

Economics and marketing of the live reef fish trade in Asia–Pacific

Proceedings of a workshop
2–4 March 2005, Noumea, New Caledonia
Hosted by the Secretariat of the Pacific Community



Theiry Chan

Coral trout in a Hong Kong restaurant. Customers choose the fish from the tank.

Edited by Brian Johnston and Being Yeeting

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Foreword

The consumption of live reef fish is an important component of overall fish consumption in a number of Asian countries. Fish markets place a price premium on live fish, with the Hong Kong and southern China trade worth an estimated A\$350 million a year. Fish are in demand for a number of factors — type, colour, taste and rarity. With population and economic growth continuing in southern China and Hong Kong, and demand for live fish spreading beyond these markets, demand is expected to rise significantly.

For some coastal communities, the potentially lucrative returns from tapping into these markets have not been matched by the realities. A number of developing countries, namely Indonesia, Papua New Guinea, Vietnam, Fiji and other Pacific Islands are involved in the trade. For coastal communities, the prices received for fish are usually low relative to restaurant prices, reflecting in part the risk and costs carried by those moving live fish from these areas to the Hong Kong and China markets. Low prices offered for catching and the deliberate targeting of spawning aggregations often lead to overfishing. This threatens the sustainability of wild fisheries, particularly where destructive fishing practices are used.

There is also often a lack of knowledge about consumer preferences and market prices for the different types of live reef fish caught. Knowing consumer preferences would allow more targeted fishing with the development of sustainable management plans, helping to alleviate stresses on wild fisheries. It would also provide a focal point for aquaculture and mariculture enterprises and research to enhance the productivity of these enterprises. Strategies to ensure sustainable fishing practices and the future role and viability of mariculture and aquaculture will assist the long-term sustainability of the trade and improve conditions for local fishing communities.

ACIAR has funded an economic and market analysis of the live reef fish food trade in Asia–Pacific with the aim of enhancing the sustainable economic development of the trade. An early initiative of the project was a workshop to set the scene by examining the status of the trade and the issues faced by various countries involved.

ACIAR is pleased to publish the papers from this workshop in this working paper, which is also freely available to download from www.aciar.gov.au

The workshop report will provide valuable insights into the live reef food fish trade in the Pacific and Asia, providing information and advice to policy makers, commercial fishers and scientists on the trade and its challenges for better management in future.



Peter Core

Director

Australian Centre for International Agricultural Research

1. Workshop Overview

Brian Johnston¹ and Being Yeeting²



Fish cages at Cat Ba, Vietnam.

Introduction

The Australian Centre for International Agricultural Research (ACIAR) and the Secretariat of the Pacific Community (SPC) hosted a workshop on the economics of the live reef food fish (LRFF) trade in Noumea, New Caledonia, 2–5 March 2005. The workshop was part of a three-year research project funded by ACIAR to study the economics and marketing of LRFF fisheries and trade and to identify the necessary conditions for the sustainability of supply and the trade in the long term. The purpose of the project is to assist countries involved in the trade to ensure they secure adequate returns for fish supplied to the market and that supply is sustainable in the long term, both from wild-caught fisheries and aquaculture. The project is being closely coordinated with a related ACIAR project on marine finfish aquaculture in the Asia–Pacific region, headed by Dr Mike Rimmer of the Queensland Department of Primary Industries and Fisheries (Australia). The aim of the workshop was to introduce the project to Pacific Island countries and to seek their participation in it, including sharing of information among fishery managers and evaluating the usefulness of the modelling approaches being developed in the project. The workshop provided a useful way of introducing the project to Pacific Island countries and to demonstrate the value of the approaches being developed. A second workshop is planned for 2006 at the WorldFish Center in Penang, Malaysia.

The workshop was attended by participants from six Pacific Island countries (Fiji, Papua New Guinea, Kiribati, Solomon Islands, Federated States of Micronesia and the Marshall Islands) and researchers from SPC, Australian National University, University of Western Australia, James Cook University, Bogor Agricultural University, ACIAR, Indonesia Research Center for Marine and Fish Product Processing and Socioeconomics, Queensland Department of Primary Industries and Fisheries and the WorldFish Center. The Indonesian researchers were invited to provide the perspective of Asian countries involved in the trade.

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Background to the trade

Marine fish are an important component of the diet in Asia and the Pacific, and their capture and culture are important sources of income in coastal communities throughout the region. In Asia, including Hong Kong and Mainland China, a number of higher value species are transported live to the market and freshly cooked. These products are often consumed at celebrations, such as special family occasions and successful business events. In restaurants, the live fish are chosen from tanks by the customers just prior to cooking and serving. Restaurant prices are 100 to 200 per cent higher than reported wholesale prices, with the preferred size being plate-sized, or 0.5 to 1.0 kilograms.

The demand for LRFF is substantial, with recent estimates valuing the trade at the retail level for Hong Kong and Mainland China at more than US\$400 million (Sadovy *et al.* 2003). About 20 000 to 25 000 tonnes of LRFF are traded through Hong Kong annually. The rate of trade was substantially higher during the mid-1990s, prior to the Asian economic crisis. Both wild-caught and aquaculture-raised fish enter the trade and a substantial portion of LRFF entering Hong Kong is subsequently transshipped to Mainland China. This proportion is estimated at 40–50 per cent, according to the Hong Kong Chamber of Seafood Merchants (E. Lai, General Manager, Fish & Vegetable Marketing Organizations, HK, February 2005).

It has proved difficult to accurately quantify the volume of trade because China-licensed fishing vessels operating out of Hong Kong have been exempt by the Hong Kong government from declaring their imported fish. Consequently, the trade statistics supplied by the Hong Kong government exclude the catches from these vessels (although some traders have voluntarily reported their imports via these vessels; Sadovy *et al.* 2003). It appears that the absence in the database of LRFF imported via China-licensed vessels may lead to the lack of accounting for approximately 3000 t per year or about 15 per cent of total LRFF imports to Hong Kong (Agriculture, Fisheries and Conservation Department, HK, March 2003). Also, prior to 1997 it was not possible to identify individual species or even species groups, as live fish imports were recorded only as either food fish or ornamental fish.

Hong Kong has been the centre of demand for LRFF for a long period. Demand for these fish increased strongly from the 1960s as personal incomes rose. Total annual reported imports of LRFF peaked in 1998 at approximately 22 000 t (Sadovy *et al.* 2003). In terms of the fish categories used by the Agriculture, Fisheries and Conservation Department (2003), ‘high value species’ comprised approximately 1000 t, ‘other groupers’ (medium priced) 5000 t, ‘snooks and basses’ 1200 t and ‘other marine fish’ 15 000 t. With the Asian economic crisis in 1999 and the eventual downturn in personal incomes in Hong Kong, reported imports declined by approximately one-third by 2003 to just under 15 000 t (Agriculture, Fisheries and Conservation Department 2003).

The Asian economic crisis caused some lasting changes in the market. Imports to Hong Kong of ‘high-value species’ grew steadily from approximately 1000 t in 1998 to 2500 t in 2003. During the same period, imports of lower-value species (Snooks and Basses and Other Marine Fish) declined from 15 000 t to approximately 5000 t per year. Prices of LRFF have fallen steadily since early 2002 and different groups of consumers have reacted in different ways to the changing market conditions. Higher-income consumers appear to have continued to demand the higher-priced LRFF in increasing quantities, while lower-income consumers have reduced consumption of LRFF.

Some key issues raised during the workshop

Pacific Island countries are seeking more timely access to data on the market conditions in Hong Kong and southern China so that they can assess the fairness of prices being paid to local fishers. Market chain analysis is a valuable tool to enable them to assess the fairness of returns being received by local fishers in price negotiations. This issue is central to their consideration of access to their fishing grounds by foreign traders and the issue of capturing resource rents that are commensurate with benefits accrued by non-local fishing companies when accessing local fishery resources.

Another challenge for Pacific Island governments is ensuring that the benefits of this access are equitably shared amongst the fishing communities. The underlying legal basis of access may need to be clarified in national fishery legislation in order to better recognise the various tiers of resource ownership. Access to LRFF by foreign traders can adversely affect local subsistence catches of reef fish as well. A ‘balance sheet’ approach is needed that looks at both the potential benefits to the community of providing access, as well as the potential costs.

The workshop participants agreed that the Pacific Islands should take a risk management approach to their wild-caught fisheries. For example, they should permit conservative access to the stock, while including regular stock status monitoring (via vessel observers and fishery independent resource surveys) as part of the management regime and recouping these management costs from the operators. They were also encouraged to clarify any legal ambiguity about stock ownership and management in legislation before granting licences, ban destructive fishing practices (penalised by the automatic loss of a licence), and close fishing grounds during spawning aggregations.

The question of how to determine sustainable levels of utilisation of wild fish stocks was recognised as being the key to establishing any long-term sustainable LRFF fishery in the Asia–Pacific region. Fishery managers require the tools to assess optimal catch levels that are both sustainable and profitable, but this information is not available. It was therefore considered worthwhile to develop some ‘rules of thumb’ on sustainable catch rates as guidance for Pacific and Asian fisheries. Some preliminary work has been undertaken on this topic as part of the APEC ‘best practice’ standards project. That work is being reviewed in this project to assess its utility for fishery managers.

The Pacific Islands have occasionally supplied small numbers of ciguatoxic fish to Hong Kong, resulting in ciguatera poisoning that has affected dozens of consumers. These incidents have been well publicised in Hong Kong and internationally, resulting in the Pacific Islands acquiring a reputation for supplying ciguatoxic fish. This has affected the supply of LRFF from the Pacific Islands, as Hong Kong distributors have become cautious about importing fish from the Pacific to lessen the risk of additional incidents. In response, strategies for avoidance of ciguatera toxin in wild-caught fisheries in the Pacific Islands need to be developed.

Aquaculture technology is advancing rapidly and higher-value species such as Barramundi Cod (humpback grouper) (*Cromileptes altivelis*) and coralgroupers (*Plectropomus* spp.) are now being raised from hatchery-reared seed stock in Taiwan. Monitoring of the production effects of this development needs to be a priority over the next few years, as prices for wild product could be significantly lowered by production surges of cultured fish.

Trade flows of LRFF into southern China need to be examined more closely, as it is anticipated that most of the growth in demand will occur there. Aquaculture production of LRFF in southern China is also rising rapidly. Demand and supply statistics for China are of poor quality and will need to be improved in order to better understand the changes occurring in aquaculture production and rising demand in mainland China in the future.

Next steps in the project

The ACIAR project will be conducted over the period July 2004 to December 2006. The principal researchers involved in the project are developing further papers on key aspects of the trade, including:

- ▶ Econometric analysis of the demand for LRFF in Hong Kong and Mainland China
- ▶ Analysis of supply relationships for wild-caught and cultured supply from the main supplying countries (Indonesia, Hong Kong and Mainland China, Malaysia, Philippines, Vietnam, Pacific countries, Australia)
- ▶ Analysis of the cost components and risks of the market chain and development of spreadsheet models for cooperating countries (wild-caught and aquaculture models)
- ▶ Market chain analysis to test for market power and whether any part of the supply chain can set prices along the chain from fisher to retailer
- ▶ Integration of demand and supply through development of models for projections
- ▶ Assessment of consumer preferences for wild-caught versus cultured product
- ▶ Use of bio-economic models and other econometric tools to identify policy options for future management of the trade to ensure it is sustainable in the longer term.

The net outcome of the research is expected to be a better understanding of the marketing chain for live reef fish, how prices are set in the chain and how Pacific and Asian fishing managers can use the tools of economics to ensure as far as is practicable that fishers and their communities receive a fair return for the sustainable utilisation of their fishery stocks. As noted in the introduction, the purpose of the overall project is to assist countries involved in the trade to ensure they secure adequate returns for fish supplied to the market and that supply is sustainable in the long term, both from wild-caught fisheries and aquaculture production.

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2. The live reef food fish trade in Fiji

Ledua Ovasisi¹

A brief history of the trade in Fiji

Fiji is one of the very recent countries in the Pacific to be involved in the live reef food fish (LRFF) trade. It was introduced by Government in the late 1990s through the Ministry of Agriculture Fisheries & Forest (MAFF) Commodity Development Framework (CDF) program.

The objective of the CDF program was to strengthen export driven/import substitution commodities. The LRFF trade was identified as one of the main export commodities under the program. The program was divided into two main sub programs reflecting the archipelagic zoning of the country. The main sub programs are the offshore fishery, which deals with the tuna/snapper industry and the inshore fishery, which deals with the harvest of resources within coastal waters.

The government anticipated that the introduction of the LRFF concept to communities would result in realisation of an economic development and the opportunity for a better living standard due to the higher potential earnings from exporting reef fish live compared with sale of dead fish to local markets. For instance, approximately 338 tonne of coral trout, rock cod and wrasse, valued at FJD\$1.35 million in the local markets are caught on Bua and Macuata coastal zone annually. These fish are sold to the Labasa and Suva markets. Exporting the same amount of fish to Asian Markets (live) would realise an annual export earning of well over FJD\$16.9 million.

LRFF development started with one pilot company and later increased to eight companies. Most of these have subsequently withdrawn and opted to move out of Fiji for the following main reasons:

- ▶ LRFF was a new concept and it will take a long time for members of the communities to adapt to the commercial demand of the trade.
- ▶ Fiji has 410 'customary fishing rights areas' managed by the Fisheries Department with 25 Fisheries Stations and 17 ice plants located within the four administrative divisions (east, west, north and central). Most communities were too concentrated on selling their catch through the rural fisheries service centers.
- ▶ The LRFF trade targets only a few species, so other fish caught are discarded or considered only for subsistence consumption.
- ▶ Cargo space for exporting is limited due to high competition from other fisheries commodities like Tuna.
- ▶ The geographical set up of some highly reliable targeted areas is too costly for the operators in terms of their remoteness (eg the Southern Lau group).

From late 2002 until early 2003, only two companies were operating — Satseas Company Ltd in Bua (Northern Division) and Atlas Ocean Products Ltd (Southern Lau).

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Actual breakdown of companies

Satseas Company

- ▶ Operation site in Bua (Islands of Galoa and Tavea)
- ▶ Deployed fish cages
- ▶ More than 40 fishermen actively participate in the fishing operation
- ▶ Mother vessel collects fish and transports to Viti Levu (Western Division) for export

Atlas Ocean Products

- ▶ Based in Suva
- ▶ Operation site in Southern Lau
- ▶ Deployed fish cages
- ▶ An average of 40 fishermen from each village actively participate in the fishing operation, fishing is done rotationally, one island after another (Lakeba, Oneata, Komo, Namuka and Vanua Balavu)
- ▶ Mother vessel collects fish and transports to Viti Levu (Suva) for export
- ▶ Company also buy fresh dead reef fish

Local fishermen only are allowed to catch fish, operators or companies are restricted to purchasing the fish, as outlined in the management guidelines.

The buying prices range from \$5.50 to \$6.00 per kg for Hump-headed Maori wrasse (*Cheilinus undulates*) and \$4.50 to \$5.00 per kg for Coral Groupers (or lower depending on the fish quality). These buying prices are fixed as part of the agreement between the custodians, operators and Fisheries Department.

Fish bought from local fishers usually pass through several levels of trade right up to the market. Market prices often change and the trade fluctuates depending on fluctuations in market price. So, the trade may sometimes disadvantage local fishers due to the fixed buying prices. Fishermen may receive very little for their fish even though actual market prices may be very high.

Export of live reef food fish

Satseas Company Limited

- ▶ Satseas Company exports flower cod (*Epinephelus spp.*) and coral trout (*Plectropomus spp.*).
- ▶ The company exported 8250 kg of live fish in 2003 valued at about \$FJD410,000.
- ▶ The company exported 5100 kg of live fish in 2004 valued at about \$FJD255,000.
- ▶ *These figures do not include the months of November and December.*

Atlas Oceans Products

- ▶ Atlas Ocean Products started a live fish operation in 2003 and exported once that year with a shipment of 13 000 kg valued at about \$FJD650,000. In Figure 1, the high value in June is due to this shipment and 400 kg exported by Satseas.

For the above breakdown, the market prices were obtained from the ADB booklet ‘While Stocks Last *The Live Reef Food Fish Trade*’.

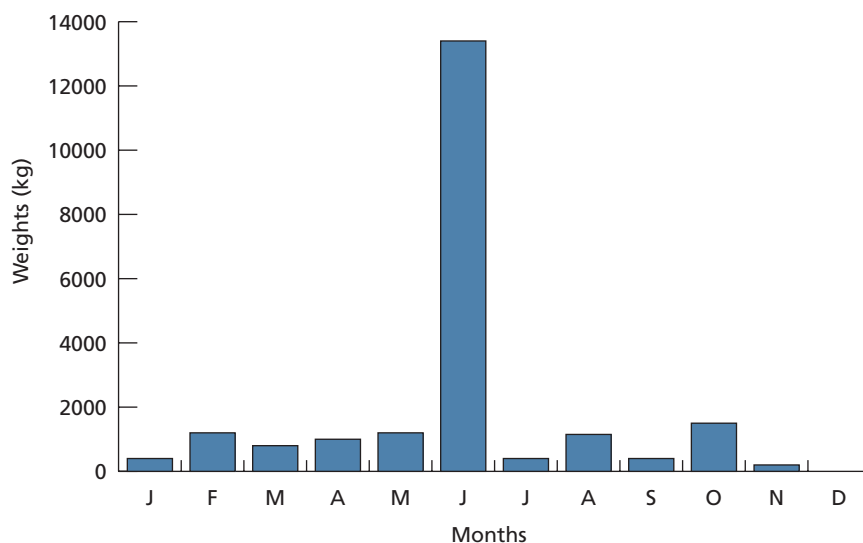


Figure 1. Live reef food fish exports (2003).

Figure 2 shows a decrease in exports because only one company was operating. Satseas only exported once in the first five months of 2004 (in February) as the company ceased operation to renew cages. Operations started in June with the export of 400 kg, following which a new company (King Fisheries Limited) took over.

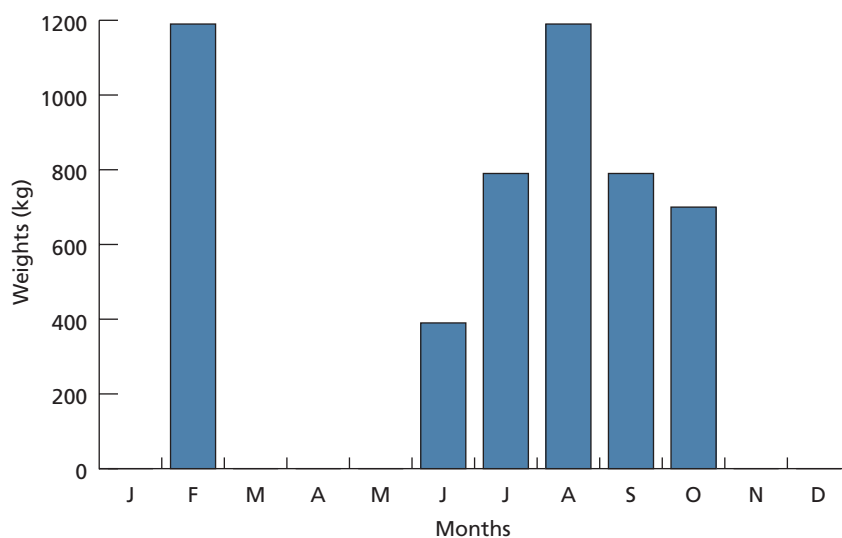


Figure 2. Live reef food fish exports (2004).

Status of the live reef food fish trade

King Fisheries Limited (KFL) is the only company operating a LRFF enterprise. KFL is a locally registered company with foreign shareholders. It is based in Nadi with a warehouse/processing factory close to the airport. KFL began operating in late June 2004, taking over from Satseas following the approval given by the Fisheries Department to export both live and dead reef fish.

The company's operational site is Bua, mainly in the qoliqoli (fishing ground) around the island of Tavea. This follows approval granted by the Buli Lekutu (Paramount Chief in Bua) to access the qoliqoli. The island of Tavea is one of the leading areas for the LRFF trade. It was also targeted by Satseas after the company moved from Galoa Island. Tavea has a lot of potential, with close to 50 fishermen actively involved in live reef food fishery. These fishermen are well known for their fishing skills and knowledge, being the traditional fishermen of the Buli Lekutu. KFL has set up fish cages with assistance from the fishermen.

The fish cages have a holding capacity of 500 kg of live reef fish. Three pens are held together to form a large cage of three separate compartments. The cages are all the same size (about 8 m by 6 m, length × width). The fish cages have been renewed to keep fish from shark attack, damage from bad weather conditions and other factors that may lead to high fish mortality.

The cages are located in front of the village, visible from the shore for security. While fish are in captivity, they are left to feed naturally without provision of feed.

In a similar way to the operation in Lau and other LRFF operations, the mother vessel tows the fishing boats (dories) out to the reef or fishing locations where the boats disperse to their preferred fishing sites. According to the fishermen, the number of boats has increased from 14 at the beginning of 2004 to 16 boats. Fishermen operating in the LRFF trade can earn an average of \$300 to \$700 per week depending on the catch landed. This has enabled these fishermen to improve their standard of living.

Once fish are purchased, they are shipped to Nadi via the mother vessel, where they are kept, processed and exported to overseas markets. The company has been exporting every week with an average of 180 kg valued at \$1,260.00.

Management and challenges

The Fisheries Department, in facilitating the development of the LRFF trade in Fiji, has developed some guidelines to help ensure the long-term sustainable development of the industry. These guidelines will be reviewed throughout the year, then finalised and documented by December 2005. The guidelines are as follows:

1. All companies must have an indigenous Fijian partner as a 51% shareholder.
2. Fijian protocol must be followed, permission to be granted by the traditional custodians followed by approval from the Provincial Office. Original copies of all formal agreements must be submitted to the Fisheries Department.
3. A baseline assessment survey should be carried out in the area targeted for operation to assess the availability of target species, viability of the business and the total allowable catch that can be taken without compromising resources for the future. The survey is to be fully funded by the operator or company.
4. The vessel is in no way to participate directly or indirectly in the taking of fish (as defined under the Fiji Fisheries Act, Cap. 158) either for subsistence or commercial fishing. Fishing may only be done by the resource custodians so foreigners or non-citizens should not be involved in catching fish, except for training purposes. The Fisheries observer on-board will ensure this condition is met.
5. Wild species such as humphead wrasse should not be considered a targeted species under this fishery and no company, organization or individual should be exporting this species under the live fish trade.

6. Companies must only engage in the LRFF operation and no other marine resources should be taken or purchased by them.
7. Fishing of targeted species is not permitted during spawning or aggregation.
8. The companies' warehouses and fishing vessels must be accessible to the LRFF project officer and enforcement officers for monitoring and inspections, as appropriate.
9. All export of live reef fish should be carried out from designated ports where fish can be inspected before being exported to overseas markets.
10. Shipment of live reef fish to overseas markets by sea is not permitted. All live reef fish exports should be by airfreight.
11. Licenses will be reviewed each year.



Ledua Ovasisi

Live reef food fish cages on the island of Tavea.

The Department sets out agreements with the company/operator prior to operation. The agreement mainly focuses on terms of operation (enforcing Fisheries regulations) that the company must comply with and any breach of the agreement will incur a penalty or automatic cancellation of the operation.

The Department is working on enforcement and monitoring with recruitment of field officers to be based permanently in the field/village or operations site to collect operational and domestic (subsistence) data which would then be analysed to check on the amount of targeted fish species harvested in a week or month.

The following monitoring system is currently used:

- ▶ A fisheries project officer boards the company vessel to monitor operations on site and the vessel's overall operational system.
- ▶ Site visits and regular meetings with fishers to monitor the benefits and impacts of the trade and how well to facilitate the development of the trade.
- ▶ Visits to companies to collect data, inspect the processing facility, discuss other relevant activities of the industry and the Department's work program.
- ▶ Companies submit data on a monthly basis to the Fisheries Department as outlined in the agreement.

Conservation measures

- ▶ Conservation of marine resources — the operation is restricted to the purchase of fish only (mainly live reef fish and sometimes fresh dead reef fish). There is ban on targeted species such as Humpheaded Maori Wrasse (*Chelinus undulatus*) which is also included in the CITES appendix II.
- ▶ Implementation of marine protected areas (MPAs) in areas highly targeted by the trade to allow target fish species and other marine resources to breed.
- ▶ Deployment of fish aggregation devices (FADs) in areas where the trade is operating to attract offshore fish species and to substitute for reef fish taken out by the trade.

Major challenges for the LRFF trade

- ▶ Monitoring of operations (as described above) linkage from the site, company factory and port to the overseas markets
- ▶ Stock assessment surveys take a long time and may be too expensive
- ▶ Educating (awareness) the communities on all aspects of the LRFF trade.

Future directs of the trade from your country

The development of the LRFF trade in Fiji is not consistent, judging from the number of operators/companies entering and leaving as highlighted earlier. The Fisheries Department is aware of the fluctuations in the trade but recognises the benefits that it has brought to local communities in the short time it has been operating. The Department views the trade as an income generating activity, but recognises that the benefits have often come with high costs.

The Fisheries Department is optimistic that, with good facilitation and monitoring, the trade can be considered as one of the best alternative sources of income for coastal maritime communities. The Department is considering changes in its fisheries activities, such as shifting the LRFF project to its research division as it involves a lot of research activities on both target and non-target species, impact of the trade or fishing operation on the environment, with comparison of LRFF target and non-target sites, the near extinction of marine species such as hump-headed Maori wrasse (*Cheilinus undulatus*). This research is important given the number of companies expressing interest in being involved in the trade and will help the Department to determine the real depth of the trade, the status of its available stock and its economic value and benefits. With this information, the Department will be in a better position to determine the future of the LRFF trade.

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3. Review of the live reef food fish fishery operation and its management in Papua New Guinea

Leban Gisawa¹

Introduction

The introduction of the live reef food fish (LRFF) fishery to Papua New Guinea (PNG) in 1990 brought mixed blessings (Lokani and Kibikibi, 1998). Because of the high value of live reef fish, fishers could increase the value of these fish by several magnitudes. Compared with the traditional trade in frozen or chilled fresh fish, which is considered a low-end market, the live reef fish trade is a high-end market with a very distinctive customer base located in Hong Kong and China. Hong Kong is the largest consumer of live reef fish accounting for 60% by weight of live reef fish (Lau and Parry-Jones, 1999). Live reef fish are eaten during special occasions such as special festivals or ceremonies and during the closure of business agreements. Higher priced reef fish such as Maori wrasse (*Cheilinus undulatus*) are eaten as a status symbol (Lau and Parry-Jones, 1999).

The Asian economic crisis brought about an apparent drop in the live reef fish market but as Erdmann and Pet (1999) report, there has been an increase in effort in the capture of live reef fish in Indonesia and this trend is spreading to other parts of the Pacific region. The recent devaluation of the kina would mean that the prices of live fish to the fishers would be higher and would therefore put pressure on fish stocks. However, due to limited access to the LRFF trade in PNG, coupled with a strict management policy, the situation is insignificant at present as opposed to the other inshore fisheries.

Historically, the trade of live reef fish for human consumption introduced a new set of problems including destructive fishing methods such as the use of cyanide and targeting of spawning aggregation sites in some parts of PNG. Unfortunately the use of cyanide also impacts on non-target fish species, corals and other invertebrates, and the marine environment in general. Cyanide is an efficient method to capture fish but can also cause excessive mortality in the target species. Its confirmed use in the live reef food fishery in PNG has been a concern to government agencies and other stakeholders.

The deliberate targeting of spawning aggregation sites has been a major concern in PNG and is considered a significant threat to the sustainability of fish stocks. Target species of grouper and coral trout spawn at predictable times and locations thus enabling fishers to target them easily. Catch rates are high during spawning periods, because target fish species usually aggregate at known locations making them easy targets. Many of the LRFF fishers deliberately target spawning aggregations because it enables them to land a high volume of fish within a short period of time, thus maximising their income. Targeting spawning aggregations leads to a 'boom and bust' pattern of operation, which is very common in the LRFF trade.

In order to contribute to the effective management of the LRFF trade in PNG and minimise the negative impact on the coral reef systems, an understanding of this fishery in PNG and the market was required. Extensive reviews are available for the demand side of the market (Johannes and

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Riepen, 1995; Lau and Parry-Jones, 1999) but only limited information is available for the supply side of the market. Much of the negative effect of the trade happens in the countries where the fish are caught. It is therefore important that a clear understanding of the dynamics of the trade in the supply country and the impact of fishing on the target and non-target fish stocks are available for sound management decisions to be made. This review is a compilation of the available information on the LRFF fishery in PNG that has led to the current status of this fishery and the associated management regimes.

Live reef fish trade in Hong Kong and China

It is important to understand the market of the LRFF trade in Hong Kong and China, particularly the trends in the market as this dictates what the fishers will be targeting in order to maximise income. It also helps to understand the spread of the trade from the principal demand centre of Hong Kong and China. From an economic perspective, the spread of the trade eastward means that costs will increase. If the trade is going to spread further from Hong Kong and China, it may well mean that the fishers would have to increase the catch. This means they will need to maximise their catch within a short period in order to maximise profits. The two legal fishing methods (see below) used in the trade return lower catch rates for the target species than the illegal method (the use of cyanide). It would therefore be expected that the risks of using the cyanide fishing method would be high in fishing areas further away from Hong Kong and China if not managed well.

Understanding the economics of disposable income of consumers in Hong Kong and China is the key to understanding the demand in these countries. Lau and Parry-Jones (1999) provide an updated review of the dynamics of how the trade behaves in Hong Kong. High demand for live reef fish is mostly associated with festivals. Mother's Day commands the highest demand for live reef fish. Celebratory banquets such as those held at birthdays and weddings also command high demand for live reef food fish (Lau and Parry-Jones, 1999). (The famous) Chinese New Year also results in high demand for live reef food fish and other fishery products.

Demand is also size specific. Sexually immature giant groupers and humphead wrasse are preferred. The demand for immature fish translates to high prices for these fish so fishers would have to target them in order to maximise income. Johannes and Riepen (1995) also highlighted the high demand for the lips of humphead wrasse. The most commonly exported live reef food fish in PNG are the plate-size coral trouts (*Plectropomus spp*). It was therefore important to implement capture size limits and or closed seasons and areas.

The price paid to the fishers for their live fish is very high compared to the price of chilled or frozen fish, although it is not a true reflection of the market price. For example in all the live reef fish operations that have occurred in PNG, the prices paid for live reef food fish were the same or slightly higher than for chilled fish. The reason for this is probably because the operator has to sell his fish to other middlemen in Hong Kong. Lau and Parry-Jones (1999) identified at least five middlemen between a fisher and the final consumer at a restaurant. When fishers get paid a low price for fish, they need to obtain a higher income by catching more fish, which may mean the use of destructive fishing methods. It can be assumed that if fishers were paid well for their fish, then they would not have to fish so hard and resort to destructive fishing practices.

Impact on coral reefs

The threat from the LRFF trade comes mainly from the use of cyanide to capture fish and from targeting spawning aggregations. Depending on the level of concentrations, cyanide can cause direct mortality to fish and other sedentary organisms. Other threats associated with cyanide, and other fishing methods of the LRFF trade, include: coral structural damage caused by placing corals and rocks around traps to increase the catching capacity of the traps; and fishers ripping off coral to access to fish stunned by cyanide and trapped inside coral structures.

Although the use of cyanide has been confirmed in PNG (pers. obs.) investigations by the National Fisheries Authority in New Ireland (e.g. Mobiha, n.d.) and Milne Bay Province has not identified any significant coral and reef damage. This can probably be attributed to the discrete use of cyanide by fishers in trying to avoid detection and prosecution.

There are no confirmed reports on the targeting of spawning aggregations, but it could have occurred. Fishers fish in locations that yield high catch rates. These are most likely to be spawning aggregations if there is a seasonal fluctuation in the catches. If spawning aggregations have been targeted in PNG, there are no baseline data to evaluate if there has been any ecological damage caused to the spawning aggregations. Lyle Squire (*pers. comm.*) as in Lokani (1999) indicates that his preliminary assessments of spawning sites in the Solomon Islands have been disseminated beyond that of Indonesia and the Philippines. He also indicates that fishing pressure from subsistence fishing on the spawning aggregations can contribute to the over-fishing of spawning aggregations.

Traditional reef owners at Trobriand and Goodenough Islands in Milne Bay Province and Mait Island in New Ireland Province have the perception that the live reef fish fishery has caused destruction to their reefs. There are no baseline data or assessments to verify these claims. There may be a strong chance that some of these claims may be true.

In order to measure any coral or reef damage caused by live reef food fish fishing, it is important that there is some baseline data to measure the level of damage against. Examples, such as those experienced in the Philippines and Indonesia, are good for awareness but there needs to be some level of enforcement in PNG that will enable destructive fishers to be identified and possibly prosecuted.



International MarineLife Alliance

The threat from the LRFF trade comes mainly from the use of cyanide to capture fish and from targeting spawning aggregations.

Impact on communities

The LRFF trade brings both positive and negative impacts to communities. The positive aspects of the fishery for communities are well appreciated but not clearly understood. Currently, the negative impact of the fishery is not well understood. A number of studies are being planned or taking place (e.g. in the Solomon Islands and PNG) that aim to understand the socio-economics of communities associated with the LRFF trade.

Where traditional tenure systems are in place, the fishery can pressure the communities into strengthening their marine tenure system and their traditional governing system. Communities may also become aware that the resource is finite. This is contrary to traditional thinking that live reef fish resources were created by God and therefore infinite.

The live reef fish operations that have occurred in PNG have all had social impacts on the associated communities. Richards (1993) points out that live reef fish operations are as disruptive as bait fishing, especially in relation to the distribution of royalties. Physical confrontations between clans and sub-clans have occurred at Hermit Islands and Tsoi Islands in New Ireland (Richards, 1993). Similar incidents have occurred at Mait Island also in New Ireland and Good Enough and the Trobriands Islands in Milne Bay Province. In the Cateret Islands, Bougainville Province, sections of the community are suing the company that operated there for damages in compensation for the following charges: trespass to land, trespass to customary marine tenure, trespass to goods and continuous trespass. This case was filed in July 1999 with regard to the fishing operation that occurred in 1994.

In almost all operations, the companies pay a royalty to the community on top of the individual payment to fishers for their fish. The social well-being of the community can be so disruptive both for the community and the company that the company often just packs up and moves on.

Drawing from past experiences in PNG, any fishing operations that exclude resource owners and communities where development and exploitation of the resource is to take place, is very likely to result in the disruption of the fishing operations. In the consultation process, a 100% endorsement by the resource owners or community is an absolute prerequisite for a successful and profitable fishing operation. Ignorance of this would result in the disruption of the operations of the company.

Almost all the live reef fish operations in PNG have ignored socio-economic issues although some issues may have been addressed. In general, this in some way may have contributed to the early downfall of the operations. The most important socio-economic issues would be:

- ▶ Reef ownership
- ▶ Fishing and use rights
- ▶ Fishing of spawning aggregations
- ▶ Royalty distribution.

A live reef operation that was intended to operate in New Ireland in 1992 failed to start due to conflict over fishing grounds with the villagers (Aini and Hair, 1995). Richards (1993) similarly cites a socio-economic reason as a contributing factor in the closure of the operation at Western Islands in Manus Province. The issue of reef ownership and financial benefits in the Trobriand and Good Enough Islands operations contributed to the early closures of these operations.

Fishery

Since the commencement of the live reef fish fishery in PNG in 1991, growth of the fishery has been insignificant. The fishery has not increased to the extent that it has in the Philippines and Indonesia. Annual harvest of live reef fish in PNG ranged from a low of fewer than 3 tonnes in 1993 to a high of over 35 tonnes in 1997. The relatively low yield of the fishery can be partially attributed to the need to negotiate access to reef areas owned by a large number of coastal and island communities. The government's intervention through the introduction of the moratorium on licences for the live reef fish fishery in 1997 has kept the fishery under check. However there is continuous pressure from interested parties in the trade for the moratorium to be lifted.

Export

Fish, which are being caught alive, are kept in cages at various sites. These are transferred to carrier vessels for transport to the markets in Hong Kong. Live reef fish operators who are based in PNG are responsible for catching the fish. Once a profitable quantity is accumulated (at a minimum 10 tonnes but sometimes lower e.g. Table 1) an order is placed for a live reef fish carrier vessel to be chartered from Hong Kong. The trip from PNG to Hong Kong takes about 12 to 14 days.

Before export, an approval from the National Fisheries Authority (NFA) is required by law in order to export legally. In most cases, inspection of the fish is required but is not necessary under current legal requirements. A listing of the type of species by common name, quantity and value is given as part of the export requirements.

The export data is important as it highlights not only the target species required in the market, but also other information such as the by-catch (when compared with the actual catch data), fish mortality.

Table 1. Fish exports from Milne Bay (September 1997). All fish were declared at an export price of K10.00.

Species	Number	Weight	Value
Coral Trout	900	700	7,000
Polkadot Cod	500	400	4,000
Maori Wrasse	175	1350	13,500
Big Rock Cod	170	1500	15,000
Rock Cod	3500	1450	14,500
High Fin Coral Trout	50	100	1,000
Mixed Fish	800	600	6,000
Total	6095	6100	61,000

Table 2. Fish exports (December 1997). All fish were declared at an export price of K10.00.

Species	Number	Weight	Value
Coral Trout	5368	4789.8	47,898.00
Polkadot Cod	60	79	790.00
Maori Wrasse	242	1119.38	11,193.80
Big Rock Cod	138	1173	11,730.00
Rock Cod (<i>E. corallicola</i>)	607	578.3	5,783.00
Coral Trout	120	153	1,530.00
Mixed	228	399.3	3,993.00
Total	7033	8291.78	82,917.80

Table 3. Annual live reef fish exports based on declared exports grouped into common names. It is expected that the actual exports may be higher than officially recorded.

Year	Species	Quantity (kg)	Value (Kina)
1991	Wrasse	4101	24,606
	Grouper	3356	20,136
	Coral Trout	215	1,1290
1992	Wrasse	8888	53,328
	Grouper	4699	28,197
	Coral Trout	2662	15,975
1993	Wrasse	820	4,920
	Grouper	210	1,050
	Mixed reef Fish	150	375
1994	Reef Fish	4100	24,634
1995			
1996	Coral Trout	1362	13,620
	Rock Cod	156	1,560
	Wrasse	2983	29,830
1997	Rock Cod	2887.25	62,289
	Coral Trout	6403.75	143,081.3
	Grouper	6000.5	77,675.02
	Wrasse	8837.25	283,116
	Other	663.25	10,975.72
1998	Barramundi Cod	6	240
	Coral Trout	8327	333,080
	Rock Cod	1636.75	65,470
	Wrasse	1754.5	70,180
	Other	32	1,280
1999	Coral Trout	339.41	4,894.3
	Rock Cod	5371.6	47,377.52
	Wrasse	503.4	9,735.76

A typical export of live reef fish may contain seven groups of fish types (Tables 1 and 2). Aini and Hair (1995) provide a listing of the species exported from Kavieng. A total of 22 species from six families was exported from that shipment. Although the typical target species is restricted to at least six species (e.g. Table 1), the live reef fish market demand may change to include species that were not exported previously. This happens when the demand for the other species increases thus increasing the price of the fish.

Fishing methods

Two methods have been used legally in the live reef food fish fishery in PNG. They are the use of hand-lines and traps. Hooks used in hand-lines are normally barbless to minimise damage to the fish but barbed hooks are known to have been used. Bait used and the fishing time is made by choice of the fishers based on experience. When targeting certain species, fishers normally use a specific bait type and fish at a specific time for the target species.

Traps used by fishers in PNG are mainly the rectangular and arrowhead design made of steel or mangrove frames and covered in chicken wire mesh. Both baited and unbaited traps are used. The common practice when using traps is to use hooker gear to help set it up by packing the surround of the traps with rocks and corals. This is supposed to increase the catching capacity of the traps by reducing the soak time. Rocks and corals around traps are supposed to create a realistic habitat for the groupers and coral trout thus attracting them to the traps. Traps surrounded by rocks and

corals are checked by fishers on a daily basis while those without rocks and corals are checked after two days or more.

Cyanide although illegal has been used in PNG. Former PNG fishers in all the operations have acknowledged the use of cyanide in the capture of live reef food fish. The cyanide method used is the same as those used in the Asia region (see Barber and Pratt, 1997). The method involves diluting cyanide in a squirt bottle to a concentration that will not kill fish. The fishers take the squirt bottle underwater using a hooker and squirt the cyanide as close as possible on the target fish. If fish retreat into crevices, the fishers squirt cyanide into the crevices. Once the fish are stunned, fishers rip the corals in order to access the fish.

Fishing time appears to be a personal choice by the fishers or the live reef fish operators. In the Good Enough Live Reef Fish Operation in Milne Bay Province, fishing was carried out from 6 am to 6 pm. In New Ireland Province, fishing was undertaken during the day and night.

Fishers normally fish off a specially fitted dinghy with a seawater tank compartment that allows free flow of seawater into the tank. The fish are kept in the tank for the duration of fishing. The tank is used to transport the catch to the proper fishing vessel where they are kept or further transported to cages anchored off the reef or nearby islands.

Fish kept on the fishing vessel or in anchored cages require regular feeding. Sources of feed are the by-catch from hand-line and traps and sometimes from fish, which die while in the cages or holding tanks in the fishing vessels. If there is insufficient fish food from the by-catch, the live reef food fish operator employs net fishing. In the New Ireland live reef fish operations, villagers were encouraged to catch fish and sell it to the operation. The villagers used a variety of methods ranging from spear fishing to net fishing. The New Ireland live reef food fish operator also used a small purse seine fishing method to capture schooling pelagics for fish food.

Target species

The target species can be examined from the supply (place of capture) or from the demand (consumers) side of the trade. The target species in the supply side of the LRFF trade are principally dictated by the demand. Factors influencing demand are not well understood but include the disposable income of wealthy businessmen in Hong Kong and China. One of the factors that may influence the target species is the demand for species which are rare. For example, when wrasse was banned from export in Indonesia, and it was proposed for listing in the red list for endangered species, its price tag increased. Demand for wrasse was based on its rarity. Lau and Parry-Jones (1999) provide good information on the species in demand.

No authoritative study is available on the live reef food fish target species in PNG but in general the Maori wrasse and serranids are the principle species targeted. High priced fishes are the principle target species. Aini and Hair (1995) list 24 species (Table 4) from a single export from Kavieng. This listing gives an indicative species range captured for the live reef fish trade.

In general, the principal target species are Maori wrasse and species in the Serranidae family, particularly barramundi cod and coral trouts. Species of fish from other families, although listed in exports, are not major target species.

Table 4. Species list for a single export from Kavieng in 1994.

Family/Species	Common Name
A. Serranidae (19 species)	
<i>Epinephelus fuscoguttatus</i>	Flowery cod
<i>E. malabaricus</i>	Malabar cod
<i>E. microdon</i>	Marbled cod
<i>E. corallico</i>	Flowery cod
<i>E. cyanopodus</i>	Speckled cod
<i>E. chlorostigma</i>	Brown spotted cod
<i>E. lanceolatus</i>	Giant cod
<i>Plectropoma leopardus</i>	Leopard coral trout
<i>P. areolatus</i>	Squaretail coral trout
<i>P. maculatus</i>	Bar checked coral trout
<i>P. laevis</i>	Footballer coral trout
<i>Cephalopholis maniata</i>	Coral grouper
<i>C. cyanostigma</i>	Blue spotted rockcod grouper
<i>C. argus</i>	Peacock grouper
<i>C. sonneratti</i>	Tomato grouper
<i>Variola louti</i>	Coronation trout
<i>Cromileptis altivelis</i>	Barramundi cod
<i>Anyperadon leucogrammicus</i>	White-lined grouper
<i>Athaoperca rogae</i>	Redmouth grouper
B. Lutjanidae	
<i>Lutjanus bohar</i>	Red bass
<i>L. semicinctus</i>	Half-barred snapper
<i>L. gibbus</i>	Paddle tailed snapper
<i>L. monostigma</i>	Onespot snapper
<i>L. vitta</i>	One linned snapper
<i>L. carponotatus</i>	Stripey seaperch
<i>L. rivulatus</i>	Scribbled snapper
<i>L. fulvus</i>	Flametail snapper
C. Carrangidae (1 species)	
<i>Caranx lugubris</i>	Black trevally
D. Lethrinidae (2 species)	
<i>Lethrinus elongatus</i>	Long-nosed emperor
<i>L. lentjan</i>	Redspot emperor
E. Labridae (1 species)	
<i>Cheilinus undulatus</i>	Hump headed maori wrasse
F.	
G. Scorpaenidae (1 species)	
<i>Synaceia verrucosa</i>	Reef stonefish

Source: Aini and Hair, 1995

Catch rates

No consistent monitoring of catch rates in live reef fish operations have been undertaken in PNG. Limited data that have been analysed give some indication of the catch rates for handline fishing. No data is available for trap fishing and consequently there are no estimates for trap fishing targeting live reef fish in PNG.

Catch rates reported from PNG are relatively low compared to the Asia region. Catch rates for handline fishing range from 0.3 kg/boat per day to 20 kg/fishers per day. A preliminary assessment found a relatively high catch range from 0.5 to 20 kg per fisher in the Hermit islands of Manus. Catch rates of target species for the Good Enough Island operation averaged at 5 kg/fishers/day (Lokani and Kibikibi, 1998). Aini and Hair (1995) found relatively low catch rates at Tsoi (0.3 kg/boat/day) and the Tigak Islands (0.3 kg/boat/day) in New Ireland Province during trial fishing by a live reef fish operator.

Table 5. Target species catch rates for the Good Enough Island operation. The effort used was 64 fishers using one hook fishing from 5 am to 6 pm.

Month 1998	Days Fishing	CPUE kg/line/hr	CPUE kg/fishers/day	Catch per month
February	14	0.34	4.23	3 795
March	20	0.41	5.26	6 875
April	4	0.36	4.79	1 226
Total	38			11 896

Source: Lokani and Kibikibi, 1998

Live reef food fish operations

Live reef food fish operations have followed a similar pattern. Each operator establishes a contact with links to the area intended for fishing operation. The operator identifies a key person to organise obtaining licences from the National Fisheries Authority. This is followed by a series of agreements signed between the operator and the villagers in the area of operation. The agreements cover access to reefs, compensation and other financial benefits.

Manus Province

The first live reef fish operation took place at Hermit Islands (see Figure 1), Manus Province in 1991. This was followed by other operations in New Ireland, Bougainville, Milne Bay, East New Britain and Central Province (Figure 1). In New Ireland, live reef fish operations were undertaken along the east coast and at Tsoi, Tigak Islands and Mait Islands. The operation in Bougainville was undertaken at Cateret Islands.

The live reef fish operation at Hermit Islands in Manus Province occurred between July 1991 and mid-1992. The operation was endorsed by the provincial government. At least four export shipments totalling 23.9 metric tonnes were made during the 18-month operation (Richards, 1993). Exports listed in Table 3 for 1991 and 1992 was mostly for this operation. Fourteen species were known to have been targeted by the operation but only four species were recorded in the catch data. These were *Epinephelus malabaricus*, *E. polyphkadion*, *Plectropomus leopardus* and *Cheilinus undulatus*. The catches of *E. polyphkadion* declined over time between July 1991 and May 1992. There was also a decline in the average weight of *C. undulatus* during the same period of fishing (Richards, 1993). The catch rates for the target live reef fish ranged from 0.5 to 20 kg per fisher per day. This catch is lower than the 30 kg catch rate reported in Asia. This may be attributed to fishing at aggregation sites. Although aggregation sites are well known to the fishers at Hermit Islands, they were not deliberately fished by them. Fish are said to aggregate between April and August at Hermit Islands. The aggregation sequence is grouper, coral trout then wrasse.



Figure 1. Map of Papua New Guinea showing the location of the live reef fish operations. All of these operations are no longer operational.

New Ireland Province

Two companies operated from New Ireland province along the east coast of New Ireland and at Mait Island (see Figure 1). The east coast operation was undertaken between 1992 and 1993. That operation recorded a single official export of 1.640 tonnes of wrasse. It is understood that other species were also targeted.

The Mait Island operation took place between 1997 and 1999. A total of 5.506 tonnes of fish comprising wrasse, coral trout grouper and sea perch was initially exported in 1997 (Table 6). The operation made a second export in 1999 (see Table 3), which was also the only export for that year totalling 6.214 tonnes. The second export was accumulated for a period of more than one year. Arrowhead and rectangular traps and handline fishing methods were used. Although local fishers actively participated in fishing, the operation also employed a core group of foreign fishers from the Philippines. The Mait operation identified spawning periods for cod from March to April, coral trout from July to September and wrasse from December to February. With this knowledge, it would not be surprising for the Mait operation to have targeted spawning aggregations.

Table 6. Declared export of live reef food fish from Kavieng on 23/10/97.

Species	Weight (kg)	Unit Price (US \$)	Value (US \$)
Wrasse	926.5	12	11,118.0
Coral trout	51.5	9	463.5
Grouper	4340.5	7	30,383.5
Sea perch	188.0	7	1,316.0
Total	5506.5		43,281.0

In response to concerns that there was over-fishing and the use of destructive fishing methods at Mait Island, Mobiha (n.d.) conducted an underwater visual census of reef fish at Mait Island in 1997. The survey also included a spot check on the physical damage, if any, that may have been caused by fishing.

The survey recorded 570 individuals from 49 species in a survey area of 0.477 hectares. Among thirteen families recorded, Acanthuridae, Lethrinidae and Lutjanidae were the most common. Labridae and Serranidae targeted in the live LRFF trade were less common (Table 7). No coral damage was identified.

Table 7. Density (number/m²) summarised by Family for three reef types at Mait Island (Mobiha, n.d.).

Family	Inner SW reef	Inner NW reef	Outer edge NW reef	Sum
Acanthuridae	.411	.456	0.221	1.088
Balistidae	0	.0120	0	0.012
Carangidae	.011	0	.005	0.016
Haemulidae	.028	0	.003	0.032
Holocentridae	0	0	.026	0.026
Kyphosidae	.011	0	0	0.011
Labridae	.094	.038	.004	0.136
Lethrinidae	.265	.124	.170	0.559
Lutjanidae	.376	.167	.475	1.018
Mugilidae	.012	.009	.009	0.03
Scaridae	.181	.040	.090	0.311
Serranidae	.115	.062	.141	0.318
Siganidae	.011	0	.059	0.07

East New Britain Province (Baining)

Little information is available from the live reef fish operation at Baining in East New Britain (see Figure 1). The operation is thought to have lasted for less than one year. The company that operated at Baining moved on to Cateret in Bougainville and then later to Kavieng.

Milne Bay Province

Two live reef operations were undertaken at Milne Bay Province at Trobriand Islands and at D'Entrecasteaux Islands (see Figure 1). The Trobriand Islands operation took place between 1996 and 1997 while the D'Entrecasteaux Islands operation was undertaken between 1997 and 1998 (see Table 1 and 2). Both operations were joint venture arrangements between Hong Kong-based and local companies. In both instances the arrangement was for the Hong Kong-based company to provide finance and for the fishers training while the local partner was to provide labour and access to the traditional fishing grounds.

Both operations officially exported a total of 35 tonnes valued at half a million kina (National Fisheries Authority Statistics). It is possible that the actual export of fish from the province was much higher than this. In addition to the official export, the actual volume of fish caught is thought to be twice that of the actual export, taking into consideration the by-catch and the mortality of fish during fishing and during storage in the cages.

The operation that was based at D'Entrecasteaux Islands operated 8 × 500 kg cages located at eight different locations. A 25 000 kg capacity cage was anchored off the main base at Watuluma. To supply these holding/storage cages with live fish, a total of 24 dinghies crewed by two fishers each fished for six days a week from 6:00 am to 6:30 pm (inclusive of travel time to the fishing ground).

North Solomon Province

The live reef fish operation undertaken in Bougainville was restricted to the Cateret Islands (see Figure 1) under an arrangement with certain individuals from that village. The operation commenced in 1994 and was undertaken by a company that was based in Kavieng. Two shipments of fish were made but there are limited records on the catch composition and volume of fish. Aini and Hair (1995) estimated 1763.8 kg of fish from the Cateret Islands was landed at Kavieng in two shipments in September and November 1994. Most of the fish (80%) landed in September was caught by Chinese fishers employed by the live reef fish operator. Only 20% was landed by local fishers. Local fishers improved their catch significantly to account for 60 % of the catch landed in November 1994.

Vaiola louti, *Epinephelus microdon* and various species of the genus *Plectropomus* comprised much of the catch during a 12-day fishing period in November 1994. Although a target species, *Cheilenu undulatus* was not recorded (Aini and Hair, 1995). There is no explanation given for its absence from the catch, but may be attributed to the earlier fishing effort although no data is available for the earlier fishing period. Aini and Hair (1994) estimated the catch for the Cateret Islands at 3.8 kg/boat/hr, which is higher than the catch rates recorded for the Tigak Islands.

Certain individuals and the Cateret Area Committee were not happy with the operation of the company and consequently forced the company to close its operation in November 1994. Among the complaints raised by the community was: unpaid royalties as agreed to by the community for access to the traditional reefs; unpaid wages for the local employees; unpaid fees for various services provided; and fishers not paid for fish sold to the company. Six years after expelling the company from the island, the complainants finally filed a Writ of Summons at the Waigani National Court in June 1999 claiming for damages and compensation for trespass to land, trespass to customary marine tenure, trespass to goods and continuous trespass. The outcome of the court challenge is, however, not known.

Legislative framework for fishery management

All live fish operators in PNG are required to obtain licenses from the National Fisheries Authority as required under the *Fisheries Management Act 1998*. Licenses issued for live fish operations have been issued under very specific conditions, which included banning the use of cyanide and the use of hookers. Enforcement of these conditions has improved compared to its initial establishment. Although not officially acknowledged, the use of cyanide and hooker have been used by past live fish operators in PNG.

In an effort to make live fishing sustainable, a new approach to management is being adopted by the National Fisheries Authority. This involves the introduction of a comprehensive fishery management plan on the live reef food fish fishery. Under the LRFF fishery management plan, all live fish operations will be strictly regulated with the involvement of the provinces and the traditional resource owners/communities. This is achieved with two levels of the fishery plan. The first level is the establishment of the National Fishery Management Plan, which is broad, applies to the whole country and provides the framework for the second level of the fishery plan. The second level is site based and involves the communities in its formulation and enforcement. The second level comprises 'site specific management guidelines' specified in the national management plan. However, in all cases, the guidelines only form part of the licensing conditions.

The LRFF fishery can also be managed using various provisions of the *Fisheries Management Act 1998*. However, comprehensive management is best achieved through a fishery management plan as provided for under Section 28. Licensing conditions (Section 43) and Gazettal Notices (Section 30) can be invoked to cater for any specific restrictions on fishing.

Surveys

M'buke Islands — Manus Province

Two surveys were conducted during the trial stages of the live reef food fish from 1999 and 2001. The first survey was conducted at M'Buke Island, Manus Province, basically to identify spawning aggregations of target species and estimate the abundance of target species. The result of the survey was intended to assist the National Fisheries Authority make decisions on the development of the trade in Papua New Ireland. Unfortunately, the results indicated that M'Buke Islands alone couldn't independently make a viable operation. Consistent with the research findings, the M'Buke Island project had its licence terminated as a result. The survey was conducted jointly by 'The Nature Conservancy' (TNC) and the National Fisheries Authority.

Stock assessment survey — Tingwon Islands

The reef fish resources of Tingwon Island, New Ireland Province were surveyed during a one-week period between 31st July and 4th August 2000. The survey was basically to establish baseline data or records of fish species associated with reefs within the Tingwon group of islands in preparation for a live reef food fish trade. Reef food fish resources surveyed included species from the family: Acanthuridae, Balistidae, Carangidae, Haemulidae, Holocentridae, Kryptosidae, Labridae, Lethrinidae, Lutjanidae, Mullidae, Platacidae, Scaridae, Serranidae and Siganidae.

The main objectives of the survey were to determine for the reefs of Tingwon Island the:

- ▶ Species composition of food fish species that are utilised by the LRFF trade fishers such as the Serranidae and Labridae families
- ▶ Occurrence of species from these families within reefs in the Tingwon Island reef area
- ▶ Size composition of the main species (Labridae; *C. undulatus* and some Serranidae species) within the area.

The most common family of food fish species counted during the survey was from the families Serranidae (15 species), Acanthuridae (13 species) and Lutjanidae (10 species). These families had over 50 individuals recorded at most of the four areas surveyed.

The reef food fish species are abundant on the shallow reefs around Tingwon Island. All four areas surveyed around the island have an abundance of reef food fish species. Other results can be summarised as follows:

- ▶ The two families (Labridae and Serranidae) of reef food fish targeted by LRFF fishers occur in good numbers within the Tingwon Island waters.
- ▶ The family Labridae, species *C. undulates*, was found to have high densities and biomass as expected from an area that has had no high fishing pressure at the present time or in the past.
- ▶ The family Serranidae had a lot of species present in the waters of Tingwon Island. The most common species were not large species targeted by the live fish fishers. These species include *Cephalopholis urodela* and *G. albomarginata*. Live fish targeted species from the genus *Plectropoma*, *Eppinephelus* and *Variola* were found in very small numbers. This is probably due to these genera being very cryptic and diver-shy.

The survey provided much-needed information for the development of the site-specific management framework for the Tingwon island communities with a population of over 200 people.

Another survey was also conducted by TNC and the National Fisheries Authority in New Ireland Province, precisely within the reef areas of the live reef food fish affected communities. The survey recommended for actual spawning sites and potential spawning sites to be closed to all forms of fishing. The closed areas were reflected in the licence conditions for operating live reef food fish within the selected management areas.

Present catch records

The operation of LRFF trade in PNG was rather slow under the current management regime in 2001. Generally catch was low due to the transfer of know-how to the resource owners (Gisawa and Lokani, 2001). The current management regime only allows the locals to fish while the operators provide a market for the fishers. Operations of the trade in PNG require 100% observer coverage as outlined in the management plan. The activity is organised such that live fish carrier vessels act as platforms from which fishing is conducted. Specially designed dinghies are dispatched from the carrier vessels with two local fishers in each dinghy for each daily fishing trip. At the end of each day's fishing, fish are weighed and recorded for all dinghies. An average fishing trip takes about two to three weeks. Once the vessel is back at the station, the accumulative weight is calculated for each dinghy and the money equivalent is paid to the respective fishers.

Since its inception under the current management regime, the LRFF fishery has always been operated under one licence with multiple pick up stations at different provinces. It was not until in late 2004 when the second licence was issued. The latter licence operates out of Central Province and exports to Hong Kong by via Cairns (Table 8). The beach price offered to fishers varies between the two operators. The company exporting by sea offers slightly higher price than the one exporting by air, presumably due to the different cost involved.

Table 8. Live reef food fish export from the respective management areas under the current management regime.

Year	Milne Bay		Central		New Ireland		Total	
	Qty (Kg)	Value (PGK)	Qty (Kg)	Value (PGK)	Qty (Kg)	Value (PGK)	Qty (Kg)	Value (PGK)
2001	0	0	0	0	6 165.7	112,275.78	6 165.7	112,275.78
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	7 212	126,192.39	7 212	126,192.39
2004	14 278	337,650.41	0	0	0	0	14 278	337,650.41
2005	7 220	184,617.52	9350	71,861.99	0	0	16 570	256,479.51
Total	21 498	522,267.93	9350	71,861.99	13 377.7	238,468.17	44 225.7	832,598.09

There was no export recorded in 2002, as the quantity of fish kept in cages could not warrant a viable export. The species composition also differs between provinces and companies (Table 9).

The accumulative weight of live reef food fish exported out of PNG under the current management regime is over 44 mt valued at over K0.8 million (Tables 1 and 2, Figures 1 and 2). The annual average for export by quantity is around 7 tonnes valued at around US\$40,000. The common target species making up most of the export quantity is the leopard coral trout (*Plectropomus leopardus*) and brown marbled grouper (*Epinephelus fuscoguttatus*).

The fishery exports for the live reef food fish is expected to increase over the next years mainly due to an additional licence and the increase in the number of pick up points. The National Fisheries Authority will continue to investigate options for the aquaculture of the common target

Table 9. Species composition from export declaration and observer reports.

Species	2001		2002		2003		2004		2005		Total	
	Qty	PGK	Qty	PGK	Qty	PGK	Qty	PGK	Qty	PGK	Qty	PGK
Humphead wrasse	758.6	30,353.71	0	0	731	30,419.33	1 727	71,866.19	2 580	33,149.81	5 796.6	165,789.04
Leopard coral trout	0	0	0	0	0	0	9 447	211,680.5	8 901	173,040	18 348	384,720.50
Squairetail coral trout	827.4	15,891.17	0	0	987	15,797.06	1 669	32,055.06	321	6,678.94	3 804.4	70,422.23
Barramundi cod	45.3	1,812.58	0	0	0	0	0	0	0	0	45.3	1,812.58
Brown marbled grouper	3628	58,066.58	0	0	4071	58,641.17	0	0	568	10,000	8 267	126,707.75
Camouflaged grouper	0	0	0	0	1273	203,74.52	1 435	22,048.66	0	0	2 708	42,423.18
Mix grouper	109	1,046.74	0	0	0	0	0	0	4 200	33,610.76	4 309	34,657.50
Snappers (<i>L.argentimaculatus</i>)	627.4	4,016.65	0	0	0	0	0	0	0	0	627.4	4,016.65
Snappers (<i>L.rivulatus</i>)	170	1,088.35	0	0	150	960.31	0	0	0	0	320	2,048.66
Total	6165.7	112,275.8	0	0	7212	126,192.4	14 278	337,650.4	16 570	256,479.5	44 225.7	832,598.09

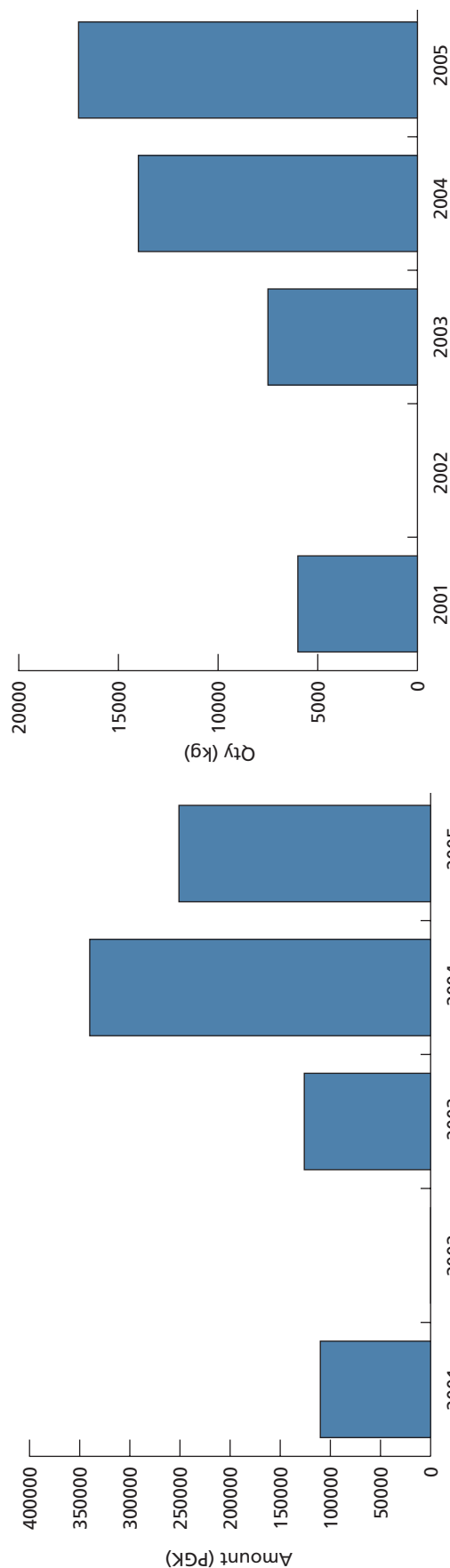


Figure 2. Annual export value for the live reef food fish operations in PNG.

Figure 3. Annual export of live reef food fish in PNG.

species. The aquaculture proposal will complement the current Asian Development Bank (ADB) Coastal Fisheries Development Project undertaken by Gillette, Preston & Associates (GPA), thus, rehabilitating Nango Island in New Ireland Province into a research station for coastal fisheries development in PNG. The National Fisheries Authority has allocated seed funding for the construction of the facility and GPA has been nominated to provide supervision on the construction of the facility. Once fully functional, the facility will provide research into post larval capture and culture of commercial species for the live reef food fish trade and the aquarium trade. At this initial stage, it is important to ensure that the coastal communities adopt the tradition of culturing fish, an activity totally different from the present practice.

The National Fisheries Authority's policy on the LRFF trade is to allow the fishery to develop under a very strict management regime as is the case at present. This policy gives effect to the National Government's export-driven policy in an attempt to stabilise the country's dwindling economy.

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4. The live reef food fish and ornamental fish trades in Kiribati

R.T. Awira¹

Introduction

Kiribati's marine resources have been utilised on a sustainable level for generations. Fishermen in the past fished for their daily needs and methods of fishing were more environmentally friendly and sustainable than today. There was no incentive to overfish as making a profit was not part of the way of life. The arrival of a cash-based economy to replace the subsistence-based economy has changed the way of life from one of living harmoniously with the environment to one where the environment is being degraded by the continuous effort to earn large profits. Fishermen today chase profits with little regard for the marine environment. Coupled with the need by government to provide good services, the marine environment has become the victim, carrying capacity is reduced and thus the abundance of associated living resources.

Kiribati's seafood exports have increased since 1979 post independence. Early development plans were directed at offshore fisheries; however, technical and financial problems have shifted the focus inshore. This shift took into consideration the accessibility of the inshore resource and the low cost of capital investment involved. More companies now operate in the inshore sector than offshore. In 1999, 18 companies were operating in the inshore sector compared with only six operating offshore (Fisheries Division, 1999).

Inevitably, this shift has increased the rate of exploitation of various coastal and reef resources to such an extent that these resources have been reduced to a critical level. For example, the giant clam, *Tridacna gigas* on four islands (Butaritari, Abemama, Nonouti and Tarawa) has been fished beyond its maximum sustainable yield (Tekinaiti, 1990), and is already an endangered species. Surveys conducted in 1999 on the black teat sea cucumber, *Microthele nobilis* and the white teat sea cucumber, *Microthele fuscogilva* on Butaritari, Abaiang, Abemama, Nonouti, Aranuka Tabiteuea North and Tabiteuea South showed that the density of these species has decreased due to excessive commercial exploitation (Kazu, 1999).

Although they are declining, marine resources remain an important part of the Pacific region's wealth. Countries like Kiribati will continue to depend on their marine resources for economic development to boost slow moving economies and improve living standards. The policy of the Kiribati Government (the previous government) of 'Kamaeuraon Te I Kiribati' (improving the living standard of the people) intensively promotes economic development in the marine sector. Through this policy, both local and overseas companies are encouraged to invest in the commercial exploitation of inshore and reef fisheries resources such as lobsters, octopus, aquarium fish, sharks (for their fins), sea cucumber and reef-fish. Recently, groupers have been exploited for live reef-fish markets in Hong Kong.

Country profile

People and population trends

The Republic of Kiribati (Figure 1), is a group of islands scattered over 5 million sq. km of ocean on either side of the equator and the International Date Line. All islands in the three groups are

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true atolls with the exception of Banaba, which is a raised limestone island. The total land area of the 33 islands is estimated at 822.8 sq. km with Christmas Island, which has the largest land mass of any atoll, comprising almost half of the total. All islands are low coralline structures with few elevations above 4 m. Kiribati is thus one of the nations whose existence is threatened by a possible rise in sea level due to global warming.

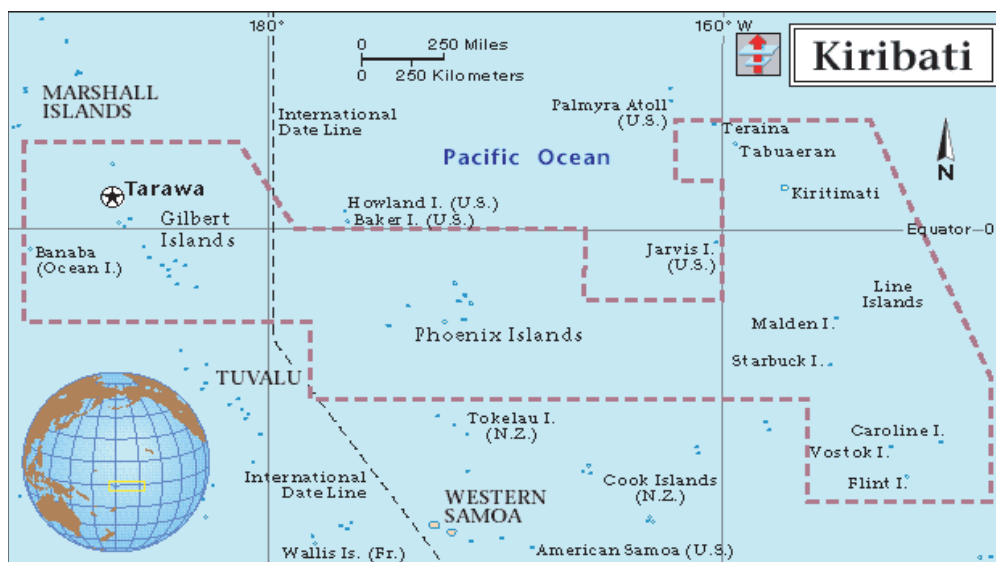


Figure 1. The Republic of Kiribati, atolls and islands.

The population of Kiribati (year 2000) is 84 955 with a de facto growth rate of 1.42 percent. About 37% of the population, classified as urban, are concentrated on South Tarawa. The rural population of 56% inhabits the periphery of the Gilbert Group. The Line and Phoenix Groups have about 8% of the total population. The total population density is 104 per sq. km (2000 census). The movement of the population from rural areas to urban centres, which is common throughout the developing world, is significant and could have serious implications on the social and economic situation of the country if left unchecked.

The economy

Kiribati is a 'Least Developed Country' with a subsistence-based economy and a growing cash sector (CPO, 2000). The national economic objective is the reorientation of the economic strategy in favour of a private-sector led development (Kiribati, [MFEP], 2000). Gross domestic output at factor cost, which broadly reflects the outputs of goods and services in a given year, stood at \$75,484,000 in 1999 with a growth rate of 5%. GDP *real per capita* was estimated at \$805 in 1999 compared to \$775 in 1995 (CPO, 1997; CPO, 2000). Income earnings are derived from external sources such as fishing licence fees, seamen's family allotment and the Revenue Equalization and Reserve Fund. The patterns of trade continue to exhibit a large deficit due to the high import bill, eg \$63 million in 1999 (CPO, 2000) compared with \$48 million in 1995 (CPO, 1995). Copra remains a major export item. Other export items include seaweed, handicrafts, shark fins and tuna while sea cucumber and pet fish contributed less than one million dollars each in 1996. Recent trade reports have shown the potential contribution of marine resources and small-scale industries

to reverse the trade imbalance. Despite large trade deficits, the overall balance of payments is positive with rising net factor incomes, continued development transfers and flow of fishing licence revenues. The scale of government expenditure relative to GDP is enormous, accounting for more than 42 per cent of GDP at factor cost.

The government's position has been a cautious fiscal policy with the economic strategy focusing on the development of the private sector. Although Kiribati is endowed with a high Exclusive Economic Zone resource potential, there is a need to develop its productive sector including marine and fisheries resources. The government is aware of the potential role of the 'cooperators' of growth, ie the local and foreign investors, and its medium-term investment scenario is to actively involve such cooperators within the framework of a private sector led development strategy (CPO, 2000).

The live reef food fish trade

The LRFF trade commenced in Kiribati in 1996. The trade was practiced on Nonouti, Tabiteua north and Onotoa in the southern Gilbert Group and, in 1998 and 2001, expanded to include the northern atoll of Butaritari and Abaiang (Figure 1). Three companies were involved in the trade; one registered as locally based (Marine Product Kiribati Ltd, MPK) while the other two were registered as foreign-based companies (China Star and South China Sea). Towards the end of 1999, MPK and China Star ceased operations when ciguatoxic fish were found in the exported catch, leading to hospitalisation of many people in Hong Kong.

The fishery itself was in its infancy and with the effort now being applied to coastal fisheries there is a concern that the sustainability of these resources is being compromised by the need for economic development. But as economic development is a priority, fisheries agencies are left with no choice but to develop management regimes that are compatible with economic development. For pelagic fisheries this is not a difficult task but for coastal fisheries it is very difficult and will require careful management and a strict monitoring plan.

The export figures (Figure 2) for the trade from Kiribati for the three companies show an increase in the level of export from 1996 to 1999. The highest ever recorded from the trade was almost 24 tonnes valued at A\$0.76 million. This value is based on the average wholesale price for groupers, obtained from the Fish Marketing Organisation (FMO) in Hong Kong for the month of September 2003.

A look at the production level of the three companies (Figure 3) shows that throughout its four years of operation MPK exported a total of 23.03 tonnes while China Star during its two years of operation exported a total of 26 tonnes.

An examination of the level of catch from each island (Figure 4) from 1997 to 1999 shows a dramatic decline in the level of production from the island of Tabiteua North, which is an island in the Southern Gilbert Group, where MPK was based. With no proper monitoring program in the early stages of the trade there is no way of knowing how many fish were caught and how many died during captivity. In looking at the declining trend from the island, it is apparent that the fishing intensity was very high and mortality during captivity was also very high, resulting in a very low volume of export from the island. On Butaritari the situation was reversed, the level of export was higher than for Tabiteua North and continued to increase in the second year of operations.

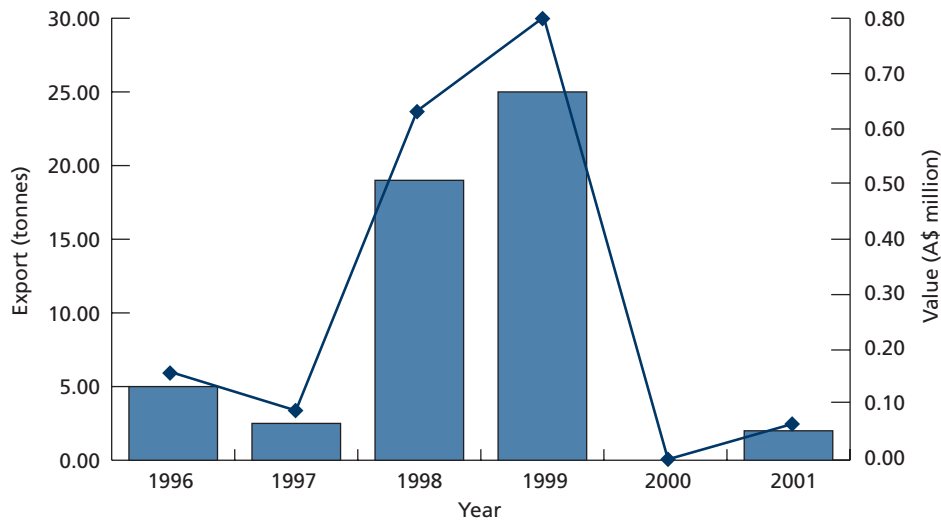


Figure 2. The overall export figures and the value of export in A\$ for the live reef-fish trade from Kiribati to Hong Kong from 1996 to 2001.

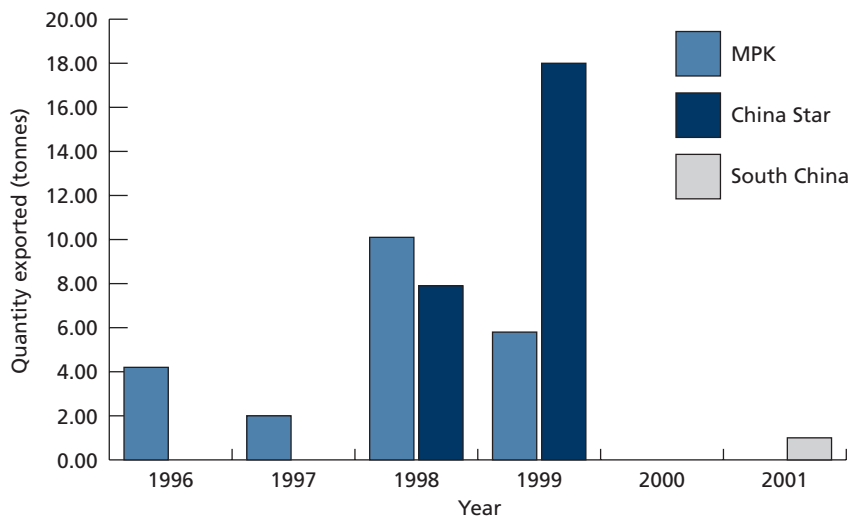


Figure 3. Export figures by companies involved in the trade from 1996 to 2001.

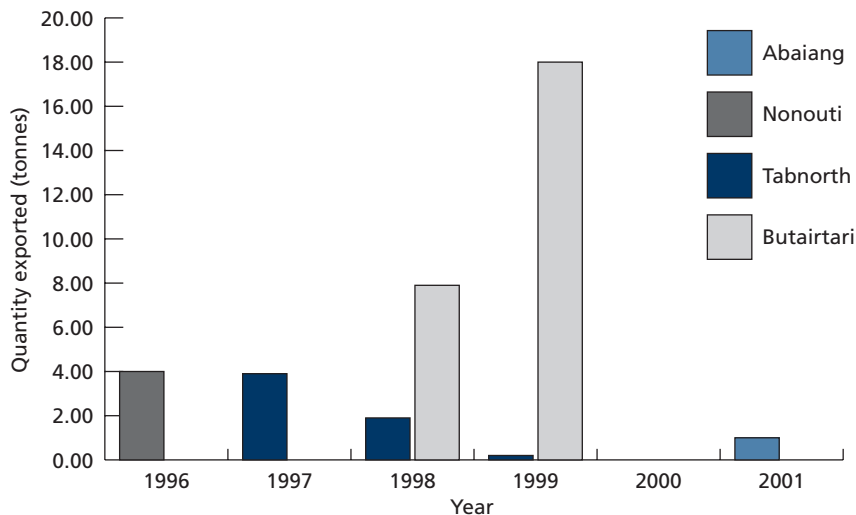


Figure 4. Live reef-fish production by island exported to Hong Kong (1996–2001).

Without any prior knowledge about the level of catch that has been harvested from Tabiteuea, the declining trend shows that fishing intensity was very high and has affected the population structure of the grouper fishery. The low volume of exports from the island during the company's four years of operation is further evidence of the high mortality rate during captivity.

This was further confirmed at the marine biodiversity workshop held on the island in 1999 where it was reported that local fishermen were seen intensively harvesting the grouper resources from the adjacent coastal reef. In their pursuit for profit, they deplete the grouper stock from the nearby reefs and are then forced to more distant fishing grounds. It was also reported that fishermen had been seen fishing for grouper in known ciguatera areas in the southern part of the island (Tabiteua South). It is this irresponsible act that has damaged the credibility of the trade, following the outbreak of ciguatera poisoning in Hong Kong in 1999. This resulted in China Star leaving the country and MPK pulling out of the trade, and thus the collapse of the trade in the same year (Tebano and Awira, 2000). The dramatic decline in the level of grouper catch from Tabiteuea is obvious when compared with the catch from Butaritari. Wastage through mortality was high, a problem further compounded by the lack of a fisheries assistant stationed on the island. On Butaritari there is one fisheries assistant on the island who monitors the operators on a daily basis.

The export figures (Figure 5) show that the major portion of export comprised mostly serranids (comprising *Epinephelus*, *Cephalopholis*, and *Plectropomus*) with 85% and the wrasses (which included only *Cheilinus undulatus*) with 15% of the total volume exported from 1996 to 2001.

In 2001, a foreign-based company started operating on Abaiang, but after sending one shipment to Hong Kong and for no apparent reason, the company did not return. No further activity has occurred.

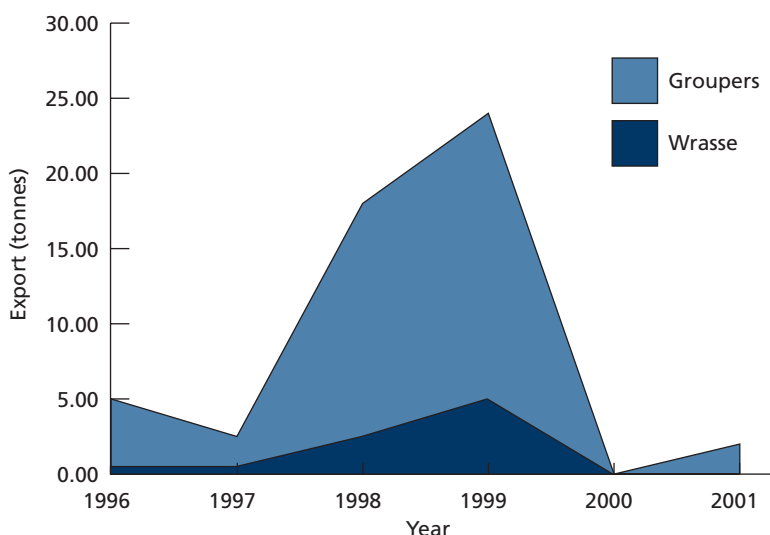


Figure 5. The composition of live fish exports (1996–2001).

The ornamental reef fish trade

The ornamental reef fish (ORF) trade commenced in Kiribati in early 1980. The trade was practiced on Tarawa in the Gilbert Group and, in 1989, expanded to include northern Christmas Island in the northern Lines Group. In late 1990, the operation on South Tarawa was closed, leaving Christmas Island the only island in the country involved in the trade. Christmas Island is the largest coral atoll (321 sq. km of land and a lagoon of 160 sq. km) in the world with an

extensive coral reef that harbours a variety of the most sought after species in the pet fish market. Six pet-fish operators with export licences operate on the island.

The Fisheries Division on the island is monitoring the operators' activities by collecting their export data and carrying out routine checks on divers to ensure that proper gear is being used to collect the fish and that divers are not damaging reefs. Despite the monitoring, divers were still harvesting the resource without regard for the marine environment. There have been numerous reports of pet-fish divers wrecking the reef but no actions have ever been taken to penalise them.

This lack of action because there are no proper legislative measures to control this fishery leaves the Fisheries Division with no legal authority to bring the divers to court.

There are now seven licensed companies involved in the trade (Table 1), most of them locally owned and exporting their catch to Honolulu and mainland USA. These operators pay a licence fee of AUD 1,800 year to harvest and export pet fish. Table 2 shows the number of pet fish exported from Christmas Island in 2002.

Table 1. Companies involved in the LRFF trade operating from Christmas Island.

Company	Status
Aveteba	Local company
Kabua Pet Services	Local company
Marine Beauties	Local company
Moving Colours	Local company
Marine Petfish Resources	Local company
Willie & the Divers	Local company

Table 2. Fish families, market value, volume exported from Christmas Island and value of exports for the year 2002.

Family	Ranking	Price per piece (A\$)	Export (pcs) in 2002	Value of export (A\$)	% Volume
Chaetodontidae	1	48.39	156	7,548.29	0.12
Tetrodontidae	2	35.39	192	6,795.74	0.15
Acanthuridae	3	14.67	4 051	59,444.37	3.10
Balistidae	4	7.79	1 361	10,597.43	1.04
Serranidae	5	6.54	2 967	19,402.70	2.27
Labridae	6	6.37	373	2,374.33	0.29
Pomacanthidae	7	5.89	114 130	671,883.31	87.47
Lutjanidae	8	4.12	716	2,948.49	0.55
Pomacentridae	9	3.54	6 533	23,113.75	5.01

The four main pet-fish species exported from Kiritibati are angelfish (Family: Pomacanthids), tangs and damselfish (Pomacentrids), wrasses (Labrids) and butterfly fish (Chaetodontids). These are exported to Honolulu. Based on 2002 export figures, nine fish families were exported and Chaetodontids had the highest value (Table 2). In the same year, 130 479 fish were exported with a total value of AU\$804,104. From that total, 87% (114 130 fish) were of the Pomacanthidae family (Angel fish) and valued at AU\$671,883.

The increased number of pet fish exported in the past seven years (Figure 6) reflects an increase in the effort exerted on the fishery and improved fishing techniques and storage, which reduces the mortality of pet fish harvested and thus leads to an increase in the number exported. The value

of pet fish exported in 2002 totalled AU\$0.80 million, a decrease of 9% from the 2001 figure of A\$0.88 million. There is no strong declining trend in the volume of exports observed since 1994 but the overall trend shows that exports fluctuate from year to year, increasing in amplitude every three to four years.

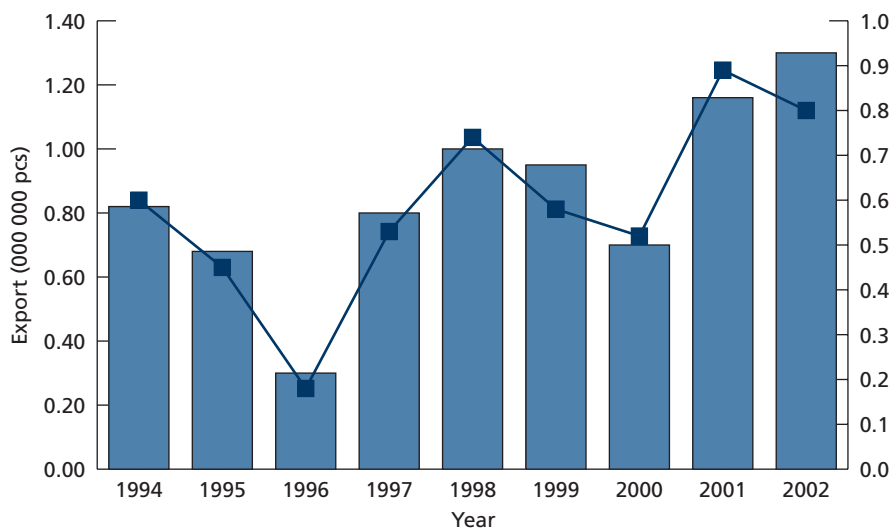


Figure 6. Number of petfish exported from Christmas Island and the value of trade (1994–2002).

The vulnerability of reef fisheries and the need for proper management

To determine the vulnerability of the coastal resources to any form of commercial fishing and to implement appropriate management guidelines it is important to study the biological traits of fish species targeted. From various research it was apparent that reef associated fish are long-lived, slow growing and have relatively low rates of natural mortality (Ferreira and Russ, 1993). Comparison of life traits of pelagic fish and coral reef fish (Table 3) shows that pelagic fish are more tolerant than reef fish to any form of commercial fishing.

Table 3. Comparison of biological traits between reef and pelagic fish species.

Pelagic fish	Reef fish
Highly productive and breed all year round by controlling release of eggs at different sites. Gonads are large and contain millions of eggs, eg one fish weighing 12.5 kg will produce eggs equivalent to 212 fish weighing 1.1 kg.	Small gonads and therefore less productive.
Fast growing, it was estimated that a skipjack could reach 4.5 kg in its first year and 14 kg in its third year.	Slow growing, the average weight obtained annually is no more than 0.5 kg. A grouper weighing 50 kg is estimated to be more than 10 years old.
In their vast ocean area, finding food is easy as they can migrate from one area of high food concentration to another.	The reef area is very limited and thus competition for food is very high.
Egg predation is low as the eggs are dispersed in a vast area.	Egg predation is very high as most eggs are used as food by other marine organisms living in the reef ecosystem.
There are no sex changes involved within a population.	1. Sex changes do occur.

Adapted from Birkeland 1997.

The vulnerability of inshore fisheries, especially reef fish, highlights the importance of coral reefs. Most of the organisms that live in the reef coexist in a delicate ecological balance (Sluka *et al.*, 1998). Characteristically, a small number of large males are dominant over a large number of females in one area of the reef, making coastal and reef fish very vulnerable to commercial fishing. As fishing selectively removes larger individuals from a population and can affect the abundance, size structure, and reproductive potential of the population as males are removed from the female population (Sluka *et al.*, 1998).

The over-exploitation of the grouper species in Palau in the early 1990s as reported by Birkeland (1998) shows that these fish species are very vulnerable to commercial fishing. In Puerto Rico, for example, grouper landings have declined from 386 mt in 1974 to 47 mt in 1978 (of which 38% were *Epinephelus guttatus*). Analysis of yield per recruit shows that commercial fishing in that country has led to over-fishing of the target species (Sadovy *et al.*, 1992).

From the above experience it is obvious that commercial fishing in the coastal and reef environment is not sustainable. However, in countries where subsistence and economic development depend heavily on the marine environment, these resources are often seen as the only way of meeting both economic and subsistence needs. With this perception there is a need to maximise benefits derived from these resources and properly manage these resources to ensure that benefits flow to the community on a long-term basis.

Fish species such as groupers (especially large groupers) are not favoured by the local community although if these fish are caught they are normally eaten. The most favoured reef fish species targeted for local subsistence and commercial use are snapper, emperor, trevally, deep-bottom fish, pelagic fish species and lagoon fish species such as mullet and bonefish.

Commercial exploitation, when properly managed and monitoring schedules are followed will benefit both the local community and exporters in the long term.

Existing management measures to ensure sustainable use of resources

Legislation is already in place to protect natural resources in Kiribati. This includes Fisheries Ordinance (1977) which provides for the regulation and conservation of fisheries resources and Prohibited Areas Ordinance (1957) which permits designation of environmental conservation areas, the Local Government Act 1984 which restricts activities that will cause destruction to natural resources and the Environment Act 1999 which provides for the protection, improvement and conservation of the Environment of the Republic of Kiribati.

A marine conservation area has been designated in the Kiribati Group on South Tarawa where one-third of the population lives. This area encompasses the spawning grounds for the most sought after species, bonefish. Plans are underway to establish more marine conservation areas in Kiribati and on Christmas Island in the Line Islands. The purpose of these conservation areas is to enhance the survival and existence of both terrestrial and marine flora and fauna. These areas will also serve as another enhancement site for the most sought after species such as bonefish, giant clams, and turtle including other endangered species. There do also exist, by-laws regulating fishing activities on outer islands. On Tamana (reef island), trolling and fishing using motorised canoes is not allowed. Abaiang ban the taking of pearl oyster shells from the lagoon.

The Environment Act 1999, which has been passed by parliament and used and implemented by the Environment Division, will no doubt provide a general approach to the conservation of marine resources throughout the country. However, this Act will only provide a general and broad remedial approach — a more specific and direct approach is required to deal with the resources

not covered by the Environment Act. As part of the Act, environmental impact assessment procedures will be produced for all development activities, which will help minimise their adverse impact on the environment and natural resources.

As well as the existing legislation, other initiatives exist to educate the public about the importance of marine resources and the need to conserve or protect them. During 1998, general science covering coral reefs, mangrove and fisheries resources have been incorporated into the primary school curriculum. Local communities have also participated in the formulation of the National Biodiversity Strategic Action Plan. Information on the importance of marine resources and the need to protect them was also disseminated to the local community.



Geoffrey Muldoon

Giant groupers, such as these in a Hong Kong restaurant, are very vulnerable to commercial fishing.

Major issues

The problem of management in an open access fishery

The origin of an open access concept was first adopted in the 15th Century when the world was being colonised. The Roman concepts (the basis of all European laws) such as *res communis* (common to all and therefore open to all) as opposed to *res nullus* (owned by no one and therefore can be claimed) were utilised in the development of new concepts such as Hugo Grotius *Mare liberum* (complete freedom of the high seas for the innocent use and mutual benefit of all) and Selden's concept of *Mare clauseum*, which asserts that the sea is capable of appropriation. These concepts were the roots of today's approach to the exploitation of marine resources. These concepts have shaped modern international laws such as UNCLOS I and II and the modern usage of our coastal and reef areas and resources in the Pacific region.

In the Pacific the concept of *res communis* was very new as most islands adopted the traditional marine tenure system, which had sustained their marine resources for time immemorial. In some Polynesian and Melanesian countries the system is still intact while in some Micronesian countries it is no longer used. In Kiribati, for example, the marine tenure system was discontinued during the colonisation of the country from 1892 to 1979. Yeeting and Johannes (1995) stated that since the departure of colonial officials, no formal registration of marine tenure rights has been undertaken. This lack of action apparently occurred because the colonial administration favoured the principles of open access, ie fishing was allowed anywhere and at any time irrespective of traditional norms (Macdonald, 1982). The local concept of marine rights was contrary to the British notion of public rights regarding the sea and its resources, the ownership of which were vested in the crown or state.

The introduction of this foreign concept dramatically changed traditional ways of thinking and principles of living within one's means and harmoniously with nature and promoted the concept of materialistic wealth. The sea became regarded as the property of the state and therefore open to all. In the pursuit of increased economic wealth and sustaining daily protein intake, combined with the need to commercially develop the coastal and reef fisheries by local and overseas investors, as encouraged by government policy, inshore and reef fisheries are being massively exploited, putting enormous pressure on some of the lagoon and reef resources.

People are moving away from their traditional culture of living in harmony with nature and are contributing to the degradation of the environment by competitively harvesting the marine resource.

Marine resources have become an important part of development in the Pacific region. For countries like Kiribati, land-based resources are limited and the government will continue to focus its attention on utilising marine resources to provide an alternative source of income for the disadvantaged sector of the population, who reside on the outer island. The government policy 'To increase prosperity and share it fairly among the people of Kiribati' will promote maximising benefits from the country's marine resources as a means of achieving its commitments to the people. Through this policy, local people will be encouraged to commercially harvest their marine resource. The establishment of fish collection and product development centres will provide incentives for fishermen to maximise benefits from their marine resources.

To achieve this policy and ensure that benefits are maximised on a long-term basis, the vulnerability of marine resources will have to be considered, especially in Kiribati where economic development is regarded as far more important than the need for conservation. The challenge for fisheries departments is to devise ways of commercialising marine resources in a sustainable way.

Management and monitoring issues

As outlined above, the cause of over-fishing lies in the open access nature of Kiribati's fishery which has led to competitive harvesting by commercial fishermen, both rural and urban. On the island of Tabiteuea north, for example, over-fishing has led to groupers from nearby coastal reefs being fished out and fishermen moving to the next island (Tabiteuea south).

The problem is not restricted to the outer island but is even worse on the capital island where fishermen have to travel to neighbouring islands such as Abaiang in the north and Maiana in the south to fish for reef fish such as snapper, which are in high demand on the capital island. The movement of urban Tarawa fishermen to neighbouring islands is an indication of the declining size of sought after reef fish such as snapper and emperor on the capital island. Stock size will continue to decline as no management or monitoring guidelines have been developed to combat the problems.

The development of fish collecting centres on six of the outer islands to improve the income earning capacity of the rural community will shift the focus from one of using coastal and reef fisheries to meet the communities' subsistence needs to one of utilising the resource for both daily and commercial needs. There are plans to extend this development to other islands and so the problems will also spread, exposing those fisheries to uncontrolled and intensive fishing as experienced on the island of Tabiteuea North.

The difficulty in collecting accurate data from LRFF operators was due to the absence of proper monitoring and management guidelines, the lack of knowledge about the trade and the absence of fisheries assistants on some islands where these operations are being carried out. In the

absence of fisheries assistants on islands targeting the trade, the collection of accurate data and the effective implementation of the monitoring program could not be carried out. This was the case on Tabiteuea for example. In the absence of a fisheries assistant, fishermen were not properly informed about the impact of intensive fishing on the coastal and reef fishery and the need to properly manage those resources for long-term benefits.

Monitoring of the pet-fish fishery was ongoing and carried out by staff of the Fisheries Sub Division, based on Christmas Island; however, monitoring effort was restricted to the volume of catch landed and the quantity exported. The lack of monitoring of the fishery was the direct result of the shortage of qualified staff on the island and the absence of the proper survey tools required to monitor coastal and reef resources.

The lack of qualified support staff, proper field work support facilities such as underwater survey equipment, office support facilities and public awareness support materials were some of the setbacks restricting the sub division from carrying out proper monitoring and management guidelines appropriate for the fishery.

The fishery has been operating for almost 10 years and there is concern that the number of high-value species has declined (Fisheries Division, 2002). As the high-value species decline, fishing intensity will be increased on lower-value species. This trend is reflected in the 2002 export figures, where some low-value species of Pomacanthids (ranked seventh in the species value listing for Christmas Island) had the highest number of exports, with more than 100 000 fish exported in 2002.

Another problem for coastal and reef resources on Christmas Island, which will have a dramatic impact on the pet-fish fishery on the island, is the influx of people from the Gilbert Group. These new arrivals, unlike the people who were born on the island, are used to competitive fishing and are not familiar with sustainable fishing practices. There is concern that the immigrants will not respect village and community rules, imposed to conserve the marine resource.

During a biodiversity workshop held on the island, the Pet-fish Operators Association and the Tour Guide Association reported that some of the Gilbert Islanders had been seen fishing for bone fish and other reef resources in large quantities to sell to the capital island, without regard for the local community's effort to conserve these resources (Tebano and Awira, 2000). If this continues, the local community is likely to adopt the attitude that 'what's good enough for one is good enough for all' and the conservation principles which had been practised will lapse.

Legislation

The basic fisheries law in Kiribati is the Fisheries Ordinance (Cap. 33) which was enacted in 1977 to replace the 1946 Fisheries Ordinance. Since 1977, the Ordinance has been amended three times, in 1978, 1983, and 1984. Under the Ordinance, the Minister may take such measures as he sees fit to promote the development of fisheries and fishing in Kiribati to ensure that the country's fisheries resources are exploited to the full for the benefit of the people. The Minister can appoint a chief fisheries officer and licensing officers to carry out the provisions of the ordinance. The ordinance confers upon the President, acting in accordance with the advice of the Cabinet, wide powers to make regulations relating, *inter alia*, to the licensing of foreign fishing vessels, the conditions to be observed by foreign fishing vessels, the conservation and protection of all species of fish, prohibited fishing gear and methods and the organisation and regulation of marketing, distribution and export from Kiribati of fish and fish products.

Although the ordinance places responsibility on the Minister to promote the development of fisheries and fishing in Kiribati for the benefit of the country, it has not stipulated provisions for the conservation and protection of the resource or the need for sustainable development.

The ordinance is also deficient in providing guidelines for fisheries management planning and development. Other countries, such as Vanuatu, Tonga, Cook Islands and Western Samoa have placed more emphasis on including planning provisions in their legislation.

Conservation has not been one of the primary objectives of the current legislation. Although there are legal provisions relating to conservation, they are scattered among several pieces of legislation.

The Ordinance prohibits certain fishing methods and practices such as the use of explosives, poisons and noxious substances. The Ordinance also makes it an offence to possess these materials where it is suspected that they will be used for fishing. The President has been given powers to make regulations providing for, *inter alia*, conservation and protection of all species of fish, the establishment of closed seasons for any area or species of fish, placing of limits on the amount, size or weight of fish which may be caught, prohibition of certain types of fishing gear or methods, minimum mesh sizes for nets, and the prohibition of any practices or methods which are likely to be injurious to the maintenance and development of a stock fish. To date, the Fisheries Conservation and Protection Regulations 1979 are the only regulations made under these provisions. This Regulation provided minimum sizes throughout Kiribati in respect of rock lobsters.

Kiribati is a party to the Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific Region. Legislation has been passed to give effect to the provisions of the Convention.

Under the Wildlife Conservation Ordinance, any area can be declared a wildlife sanctuary. Fish however, are excluded from the protection of this legislation. The Ordinance has created an offence of hunting, killing or the capture of wild turtles on land. It is an offence to take turtles from the sea. There is no regulation controlling the trade in turtle meat, eggs, skin and shells. The green turtle is protected throughout the Line and Phoenix Islands and this protection extends to their nests and eggs as well as prohibiting possession of and trade in eggs, shells and meat. Again, there is no protection of green turtle at sea.

Even though management and conservation measures are being accommodated in these various Acts. This legislation is outdated and not sufficient for strict monitoring and successful management of the coastal fisheries. The view in 1977 when the Fisheries Act was prepared was one of development of marine resources at all costs with little regard for conservation of the resource.

Despite its limitations in the conservation of fish, the Fisheries Act does provide for the development of regulations conducive to the sustainable management of the coastal and reef resources which are vested under the President's power with the advice of Cabinet (Pulea and Farrier 1994).

In the review of the Fisheries Act, Pulea and Farrier (1994) further state that the fisheries legislation contains essential structural elements for the effective management of the coastal, reef and pelagic fisheries. Under the existing Fisheries Ordinance and local council bylaws, regulations for the conservation of fish and crustacean stocks can be enacted and the way paved for imposition of output control measures such as size restriction catch quotas and closed seasons.

Important issues for consideration

The open access nature of the coastal and reef fisheries in Kiribati promotes competitive fishing between commercial and subsistence based fishermen. The dramatic decline of grouper stock on Tabiteuea when the LRFF was operating indicates that those fish species are vulnerable to intensive and uncontrolled fishing.

The ornamental reef fish trade is an important fishery, which brings in essential export income for the country. But, with the declining number of high-value species exported annually, there is a concern that the stock size of high-value fish species will continue to decline if an effective monitoring and management framework is not developed.

The government, through its policy of 'Increasing prosperity and sharing it fairly among the people' will continue to promote the development of both inshore and offshore fisheries. This will mean that fisheries trades, such as the LRFF trade, which have been suspended, will be revived, and local and overseas joint venture programs will be encouraged to develop these fisheries to generate economic activity in the rural sector. There is not a big local demand for grouper and pet-fish species so there is ample opportunity for the commercial development of these fisheries, provided that management and monitoring plans are in place and enforced by law.

The current fisheries legislation does provide essential elements required for the development of effective management regulations, however, implementation and enforcement of these regulations is a matter of concern. For the conservation of coastal and reef resources the legislation can be utilised to develop management and monitoring plans for ongoing fisheries ventures such as the ornamental reef fish trade, where urgent remedial action is required to sustain the availability of the resource and thus the benefits derived from it for current and future generations.

With the government's plan to re-open Christmas Island for re-settlement there is an urgent need to develop proper monitoring and management plans that will serve the interests of the various resource users and also ensure that coastal resources are harvested in a sustainable manner. As one of the famous destinations for fly fishermen, which brings important foreign exchange into the country, all commercial fishing activities in the coastal and reef areas on the island should be properly and thoroughly monitored to ensure that the owners of the resource are not disadvantaged and that government revenue generated from tourism is not affected.

Conclusion

To commercially harvest the coastal and reef resources in a sustainable way, monitoring and management frameworks are needed before any commercial activity is undertaken.

The LRFF trade in Kiribati is now on hold but with the government committed to maximise benefits from marine resources there is a strong indication that the trade will be revived along with the commercial development of other coastal and reef resources. The problem encountered on Tabiteuea North was the direct result of poor monitoring and management which need not occur when the trade resumes. The placement of fisheries assistants on all islands targeted for fisheries development is an important component of effective monitoring which should be implemented before commercial fishing takes place.

Fish species found in the coastal and reef environment have very complex lifecycles, which will require management and monitoring strategies that will consider not the fish itself but all other factors that are related to the survival of those fish species. Once all those interaction are taken into consideration they can assist in the formulation of management and monitoring guidelines appropriate for groupers and petfish.

The falling catch rate of high value species targeted in the ORFT is an indication that fishing intensity is high and needs to be urgently regulated to allow the fishery to recover to its optimal size.

The government policy does promote the development of our fisheries resources and to ensure that government objectives are achieved adaptive management should be implemented to ensure that the coastal and reef fisheries are harvested to maximise benefits on a long-term basis.

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5. Summary of important events in the development of the live reef food fish trade in the Solomon Islands

Peter Rex Lausu'u¹

History

The trade was started in Vella La Vella in the Western Province in 1994 by IKA Holdings Ltd. It was initially a year-round operation but this proved unviable due to large post-harvest losses. The trade involved pulse fishing, targeting seasonal grouper spawning aggregations. These methods were adopted, first in Marovo then in Roviana Lagoon. The company subsequently expanded operations to Ontong Java in 1996. There were no size limits on the fish taken and the method used was hook and line.

In November 1997, the Fisheries Department realised the urgent need to develop a strategy for sustainable management of the fishery, to avoid problems such as were experienced in Indonesia. ACIAR was requested to formulate a management plan for the country and in February 1999, a moratorium was imposed on all new live fish export licences. Primarily, it was fishing during spawning aggregations that was the catalyst for immediate action to develop a strategy to manage the live reef food fish (LRFF) trade. In November 2000, the moratorium was lifted and in March 2001, three live fish export licences were issued for a one-year operation although none of the licence holders operated.

Importance, value, number and size of operators, important species and main markets

The LRFF trade-based fishery is not a large fishery in Solomon Islands. As at March 2005, no licence had been issued and there was no operation. When operating, the main species targeted are: *Plectropomus areolatus*, *Epinephelus fuscoguttatus* and *Epinephelus polyphekadion*. These species aggregate to spawn according to overlapping parameters in time and space, but the season that the aggregations occur varies regionally within the Solomon Islands. Sites are generally deep-water passages and are relatively easy to identify.

The main market is Hong Kong. The prices paid by IKA Holdings Ltd from 1994 to 1996 ranged from \$3.50/kg to \$5.50/kg, with a 50 cent additional payment on total kg being paid to a community fund.

The three operators with licences are: Philma Export Fisheries, Pacific Suppliers Ltd. and Williams International. Their new price was \$25/target fish species at reasonable size. Although the moratorium was lifted, there have been no fishing activities since 2002 as prices offered by operators are too low compared with other countries.

Current management arrangements

The current management provides for the licensing of operators. It places the customary rights holder as pivotal to licence issue and only allows for sea-freight operations.

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Problems encountered include:

- ▶ purchase of live catch only during period of seasonal spawning aggregations
- ▶ under-valuation of and under-payment for fish
- ▶ under-reporting of exported fish
- ▶ high post-harvest mortality
- ▶ no marketing arrangements for catch of non-target species.

Current licence application procedure

Any licence applicants are required to seek approval for the operation from the Foreign Investment Board. They are required to negotiate agreement with the customary rights holder and apply for a provincial business licence from the Provincial Government. They must also apply for a fish processing establishment licence from the Department of Fisheries and Marine Resources.

Problems with current licence application procedure

In theory, the process is sound. However, the process of application is loose. It lacks legal safeguards for customary rights holders due to: agreements being very basic and customary rights holders often not being adequately advised before signing legal documents. It does not compel the applicant to safeguard fish stocks due to: operators unrestricted from purchasing fish during periods of peak spawning activities and no long-term incentive to maximise efficiency because operational and export arrangements need minimal capital outlay. It also lacks adequate means for monitoring and enforcement due to: poor recording of catch details and export figures, inadequate on-board monitoring and overly heavy reliance on the poorly resourced Fisheries Department.

Proposed management arrangements

These will require a management and development plan as required under Section 7 of the *Fisheries Act 1998*. One has now been drafted, but is pending formal endorsement by the Fisheries Advisory Council (required under the *Fisheries Act 1998*) before implementation.

Two main strategies are licence limitations and area closures. Licence application procedure would remain unchanged but strengthened. Licensing of operators will place the customary rights holders as pivotal decision-makers in the issue of licences. A mandatory licence condition would be the closure of identified spawning aggregations of key species to all fishing for a specified period. Licensing will also provide incentive for the adoption of air-freight operations and longer-term operator commitment. Management control of the fishery will be decentralised and a co-management approach implemented. This means the Fisheries Department adopts an advisory role and monitors compliance of licence conditions. Ongoing participatory monitoring of spawning aggregations of key species will occur.

Reef owner agreements

Prospective operators must give 30 days notice to customary owners that they wish to enter into negotiations for a reef owner agreement. This must be consistent with such agreements throughout the Solomon Islands, and present an operational plan outlining all details (e.g. prices

offered, village royalties, net cage placements, price and purchase of by-catch species and any employment/training opportunity).

A security bond must be paid by prospective licensees to ensure royalty payments and other commitments negotiated as part of the agreement. There must be identification and documentation of spawning aggregations of key species within the area subject to the reef owner agreement and then subject to mandatory closure for five days before and five days after new moon during three months of peak spawning activity in that area. This will apply to all fishing and all species for three-monthly periods of 10 days. The terms of agreement must not conflict with national or provincial policies and must be endorsed in the presence of an authorised fisheries licensing officer. Additional conditions can be negotiated by customary owners, including species restrictions if such measures are deemed necessary.



Mike Rimmer

Epinephelus fuscoguttatus is a medium-priced species in the live reef fish trade. It survives well and grows rapidly in culture.

Licensing

Mandatory overriding licensing conditions will mean that there will be no purchase of live fish during the period subject to closure of identified spawning grounds for key species.

Licensees must carry observers, on request by the government for scientific compliance, monitoring or other functions and cover specified costs associated with observer coverage.

Licensees must ensure that detailed daily records, pertaining to catches and purchases, are maintained in a compulsory logbook which must be submitted to the Fisheries Department on a monthly basis.

Main challenges and problems and how they are addressed locally and regionally.

The main challenges are:

- ▶ modern fisheries legislation has no guidelines for adherence or application for inshore commercial fisheries;
- ▶ a poorly resourced Fisheries Department with irregular contact resulting in a lack of advocacy between the Fisheries Department and village fisheries;
- ▶ small-scale live fishery with no immediate problems apparent with sustainability except for high post-harvest losses;
- ▶ relatively high returns for village fishers in areas of growing cash dependency which affects the political will to restrict live fish operations;

- ▶ pulse fishery that intensively targets grouper spawning grounds;
- ▶ lack of market for the non-target species;
- ▶ no incentive for long-term commitment by operators because capital costs are minimal.

Useful lessons learned and successes in efforts to address these challenges

The Fisheries Department has been inadequately resourced to properly manage commercial inshore fisheries. The customary owners are eager to take formal management control of commercial exploitation of resources within marine estates. The customary owners concede that technical advice is often necessary from the Fisheries Department, i.e. there is a strong basis for co-management. Customary owners want simple management guidelines that allow some flexibility. A landmark unanimous agreement was reached at the final management workshop with regards to the protection of grouper spawning grounds and the manner in which that protection should manifest. Present at that workshop were customary owners, LRFF trade operators, scientists, fisheries officers, NGO representatives and other interested parties. Ongoing participatory activities from the Fisheries Department are designed to promote advocacy, including monitoring spawning grounds and community extension.

Country's priorities and needs in dealing with LRFF trade, including future plans

Formal endorsement of the newly drafted management and development plan by the authorities and subsequent implementation are required, as is finalising the LRFF trade regulations as part of the *Fisheries Act 1998*. There is a need to activate the spawning aggregation monitoring program by: identifying and mapping spawning grounds within areas subject to reef owner agreements, to establish a feedback loop between fisheries officers and resource owners regarding the state of aggregations and the implications for managing fishing effort, and conducting underwater visual census training technique during the ACIAR Project. Also there is a need to activate village level workshops in live fish handling, husbandry, storage and transportation to reduce post-harvest losses.

There is an ongoing need for training in the appropriate management techniques, to be conducted in a train-the-trainer format during the ACIAR project. Currently this cannot be implemented due to lack of resources in the provincial Fisheries Divisions. Also, there is a need to conduct structured community awareness regarding the reproductive biology of the main target species and the consequences of intensively fishing spawning aggregations. This is likely to be conducted in conjunction with village-level best-practice workshops.

6. A socio-economic perspective on live reef fish for food trade for small-scale artisanal fishers based on case studies from the Pacific

Mecki Kronen¹, Samisoni Sauni¹, Lilian F. Sauni¹ and Aliti Vunisea¹



Komodo, Indonesia, loading live fish for transfer to Bali.

This summary highlights some of the economic and social aspects of small-scale artisanal reef fisheries (SSARF) in Pacific Island Countries (PIC) that need to be taken into account if a shift to a commercial fishery, such as the live reef fish for food (LRFF) fisheries, is being considered. These observations are based on experiences gained during field surveys on the current status of reef fishery resources in PICs².

The LRFF trade is one of the emerging fisheries that may add value to the region's reef resources and is considered as an attractive income generator for coastal communities in PICs. Case studies presented in Annex I illustrate that the LRFF trade may offer between three and five times the revenues that small-scale commercial reef fisheries generate. Whilst on an initial assessment the opportunity to generate the much needed cash may be appealing, the introduction of a new fishery must take into account possible risks of detrimental effects to the resource and the socio-economics of the communities concerned. Some of the risks presented here are not restrictive to the LRFF trade only. Many of the factors of concern discussed below also apply to other emerging small-to-medium scale commercial coastal fisheries in PICs such as the aquarium fishery, bêche-de-mer and live rock and coral harvesting. The factors that are likely to be common across these various commercial fisheries have been used for a qualitative comparison of their likely magnitude of impact as presented in Annex II.

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² The Coastal Component of the European Union (EU) 8th and 9th European Development Fund (EDF) funded Pacific African-Caribbean-Pacific States (ACP) and the French Overseas Countries and Territories (OCT) Regional Oceanic and Coastal Fisheries Development Programme (PROCFish) is undertaking a comparative assessment of the status of reef fisheries, both resource and socio-economic, and development of indicators to assist future monitoring.

In terms of the LRFF trade, factors that need to be considered include:

- ▶ The LRFF trade is generally very selective in terms of target species and often targets spawning aggregations. The target species are also generally important fish for local communities. The sustainability of fishery productivity, and the impact of the possible resultant competition for species that are an important food species for the local community, needs to be assessed.
- ▶ The LRFF trade is a commercial fishery but all members of the community may not be able to participate or benefit. This may result in detrimental social changes as there is a risk of inequities between groups in the community who do or do not have access to this fishery. This can lead to disputes and/or conflicts with regards to distribution of income, job opportunities etc. from Customary Marine Tenure (CMT) areas leased to the fishery.
- ▶ It is found to be the case that fishers who participate in the LRFF trade often abandon fishing for subsistence (home consumption). This pattern, coupled with increased cash income, may alter consumption patterns in favour of processed (tinned etc) imported goods, and create a burden of debts if the income flow is not continuous and does not support the increased household expenditure level. This may increase pressure on the social ‘share-and-care network’ within a community.
- ▶ The LRFF trade is likely to be mainly — if not exclusively — participated in by men. The issue of gender participation in fisheries, including possible gender inequities with regard to access to the resource, equipment and in particular, changes in access to income need to be considered.
- ▶ Participation of community members in the LRFF trade may require them to obtain motorised boats and specialised equipment. While the necessary investment costs are usually met by the entrepreneur, instalment payments for boats and equipment are generally expected to be made by participating fishers, who will own these amenities in the long-term. This arrangement involves risk of financial dependency and may influence local decision making regarding exploitation of resources, possibly leading to overexploitation (Hollup, 2000).
- ▶ The LRFF trade is an export fishery, therefore the market is determined by external factors that drive demand and influence profit margins. The market can therefore fail due to political and/or economic situations external to and beyond the influence of the participating communities.
- ▶ The long-term success of the trade will also depend on the participation of local communities and fishers for whom catching fish to keep alive for market is a new concept. Because the participating communities lack experience, skills training may be required to equip community members and fishers accordingly.
- ▶ The LRFF trade generally requires licensing in most PICs. However, responsibilities for licensing, monitoring and compliance controlling may be spread over a number of different governmental and non-governmental bodies. For instance, in the case of the aquarium trade industry in Vanuatu, foreign investors require an approval and need to register with the Vanuatu Investment Promotion Authority (VIPA). Three distinct levels are involved as regulatory and management authorities including the National Government (VIPA, Department of Fisheries and the Environmental Unit for CITES), the provincial governments (six in total) and the resource owners under CMT (Hickey, 2002). While such instruments aim to properly establish effective and efficient monitoring and surveillance mechanisms, insufficient technical expertise or management capacity, and confusion due to the various authorities involved, are major constraints in achieving sustainability of the trade.

Taking into account the above arguments, we would like to highlight three major socio-economic aspects that need to be considered for the introduction of the LRFF trade from the participating fisher and resource owner community's point of view.

Monetary and non-monetary resource values

While it is true that coastal communities in PICs are increasingly moving to a cash-based economy, the communities where reef fisheries play an important economic role (both subsistence and cash) and which are potentially targeted for the LRFF trade, are generally still more traditionally oriented. The introduction of a commercial fishery such as the LRFF trade often introduces a monetary value for the community's marine resources. Such new cash values may co-exist with, but at times can also compete with and impact on, the traditional social processes inherent in a traditional social system (reciprocal exchange system), such as contributions to food security, maintenance of networking and social coherence amongst community members, and the strengthening of social institutions (Iwariki and Ram, 1984; Kronen, 2004). In other cases, conflicts arise in fishery resource ownership, access rights, access fees and general jurisdiction over areas leased out to companies. Consequently, the risk of reducing social coherence and resilience in target communities should be considered.

Cost-benefit analysis (needs, risks and opportunities)

The need to generate income may be seen in relation to the current lifestyle and weighed against the productivity, viability and lifespan of a new commercially oriented fishery such as the LRFF trade (Adams, 1998; Foale and Day, 1997; Kinch, 2002; Foale and Manele, 2003). The socio-economic consequences, and also the risk of detrimental and usually long-term ecological effects (Adam *et al.*, 1997; Selvam and Ramasamy, 2000; Krishnan and Birthal 2002), of fisheries that may only provide immediate or short-term wealth to a community need to be considered and compared to other fisheries and/or income alternatives. Promoting and introducing a fishery opportunity that needs a relatively high investment, given the usually cash-poor situation of most rural communities in PIC, may create 'a culture of dependency' (Sauni *et al.* in prep.). Thus, a community may be forced into harvesting marine resources increasingly for export, or to collect and sell non-target species in exchange for a lifestyle of less quality (nutrition), higher dependency and reduced social coherence (Fitzhugh 2001).

Sensitivity analysis regarding sustainability, social and economic viability

The LRFF trade often involves the leasing of reef areas without properly defined boundaries which increases the potential for conflicts and disputes in CMT areas. Principles such as benefit sharing, equity in access or use of land and sea resources are fundamental to traditional social networking and security (Taylor and Singleton, 1993; Aswani, 2002). Thus, there are possible effects of commercial fisheries such as the LRFF trade to be taken into account as they may provide economic benefit to a few individuals or families through use of common resources that also support the livelihood and food security of the entire community. The terms of the trade (and associated level of harvesting) are primarily determined by the export company (based on the principle of profit maximisation), with little attention paid to the sustainability of the resource. Local partners also run the risk of companies pulling out in the advent of the application of stricter environmental controls, customs regulations, or application of management policies.

The above points are just some of the significant factors that should be taken into account by decision-makers and community leaders where a move from subsistence to one of these small-to-medium scale commercial fisheries is under consideration.

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Annex I. Case studies comparing possible gross revenues (in USD/hour fishing time) from small-scale commercial and small-scale traditional fisheries in selected communities of Fiji, Kiribati and Vanuatu.

(a) Comparison of the LRFF trade and small-scale traditional fin fisheries in the Lau Group, Fiji

	LRFF trade — Lau Group Fiji — presence of mother boat	LRFF trade — Lau Group Fiji — absence of mother boat (middleman)	Small-scale traditional fin fisheries Lau group — Fiji
Average fishing time (hours)	49.5 (week)	6 (week)	654 (year)
Average catch kg	345 (week)	30 (week)	1293 (year)
Price USD/kg	1.66	1.48	1.18 (average)
Total revenues USD	571.68 (week)	44.39 (week)	1,530.40 (year)
Revenue in USD/hour fishing time	11.55	7.40	2.34

The Lau Group case study is based on average figures from interviews conducted with 25 small-scale traditional fishers (four of whom also participated in the LRFFFT fishery) in Nukunuku village, within the framework of the DemEcoFish/PROCFish/C project, SPC, September 2002 (FJD-USD exchange rate: 0.59180).

(b) Comparison of the aquarium fish trade and small-scale traditional fin fisheries in Christmas Island, Kiribati

	Aquarium fish trade Christmas Island — Kiribati	Small-scale traditional fin fisheries Christmas Island — Kiribati
Average fishing time (hours/year)	312	800
Average catch	flame angel 20 (specimens) lemon peel 20 (specimens) gold flake 1 (specimen) blue tan 20 (specimens)	2300 kg
Price USD	flame angel 1.00 (per specimen) lemon peel 0.80 (per specimen) gold flake 10.00 (per specimen) blue tang 2.00 (per specimen)	0.50 (village)
Total revenues USD/year	4,128.00	1,150.00
Revenue in USD/hour fishing time	13.23	1.44

The Christmas Island case study is based on average figures from three aquarium fishers and 21 small-scale traditional fin fishers interviewed in Tabakea, August 2004, in the framework of PROCFish/C project, SPC (AUD-USD exchange rate: 0.75979).

(c) Comparison of live coral and rock extraction fishery and small-scale traditional fin fisheries in Muaivuso, Fiji

	Live coral and rock extraction fishery Muaivuso — Fiji	Small-scale traditional fin fisheries Muaivuso — Fiji
Average fishing time (hours/week)	20	25
Average revenue (USD/week)	10.36	11.84
Revenue in USD/hour fishing time	0.52	0.47

The Muaivuso case study is based on average figures from interviewing 28 households in August 2002 within the framework of the PROCFish/C project, SPC (AUD-USD exchange rate: 0.75979) and collection of complementary information on live coral and rock extraction fishery only in May 2003. Details of the Muaivuso case study are given in Sauni *et al.* (in prep.). (FJD-USD exchange rate: 0.59180).

(d) Comparing bêche-de-mer fishery and small-scale traditional finfisheries in Moso, Vanuatu

	Bêche-de-mer fisheries Moso — Vanuatu	Small-scale traditional fin fisheries Moso — Vanuatu
Average fishing time (hours/year)	120	128
Average catch kg/year	lolifish: 50 greenfish: 50 others: 150	320
Price USD/kg	lolifish: 1.65 greenfish: 2.75 others: 3.66	1.83 (village)
Total revenues USD/year	769.44	586.24
Transport cost to Port Vila	36.64	–
Revenue in USD/hour fishing time	6.11	4.58

The Moso case study is based on average figures from bêche-de-mer and small-scale traditional fishers interviewed on Moso Island, October 2003 within the framework of the PROCFish/C project, SPC (Vatu-USD exchange rate: 0.00916)

Annex II: Selected factors to compare the LRFF trade to other commercial and small-scale artisanal reef fisheries (0 = lowest, 3 = highest figure).

Parameter	LRFF trade	Aquarium trade fisheries	Live coral and rock fishery	Bêche-de-mer fishery	Reef fishery
Selection of target species	3	3	3	3	1–2
Target species are also used for subsistence	1–2	0	0	1	3
Income opportunities	3	3	2–3	3	2
Catch may be used in non-monetary exchange	1–2	0	0	1	3
Gender involvement	men	men	men/women	men/women	men/women
Investment needs	3	3	1	1(3)	1–3
Special skills needed	2	3	1	1(3)	1–3
Dependency on a particular marketing network	3	3	2	2	1
National market demand	1	0	0	1	3
International market demand	3	3	3	3	1
Licensing requirements	3	3	3	3	1

7. SPC’s policy on data-sharing issues¹

Being Yeeting²

The fourth Secretariat of the Pacific Community (SPC) Heads of Fisheries meeting took place at SPC Headquarters in Noumea, from 28 August to 3 September 2004. It was chaired on behalf of New Zealand by Matthew Hooper.

The Heads of Fisheries is a regional meeting of Pacific Island countries and territories that covers the entire range of interests under the control of national and territorial fisheries services. As such, it plays a unique role in promoting dialogue and experience-sharing between island nations and territories, as well as guiding the work of SPC’s fisheries programs. It complements the more sectorally-focused, political role of the Forum Fisheries Committee, which has a primary emphasis on tuna fisheries management. The Heads of Fisheries covers aquaculture, coastal fisheries management and development and living marine resource science, and has a broad-ranging and relatively informal remit for discussion that can cover any arising issue of interest or significance to participants.

The following paragraphs constitute the points of consensus agreement of SPC member country and territory fisheries service heads on issues that arose during the meeting, and which the meeting felt necessary to document, either to help in the management of the SPC work-program, to draw to the attention of a wider audience, or to signal agreement on issues that require attention by members themselves.

Concern about data sharing and confidentiality was raised due to the increasing use of data from SPC member countries by SPC fisheries programs and other outside collaborators. With the possibility of SPC developing a data repository where fisheries information from member countries will be stored, it was timely that policies regarding the ownership, use and confidentiality of such information was laid out. The decision from the meeting with respect to this issue is given as stated in Output 3 and is further described in Annex 1 below.

‘Output 3. Coastal fisheries data confidentiality/sharing policy — the meeting approved a set of data access guidelines for the Reef Fisheries Observatory (RFO) as Annex 1, based on the discussion by member country representatives within the PROCFISH Advisory Committee meeting.’

Annex 1

Coastal fisheries repository data management guidelines

General principles

In general, SPC understands that any information held in regional databases and repositories is held in trust on behalf of the member country/territory to which the information refers, or otherwise on behalf of the provider of the information.

In general, SPC shall make information available in as easily-available and timely a fashion as possible for the purpose of improving the management of Pacific Island fisheries and improving

¹ Extracts from the fourth Head of Fisheries meeting outputs.

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understanding of the basic principles underlying Pacific Island fisheries ecosystems and resource-use systems.

The following guidelines will assist the SPC Director of Marine Resources in the application of the above principles. These guidelines may be modified by Heads of Fisheries by consensus agreement either in or out of session.

Guidelines

‘Detailed agreements’: The general principles above may be amplified by specific agreement between information stakeholders concerning the acquisition or provision of information, provided that the rights of all relevant stakeholders in that information are taken into account.

‘Desensitisation’: Any quantitative information released will normally be aggregated, averaged, or otherwise stripped of sensitive components. Very specific, personal, or commercially-sensitive information will not be released or made available by SPC without the specific agreement of relevant information stakeholders.

‘Statute of limitations’: all data in SPC databases that was acquired some years previous to request for release or usage shall be considered free of encumbrance and may be used or made available subject to the above provision for protection of privacy, commercial interest and other sensitivities determined by the Director General.

‘Individual ownership’: Any information gathered by an individual member of the SPC staff during the implementation of the SPC work programme is subject to this policy and is not considered to be in any way the property of an individual member of staff.

‘Joint ownership’: Cases where data is jointly gathered or acquired between SPC and a non-SPC collaborating researcher or institution will normally be covered by a specific agreement. In other cases it is generally understood that data resulting from collaboration would be processed and results made available to SPC members as quickly as possible. SPC would avoid any commitments which might not result in timely information release of benefit to the practical fishery management responsibilities of SPC members.

‘Cost recovery’: SPC reserves the right to charge for compilation, and for retrospective recovery of any data released from the database to a third party, if this would require resources additional to the agreed work-programme. Compilation of data to fulfil official requests by SPC members is by definition part of the work-programme.

Definitions and notes

Information held in the repository may be either textual information (reports etc) held as ‘electronic documents’ or quantitative information held in highly structured databases.

‘Information stakeholder’ means a person or entity to whom an item of information has value or significance. This might include the interviewee in a questionnaire survey, the owner of a boat providing catch returns, the agency collaborating or contributing to the collection or analysis of the information, or the government of the area concerned.

In this policy, it should be understood that ‘SPC’ is the collective sum of its member countries and territories. Any ‘ownership’ ascribed to ‘SPC’ is actually ascribed collectively to member governments and administrations, and is ultimately at the collective disposal of those members.

8. Strengthening management arrangements for the live reef food fish trade in the Pacific

Being M. Yeeting¹

Background and introduction

Keeping fish alive until moments before cooking has been a popular Chinese tradition for centuries (Johannes and Riepen, 1995). This was the basis of the trade in live fish. Fish involved originally were limited to freshwater species and marine fish caught locally.

In the last few decades, the increasingly wealthy population in Hong Kong became the major source of demand. As more wild-caught marine fish were being exported to Hong Kong, a preference developed among consumers for wild-caught marine fish over farmed fish. It was claimed that wild-caught adult fish looked and tasted significantly better and the flesh was finer-textured (Johannes and Riepen, 1995). This resulted in an increase in the demand as well as the prices and number of reef fish species. Initially the sub-tropical Hong Kong grouper, (*Epinephelus akaara*) was favoured and later more tropical species, such as the leopard coral grouper (*Plectropomus leopardus*), the humphead wrasse (*Cheilinus undulatus*) and the humpback grouper (*Cromileptis altivelis*), became popular due to either their red colour (apparently associated with wealth and prosperity by the Chinese) and/or their fine-textured flesh.

With the decline in local supplies from around Hong Kong, the Hong Kong live fish traders started venturing further and entered the Philippines in about 1975. The trade was very profitable with an expanding market, extending from Hong Kong to mainland China, so the companies started looking for new sources of supplies.

The spread of the LRFF trade into the Pacific

Figure 1 shows the movement of the LRFF trade into the Pacific. As fish supplies in one place started diminishing, the companies would move on to another country or new fishing area.

In 1984, LRFF operations began in Palau (the nearest Pacific Island group to Hong Kong). Several foreign-owned companies started and stopped (with lapses of up to three years in between operations) in different locations in Palau until 1999 when all activities stopped and licences were revoked (Graham, 2001). It was only at the end of 2004, that a new foreign company was able to restart operations.

Whilst activities were continuing in Palau, the trade moved into Yap, one of the states of the Federated States of Micronesia (FSM). Initial interest was discouraged by local authorities, but some years later in May 1997, the FSM government gave a Chinese company a licence to fish and buy live reef food fish, from another state, Chuuk. This caused concern about cyanide fishing and overfishing, and with locals seen to derive little benefit from the trade, operations were forced to close in 1998.

The next country to become involved was Papua New Guinea, with operations starting there in 1991 (Richards, 1993, NFA, undated). By 1993 live reef fish companies were operating in New

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Ireland, Milne Bay, Central, Manus and East New Britain provinces (Richards, 1993). Two of the larger operations have been based in Manus and New Ireland. The Manus operation lasted from 1992 to 1994. Strong circumstantial evidence suggests that cyanide was being used (Aini and Hair 1995, NFA, undated). Spawning aggregations of groupers were also targeted. Traditional island leaders finally forced the company to leave, confiscating some of their fishing gear.



Figure 1. The spread of the live reef food fish trade in the Pacific region.

In 1994, a Hong Kong-based company began shipping live reef fish out of Kavieng, New Ireland Province, and the Caterets, North Solomons Province (Aini and Hair, 1995). As of June 1995, however, this company had reportedly managed to make only one export shipment, of less than 4 tonnes (NFA, undated). Very high mortality rates of fish in holding pens were reported, which relates to the company being a newcomer into the trade and their lack of experience.

From PNG, the trade moved further east to the Solomon Islands, starting in 1994 with a single operation at Vella La Vella Lagoon in Western Province (Johannes, 1999). This company later expanded operations to Marovo Lagoon and Roviana Lagoon, also in Western Province (Johannes, 1999, Yeeting 2001). The company closed down in 1997 but some of the same principals started a new foreign-local joint venture, and expanded operations to include the remote atoll of Ontong Java in Malaita Province (Yeeting, 2001). After a moratorium on LRFF operations from February 1999 to December 2000, the government issued three licences in 2001 to companies that had arrangements to operate in various communities in Western and Temotu Provinces. Some LRFF activity took place in 2001 but it appears that no LRFF fishing occurred in 2002, and all three licences expired by the end of 2002. As of mid-2003 no new licences had been issued. Reliable estimates of the amounts of LRFF caught and exported from Solomon Islands are not available. As an indication of the size of the fishery, government records show that in 1996, 1997, and 1998, the single LRFF operator during that period purchased about 32 tonnes, 44 tonnes, and 54 tonnes of LRFF, respectively (The Nature Conservancy and Solomon Island Fisheries, 1999).

At about the same time, operators moved into the Republic of the Marshall Islands (RMI) and in late 1994 three live reef fish (LRF) operations were known to be active. The first company Ocean Glory/Trekrona Ltd received its licence in 1995–1996 in spite of the arrest of its fishing vessel M/V Ocean Glory II and \$250,000 fine in 1994 for fishing without a licence in the RMI's waters (Smith, 1997). The vessel was rearrested in 1996 for possession of cyanide.

The second company was Pacific Marine Resources Development, Inc (PMRD), which is a locally incorporated company and was approved for a foreign fishing agreement in November 1996 for a live reef fish operation. The company also had local fishing permits for two atolls. PMRD charters a vessel from the Hong Kong partner, catches the fish, transports it to Hong Kong and then sells to the partner. The company made two shipments in 1997 (7.5 tonnes in April and 10 tonnes in May), mostly of *Epinephelus polyphkadion* and *Plectropomus spp.* (Smith, 1997).

The third company, Marshall Islands Ocean Development, Inc (MIOD) is a partnership between a Taiwanese company and local partners. MIOD received a foreign fishing licence in January 1997. Records for catches and fish exported by this company were poorly kept. The company was also known to be involved in other types of fishery, such as frozen fish, lobsters, and shark fin.

The LRFF trade commenced in Kiribati in 1996 (Yeeting, 1999). Three companies were involved in the trade; one registered as a locally based company (Marine Product Kiribati Ltd — MPK) while the other two were registered as foreign based companies (China Star and South China Sea). Towards the end of 1999, MPK and China Star ceased their operation when some of the fish they exported to Hong Kong made many people sick with ciguatera poisoning and made big news in the local newspapers. All operations were on hold from the end of 1999 to 2001. The South China Sea company was a small operation and only exported a small volume of fish (about 1 tonne) in 2001 before ceasing operations. From 2001 until now there was only one registered operation which changed names and shareholders a few times. It was not until 2003 that it became active under a new partnership with a local businessman (Awira, 2003). In 2004 this company exported almost 50 tonnes of live fish, the largest annual volume of live fish ever exported. Towards the end of 2004, another incident of ciguatera fish poisonings in Hong Kong resulted in a fall in demand. The total volume of live food fish exported to Hong Kong from Kiribati in the period from 1996 to 2004 was about 110 tonnes, caught from five different atolls.

Fiji was the next country targeted by the trade. The Live Reef Food Fish trade was introduced by the Fiji Government in 1998 as part of its Commodity Development Fund project with the hope of maximizing returns from marine resources. One company, a joint venture between an Australian company, Satellite Seafoods, and a local Fijian company, Altracor (Fiji) Ltd. started operations in Bua in 1999 on a one-year trial basis (Yeeting *et al.* 2001). With the political turmoil that occurred the following year, the government lost control of the trade. In 2001 eight companies were given a licence. Of these, only four became active. By the end of 2002 only two companies were actively exporting fish.

Generally the interest of LRFF operators did not end in Fiji but spread out into the insular Pacific, even to countries which would be considered as too far from the Hong Kong market. In 2001, interest in starting up LRFF operations reached Vanuatu where the trade started briefly but failed due to very poor fish handling practices causing high mortality. Operators also started approaching the Tongan government which insisted that a resource assessment be carried out before any decisions were made. In late 2001, SPC conducted an assessment of the live reef food fish resources in Ha'apai, the proposed area for LRFF operations. The results showed a lack of

resources to support the trade which allowed the Tonga Ministry of Fisheries to suspend interests to start operations in Ha'apai.

At about the same time, interest also reached the Tuvaluan government, but given their lack of knowledge about the trade and after seeking advice from SPC, they decided to put the requests on hold until a proper feasibility study has been carried out. This would also require an assessment of the resources.

Pacific interests and concerns

As a low-volume, high-value fishery in which local fishers can be involved and make a good income, especially for those coastal communities where such opportunities are lacking, Pacific Island countries have in general shown a keen interest in the LRFF trade. However, the trade also needs to be a sustainable activity in order to be of real benefit to Pacific Island communities and therefore needs to be managed in a sustainable manner. For this to happen, the Pacific Island countries must establish sound policies and management plans for coral reef conservation and sustainable fisheries, and have the institutional and technical capacity to carry them out. It is currently beyond the capacity of these countries to do this on their own.

For most coastal communities in the Pacific, the LRFF trade is a new fishery and its dynamics and implications are therefore poorly understood. Improving the general public's understanding of this fishery is important for supporting any management measures that may be needed to ensure the fishery's long term sustainability and to maximize benefits to local communities. With the rapid spread of the LRFF trade into the Pacific countries, it is important that fisheries departments address this with a good strong outreach program.

Although many reefs are still relatively undisturbed, the coral reef ecosystems of the Pacific are under threat from coral mining and destructive fishing methods associated with live reef fishing for both the aquarium fish markets and the food fish markets. Severe overharvesting and the use of destructive fishing methods, primarily the use of cyanide to stun and capture target species and the targeting of spawning aggregation sites have been ubiquitous features of the LRF trade in Southeast Asia for the past several decades (Barber and Pratt 1997). These practices and other destructive fishing methods, such as the use of dynamite, have had adverse effects on coral reef ecosystems as well as reef fish stocks. As stocks of desired species have become depleted in Southeast Asia, live fish operators have moved into the island nations of the western Pacific, bringing the same destructive methods with them. Unlike reef threats like coral mining, pollution, and sedimentation, LRF trade operators typically target the most remote, pristine, isolated reefs for fish collection. These are often outside the protected area and management systems and not covered by local government monitoring.

The SPC Pacific Regional Live Reef Fish Trade Initiative

The Regional Live Reef Fish Trade Initiative was developed in 1998 after the request and endorsement of SPC's 22 Pacific Island member countries and territories at the second Pacific Community Fisheries Management Workshop (Noumea, New Caledonia, October 1998). The request was triggered by a number of concerns. Firstly, the sudden increase in the number of expressions of interest by foreign LRFF trade companies mainly from Asia to extend and start operations in the Pacific region created some suspicions. Secondly, there was a general lack of understanding, including of the technical capacity in the islands, to properly address and

manage this new commercial fishery and the related Marine Aquarium Trade (MAT). This need was further highlighted by the member countries in the First SPC Heads of Fisheries Meeting (Noumea, New Caledonia, August 1999). Finally, there were concerns about the troubling experiences with both of these trades that were being reported from the Asian countries where the trade had originated. The initiative was therefore endorsed by Pacific Island member countries with the expectation that it will provide technical support to countries in addressing the problems of managing their live reef fish trades.

Aims

The primary objective of the initiative is to assist Pacific Island countries in addressing problems of unsustainable practices in the live reef fish trade. In a wider context, the initiative is also concerned with the conservation of biodiversity for a healthy coral reef ecosystem that will provide a sustainable livelihood for Pacific Island communities through good and appropriate governance mechanisms, and which will involve all stakeholders from the resource to the industry level.

The initiative will achieve this by providing the appropriate information about LRF resources and the market, appropriate governance and management tools, training and awareness to enable sustainable LRFF trade operations and better decision making for sound management that would maximize benefits to local resource owners through the following strategies:

1. The provision of required funding to support and strengthen SPC's existing capacity to institute and implement the regional initiative's activities for developing sustainable live reef fisheries in the Pacific Islands region.
2. Supporting and improving ongoing efforts to provide PIC governments, community leaders and resource owners with the information, linkages and the training necessary to respond to the challenges posed by the spread of live reef fisheries in the region. This assistance would be provided through established SPC modes of operation, involving project partners and external assistance as required, working closely with SPC member country governments and local communities.

Funding history

In the first two years, the initiative was funded mainly by the Asian Development Bank (ADB) under its Regional Economic Technical Assistance (RETA) grant. This involved collaboration with three non-governmental organizations, namely The Nature Conservancy (TNC), the International Marinelife Alliance (IMA) and the World Resources Institute (WRI). The funding was limited to supporting project activities which meant that other funding had to be found to support SPC's capacity to coordinate and implement the initiative. This funding was provided by TNC and resulted in the recruitment of a live reef fish specialist at SPC to provide technical advice to SPC member countries and coordinate the initiative. The ADB grant made it possible for SPC to start providing the needed assistance to its member Pacific Island Countries and Territories (PICTs) especially in addressing the LRFF trade management issues which were the main area of concern. However, the funding provided for only 25% of the requested three-year total project budget, resulting in limited assistance and a lack of funding for some important areas.

With no forthcoming extension of the funds from ADB to keep the initiative going, other potential sources of funds were sought. In July 2001, the John D. and Catherine T. MacArthur Foundation approved part of the requested funds to support the initiative for a further

three-year period to March 2004 inclusive. The MacArthur Foundation grant provides support for the initiative's staff costs and activities. The planned activities for the new funding were built on the achievements and outstanding needs from the previous ADB funded work and new issues put forward by member countries. Given that only half of the requested fund from MacArthur Foundation was granted, it was necessary to downsize a number of the intended activities and suspend some until further funding is obtained. Towards the end of 2003, approval for an extension of the MacArthur Foundation grant for a further 3 years was received which will take the Initiative up to the end of March 2007. Again, less than half the funds requested were granted which gives limited funds to support all planned project activities. The planned activities are essential for the overall effort to establish and support sustainable live reef fish operations in the Pacific region and therefore SPC will continue to seek additional funding to ensure their completion.

Challenges for the initiative

The main problem to be addressed is the growing difficulty of managing the LRF fishery by Pacific Island fishery managers and resource users, in the face of the rapid introduction of new fishing practices and trades. The major constraint to addressing this problem is the lack of capacity within the countries to train local fishing communities in sustainable fishing practices and the comparative lack of good governance and management mechanisms for the trade.

Given the constant demand for wild-caught live reef fish on Asian markets, it is likely that the LRFF trade will continue to expand rapidly into the Pacific, even to new areas where operations may previously have seemed impossible. In order for SPC to contain and address the rapidly growing LRFF trade in the Pacific it will need to strengthen its capacity and improve its response mechanism to requests from member countries for technical assistance in dealing with LRFF trade issues. To develop a rapid response mechanism and to build and strengthen collaborations with other partners working on similar issues in the region, SPC would need funding support. This collaborative approach will not only strive to provide the basic information required for managing the LRFF trade but should be aimed at building local capacity within Pacific countries to provide them with the ability to address their own problems with the trade and manage the industry in a sustainable manner.

The countries, themselves, should be committed at both the government and community levels to support and facilitate the initiative in its efforts to provide assistance. The political will and the support of the communities at the village level are especially very important for any management measures to be effective and therefore establishment of such support, which is not an easy task, is at the forefront of any of the efforts of the initiative in assisting countries.

Table 1 shows the status of management control for the LRF trade in Pacific countries in 1999 at about the time when the initiative started. The information was based on results of a questionnaire survey received from countries, through country visits and any available information from reports and technical papers.

The initiative has tried to achieve its expected goals through activities designed to address the needs and requirements of member countries. The activities, achievements and problems experienced so far by the initiative under the different phases of funding are described in the following sections.

Table 1. Management status of the live reef fish trade in Pacific countries (1999).

Country	Awareness (G//C)	Assessment (Stock)	Policy	Management plans	Best practice	Capacity (Inst/Tech)	Monitoring (local/export)
Fiji	L/M/L	L	L	M	M	O/O	L/L
Marshall Is	L/L/L	L	O	O	L	O/O	O/L
Solomon Is	M/M/M	L	M	M	L	L/L	O/L
PNG	M/M/L	L	L	L	L	L/L	L/L
Kiribati	L/L/L	L	M	M	L	L/L	L/L
Samoa	L/L/L	O	M	O	O	L/O	O/O
Vanuatu	L/L/L	L	L	L	L	O/L	L/L
Cook Islands	M/L/M	L	L	L	L	L/L	L/M
Tonga	L/L/L	L	M	O	L	O/L	L/L
Palau	M/L/M	M	M	M	M	L/L	L/L
FSM	L/L/L	L	L	L	O	O/O	L/L

Keys: G = Government, I = Industry, C = Community, Inst.= Institution, Tech = Technical.

Status levels: H = High, M = Medium, L = Low, O = none.

Activities, achievements and problems

ADB-RETA funding

For the initial initiative work program, SPC identified seven main areas of assistance for its member countries. These areas are relatively common for PICs and with assistance, should provide a realistic and strong basis for the sustainable management of their LRF operations. The main issue and area of concern was the LRFF trade, which the funding was particularly targeting, thus this was the focus of activities. The seven areas of activities were:

- (i) Live reef fish trade awareness
- (ii) Assessment of LRF resources
- (iii) Development of appropriate LRF trade policy and regulations
- (iv) Development of LRF trade management strategies and plans
- (v) Development of sustainable LRF trade operations
- (vi) Institutional strengthening and capacity building for LRF trade management
- (vii) LRF trade monitoring

The activities and achievements in each of these areas are described below.

(i) Live reef fish trade awareness

Activities: Three different levels of awareness are recognized. Awareness at the community level includes local fishers. Awareness at the operator's level and finally at the various government levels includes fisheries officers, planners, boards and politicians. TNC provided some funds to initiate the development of awareness materials for decision-makers, but there is a lack of resources to fully produce and implement these materials. Additionally, material for communities and fishers written in local languages is also needed. Once the materials are produced, they need to be disseminated as widely as possible. As well, in-country training workshops for fisheries extensive

workers, are needed, to ensure they fully understand the messages in the materials as well as to learn the best delivery mechanisms. This will ensure that the LRF awareness methods are used and delivered effectively to local communities.

Achievements: LRF trade awareness materials in the form of information sheets and fact sheets describing the trade in general, from the resource to the market, have been produced. Some facts on the biology of the targeted species, the importance of management, monitoring and even a checklist of requirements when dealing with new interested companies is provided as part of the package. Also, in addition, plastic fish identification cards and a fish poster of important LRF species in the Pacific have also been produced. To complete the awareness materials, a short video explaining the trade and the associated potential problems, is also available. These materials have been circulated to all SPC member countries.

Problems: It has been difficult to evaluate the effectiveness of the awareness materials. The plan to conduct in-country training workshops was not possible due to the shortage of funds. The biggest concern relating to the materials, is ‘Are the materials getting to the community level and being understood?’ This particular concern could have been addressed with translation of the materials to local languages, but again the problem is the shortage of funds.

(ii) Assessment of resources

Activities: Some knowledge of the LRF resources in terms of what is there and how much, is essential in order to make decisions on level of harvest and appropriate management for each country. Preliminary assessments should include:

- ▶ assessment of total and exploitable fish stocks
- ▶ analysis of the main structures of these populations
- ▶ the reef’s health status
- ▶ location and state of spawning aggregation sites
- ▶ assessment of ciguatera fish poisoning levels in LRF fishing areas.

To gather this information, some technical knowledge is required. A sampling strategy is needed to obtain a reliable picture of the resource. An adequately tested sampling method would be used to provide high-quality information that can be repeated in both space and time for long-term monitoring. This is one activity where local capacity building in terms of technical know-how should be emphasised. However, to address the more immediate need, assistance in conducting in-country assessments would be required. This would also give local officers hands-on field training on the assessment methods and basic analysis and interpretation of results through training workshops and/or, probably more cost effectively, through short-term capacity building attachments for Pacific Island fisheries officers to join the project core team in their field assessment work.

Achievements: A total of six live reef fish resource surveys using the underwater visual census method were conducted in four countries. Two surveys were done in Fiji (in Bua and in the Lau Group), two in Kiribati (Abaiang Atoll and Kiritimati), one in Tonga (Haa’pai), and one in Vanuatu (Efate). The surveys provide a first baseline estimate of the LRF stocks in the respective surveyed areas. During the surveys, preliminary collection of spawning aggregation information was made. Also, the opportunity to train local fisheries officers on the survey method was encouraged as much as possible. At least two countries have learned and acquired the survey methodology which has enabled them to conduct resource surveys on their own in other parts of their country.

Problems: During the survey there is usually not enough time to analyse the data and interpret the results, steps which are essential for the capacity building of local staff for doing resource surveys. In all cases, the data is taken away from the country, the analysis is done and a report is sent back. The problem with this is that there is no ownership factor, sometimes the report is not well understood and usually the outcomes from the report are not able to link and relate to the Fisheries Departments' capacity and planning. As a result, countries usually do not take up and follow the recommendations in the report. Countries that learned the survey method and conducted additional surveys on their own were not able to fully benefit from the data due to their lack of analytical skills. These skills need to be improved but the ADB-RETA funds were not able to cover any training in this area.



Geoffrey Muldoon

Fish traps, Kavieng, Papua New Guinea. Because the live reef fish trade is new in the Pacific, most countries lack policies to control it.

(iii) Development of LRF policy and regulations

Activities: Because the LRF trade is new in the Pacific, most countries lack policies and regulations to control it. These are important to ensure that the government and local communities know how to deal with foreign LRF investors or buyers, that the resources are utilised in a sustainable way and that the resource owners get the true benefits. This will involve working closely with the relevant government departments and helping coordinate their efforts. Bringing policymakers, fisheries managers, industry representatives and resource owners together to discuss issues is an effective way of getting dialogue and understandings between the different players. These meetings may be in the form of in-country small consultative workshops and country visits to formulate realistic LRF policies and regulations.

Achievements: In all countries where the resource surveys are carried out, existing management policies and regulations have also been assessed. Proposed policy guidelines and suggestions for regulations are then included as part of the report for each country. Other countries have been advised where possible. Countries that have been provided with policy guidelines and proposed regulation measures are Fiji and Kiribati. The Solomon Islands and Papua New Guinea have also been advised with assistance from The Nature Conservancy provided under its Melanesian Program.

Problems: It has not been easy to provide simple policy guidelines and regulations and the guidelines provided have been basically treated as just that. Having a legal advisor who is familiar with individual country laws would help. Attempts to involve local legal counsellors employed

by the government have not been successful due to the limited numbers of such people in the Pacific. In some countries private legal advisors are available but they are often too expensive for the initiative to fund. As a result, it has taken a long time for the countries provided with the guidelines to finalise and formalise national policies and regulations to provide the management framework required for the LRF trade.

(iv) Development of LRF management strategies and plans

Activities: Workable LRF management strategies and plans have to be developed for all the SPC member countries involved in the trade in order to ensure sustainability of the resources and the trade. A few countries have started developing management strategies and plans but these have not been implemented. The consultative workshops mentioned above could be used to formulate the basic infrastructure of the plans.

Achievements: This part of the activities is similar to that of activity (iii) above. Draft management plans have been proposed for Fiji and Kiribati and are still in the process of being finalised for submission to parliaments for endorsement. The Solomon Islands and Papua New Guinea with assistance from TNC's Melanesian Program were able to develop management plans and regulations, which have been approved by their government.

Problems: Progress has been very slow. A legal advisor is needed to word the management plan appropriately and to ensure that it accords with the country's laws. The lack of funds to provide this support has been a significant problem.

(v) Development of sustainable LRF operations

Activities: This would involve working with and training fishermen in non-destructive fishing methods, good fishing practices (to minimise by-catch), sustainable resource management and good handling practices (to minimise mortality), and quality control and marketing strategies for the local LRF operators. A few demonstration sites will be selected and developed to test and show the applicability and practicality of recommended practices.

Achievements: Not much was achieved in this area. However, the issue has been discussed globally and 'Best Practice Standards' have been discussed and developed in a project with TNC, MAC and IMA. SPC has been involved in the initial consultations to develop these guidelines.

Problems: With only one member of staff on the initiative, additional capacity is needed. The Best Practice Standards is a detailed document which might need simplifying. People involved in the LRF trade at the fishing level are usually people from local communities. Simple visual and easy best practice manuals in local languages need to be developed by experienced people directly involved with trade. This has not been possible with the limited funding.

(vi) Institutional strengthening and capacity building for management of the LRF trade

Activities: Most governments in the Pacific lack the basic infrastructure to support management efforts. This is mainly due to the lack of coordination among government departments to effectively utilise the existing system and also partly due to a lack of skills and resources. Help is urgently needed to identify problems and assess requirements to implement management plans and regulatory measures. The incorporation of user pay options within the management regime will be investigated in order to develop a local self-supporting management system, or at least minimise management costs.

Building local capacity within countries is a very important part of the project which will be undertaken through working with local counterparts in each country as well as by providing short-term capacity building attachments between countries or with the collaborating organizations.

Achievements: There has been some success mostly in developing survey skills of fisheries staff in Fiji and Kiribati. Recommendations and identification of key areas that need to be improved has been provided for some countries where assessment work has been conducted.

Problems: In-country training is limited to survey methods and is too short for local staff members to get a good grasp of it. Several follow-ups by the initiative staff to take part and supervise additional surveys will help ensure that staff are confident enough to use the methodology on their own. Limited funds have not allowed for such follow-up. Data analysis skills are an important need which has not been addressed appropriately under the RETA.

(vii) LRF trade monitoring

Activities: Three different kinds of LRF trade monitoring are envisaged in the Pacific. The first is fisheries-independent, will involve trained fisheries officers undertaking regular underwater visual census (UVC) of stocks which is basically an extension of the initial baseline assessment of the live reef fish resources. The second method will be to monitor LRF operations by collecting data/information from fishermen and operators. The third will be surveillance and monitoring of exports and collection of customs information. In order for the monitoring to be effective at the three different stages it is necessary to involve local fisheries officers. Training of fisheries officers in the three monitoring approaches would therefore be necessary. Considerable in-country follow ups and evaluation of these monitoring systems would also be necessary to ensure their appropriateness and effectiveness.

Achievements: Monitoring programs have been developed for Fiji, Kiribati and PNG. Part of the proposed monitoring program involves re-surveys of LRF trade fishing areas with the UVC method. Monitoring forms have been designed to collect relevant information that is important for management at different stages of the trade.

Problems: To date none of the monitoring programs have been implemented. Local in-country training on the monitoring program is needed to kick-start the monitoring and ensure that it is properly implemented. The implementation of such monitoring programs requires capital, which most countries do not have. User-pay systems are therefore being considered as one option. Monitoring programs will probably need regular follow up, which will incur more costs, to ensure that the data collected is of good quality and that the data forms are relevant. Once again, lack of funding is a problem.

Generally, very few of the assisted PICs have developed a complete LRF trade management plan or monitoring program and those that have are yet to implement it. This is mainly due to a lack of funds, both within the countries and also for the initiative, to support follow-up assistance in the initial implementation phases which is essential to give local staff some hands-on experience and confidence to run the programs. Also, in many cases the political will to push and support these efforts is weak, which makes it more difficult.

Educating the general public through an outreach program is seen as fundamental to support any management efforts. Some awareness materials have been developed and produced for the LRFF trade while awareness materials for the aquarium trade still need to be developed. Equally important to the production of these materials is delivering awareness to the communities through extension work although this has been largely overlooked and unfunded.

Some positive outputs

On the other hand, given the limited funds that have supported the initiative, some positive outputs and achievements should be noted. First of all, in the late 1990s, most LRFF trade operations in the Pacific were carried out without any management control. This has changed

with management plans (Solomon Islands, PNG) or management guidelines (Fiji, Kiribati) now in place to guide fisheries authorities. In the same sense, the live food fish resources of Pacific countries, which were once very accessible to foreign operators are now being considered in the light of sustainability and maximum benefits for local communities, which is a result of improved awareness about the trade.

In recent cases, where new companies have wanted to start operations in Tonga and Fiji, the fisheries authorities in these countries have promptly contacted SPC for advice. SPC was able to respond very quickly, providing the awareness materials (English versions) developed under the initiative and then conducted a quick survey with the use of the Initiative's rapid response funds. This provided for more informed advice and, more importantly, it demonstrated the process by which countries should address new LRFF trade operations.

Year 1998–2004: past activities and lessons learned

Based on the outcomes and lessons learned from the ADB-RETA, the objectives and activities for the next funding phase of the initiative were reviewed. The goals have remained the same but the focus and context of the activities were changed slightly for a more effective delivery of the assistance to countries and a more efficient way of achieving the objectives. First, several unfinished parts of previous activities were taken up and added either to previous activities that had been restructured or to new activities to address new issues with a stronger focus on assisting countries with their marine aquarium trades. This has allowed effective and focused use of the limited funds on activities that will help efforts under the initiative to progress and achieve the ultimate aim of managing the live reef fish trades in a sustainable way. The revised list of activities submitted for funding includes the following:

- (i) Capacity building of PIC fisheries staff through attachments
- (ii) Assessment of marine aquarium trade resources
- (iii) Development of marine aquarium trade national management policies, plans and regulations and monitoring programs
- (iv) Development of marine aquarium trade awareness materials including fish ID cards and a fish poster
- (v) In-country assistance and support for implementation of LRF trade management plans and monitoring programs
- (vi) Development of an interactive LRF trade regional database that will have information about both the LRFF and the marine aquarium trades.

Unfortunately, with less than half of the funds requested granted, there was only enough money to cover the cost of SPC's co-ordination capacity, leaving very little for activities. As a result, activities had to be downsized and restructured to fit the limited budget while at the same time, other potential funding sources are being investigated.

Given the importance of capacity building as a basis for supporting management of the LRF trade, it was necessary to restructure the other activities around it. So activities ii) and iii) are integrated into activity i) resulting in the following four main areas of activity.

(i) Capacity building through attachment training at SPC

Activities: A 3-month training program was developed where a nominated fisheries member of staff working on LRF trade issues undertakes an attachment at SPC headquarters in Noumea.

The trainee is required to work with and under the direct supervision of the SPC live reef fish specialist. Some of the training activities are co-coordinated with other parts of SPC, such as the information section, information technology and the Pacific Regional Oceanic and Coastal Fisheries (PROCfish). The trainees undertake the following main activities.

- ▶ Orientation and work organization (1–2 days)
- ▶ Review and update of country situation, policies, management etc, report writing. This will require the attachment officer to collect all important and relevant information and available data on the country's LRF trad that they would need in writing up the review at SPC. (2 weeks)
- ▶ Review of Vanuatu management policies and regulations (1 week)
- ▶ Field assessment of live fish resources, including hands-on training on survey design and methods. (2 weeks)
- ▶ UVC survey data entry (1 week)
- ▶ Data analysis, using the Reef Resource Assessment and Calculation Tools (ReACT) software developed by SPC, interpretation of results and report writing (2–3 weeks)
- ▶ Development of relevant LRF trade public awareness materials for aquarium fish trade (1–2 weeks)
- ▶ Translation of ciguatera brochure into local language (3 days).
- ▶ Developing country's LRF trade management framework and plan (2 weeks)
- ▶ Developing country's LRF trade monitoring program (1 week)

The attachment training program assumes a cost-effective approach which aims at accomplishing and covering several needs at the same time. It provides the capacity building needs in giving the trainee a full understanding of the dynamics of the LRF trade, then in the resource assessment part, field survey methods training, analysis and interpretation of data and using the information to develop appropriate management policies, plans and regulations. The resource survey in itself provides needed information about the resources. The outputs from the attachment training in the form of a technical report about the LRFT resources, a draft LRFT management policy guideline, a LRFT management plan with regulative measures and a monitoring program will provide the trainee with all the necessary management framework and skills for managing the LRFT. With all these being done with the trainee direct involvement, means that the trainee will have a sense of ownership and more importantly, a full understanding of what the documents mean.

Achievements: Three countries have gone through the attachment training program with very positive feedback. At the end of the attachments, the countries, Fiji, Kiribati and Vanuatu have draft management policies, management plans and a monitoring program which they fully understand and which can be realistically implemented. The trainees are also able to conduct resource surveys, analyse and interpret the data and write useful reports to support management decisions.

Problems: Overall, eight countries have applied to take part in the attachment training program. These countries will have to wait until more funding becomes available to continue the program. The cost of running the program for three countries was more than the funds available for activities and so no funds are available for the other required activities.

(ii) Developing awareness materials for the marine aquarium trade

Activities: Awareness materials similar to those developed for the LRFF trade need to be developed for the aquarium trade, especially for local communities in rural areas which will no doubt be the target for new collecting areas. The materials will have to be translated into local languages of the different countries involved in the trade. The aquarium fish ID cards are essential for the monitoring program.

Achievements: The trainees have started compiling a list of the type of awareness material and information required for the different countries. There is no funding for the actual production of the materials at this stage.

Problem: Lack of funding.

(iii) In-country assistance and support for implementation of LRF trade management plans and monitoring programs

Activities: The SPC LRF trade will do at least a follow up country visit and work with the local LRF trade officer to ensure the management plans and monitoring programs are implemented effectively. Further training of local staff, especially to ensure a complete understanding and effective implementation of the monitoring program, may be necessary. Advice will be provided to refine the plan as needed. This is important to ensure that the developed management plans and the monitoring programs are used and are effective for each country's situation.

Achievements: No work has been done on this aspect and so there are no accomplishments yet.

Problem: Lack of funding.

(iv) Development of an interactive LRF trade Pacific regional database for the LRF trade

Activities: An interactive regional database will be developed and made accessible through the SPC portal. The database will be a source of technical information, trade information and recent relevant news about both LRF trades in the Pacific. It will also be a mechanism by which the details and volumes of exports and prices of products from Pacific countries can be monitored, analysed and updated and then sent back to countries through secured links. The activity would need to contract an appropriate database consultant to do what is required.

Achievements: None yet. This has not been implemented.

Problems: Lack of funding.

MacArthur Foundation grant extension

The MacArthur Foundation approved a request to extend the grant for another three years (2004–2007) although the total grant was less than the funds requested so the initiative is still faced with the problem of lack of funds to cover all activities.

In the extension, the initiative will carry on the unfinished business from the previous grant and will maintain its focus on capacity building efforts through its attachment training program. Countries currently in line for this training include Marshall Islands, Tonga, Samoa, Palau, FSM and Tuvalu. The new funds will only be able to support two attachments only so SPC will need to find more funds to cover the remaining countries.

Collaboration with external partners

The SPC initiative should recognize its lack of capacity and expertise in certain important areas of the trade. These areas are better addressed through the hiring of outside expertise or through collaboration with external partners. Such areas include:

(i) Developing a standard best code of conduct for operations

This work is better done by a certification agency. The Marine Aquarium Council (MAC), a US based non-governmental organisation, has been working on a certification process for the aquarium trade and is also working on best practice guidelines for the LRFF trade with TNC. The SPC initiative does not have any formal collaboration with MAC but the two groups have been communicating closely with each other. So far this non-formal relationship has seemed to work but there have been discussions on developing a formal partnership to work more closely and especially for working together on some new projects.

(ii) Assessing the economics and benefits of the trade through the whole chain of custody

A project to look at this issue has been developed in partnership with the Australian National University with funding from the Australian government through the Australian Centre for International Agricultural Research (ACIAR). The two-year project will look at the economics of the LRFF trade from the resource side to the retail end. It is hoped that an economic model will be developed that will enable resource owners to evaluate the value of their resources instantly in relation to market price fluctuations.

For the aquarium trade, a joint project between MAC and the Foundation of the People of the South Pacific International (FSPI) has been approved and will commence very soon. The project aims to look at the costs and benefits of the marine aquarium trade. SPC is not a partner in this project but, again, has been communicating with the two organisations to keep up with the project's developments.

(iii) Examining potential options for transport systems and links to markets.

This issue probably fits better under the mandate of the Pacific Islands Forum Secretariat (PIFS) who, when approached with this issue, noted that a proposal on the same kind of issue for sashimi grade tuna was advanced by the Forum Fisheries Agency (FFA) at the 35th Pacific Island Forum Officials Committee Meeting held in Apia, Samoa in August 2004. The issue with regard to LRF trade products may need to be further developed as part of a push for improved transportation mechanisms for marine products in general from the Pacific to international markets.

Year 2004–2007: future activities

In conclusion, Table 2 shows the current management status of the LRF trade in the Pacific to demonstrate progress in different areas based on the activities shown in Table 1.

A direct comparison of Tables 1 and 2 gives us a general view of how the management of the LRF trade has progressed. It is obvious that general awareness about the trade has improved greatly. It is also important to note that in several countries like Fiji, Solomon Islands, PNG, Kiribati and Vanuatu, the management framework has been set up and the capacity to implement also exists. For these countries the struggle lies with implementation of the management plan. It is important to note that these are the countries that have received assistance from the initiative and from other partners. The countries with little change in their status are those where very little or no assistance has been provided through the initiative. These countries are the main target in the next few years.

Overall, the initiative appears to have had a positive impact on the LRF trade. Implementation is a problem in most countries and the initiative will be putting some effort into that area. The initiative is strongly guided by the needs of its member countries and encourages them to inform SPC especially of any new issues that are not being addressed.

Table 2. Revised management status of the live reef fish trade in Pacific countries (2004).

Country	Awareness (G/I/C)	Assessment (Stock)	Policy	Management plans	Best practice	Capacity (Inst/Tech)	Monitoring (local/export)
Fiji	H/H/M	H	M	H	H	M/H	M/H
Marshall Is	M/M/L	L	L	O	L	O/L	L/L
Solomon Is	H/H/M	M	H	H	M	M/M	L/M
PNG	H/H/M	M	H	H	M	M/H	H/H
Kiribati	H/H/M	H/	H	M	M	M/H	M/H
Samoa	M/M/L	O	M	O	O	L/O	O/O
Vanuatu	H/H/M	H	H	H	H	H/H	M/H
Cook Islands	M/M/M	H	M	M	M	M/M	M/H
Tonga	M/M/L	M	M	L	M	L/L	L/L
Palau	H/M/M	M	H	M	M	M/M	L/M
FSM	M/L/L	L	L	L	O	O/O	L/L

Keys: G = Government, I = Industry, C = Community, Inst.= Institution, Tech = Technical.

Status levels: H = High, M = Medium, L = Low, O = none.

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