; Once stream mouth restoration is completed, set up a series of restoration experiments in Cuvu Bay;

- Film and photograph the before and after status of the Cuvu sites;
- Sign MOUs with USP and WWF for between site collaborations;
- Conduct a more extensive site analysis of Verata and Ono Tikinas;
- Trial reef restoration work in the WWF and USP collaboration sites, as indicated
- Continue developing curriculum materials for community management of reef fisheries;
- Arrange for teachers of Cuvu District to be trained in a curriculum of environmental awareness and ethics of conservation (with the NGO "Live and Learn" *Green Schools Program*, and the FSP-Fiji's *Virtues Project*); and,
- Begin the Environmental Awareness Theater training activities in Rukurukulevu village.

6. The Project as a Model of Community-Based Governance

Beyond the environmental impact of this project, the social and political/administrative impacts may be even more far-reaching on Fiji and other island societies. The political crises in Fiji and the Solomons have served to emphasize the importance of this community-based approach towards problem solving and village governance. Although not considered during the initial grant proposal writing, in the past few months the need to monitor, refine, and promote the PLA (Participatory Learning and Action) methods of the project as a model worthy of replication throughout the region has become apparent. We are presently seeking additional funds to be able to involve Dr. Hugh Govan more closely in the process monitoring aspects of the project.

The project is breathing new life into Cuvu Tikina. The voices of the women and youth are being heard more clearly from within the structure of the PLA workshops, resulting in new and creative solutions to long-standing community problems. The setting up on a Tikina-level environment committee and working groups has further helped to initiate a process of empowering the traditional and chiefly structures to better administer the affairs of the people.

<u>Session 5 : Managing the Trade / Duel Role for Government – Industry Oversight - CITES Requirements</u>

THE CONVENTION ON THE TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA (CITES) : BACKGROUND, REQUIREMENTS AND APPLICATION OF THE TREATY TO CORAL REEF SPECIES

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1. Introduction

CITES is an international agreement to protect wildlife by ensuring that trade does not threaten the survival of a species in the wild. It is designed to prevent further decline of wildlife and ensure that international trade is based on sustainable use. There are several hundred species listed on Appendix I and over 20,000 species listed on Appendix II. The treaty covers plants and animals, including terrestrial, freshwater and marine species.

The treaty was established in 1973, and is administered in Geneva Switzerland. There are currently152 member parties that work together to ensure that wildlife trade is carried out according to the provisions of the treaty. Countries cooperate by issuing permits for export of species that are in legal trade, and are not threatened by this trade. These permits are supposed to be verified at the port of export and the port of entry.

Countries that are parties to CITES have a biennial meeting (Conference of the Parties) to discuss policy and technical issues, implementation problems and scientific interests. At this meeting, country proposals for new listings and down listings are discussed and voted on. There are also annual technical meetings of the Animals and Plants Committees and an annual Standing Committee meeting. Non-governmental organizations representing conservation, animal welfare, trade and scientific interests can attend both meetings and contribute to debates, but they cannot vote on listing proposals.

2. Provisions of the treaty

The Appendices

CITES provides for three levels of trade control depending on the conservation status of the species. Each level of protection has different permit requirements. Appendix I includes species that are threatened with extinction and are or may be affected by trade. No commercial trade is allowed in wild-harvested Appendix I species, but these can be traded for museum specimens, public display and scientific purposes.

Species listed on Appendix II are not presently threatened with extinction but may become so if trade is not controlled. These species can be traded commercially, provided that the exporting country issues a permit indicating that trade is legal. The permit must also include a non-detriment finding that indicates that trade in the permitted quantity will not be detrimental to the survival of the species in the wild or its role in the ecosystem. Species listed on Appendix III include animals and plants listed by a range country to obtain international cooperation in controlling trade. A country can unilaterally list a species on Appendix III, but listing of a species on Appendix I and II species requires a vote of 2/3 of all parties.

Scientific Authorities and Management Authorities

Each country that is a party to CITES has a Scientific Authority and Management Authority. The Scientific Authority is responsible for reviewing permit applications for export, compiling information needed to make a non-detriment finding and determining the volume of a species that can be sustainably traded. The treaty obligates them to monitor the trade and the effect of this trade on wild populations. The Scientific Authority also develops proposals for new listings or down listings and reviews proposals submitted by other countries.

The Management Authority issues permits and certificates for trade. If a quota has been established by the Scientific Authority for a species in trade, the Management Authority may allocates this quota to the exporters. The Management Authority also has the responsibility of ensuring that the trade in a specimen is legal, and that species is handled to avoid cruel treatment. Each country is required to submit an annual report on the total exports and imports of CITES listed species. The Management Authority prepares this report.

Permit requirements

CITES listed species have different permit requirements depending on the Appendix in which they are listed. For Appendix I no commercial trade is allowed. However trade can occur for scientific purposes, museum specimens and for public display. Shipments of an Appendix I species requires an export permit and import permit. The import permit must be obtained first, and this permit must indicate that the trade will not be detrimental to the species, it is not commercial, and the importer is suitably able to take care of the organism. Appendix I species can be traded commercially only if it is from an approved captive-breeding facility, and the shipment is accompanied by an exemption certificate.

For Appendix II listed species, an export permit can be issued for any purpose, provided that the trade is legal and the Scientific Authority has determined that the specimen was legally acquired and that trade won't be detrimental to the species survival. CITES does not require import permits, but countries are allowed to have more stringent requirements than that required by the treaty. For instance the EU also requires import permits for any Appendix II species that are imported into Europe.

For Appendix III species, export permits are required only from the country that listed the species. Other range states must provide a certificate indicating that the species did not originate in the country that listed it. In this way, other countries can assist the exporting country to enforce domestic regulations.

If a species is transshipped, the re-exporting country must issue a certificate of re-export, and the shipment must contain a canceled copy of the original CITES permit. For countries that are not a party to CITES, shipments of CITES-listed wildlife must contain an export certificate that contains the same information as that contained on the CITES permit. A CITES listed species that is captive bred to the F_2 level can be traded without an export permit, provided that the captive breeding facility is certified by CITES. However, these shipments must contain an exemption certificate.

The non-detriment finding

One of the most important provisions within CITES for ensuring conservation is the non-detriment finding that is made by the Scientific Authority. For any species in trade, the exporting country must assess biological criteria of that species and make a risk assessment analysis. This includes information on the status of the species in trade, whether that species is wild-harvested or captive bred, how much trade is proposed, and whether that trade will impact the species or its role in the ecosystem. This assessment should include :

- An analysis of life history characteristics;
- The vulnerability of the species based on its abundance and life stage at which it is harvested;
- Whether it is taken using destructive collection methods; and,
- Whether it is a species that plays a critical role in structuring the ecosystem or maintaining ecosystem health.

In addition, if a management plan for that species does not exist, the Scientific Authority is supposed to issue a quota for the maximum volume of trade that can occur without harm, based on the above information.

3. Application of CITES to Coral Reef Species

There are several coral reef species listed in CITES. All sea turtles are listed on Appendix I. Coral reef organisms listed on Appendix II include antipatharians (black coral), hard corals queen conch and giant clams. Hard or stony corals include blue coral, organ pipe coral, fire coral and all scleractinian corals. Other reef species including reef fish, crustaceans, echinoderms, soft corals, and precious corals are not listed in CITES even though these are in international trade.

One of the benefits of the Appendix II listing is that CITES provides a way to monitor the total global trade. Each importing and exporting country that is a party to CITES must submit annual reports on the total trade in CITES listed species. For hard corals CITES annual reports record the type of coral in trade, the quantity, country of origin and importing country, whether it is alive, raw coral (colonies that were collected alive, bleached and exported as dried skeletons), or manufactured coral items including carvings. The type of coral is reported either as Scleractinia for coral rock that can not be identified to a higher taxonomic level, or to a minimum of Genus for readily identifiable coral taxa.

The volume of trade is listed as the number of items for coral transported in water or weight in kg for coral transported out of water (e.g. skeletons or live rock. The database also has information on whether it was harvested from the wild or captive reared.

Coral Reporting Resolution

Several countries have expressed concern about the CITES Appendix II listing for corals. Unlike other species listed in CITES, there has been a lot of confusion over the identification of species in trade, how to report the volume of trade, and how you can make a non-detriment finding. Because of this coral reporting procedures are currently under review. At the last CITES Conference of the Parties (COP 11) a resolution was adopted that defines what material can be reported as Scleractinia.

In the past, countries often lumped readily identifiable coral skeletons under the category "Scleractinia". Now, all coral that has identifiable skeletal features must be reported to the level of genus, or species if possible. Scleractinia can only include material recognizable as coral rock, but not identifiable to genus. In addition, the resolution exempts coral sand and coral gravel less than 30 mm in diameter from the provisions of the treaty.

There has also been an attempt to standardize the units listed on permits. Any coral that is transported in water must now be reported by item, while any coral, including live rock, that is exported out of water must be reported by weight. In addition, definitions have been established for different types of material reported as scleractinia and as true stony corals.

This past summer a new coral working group was established to further revise listing requirements. This group has participation by Australia, Fiji, Indonesia, the UK the Netherlands and the US, and includes government officials, conservation groups and industry representatives. The working group has three major mandates. One is the level of taxonomic specificity required on permits. The working group must decide if all corals have to be reported to species, or whether only certain corals can be reasonably expected to be identified to the level of species.

Coral identification presents a lot of problems because of the vast number of species that occur in the wild. There are about 120 genera that have been reported in the CITES trade database and these include about 700 species of reef-building scleractinian corals and hydrozoans; there are also at least another 700 species of ahermatypic deep water corals. While in many cases the collectors and exporters can identify coral to species, wildlife inspectors generally do not have training in coral identification and they are having difficulties verifying permits at the level of genus. The working group has initially proposed that all monospecific taxa can be reported to species, while other corals should be reported to species if possible, but are only required to be reported to genus.

The second objective of the working group is to determine whether a Scientific Authority can realistically make a non-detriment finding for corals if they are not reported to species. Countries must issue a non-detriment finding for trade in a species that indicates that trade will not harm the survival of that species. However, if you are only reporting a coral to genus, it is not possible to guarantee that trade will not negatively affect a particular species. Many genera consist of two or more species and some of these may be uncommon or more vulnerable to human impacts. There is another approach for making the non-detriment finding, however. This involves an assessment that trade will not affect the role of the species in its ecosystem. The working group is currently evaluating whether you can make such a non-detriment finding at the level of genus.

The third objective is to determine whether a different code should be applied to corals that are being raised in mariculture facilities. The group is looking at the definitions of captive breeding used within CITES for other species and how this relates to coral. Captive bred organisms include species that were raised in captivity, are removed from wild populations, and do not require continued harvest of wild population to maintain brood stock. Within CITES a code for reporting that differs from that used for wild-harvested specimens. The problem with corals is that many corals are being raised in the field from small fragments taken from wild populations, and to date, commercial attempts to raise coral from larvae have failed. It is recognized that maricultured corals require more effort than collection of wild-harvested specimens, and as such may be less detrimental, and a separate code for reporting may be justified.

Benefits of CITES for Coral Reef Species

Although there are currently many problems with implementation of CITES for coral reef species, the CITES listing is particularly valuable for conservation of coral reef species. It establishes an international framework for the regulation of trade, and can help prevent overexploitation. Using CITES data it is possible to get an idea of current trends in the trade of a particular listed taxa or of an exporting or importing country or whether the trade has shifted to another country or region. CITES also places part of the burden to prevent overexploitation on the importing country. It helps promote bilateral and multilateral cooperation, and gives importing countries with additional authority to implement other restrictions should the Appendix II listing be determined to be insufficient for the conservation of a taxa. Finally, because countries must issue a non detriment finding in order to trade in a CITES listed species, CITES promotes projects that assess the status of the resource in trade.

Session 6 : Action Strategy for Pacific Island Countries

SUMMARY OF GROUP DISCUSSIONS
(See Appendix 1 for Presentation Reports from Working Groups)

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CONCLUSIONS FROM THE WORKSHOP

MARY TO PROVIDE

APPENDIX 1

Group 1. Tonga and Cook Islands

Government / Country Opportunities

- Export earnings and balance of trade
- Employment
- Technology transfer
- Permit / Licence fees (Tonga)
- Revenue support for local government owned mariculture industry in Tonga
- Raising awareness resource use issues
- Gives value to these resources
- Tax revenue

Industry Opportunities

- Mariculture
- Quality product with good operators and good relationship with the government
- Large collection area with respect to the number of collectors / operators
- Present rotational system with the current number of operators can support sustainability / renewable harvest
- Good comprehensive industry data (Tonga)
- High literacy rate and well educated workforce (Tonga)
- Low labor costs (Cooks)
- Lack of competition as only one cooperative operating (Cooks)
- Reputation for providing a higher quality product

Government / Country Constraints

- Difficult to monitor as there is a lack of local expertise, a lack of funding, and a lack of proper information reporting systems in place

- Lack of integration between government departments as to who has the management / permitting responsibilities, and there is a poor information dissemination, and there is evidence of nepotism and bribery

- Out of date or inadequate legislation, though Tonga is further along with respect to adequate legislation compared to the Cooks

- Difficulty with enforcement

- Lack of awareness amongst government decision makers

- Uncertainty about economic sustainability

- Duplication of international sources of products as product movement is not coordinated and consequently there is a waste of money

- Expansion of industry to outer islands

<u>Country Constraints</u>

- Too many operators for present management system and under present traceability system

- More than one operator operating in the same zone at the same time resulting in no traceability, yet the government feels it is satisfied with the present system

- Space availability on transport and the cost of freight

- High collector turnover

- Limited number of flights to international markets

- There is a negative public perception of the industry

- Non aquarium trade activities impact on the reef resources

<u>Possible Actions and Solutions</u>

- One operator should be assigned to one collection area but a legislative change is required

- Improvement of data reporting and collection procedures as well as improvements in management systems that will require monitoring

- National Workshop where there should be a discussion of legislation Environmental Management Plans, HIP, Government Department integration and avoidance of duplication, and education for members of the public service, NGO and decision makers

- Improvement of legislation and planning and enforcement of legislation

- Regional and internal technology transfer

Group 2. Palau, Marshall Islands, and American Samoa

Constraints

Government Constraints

- Lack of financial and skilled human resources.
- Lack of manpower to monitor divers during harvesting operations and a lack of financial motivation for monitoring.
- Lack of management resource plans, best practice guidelines, policies.
- Lack of technical expertise for monitoring.
- Lack of data for management purposes and lack of analysis.
- Corruption.

Industry Constraints

- Lack of manpower to monitor divers during harvesting operations and a lack of financial motivation for monitoring.
- Environmental problems that can affect harvesting eg bleaching.
- Conflicts between National and State governments.
- Limited availability of cultured giant clams.
- Shipping (by air) space limited.

Community Constraints

- Lack of understanding of basic biological information.
- Lack of information on harvesting activities their effects.
- Lack of monitoring approaches.
- Conflict between traditional and governmental management and laws.
- Not empowering local communities to be responsible for marine resources in their respective waters.

Opportunities

Government Opportunities

- Seeking assistance to develop management plans that include the industry and the community in the planning process.
- Working with MAC to develop some aspects of management plans and best practice for governments.
- Monitoring aspects of MAC may help governments reduce enforcement requirements.

- Training.
- Create more requirements for reporting and possibly increase fees for enhancing enforcement and monitoring.

Industry Opportunities

- Better access to markets.
- Reputable operators (MAC certification). Limited entry.
- Streamline bureaucracy.
- Mariculture opportunities.

Community Opportunities

- Promoting and enhancing traditional environmental knowledge.
- Public awareness and education.
- Community monitoring.
- Community empowerment within traditional structures.
- Community mariculture activities.

Group 3. Fiji and Samoa

Monitoring Assessment

Steps required:

- Assess funding capacity for workshop training using expertise from University in Fiji (USP) for biodiversity assessment; and from industry for other aspects; as well as from Fiji Fisheries and Dept Environment.
- Define methodology by (a) Collating industry records (DoE) especially with respect to seasonal and industry demand trends (Summer in the northern hemisphere is traditionally a slow season); (b) Field assessment techniques; (c) Confine assessment to collected species; (d) review and feedback system; (e) Need for databases to conform across departments and to conform with global reporting.
- Recording collection with emphasis on uniform record keeping, which must be consistent across all aspects of the industry; Standard reporting needs developing for fisheries credibility.
- Funding options are seen to be potentially from CSPOD-101with SPREP facilitation.

Policy Considerations :

- Zonation issue for operators and traditional areas.
- CITES management.
- Certification (Needs to be in country and criteria need to be agreed on) – Fiji is more ahead than other countries from assessment and monitoring standpoint.
- Legislation, regulation, and enforcement are seen as other critical factors.

- Need to re-convine the joint Marine Aquarium Council and Curio Traders meetings.

<u>Group 4. Vanuatu and Solomon Islands</u>

Needs

- Departments of Fisheries and Environment need to improve interactions including the sharing of information and fostering a greater understanding of issues and the role of government.
- Improving the ability to meet CITES obligations and requirements.
- Need for a National industry profile.
- National workshops required to address local issues.
- Export data needs to be included in the Global Monitoring and Assessment Database.
- Data collection needs to be standardised eg same units of measure (kilograms?).
- Self assessment and gap analysis for in country industry reporting and assessment.
- Training programs need to be established and regularly updated and repeated.
- Need an Integrated Management Plan to include all relevant species.
- Improvements to "MCS" that will be effective.
- Need as a baseline an overall assessment of the resources.
- Cost effective way to assess the resource will have to include training local capacity to do so.
- "Spot check" teams are possible mechanisms to supplement MCS and certification surveillance.
- MAC and certifiers need to understand the different tenure systems.