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Aquarium products in the Pacific Islands:

A review of the fisheries, management and trade

FAME
Fisheries, Aquaculture and Marine Ecosystems Division

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Robert Gillett, Mike A. McCoy, Ian Bertram, Jeff Kinch,
Aymeric Desurmont and Andrew Halford

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Abbreviations used in this report

ACIAR	Australian Centre for International Agriculture Research
BMR	Bureau of Marine Resources (of Palau)
CIAF	Cook Islands Aquarium Fish
CITES	Convention on International Trade in Endangered Species
AFF	Aquarium Fish Fiji
DFWR	Division of Aquatic and Wildlife Resources (of Guam)
DRMM	Direction des ressources marines et minières (of French Polynesia)
FAO	Food and Agriculture Organization of the United Nations
FOB	free on board
FSM	Federated States of Micronesia
FTE	Full-time equivalent
MFMR	Ministry of Fisheries and Marine Fisheries (of Solomon Islands)
MIMRA	Marshall Island Marine Resources Authority
MMME	Micronesia Management and Marketing Enterprises
MMR	Ministry of Marine Resources (of Cook Islands)
MFMRD	Ministry of Fisheries and Marine Resources Development (of Kiribati)
NC	New Caledonia
OIE	World Organisation for Animal Health
PICTC	Palau International Coral Reef Center
PICTs	Pacific Island countries and territories
PNG	Papua New Guinea
SCUBA	self-contained underwater breathing apparatus
SPC	Pacific Community
UBA	underwater breathing apparatus
VFD	Vanuatu Fisheries Department
WSI	Walt Smith International

Executive summary

This report	• This report is an overview of the fisheries, management and trade of aquarium products in the Pacific Island region. • The study involved visits to Pacific Island countries and territories where the trade is active or has been active in the recent past. Those visits resulted in the preparation of national aquarium trade profiles, which are given in Appendix 2 of this report. • Data in the profiles are compiled, compared and combined with information from the literature and from aquarium specialists to portray the aquarium trade in the region and to explore topics of special interest.
Aquarium companies and employment	In late 2019 there were 34 companies exporting aquarium products in the region. Most of them were quite small, especially in Kiribati (which had the most, 13). About 257 people (full-time equivalent) were directly employed by these 34 companies. The three countries employing the most people were Kiribati (90 people), Fiji (60) and Tonga (55).
	During the past few years, several aquarium companies in the region failed. Reasons for failure include a shock to the world economy, a natural disaster at the location of company activities, death or retirement of the company owner, negative changes to the air freight situation, bans on the export of live rock, denial of export permit due to non-payment of back taxes, general lack of profitability, and national business condition issues, not fishery issues.
The export of aquarium products	• Aquarium export data are inadequate in most places surveyed. Consequently, many of the national estimates of annual exports in this report are semi-educated guesses. • The recent annual free-on-board value of the aquarium trade in the region can be crudely estimated to be about USD 7.4 million. Due to the poor data used to make this estimate, this amount should be treated with caution. • Nine countries in the region are active in the aquarium trade. • Fiji, with its two aquarium companies, is responsible for almost half the value of exports from the region. • The value of annual aquarium exports in 2018 were only about one-third that estimated by an SPC study in 2008.
Prices for aquarium products	• The present survey was able to obtain good price data for only one fishery: aquarium fish at Christmas Island in Kiribati. • Domestic prices for particular species are determined by the global supply and demand, rather than by the rarity of that species in the country of origin. • Important determinants of the cost structure of producing aquarium products are air freight charges, divers' pay, electricity and holding/packing expenses.
Aquaculture of aquarium products	• Seven countries have been involved in culturing products for the aquarium trade in recent years. • Coral and tridacna are the aquarium items cultured by the most countries. • The aquarium products of two countries in the region, Palau and Federated States of Micronesia, are exclusively from aquaculture operations.
CITES issues	An important aspect of the aquarium trade is compliance with the requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In practice, the aquarium products in this region covered by CITES are largely tridacna, hard corals, and a few fish species. One of the major CITES issues for the aquarium trade is the degree to which fisheries departments and environment departments work together smoothly to facilitate exports of CITES items.

Management of aquarium fisheries	• The main management measures are given for each country in the study. • Tonga, Marshall Islands, and Vanuatu have by far the most detailed management arrangements for the aquarium fisheries. Today (as well as ten years ago) Tonga and Vanuatu are the only two countries in the region that have formal aquarium fishery management plans. • A surprisingly large number of countries have aquarium fishery management plans that remain as drafts. Several have been in draft form for over five years. • Aquarium management plans are recommended and should include limitations of licenses and permits issued for operators and collectors within given areas.
International market for aquarium products	• The United States is by far the largest market for aquarium products, with about 69% of global aquarium fish imports. • In terms of supplying the US market, approximately 40 countries export aquarium fish to the marine aquarium trade in the country, with the Philippines and Indonesia accounting for 86.6% of the imports. • In terms of price trends in the international market, there appears to be a lack of significant increase in real prices in the past decade. • Because about 50% of the landed cost of aquarium products is airfreight, prices obtained by PICTs suppliers are sensitive to changes that affect airlines.
Competitive advantages of products from the Pacific Islands region	The advantages of the Pacific Islands in the aquarium trade are that the region: • is known for being drug free; generally there is no association with chemical collection in the Pacific Islands; • has a relatively short supply chain; • has a reputation for high quality, low mortality and good availability; • has several well-known "flagship" producers that elevate the awareness of the region and its associated high quality; • has several rare species that command high prices; and • has a cost advantage over Australia.
Fishery agency facilitation of the aquarium trade	There are several types of actions that a government fishery agency could do to facilitate the aquarium trade. The most important is providing well-oiled government services. This would include efficiently issuing export permits, dealing expeditiously with important issues as they arise, having reasonable charges, and working closely with the environment agency on CITES issues.
Recommendations	The main recommendations of the study deal with the following aspects. • Well-oiled government services In countries that wish to promote the aquarium products trade, it is recommended that the government fishery agency take steps to improve the services required by aquarium companies. • Aquarium fishery management plans Countries that have active aquarium fisheries should have good aquarium fisheries management plans and the means to implement them. • Aquarium product export data Government fisheries agency staff should scrutinise the volume and value of fishery exports in the official customs department data for erroneous information and omissions, and closely collaborate with customs to identify the causes of any errors and take mitigation measures. • National aquarium fishery associations It is recommended that aquarium companies form national associations to be able to speak with a unified voice to the fishery agency and other government entities. • Future studies of the aquarium trade It is recommended that future aquarium product studies in the region closely scrutinise past studies, determine the most appropriate metrics, and use terms that allow comparisons.

1.0 Introduction

1.1 Background

The trade in aquarium products encompasses the harvesting and sale of items for display in saltwater and freshwater tanks. The marine portion of the trade involves fish, coral, live rock, tridacna clams, and other invertebrates. Worldwide, it is a very large business with most estimates of the value of the global market in marine aquarium products exceeding USD 200 million.[1] In the comprehensive reference *From Ocean to Aquarium* it is estimated that between 1.5 and 2 million people worldwide are believed to keep marine aquariums (Wabnitz et al. 2003).

Public interest in aquariums appears to have been first generated in England in the 1850s by Philip Gosse, who created and stocked the first public aquarium in the London Zoo (Brunner 2003). The first aquarium water pump was designed in the early 1900s, and as residential electricity became more widely available after World War I, so did home aquariums. In the 1950s, developments in plastic shipping bags and efficient air transport allowed more exotic fish species to be kept in aquariums (www.nhpets.com).

Originally, the aquarium trade was largely restricted to freshwater organisms but, in the 1960s, interest in marine products expanded tremendously. Today, the value of the freshwater component of the global aquarium trade remains about ten times larger than the marine.

Organisms for marine aquariums were first procured in large numbers in Florida[2] and then expanded in the 1960s to Hawaii and the Philippines. Pacific Island countries and territories (PICTs) began to supply the aquarium trade about 50 years ago. By 2010, there were at least 13 PICTs involved in the trade (Teitelbaum et al. 2010).

The last comprehensive assessment of the aquarium trade in the Pacific Island region was done in 2008 by SPC (Kinch and Teitelbaum 2009). A summary of the report of that activity is given in Box 1.

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1 This amount is for only the marine component of aquarium products. The freshwater component is about ten times greater.

2 It is interesting to note that Tony Nahacky, one of the pioneers of the aquarium trade in the Pacific Islands, grew up in Florida, where his parents owned an aquarium store. As a youngster, Tony became one of the first aquarium fish collectors and sold some of the first marine fish ever available to the hobby in his parent's store. As he developed his skills, he went on to Hawaii at the beginning of the trade there, before expanding to Fiji in the mid-1980s (W. Smith, personal communication).

Box 1: The 2008 sub-regional workshop on the marine ornamental trade in the Pacific

In December 2008, a sub-regional workshop for the marine ornamental trade was held to identify national and regional initiatives that will ensure the long-term ecological, social and economic sustainability of this very important fishery for the Pacific region. It was attended by a wide range of stakeholders, including representatives of governments and the private and public sectors, and specialists active in the marine ornamental trade in the Pacific region.

The aquarium fishery in the Pacific region has been in operation for over 30 years, exporting aquarium organisms to the United States and European markets and, increasingly these days, to Asia. Forty companies are involved in 12 PICTs, employing approximately 1,470 households in supply activities or facility operations.

Cultured aquarium organisms are becoming increasingly important, with many PICTs exporting cultured giant clams and cultured corals. Experimental production of ornamental fish is also being investigated, with a major push for post-larval ornamental fish culture being considered.

During the course of the workshop, several specific areas of need emerged – the need to:

- conduct a market analysis to gain a greater understanding of the market, including: the identification of new aquarium organisms and their potential for sale; commercial viability factors, such as freight costs, freight space and flight connectivity; and transparency, equity sharing and pricing structures;
- assist PICTs on compliance and capacity issues regarding the Convention on International Trade in Endangered Species (CITES), and the new regulation imposed by the World Organisation for Animal Health (OIE);
- investigate the potential of a Pacific eco-certification programme as an avenue for government and industry to work together to ensure sustainability of the aquarium fishery;
- assess the virtues of formal stock assessments and risk assessments with regard to sustainability issues surrounding the supply of aquarium organisms; and
- establish a marine ornamentals working group as a regional focal point for market analysis and international agreement advocacy (particularly on OIE and CITES issues), as a way to distil and discuss problems and issues, to provide an avenue for promoting Pacific aquarium organisms, and as a mechanism for coordinating technical input and research activities.

Source: Kinch and Teitelbaum (2009)

1.2 This study

The marine aquarium trade is important to several PICTs, but the situation in each country is dynamic. Aquarium businesses have risen and fallen, products and prices are constantly adjusting to global market forces, and regulations in exporting and importing countries are changing. Some concerns have been expressed about the condition of aquarium resources, the impacts of harvesting on the marine environment, and the welfare of the divers who collect the various products. Individuals and agencies involved in the management of the aquarium trade need to be aware of these concerns. For this reason, the Pacific Community (SPC) sponsored a review of the fisheries, management, and trade of aquarium products in the Pacific Island region.

This study was commissioned in August 2019, along with a parallel study of the trochus trade in the region. The aquarium product study involved visits in October and November 2019 by consultants of the study or SPC staff to countries that have or had significant involvement in the aquarium trade: Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Marshall Islands, New Caledonia, Palau, Papua New Guinea, Tonga, Solomon Islands and Vanuatu. Information was also obtained by telephone from other countries and territories of the region with limited involvement in the aquarium trade. National aquarium trade profiles for the countries visited were prepared and are given in Appendix 2 of this report. Material from the profiles and other information obtained during the study were used to produce the main text of this report.

Some terms used in this report require clarification:

- tridacna is used to mean all giant clams of the order Tridacninae, including those in the families Tridacnidae and Hippopus;
- aquarium products is used to mean fish, coral, other invertebrates, and live rock (both natural and fabricated) for display in aquariums; and
- aquaculture is used to mean the holding of organisms for growth and desirable changes.

Many individuals contributed national-level information and they are identified in the concluding section of each profile. Several high-level specialists in various aspects of the aquarium trade contributed information and ideas to this study. This included Colette Wabnitz (University of British Columbia), Tony Nahacky (independent consultant), Walt & Deb Smith (Walt Smith International), David Oliver (Aquarium Fish Fiji), Ed Lovell (Biological Consultants Fiji) and Bob Fenner (author of *The Conscientious Marine Aquarist* and past president of the Marine Aquarium Conference of North America).

2.0 Companies in the Pacific Islands aquarium trade

As mentioned in the introduction, Pacific Island countries and territories (PICTs) began to supply the aquarium trade about 50 years ago. A picture of how the industry emerged across the region is given in Table 1, which was constructed using information from the individual national profiles (Appendix 2).

Employment data gathered across several countries are often messy. The company employment information in Table 1 therefore requires considerable explanation. For the column headed Direct company employment in late 2019, the stated numbers are full-time equivalents and include employees but not owners. Divers are included in the estimates. In countries where independent aquaculture operations supply aquarium products, these are not included in the estimates because of lack of information on employment at those operations – or even estimates of the numbers of functioning farms. The numbers given refer to actual employment in October/November 2019 and do not include employment by recently failed companies, nor of companies intending to start operations. For some countries, employment was estimated, despite the available information being crude or incomplete. The employment information in the table should therefore be indicative, rather than accurate.

The first aquarium companies in the region started in the 1970s. They were all in locations with direct flights to the United States: Fiji, FSM and French Polynesia. Those operations were all headed by expatriate Americans with backgrounds in the aquarium industry.

Bearing in mind the explanations given above for the employment information, it is crudely estimated that, in late 2019, about 257 people (full-time equivalents) were directly employed by the aquarium companies. The three countries that currently employ the most people are Kiribati (90 people), Fiji (60) and Tonga (55).

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Table 1: Participants in the Pacific Islands aquarium trade: the pioneers, survivors, products and employment

	Start of the trade	Current status	Current aquarium products	Direct company employment in late 2019
Cook Islands	In 1988, one locally registered company, Cook Islands Aquarium Fish Limited, was given permission to collect and export marine aquarium fish from Rarotonga.	The company still exists but the owner does aquarium fish collection and exports as a hobby.	No exports have occurred in the period 2017–2019. Tridacna was exported up to 2016 and fish up to 2016.	2
Federated States of Micronesia	In the 1970s, Dick Croft (who later became a fisheries officer) came to Pohnpei to start an aquarium fish export business. The oldest commercial aquarium business still in operation is Micronesian Marketing and Management Enterprises (MMME), which was established in Kosrae and took over the government aquaculture facilities in late 2008.	In late 2019, two companies were engaged in the export of aquarium products: MMME in Kosrae and the Marine and Environmental Research Institute of Pohnpei (MERIP).	Coral and tridacna. Fish shipments ceased in 2015.	About 12 employees
Fiji	Fiji Biomarine started collecting aquarium fish in the mid-1970s but stopped operations in the early 1980s. The oldest aquarium business still in operation is Aquarium Fish Fiji, which commenced operations in August 1984, working out of Pacific Harbour.	The peak of the aquarium trade was in 2002 to 2003, when seven companies exported products. Currently there are only two companies with substantial operations: Aquarium Fish Fiji (AFF) and Walt Smith International (WSI).	The Ministry of Fisheries uses the categories of hard coral, soft coral, ornamental invertebrates, ornamental fish, coral base rock and cultured rock, and live rock. Products in all six of these categories were exported in 2018, according to the Ministry's database. Permits for coral exports were halted (possibly temporarily) in December 2017.	About 60 employees
French Polynesia	The aquarium trade has been active in French Polynesia since the early 1970s, starting with the wild collection of aquarium fish and evolving recently to include tridacna.	In late 2019, there were three active companies – none of them in business for more than 20 years: Tahiti Marine Aquarium, Tahiti Tropical Fish, and Te Hotu Miti.	For production for the aquarium trade, the island of Tahiti produces only finfish, while the Tuamotu Group produces both finfish and tridacna. Coral exports are not allowed.	About 19 employees
Kiribati	The aquarium trade started on Christmas Island in the late 1970s. On Tarawa the aquarium products trade started in 2009 with the export of tridacna by the company, Atoll Beauties.	In late 2019 there were 13 aquarium exporting companies on Christmas Island and one on Tarawa.	Aquarium fish from Christmas Island and tridacna from Tarawa	Christmas Island: About 3 employees for each of the 13 companies, plus a total of about 40 divers. Tarawa: About 8 employees. Total: about 90 employees

	Start of the trade	Current status	Current aquarium products	Direct company employment in late 2019
Marshall Islands	Robert Reimers Enterprises established a tridacna farm at Wau Island, Mili atoll in 1988. Apparently, the oldest of these on-going operations started in the late 1980s	In late 2019, four aquarium exporters were operating, one of which was based in Kwajalein.	Two companies export almost exclusively aquarium fish, one exports clams/corals and other invertebrates, and one exports fish, clams and corals. Live rock exports began in the early 1990s but ceased in 2007.	19 divers 10 shore crew 6 clams/coral [does not include independent clam farmers]
New Caledonia	In the 1980s, one company, NEMO, exported various species of aquarium fish to one company based in Los Angeles, USA. The operation was short lived.	In late 2019, two companies were exporting products: Aquarium Fish New Caledonia and Lagoon Aquatics, the latter was started in the late 1990s.	The profitability of aquarium trade businesses largely relies on one species, the velvet angel. Small amounts of other types of fish, including seahorses, are exported.	About 4 employees plus contract divers, perhaps 6 total.
Palau	Commercial exports of aquarium products from Palau were started by a local company in 1991. During the early and mid-1990s, the subject of collecting aquarium products in the wild for aquarium use became contentious, driven by the tourism industry.	In late 2019 two commercial companies were involved in the aquarium trade: Watson Mariculture and BIOTA Palau.	The aquarium products of the two companies operating are (1) Watson Mariculture: soft corals and other invertebrates; and (2) BIOTA Palau: culture/ export of fish, clams and corals.	About 15, not including an unknown number of tridacna farmers
Papua New Guinea (PNG)	EcoAquariums was the first private company to export marine aquarium organisms from PNG. It operated from 2011 to 2012.	In late 2019, there were no companies exporting products for the marine aquarium trade. Two companies have recently been granted licenses and one was building a facility.	None	None
Solomon Islands	Solomon Islands Marine Export was started in 1995 and ceased operation in 2008, when its owner died. Aquarium Arts Solomon Islands started in 1998 and continued until 2015.	In late 2019 there were no companies exporting products for the aquarium trade.	None	None
Tonga	The aquarium trade began in 1988 with two operators harvesting live hard corals. In late 2019, several companies were involved in the aquarium trade, with South Pacific Paradise Export the oldest (since about 2000).	In late 2019, five companies were involved in the aquarium trade: Ecological Reef Fishing Int., South Pacific Paradise Export, Quality Reef Life Marine Tonga, Nahau Reef Export, and JLE International.	In 2018 the rankings of aquarium exports (by piece) were: invertebrates 60%, live hard coral 22%, soft coral 11%, live fish 6% shellfish 2%, live rock 0%.	The number of employees (full-time equivalents) for the 5 companies was: South Pacific Paradise: 3; Ecological Reef: 16; Quality Reef Life Marine: 12; Nahau Reef Export: 16; JLE International: 8. Total 55
Vanuatu	The aquarium trade started when Vanuatu Marine Exports company began operations in 1992. Currently, there are no active companies in the trade. The last company in the Vanuatu aquarium trade (Sustainable Reef Suppliers) made its final shipment in late 2017.	In late 2019, there were no companies exporting products for the aquarium trade.	None	None

In late 2019, there were 34 aquarium product exporting companies in the region. Most of the companies were quite small, especially in Kiribati (which had the most, 13). Typically, the only permanent employees of the companies are the owners – who are usually a married couple. Only two companies (both in Fiji) employ more than 25 people.

In the past few years, several aquarium companies in the region have failed. Company failure reasons have included a shock to the world economy, a natural disaster at the location of company activities, death/retirement of the company owner, negative changes to the air freighting situation, bans on the export of live rock, denial of export permits due to non-payment of back taxes, general lack of profitability, and national business condition issues.

According to information in the national profiles, in late 2019, no country in the region was exporting live rock. Only Tonga was exporting hard coral from the wild. None of the aquarium products exports of Palau and FSM are from the wild.

In late 2008 an inventory of aquarium companies (Kinch and Teitlebaum 2009:3) showed that the industry was "employing approximately 1,470 households in supply activities or facility operations" and 40 companies were involved in the aquarium trade. In comparing that information with the situation in late 2019, the following can be stated.

There has been a 15% decline in the number of companies. The demise of the aquarium trade in Cook Islands, PNG, Solomon Islands and Vanuatu is responsible for most of the change in company numbers over the eleven-year period.

It is not possible to compare the 'number of households involved' in the 2008 survey to the 'direct company employment' of the 2019 survey. What can be stated is that, in 2008, the households in PNG, Solomon Islands, and Vanuatu (i.e. countries where the aquarium trade is no longer active) were responsible for 27% of the involved households.

3.0 Pacific Island aquarium product exports

The national aquarium profiles (Appendix 2) provide the basis for estimating the value of the exports of aquarium products from the region (Table 2).

The quality of aquarium export data is inadequate in most places, and it may be years before the situation changes to the point that a reasonably accurate estimate of exports can be made. In this section, many of the national estimates are semi-educated guesses – and they are put forward here to make a crude assessment of the magnitude of the trade in the region and, hopefully, encourage others with more knowledge to come up with better estimates in the future.

Table 2: Annual exports of aquarium products from PICTs

	Annual free on board (FOB) value (USD)	Annual volume	Comments
Cook Islands	0	0	No exports in 2018 or 2019
FSM	No good price data are available. Using the 2018 export numbers and crude estimates of value per piece, the FOB value of exports in 2018 is estimated to be around USD 318,000.	Tridacna: 7,752 pieces for 2018 Coral: 30,000 pieces for 2018	Estimate of FOB value should be considered very crude.
Fiji	USD 3,500,000 for 2017	Volume data are available for only one of the two exporting companies: fish 93,460 pieces, assorted invertebrates 22,180 pieces, live rock 313,205 kgs, cultured rock 33,604 kgs, and cultured corals 3,995 pieces (all for 2017). The second company's export value is thought to be about 2/3 that of first company.	The available information is insufficient for making an estimate of the annual volume or value of aquarium exports of the country – but some crude speculation from the national profile is given here.
French Polynesia	USD 424,000 for fish for 2018; USD 307,000 for tridacna for 2018; USD 731,000 total for 2018	Fish: 27,300 pieces for 2018 Tridacna: 15,108 pieces for 2018	
Guam	USD 16,000 in 2018	Fish: 3,147 pieces in 2018	
Kiribati	USD 1,007,850 for fish for 2018 USD 17,500 for tridacna for 2018 USD 1,066,600 total	Fish: 105,311 pieces for 2018 Tridacna: 1,750 pieces for 2018	Fish values are 'earned values', i.e. price paid for the fish by the importer and therefore must be deflated by air freight costs to obtain FOB values.
Marshall Islands	No price data available. Using the FY 2018 export numbers and crude estimates of value per piece, the FOB value of exports in FY 2018 is estimated to be around USD 750,000	Fish & inverts: 123,335 pieces for FY 2018 Coral & tridacna: 35,374 pieces for FY 2018	Most export declarations are said by MIMRA to contain a value of $1 [sic]; In FY 2018 the country re-exported 474 pieces of tridacna from Kiribati, 2,966 pieces tridacna from FSM, and 12,704 pieces of coral from FSM. Estimate of FOB value should be considered very crude.
New Caledonia	USD 323,000 for 2018	Fish and water: 12,469 kg for 2018	
Palau	No price data available. Using the 2018 export numbers and crude estimates of value per piece, the FOB value of exports in 2018 is estimated to be around USD 310,000	Cultured fish: 13,798 pieces for 2018 Soft coral: 6,737 pieces for 2018	No hard corals exported in 2018
Papua New Guinea	0	0	No exports in period 2017 to 2019
Solomon Islands	0	0	No exports in period 2016 to 2019
Tonga	USD 401,546 for 2018	Total pieces of aquarium products in 2018 is 285,230, of which 17,000 are fish.	
Vanuatu	0	0	No exports in the period 2018 to 2019
	Total = about USD 7.4 million		

PICTs totals in Table 2 are presented graphically in Figure 1.

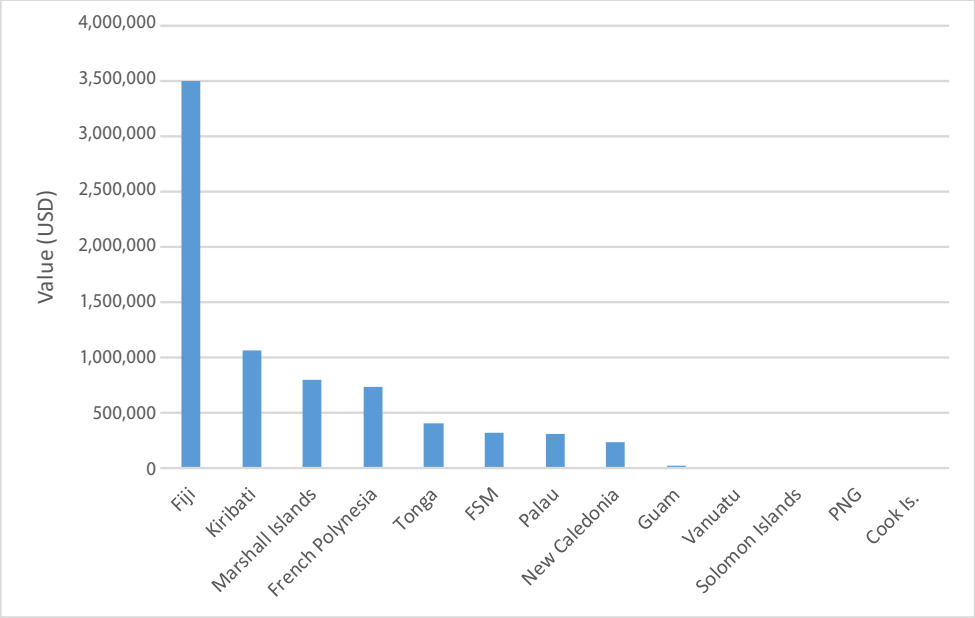

Figure 1: Annual value of exports of aquarium products from PICTs

Numerous explanations and caveats are required for information in Table 2. In countries where price data are not available, semi-arbitrary free on board (FOB) values per piece were established, based on discussions with industry and data from countries where they are available. These are: wild fish USD 5, cultured fish USD 20, tridacna USD 10, hard coral USD 8, soft coral USD 5, and other invertebrates USD 3. In using these prices, it should be noted that there is a huge range of prices for various types of fish, a large range for corals, and not much range for tridacna. The use of these values per piece is likely to be the largest source of uncertainty in the table, especially for fish. Other explanations/caveats are listed below.

- Unless otherwise noted, the exports are for 2018.
- For brevity, in the table and in Appendix 2, 'inverts' is used to mean invertebrate aquarium animals other than tridacna or coral.
- In the information available to the study, the values cited are in various forms, including 'export value', 'annual value', 'contribution to the economy', and 'gross sales'. To the degree possible, the values given in the table are adjusted to be FOB values – and therefore exclude airfreight costs.
- For several countries, the export data are producer-supplied and are un-verified.
- The results are complicated by re-exports, especially in Micronesia. For example, the Marshall Islands has imported tridacna from FSM and Kiribati and coral from FSM – all for later export in a year which may be different from the importing year (i.e. calendar year vs various fiscal years).

Table 2 shows that the recent annual FOB value of the aquarium trade in the region can be crudely estimated to be about USD 7.4 million. Due to the caveats described above, this amount should be treated with caution and should be revised as better information becomes available. Special attention should be given to verifying the Fiji export data to determine whether it captures all aquarium exports from the country.

Table 2 also shows that:

- nine PICTs are active in the aquarium trade;
- Fiji, with its two aquarium companies, is responsible for almost half the value of exports from the region; and

- using the table and some confidential company information, the number of aquarium fish exported annually can be crudely estimated to be about 430,300 pieces. With the existing information, it is not possible to make estimates for the quantity of annual exports for the other aquarium products.

The results of the present study can be compared to an earlier SPC estimate. In *Proceedings of the sub-regional workshop on the marine ornamental trade in the Pacific* (Kinch and Teitelbaum 2009:3) it is stated: "The annual value export by the industry is estimated to be in the range of USD 20 to 30 million". The 2008 workshop also indicated that at least 12 PICTs are involved in the aquarium trade. If we assume that 'annual value export' equates to annual FOB values, then aquarium exports in 2018 were only about one-third of those estimated by the 2008 workshop. However, the poor data (presumably in both periods) could affect this comparison.

A report on aquarium fish commissioned by the Forum Fisheries Agency (Pyle 1993:136) stated that: "around 200,000–250,000 fish with an approximate export value of USD 1–1.5 million are exported annually from FFA member countries other than Australia".

Table 3 summarises the types of aquarium products exported by PICTs in recent years.

Table 3: Types of marine aquarium products exported in significant quantities in recent years

	Cultured				Wild harvest			
	Fish	Corals	Tridacna	Live rock	Fish	Corals	Tridacna	Other invert
Cook Islands	0	0	0	0	0	0	0	0
FSM	0	✓	✓	0	0	0	0	0
Fiji	0	✓	0	✓	✓	0[3]	0	✓
French Polynesia	0	0	✓	0	✓	0	✓	✓
Guam	0	0	0	0	✓	0	0	0
Kiribati	0	0	✓	0	✓	0	0	0
Marshall Islands	0	✓	✓	0	✓	0	0	✓
New Caledonia	✓	0	0	0	✓	0	0	0
Palau	✓	✓	0	0	0	0	0	0
PNG	0	0	0	0	0	0	0	0
Solomon Islands	0	0	0	0	0	0	0	0
Tonga	0	✓	✓	0	✓	✓	0	✓
Vanuatu	0	0	0	0	0	0	0	0

In the present study, the poor export data placed a severe restriction on gaining insights into the aquarium trade in the Pacific Island region. This conclusion is similar to that of a study covering the aquarium trade in several of the world's regions. A global report on understanding the trade in marine aquarium animals states that there is no clear picture of the number of live marine fish and invertebrate species or individuals involved in the aquarium trade, primarily due to insufficient global tracking of the import and export of these animals and despite the recent growth and diversification of the aquarium trade, to date, data collection is not mandatory, and hence comprehensive information to study trade pathways, including species volume and diversity, is lacking (Rhyn et al. 2017).

3 Permits for wild-caught coral were not issued after Dec 2017

4.0 Domestic prices for aquarium products

The available information on prices for aquarium products in each of the countries covered in this study are given in each national profile (Appendix 2). The aim of the national profile work on prices was to obtain the readily available information on prices paid to harvesters, possibly by species. Unfortunately, good price data were obtained for only one fishery, aquarium fish at Christmas Island in Kiribati (given in the Kiribati profile in Appendix 2). It was, however, possible to get other types of relevant price information from some countries. Table 4 gives the available price information.

Table 4: Price information for aquarium products

	Prices paid to harvesters	Other type of price information
Cook Is.	No price list was available for species.	CIAF Ltd pays a third of the price received from wholesalers / retailers to the aquarium fish collectors. The payments are dependent on the catch (species and numbers) for each collector.
FSM	No price list was available for species.	Exporters were reluctant to provide any information on prices paid to local producers.
Fiji	The aquarium companies are reluctant to divulge much information on prices paid to harvesters.	The available data on prices for specific aquarium products are limited to the value declared to customs (i.e. FOB prices).
French Polynesia	The exporting companies are understandably reluctant to give information on prices paid to harvesters.	DRMM staff have access to declared FOB prices. In a summary report, the average declared value for finfish exported in 2018 was CFP 1,578 per fish, which is 2.6 times the value 20 years ago. The average FOB value for tridacna exported in 2018 was CFP 2,065 per clam.
Kiribati	Gives prices paid to divers for each of the top ten fish species.	The owner said it would be misleading to give tridacna prices paid to farmers as varying degrees of support are given to the farmers, depending on the location.
Marshall Islands	No exporter of aquarium products was willing to divulge prices received for exports.	MIMRA indicated that an average price paid for tridacna farrned at Likiep is around USD 2.85 per piece. One aquarium fish exporter said that, on average, he may pay his divers a third of the wholesale value of fish.
New Caledonia	No information was available.	
Palau		According to one clam mariculture operator, the price paid to local farmers for aquarium clams for export ranges from USD 6 to USD 10 depending on species and size.
PNG	[all price data are over ten years old]	
Solomon Is.	[all price data are over ten years old]	Kinch (2004) gives buying prices in Solomon Islands and selling prices in USA for about 45 species of fish and invertebrates. In general, the overseas selling price is about 6.6 times the buying price (the range is between 5 and 14.2).
Tonga	The aquarium companies are reluctant to divulge much information on prices paid to harvesters.	The only readily available information on actual prices at first sale is for the tridacna that the Ministry sells to exporting companies. Examples of the pricing are TOP 10.92 for a 5 cm *T. maxima*, TOP 15.52 for a 5 cm *T.squamosa*, and TOP14.95 for a 5 cm *T.derasa*.
Vanuatu	The last company to participate in the Vanuatu aquarium trade was very cooperative with the present survey, but was reluctant to discuss prices.	

In reflecting on the above information, during the design of this survey it may have been naïve to believe that the managers of businesses in a very competitive industry would share sensitive price information for eventual publication in a document that would become publicly available. On a different level, the use of unverified company-supplied prices for comparison purposes may not be very useful and could be misleading.

Harvesters are often amazed or even shocked at the difference between what they are paid for an aquarium item and what they see in advertisements for similar products in a North American retail aquarium shop. Those surprised harvesters may not be aware of the high air freight costs nor the number of middlemen the items must pass through from the ocean to the shop. In the classic reference *From ocean to aquarium* (Wabnitz et al. 2003:13) it is stated: "Shipping charges are the main reason behind the discrepancy between marine ornamental prices in the exporting country and final retail price – in the case of fish, shipping charges often correspond to approximately half to two thirds of the landed price incurred by the importer." This has sometimes resulted in public image problems (i.e. that suppliers are getting ripped-off).

Other relevant aspects of domestic prices for aquarium products are listed below.

- In general, domestic prices for particular species are determined by the global supply and demand, rather than by the rarity of that species in the country of origin.
- In countries that have had a sea cucumber fishery in the recent past, the divers are often accustomed to very high pay, relative to what the aquarium industry can afford. As explained by one aquarium company owner: "Divers are spoiled by BDM [beche de mer]". This may at least partially account for the interest by companies in using divers from South-East Asia (Section 9.2 below).
- Besides the previously-mentioned diver's pay and air freight charges, important determinants of the cost structure of producing aquarium products are electricity charges (one exporter in Fiji pays USD 9000/month), and packing procedures (including balancing the minimal use of water with minimising mortality).

5.0 Aquaculture of aquarium products

Eleven years ago, Kinch and Teitelbaum (2009:4) stated: "Wild-harvested aquarium organisms have been the mainstay of the aquarium trade since its beginning. Increasingly, though, a greater diversity and volume of cultured organisms from PICTs are entering the market". That trend has continued. Table 3 above shows that seven countries are culturing products for the aquarium market in recent years.[4] From the table it can be seen that:

- coral and tridacna are the aquarium items cultured by the most countries; and
- the aquarium products of two countries in the region, Palau and FSM, are exclusively from aquaculture operations.

The national aquarium profiles show that advances have been made in the relatively complex culture of aquarium fish in New Caledonia and (especially) Palau. On the other hand, the high expectations for capture and culture of post-larval ornamental fish from the wild have not come to fruition.

As the vast majority of aquarium products cultured in PICTs are for export, various international developments in aquaculture have a major impact on the viability and direction of culturing aquarium products in the Pacific Island region. These are briefly described below.

4 For the purpose of the present study, "aquaculture" is considered the holding of marine organisms for growth and desirable changes. "Recent years" is considered to be 2018 and 2019.

- Within USA, about half of coral culture is done by large companies and half by 'garage producers' (i.e. hobbyists who sell part of their production). The production by garage producers puts downward pressure on aquarium coral prices, largely by eliminating several steps in the supply chain.
- 'Coral frag swaps' are becoming increasingly popular in USA and United Kingdom. Hobbyists meet at informal markets and sell aquarium coral. One website[5] lists over 100 frag swaps planned for 2020 in North America.
- The increasing production of coral in USA by hobbyists and the increasing popularity of frag swaps have led several people in the aquarium trade to believe that, in the future, a larger proportion of aquarium coral for sale in USA will come from USA domestic production.
- Outside USA, the aquaculture of corals is gravitating to areas with low production costs (i.e. Southeast Asia).

During the present study, one knowledgeable individual indicated that what happened in the procurement of freshwater aquarium fish may provide some insight into marine aquarium fish. Most freshwater aquarium fish were originally obtained by capture in the Amazon Basin and Africa, but this changed to culture in Florida and then (for reasons of production costs) moved to Asia. (W.Smith, personal communication)

Some comments in the SPC review of aquaculture in the region seems especially relevant to efforts to promote the farming of coral. For example, in FSM, there is: "Some demand for cultured corals, which are relatively easy to grow with a far lower investment" (Hambrey Consulting 2011:103). But in contrast in Solomon Islands, "Wild corals can be collected more easily and cheaply and there is little if any premium on cultured corals" (Hambrey Consulting. 2011:118). In this regard, two countries in the region that are trying to encourage the culture of coral still allow the wild harvest of coral.

An additional consideration on the culture of aquarium products concerns the geographic distribution of societal benefits. In some countries (e.g. Solomon Islands) there has been considerable effort to involve remote communities in the trade of aquarium products. One researcher, drawing on worldwide experience in the culture of aquarium products, states: "Typically, aquaculture concentrates production near central distribution gateways, and not in remote villages" (Rhyne et al. 2012:6).

6.0 CITES issues

An important aspect of the aquarium trade is compliance with the requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. A summary of the relationship between CITES and the aquarium trade in the region is given in Box 1.

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5 https://www.reef2reef.com/threads/2019-frag-swaps-and-shows.510447/

Box 2: CITES and the aquarium trade in the Pacific region

In practice, the aquarium products in this region covered by CITES are largely tridacna, hard corals and a few fish (e.g. humphead wrasse, seahorses). Under CITES, for any international trade to occur in these species, it must be determined that the trade is not detrimental to the survival of the species in the wild, and must involve only specimens that were obtained in compliance with national laws for the protection of fauna and flora. To ensure that trade in a species covered by CITES is non-detrimental, a number of steps must be completed prior to export.

- The CITES scientific authority of the state must advise that the export would not be detrimental to the survival of the species.
- The CITES management authority of the state must be satisfied that the specimens were not illegally obtained.
- The scientific authority may also determine that limits should be placed on the export of a species in order to maintain it throughout its range at a level consistent with its role in the ecosystems in which it occurs. Annual quotas are one example of such limits.

The management authority is ultimately responsible for the issuing of permits. In relation to importation of the CITES listed species, the importing state requires the CITES export permit to allow entry of the products.

In the Pacific Island aquarium trade, some of the CITES-related issues that require attention are:

- the need to delineate responsibilities between the various the government agencies with CITES responsibilities (most often environment and fisheries departments);
- the need for training in taxonomic identification of individual species in trade (particularly for customs officers);
- improvement of export data collection; and
- Ensuring there is adequate financing and procedures in place for the issuance of CITES permits.

Source: modified from Kinch and Teitelbaum (2009)

During the present study, in addition to the above CITES issues, other difficulties were noted in complying with CITES requirements. These included:

- in one country there is only a single person authorised to sign CITES permits, so considerable advance planning is required; and
- one country was temporarily blocked from exporting aquarium tridacna to USA when US authorities discovered people from that country entering USA carrying non-authorised shipments of dried tridacna.

CITES export data require some comment. The CITES Secretariat maintains an on-line database (https://trade.cites.org/en/cites_trade/) where it should be possible to see imports/exports for items covered by CITES, including aquarium items. However, for several PICTs, the CITES on-line database indicates export quantities of aquarium products that are very different from those given by the fisheries or customs databases of the exporting country. While it is understandable that some differences could arise because the CITES export database is oriented to the authorised number for export, which could often be more than what was actually exported, this does not account for several discrepancies. For example, reports of the fisheries service of French Polynesia show that, in 2018, 119 CITES export permits were issued for a total of 28,975 tridacna and 15,108 tridacna were actually exported during the year. The CITES on-line database[6], however, shows only 3,377 tridacna exported from French Polynesia during 2018.

Most PICTs that participate in the aquarium trade are contracting parties to CITES. Cook Islands, Kiribati and Marshall Islands are not contracting parties. As such, they are still able to export aquarium products to contracting parties, but there may be some additional difficulties. Examples of these problems are that the non-contracting parties may be less well informed about changes in CITES procedures, forms and coral nomenclature. Past experience indicates that non-contracting parties tend to have more problems at the importing end (C. Wabnitz, personal communication).

6 Accessed 8 December 2019.

7.0 The management of aquarium fisheries

The main management measures given in the national aquarium profiles have been extracted from Appendix 2 and used to formulate Table 5.

Table 5: The main aquarium management measures used by PICTs

	Main measures
Cook Islands	Management is restricted to a ban on fishing inside the lagoon and on reef flats. MMR has had a draft marine ornamental fishery management plan since 2012.
FSM	Strong local reef tenure systems exist in Yap State and Chuuk State. No such systems exist in Kosrae or Pohnpei states, although there are some municipal controls in the former. Chuuk requires prior written permission from the Director of Marine Resources to export or import any live fish or viable fish eggs, prohibits the harvesting of corals for commercial export, and prohibits the commercial export of clams.
Fiji	The current rules of the aquarium trade in Fiji include a ban on the export of live rock, a (possibly temporary) ban on the export of coral; a quota system for coral; and a requirement for companies to have an environmental impact assessment, a collection area management plan, an export permit from the Ministry of Fisheries, an export permit for species covered by CITES from the ministry responsible for the environment, a fishing licence for the operator of a collection vessel, and to submit statistics to the Ministry of Fisheries.
French Polynesia	There are no regulations specific to the aquarium fish fishery. For the aquarium tridacna fishery, are there several territory-wide regulations specific to the fishery, including: (a) requirement for a licence to possess, transport, or market any tridacna destined for the aquarium market; (b) a minimum size of 4 cm for spat-collected tridacna; (c) a minimum size of 12 cm for wild collected tridacna; (d) harvesting of tridacna only from those islands where it authorised; and (f) a quota for those islands where authorised.
Guam	There is a moratorium imposed on the export of aquarium fish. The commercial harvest of tridacnid clams is prohibited.
Kiribati	There is a draft management plan put together by the coastal fisheries management section at SPC. There is no exporting of live rock or hard coral.
Marshall Islands	The MIMRA Aquarium Fishery Regulations 2015 require a license for the export of marine ornamentals (USD 1,000 fee) and limit the number of active licenses in the country to a maximum of seven at any one time. Total allowable catches may be established and implemented. Local governments in consultation with MIMRA may take conservation and management measures.
New Caledonia	To be allowed to fish for ornamentals, a fisher must obtain a "specific inshore fishing authorisation" in addition to the general inshore fishing authorisation that all professional fishers must hold. Professional fishers doing SCUBA or UBA activities must hold a specific fishing authorisation for marine aquarium organisms.
Palau	Palau prohibits the commercial export of hard corals unless they are cultured. Any person who takes more than five specimens or pieces of aquarium species in a single day must have an aquarium collecting permit. Only Palauan citizens can apply for such a permit. No person may export aquarium species unless s/he has an aquarium collecting permit or a marine research permit issued by the Ministry of Natural Resources, Environment and Tourism.
PNG	A draft national marine aquarium fishery management and development plan was prepared by the National Fisheries Authority in 2014. This plan has licensing conditions, gear restrictions, and set total allowable catches and reporting requirements. The draft plan is still not in effect.
Solomon Islands	According to MFMR staff, there are draft management plans for coral and clams, but they are not yet in effect. There are several regulations that apply to all fisheries in Solomon Islands, including the fisheries related to the aquarium trade. These include (a) possession of underwater breathing equipment for the purpose of harvesting any fisheries resource; (b) requirement for a licence to operate a fish processing, storage or export facility; and (c) requirement for an export licence for each consignment of live fish or fish product. Several regulations have special application to the aquarium trade, including the following prohibitions: (a) no fishing, selling, buying or exporting branching coral, soft coral, and mushroom coral; (b) no selling, buying or exporting clam meat or clam products of the genus Tridacna and Hippopus not under a management plan; and (c) no export of all live and dead corals or live rock not under a management plan.
Tonga	Five types of management measures are specified in the Tonga Marine Aquarium Fishery Management and Development Plan 2017–2019: (a) marine aquarium resource operator requirements; (b) prohibitions; (c) restrictions on collection methods and areas; (d) catch limits per licensed operator; and (e) monitoring/reporting requirements.
Vanuatu	The Vanuatu National Marine Aquarium Trade Management Plan gives 64 management measures in 11 categories: limitations, licensing, fishing methods and collection practices, prohibitions, facilities and husbandry, employment of foreign workers, use of underwater breathing apparatus, areas of operation, conservation, reporting, and observers. Some of the management measures are: only four export operators are allowed, a fishing license is required, a contract with the reef owners is required, the export of wild-harvested tridacna and hard corals is prohibited, the collection of food fish is prohibited, a total of only four foreign workers is allowed, and each operator is required to pay an observer fee to the Fisheries Department.

Source: Appendix 2

Some observations can be made on the above table:

- Tonga and Vanuatu have by far the most detailed management arrangements for the aquarium fisheries. Today (as well as ten years ago) those are the only two countries in the region that have formal aquarium fishery management plans.
- A surprisingly large number of countries have aquarium fisheries management plans that remain as drafts: Cook Islands, Kiribati, PNG and Solomon Islands. Several have been in draft form for over five years.

The use of underwater breathing apparatus (UBA) is banned in some countries that participate in the aquarium trade (e.g. French Polynesia, Solomon Islands). It is interesting to note that an SPC report (Nahacky and Wabnitz 2014) gives several reasons for the aquarium fishery being exempted from any national ban on the use of UBA in fishing, including: (a) the negative impact on the habitat is greater if collection is done by free diving, as fishers have less time to carefully collect the fish; and (b) collection of fish in only shallow water (<10 meters) restricts proper rotation of the fishing area and intensifies the impact on a narrow section of reef.

With a few exceptions (e.g. Fiji and Christmas Island), stock assessments of the fish component of the aquarium trade have not been carried out, although some stock assessment work has been carried out in a few countries for the coral and tridacna components of the trade. This assessment situation in the Pacific Islands is not remarkably different from other regions in the world. Looking across many regions, Wabnitz et al. (2003:58) state: "Most of the restrictions that regulate the trade to date have been put in place, despite a lack of information on the population status and life characteristics of the targeted species."

To show that the aquarium fishery can be sustainable, the situation of Aquarium Fish Fiji is often cited: the company has been harvesting in the same area near Pacific Harbour for the past 35 years without a noticeable change in catch rates. The case of Christmas Island is also often cited; it is an example of the need for aquarium fisheries to be managed. Several years ago, there was a flame angel boom on the island that involved an unregulated number of divers hunting for the valuable *Centropyge loriculus*. The result was a decline in the resource, as well as in the market price. In only a few years, flame angels went from an export price of more than USD 15 to less than USD 6 (Teitelbaum et al. 2010).

A recent study (Dee et al. 2014) reviewed aquarium fishery management practices around the world. The report stated that overcoming barriers to effective management and regulation of aquarium fisheries is daunting, given that trade includes over 1800 species of fish, hundreds of species of coral, over 500 species of other invertebrates, and live rock. Globally, many strategies to monitor, regulate and manage the aquarium trade have been attempted. Strategies reviewed by the study included international agreements, marine protected areas, rotational closures, banned-species lists, quotas, cyanide detection, gear restrictions, size limits, licensing and limited entry into the fishery, and regulations on imports. The study concluded that moratoriums on certain species, no-take reserves, tiered quota systems, and import and export restrictions, among others, were examples of management successes.

The SPC publication *Best practices for the collection, transport, holding and export of fish and corals in the aquarium trade* (Wabnitz and Nahackey 2019) has considerable relevance to the management of aquarium fisheries by describing procedures, many of which contribute to the long-term sustainability of aquarium resources. In addition, the report makes a general recommendation on the management of aquarium fisheries in the region: "Implementation of these practices should be accompanied by a management plan that is specifically designed for regulating marine aquarium fishery practices/activities, and include regulations that limit the number of licences and permits issued for operators/collectors within given areas" (Wabnitz and Nahackey 2019:1).

Because the aquarium fishery is export oriented, there is relatively good enforcement of management measures at the point of export, such as banned species and quotas. In most PICTs, other types of management measures such as gear and area prohibitions appear to be not well enforced.

8.0 International aspects of the aquarium trade

8.1 Trends in the aquarium product trade outside the Pacific Islands

It is likely that the major historical trend in the marine aquarium trade outside the Pacific Island region was the tremendous expansion of production in the final decades of the 20th century. Some authors (e.g. Bruckner 2001) cite an increase in the volume to be 10% per year during that period. Other significant historical trends have been:

- expansion of the main areas of fish collection from Florida to Hawaii and the Philippines in the 1960s;
- expansion of live coral and live rock production for the aquarium trade in the mid-1980s;
- a shift, starting in about 1990, in consumer preference from aquariums that hold only fish to those that hold a variety of organisms (i.e. mini-reef ecosystems);
- the increasing momentum of the aquaculture of corals and other invertebrates for the aquarium trade in the mid-1990s; and
- a significant (but not huge) downturn in the trade for a few years during the economic recession of 2008/2009.

Information on the newer trends is more difficult to obtain. Rhyne et al. (2017:2/36), citing numerous studies, states that currently "there is no clear picture of the number of live marine fish and invertebrate species or individuals involved in the aquarium trade, primarily due to insufficient global tracking of the import and export of these animals."

During the present study, several aquarium specialists offered anecdotal information on new trends and developments affecting the industry. One of these concerns was the production of hard corals for the aquarium trade. As mentioned in Section 5.0 above, there is an increasing proportion of coral produced by aquaculture and, within the aquaculture sector of USA, about half is grown by 'garage producers'. Outside USA, the aquaculture of corals is gravitating to areas with low production costs (e.g. Southeast Asia).

Other recent international aquarium trends/developments are briefly described below.

- In the retail aquarium business, services (rather than products) are making up a growing proportion of income. One specialist indicated that, currently, about 40% of the income from 'mom and pop aquarium stores' in North America comes from services such as installing and maintaining aquariums (R. Fenner, personal communication).
- During the past five years there have been major advances in the breeding of fish. Some expensive fish that were formerly caught only in the wild can now be raised in tanks (W. Smith, personal communication).
- The Philippines, formerly known for the use of cyanide to capture aquarium fish, is gradually becoming cleaner (W. Smith, personal communication).
- With improvements in air transport links, more aquarium fish from relatively unknown places are appearing in the major markets (D. Smith, personal communication).
- In Europe and USA there is increasing pressure from environmental groups that dislike the aquarium trade (T. Nahacky, personal communication).
- Aquarium product exporting countries that do not have the efficient government services required by the aquarium trade are at an increasing disadvantage in the trade (C. Wabnitz. personal communication).

8.2 The international market for aquarium products

USA is by far the largest market for aquarium products. Good recent data for aquarium fish commerce are lacking, but Wabnitz et al. (2003), using data from importers for the years 1997 to 2002, show that 69% of aquarium fish imports are made by USA and 20% by the United Kingdom[7]. The CITES importing data for coral show that USA imports 68% of all live corals, with the EU importing 24%, mostly split among Germany, France, Netherlands and the United Kingdom (Jones 2008).

In terms of supplying the US market, approximately 40 countries export fish to the marine aquarium trade in USA, with Philippines and Indonesia accounting for 86.6% of the imports (Rhyne et al. 2012).

The global aquarium market is dominated by a few large wholesalers. Three of the biggest players are:

- Quality Marine This business has been operating for over 35 years and is located near the Los Angeles airport, USA. The company indicates they have state-of-the-art marine fish holding arrangements in their 40,000 square foot facility.
- De Jong Marinelife This business has been operating for over 60 years and its main facilities are located in Netherlands. The company indicates it has a stock of 25,000 animals and imports its marine products from over 55 suppliers worldwide.
- Tropical Marine Centre This business has been operating for over 50 years and is located in Hertfordshire, England, with a branch in Portugal. The company indicates it imports marine products from 26 countries and supplies 1200 retail stores in the United Kingdom and 500 in the Iberian Peninsula.

In the present study, several participants in the international aquarium trade were asked about price trends in the international market. The responses varied widely, but typical replies were that for the range of aquarium products prices seems to be just about tracking inflation, there has been no real change in about ten years, and pricing has been stagnant and not keeping up with increased expenses. These responses suggest a lack of significant increase in real prices in the past decade.

Some additional features of the prices of PICT aquarium products on the international market are described below.

- Because about 50% of the landed cost of aquarium products is airfreight, prices obtained by Pacific suppliers are sensitive to changes that affect airlines. This obviously includes changes in the price of fuel but, judging from the numerous studies on airfreighting tuna out of the region, it also includes the cargo capacity of the type of aircraft used for flights to USA (and, to a lesser extent, to Europe).[8]
- Several people with insight into the international aquarium trade offered the advice that PICTs should not attempt to compete with Southeast Asia on aquarium product prices because Indonesia and Philippines will always have low prices due to low production costs – but PICTs should strive to compete on quality.
- For aquarium fish, Southeast Asia is the price setter, but the lingering reputation of Indonesia and Philippines for high mortality and the use of cyanide prevents to some extent those countries from receiving premium prices.
- For aquarium coral from the wild, Australia is the price setter, due to its large production.
- Concerning aquarium tridacna, Vietnam can produce a cheap product, but as one trade specialist stated, "Those clams tend to be ugly."

7 The United Kingdom is made up of England, Scotland, Wales and Northern Ireland.

8 When Fiji Airways switched from B747 to A330 aircraft for Nadi to Los Angeles flights in the early 2010s, the cargo capacity for exports dropped significantly. More recently, the change from A330 to A350 aircraft for that sector expanded the capacity.

8.3 Demand for aquarium products from the Pacific region

The demand for aquarium products is summarised by Rhyne and Tlusty (2012) in these extracts:

> The aquarium hobby has been termed a luxury hobby, and therefore it can be inferred that the economic health of the consumer will directly affect the size of the hobby. The U.S. is the major destination port for coral reef wildlife, and economic health was greatly affected by the global recession of 2007-2009 (Bricker et al. 2011). …
>
> The second major factor affecting the aquarium industry is technology. Perhaps the most significant change in husbandry technology that affects the size and accessibility of coral reef tanks is lighting. Changes in aquarium lighting have allowed for an increase in the number of manufacturers offering packaged mini or nano-reef aquarium systems that are directly marketed to consumers for reef aquariums. Advances in technology will affect various species differentially.

The effect of the 2007–2009 recession on PICT aquarium producers is interesting. One of the major exporters in Fiji reports that the recession resulted in a change in demand for his products. Other producers in the region reported a significant impact, with one citing the recession as a contributing factor to his business closing. On reflection, one explanation could be that the Fijian producer targets consumers at the upper end of the market – people whose relatively minor expenditure on hobbies is not significantly affected by spikes in the economy.

The terms of reference for the present study specifically ask whether there is a "readily accessible market for aquarium species". Because it is obvious that there is a large international market for aquarium products, a more relevant issue is whether aquarium products from PICTs can compete in the international market. To explore this issue, it is important to identify any competitive advantages of products from the Pacific Island region. During the present study, recognised specialists in the aquarium trade[9] were asked for their opinion on the advantages that the region enjoys relative to producers in other regions. The replies that were especially common were that the Pacific Island region:

- is known for being drug free: "Generally there is no association with chemical collection in the Pacific Islands" and "Nobody in the region uses drugs to capture fish";
- has a relatively short supply chain; collected specimens move relatively quickly to good systems and arrive in prime shape;
- has a reputation for high quality, low mortality and good availability; this is related to the supply chain point above – but goes further;
- has several well-known 'flagship' producers that elevate the awareness of the region and its associated high quality. As stated by a USA-based aquarium specialist: "The Smiths are category killers for high quality and availability";
- has several rare species not present in Southeast Asia that command high prices; and
- has a cost advantage over Australia.

Many of the above advantages are related to perceptions by importing country wholesalers, retailers and consumers. Aquarium specialists repeatedly make statements such as "in the aquarium business, reputation is everything" and "an exporter is only as good as his last shipment". As in the Pacific Island tuna trade, a government fishery agency in the region can and should take steps to make sure that a country's reputation in the trade is not tarnished.

9 Specifically, Colette Wabnitz, Tony Nahacky, Walt & Deb Smith, David Oliver, Ed Lovell, and Bob Fenner.

Returning to the issue of whether aquarium products from PICTs can compete in the international market, there appears to be a consensus of opinion among aquarium specialists that there are certain prerequisites for countries and companies to be successful competitors: (a) good air cargo service to the main markets in terms of cost, reliability and capacity; (b) other elements of the cost structure are good (e.g. electricity, labour); and (c) there are species of interest in abundance.

9.0 Additional observations on the Pacific Island aquarium trade

9.1 Government services

In the present study, during several of the country visits, fishery officers asked about what the government fishery agency could do to assist in promoting the aquarium trade and facilitate the operations of aquarium companies. Mindful that the aquarium trade in the region has contracted considerably in the last decade, this is an especially relevant issue. It can be examined from several perspectives, including the causes of the recent failures of aquarium companies and comments from the managers of currently operating aquarium companies.

From the perspective of company failures

- Section 2.0 above reviews the causes of recent failures of aquarium companies. Most of the causes appear to be outside the ambit of a government fishery agency, e.g. shock to the world economy, natural disaster at the location of company activities, death/retirement of the company owner, negative changes to the air freighting situation, and national business condition issues (not fishery issues).
- A few causes of failure relate to fisheries issues. Probably the most common of these is national bans on exporting certain products, especially coral and live rock. While not disputing the justification for those bans, it should be noted that the technology, expertise, and investment required for a company to export those items is considerably less than for exporting live fish. Bans on coral and live rock have, therefore, a disproportionately larger effect on embryonic companies, which are most often owned/operated by Pacific Islanders, rather than expatriates.

The comments from operators of currently functioning aquarium companies indicate several types of action that a government fishery agency could do to facilitate the aquarium trade. The most important from discussions is providing well-oiled government services. This would include efficiently issuing export permits, dealing expeditiously with important issues as they arise, having reasonable charges, and working closely with the environment agency on CITES issues. An example of a government service that is not well-oiled is in the Pacific country that allows an exemption for the use of scuba for aquarium fishing, but the fishery agency took nine months to process the scuba application. From company comments, other ways that a fishery agency could help are: (a) assuring that there is a sensible and transparent fishery management regime; and (b) taking steps to safeguard the national reputation in overseas aquaculture markets.

9.2 Foreign divers

Another issue in the Pacific Island aquarium trade that deserves some attention is the use of divers from Southeast Asia. Many companies in the region feel that, to compete internationally, they require highly experienced and productive divers, and in many countries they are not available locally – hence companies are allowed to employ foreign divers. Due to the range of national conditions and policies, it is not possible to comment on the desirability of this policy but several realities should be pointed out. Diving constitutes much of the relatively high-paying employment in the aquarium trade that is suitable for Pacific Islanders. On the other hand, aquarium company viability is likely to be negatively affected by banning foreign divers. Where foreign divers are brought in with the supposed intention of training local divers, experience has shown that this rarely occurs without a stipulated deadline for completion of the training and phasing out of the foreign divers.

9.3 Export statistics

Section 3.0 of this report concludes that aquarium product export data are unsatisfactory in most places and many of the national estimates are semi-educated guesses. This situation is not confined to the exports of the aquarium products – information on coastal fishery exports in general is also poor in many PICTs. An SPC study in 2016 examined the issue of coastal fishery exports:

> In about half of the PICTs the government fisheries agency monitors exports independently of the government customs agency. This is presumably to gain more detail on the commodities export, but could also be used as an enforcement tool (e.g. prevent the export of banned species and sizes), as a quality control measure, and to supplement other fisheries statistical systems, especially for coastal fisheries. All of these could be very useful in fisheries management. However, in many countries these fisheries agency export data systems are not functional – they produce inaccurate information on exported fisheries commodities, especially for coastal fisheries… Conceptually, the idea of a fisheries agency doing independent monitoring of exports is good, but in most countries of the region that do it, either poor and/or non-available information is produced at considerable expense. It seems logical that such export monitoring systems in several countries should be improved or abandoned (Gillett 2016:484).

Bearing in mind the adage 'If it can be measured, it can be managed' (and its converse), the lack of good export data on aquarium products is constraining effective management, as well as preventing gaining insight into the trade. Improvements to export data would benefit the management of many coastal fisheries, including the fisheries for aquarium products.

10.0 Recommendations

Several suggestions are given in various parts of this report. The ones that are especially important are presented here as recommendations.

Recommendations for government fishery agencies

Well-oiled government services

In countries that wish to promote the aquarium products trade, it is recommended that the government fishery agency take steps to improve the services required by aquarium companies (e.g. issuing of export permits). As the needed improvements are country specific, some work would be required to identify specific items for improvement. Rather than rely on the perceptions of fishery officers to determine these items, significant formal dialogue with aquarium companies is essential.

Aquarium fishery management plans

Although the benefits of management plans are widely recognised, most PICTs have no aquarium management plans or plans remain in draft form, with the latter sometimes being especially confusing.[10] Good management plans can provide companies with a degree of clarity and stability, and therefore could contribute to the viability of the trade. Some important considerations for formulation of a management plan are: (a) important aspects to be covered are given in Section 7.0 of this report; (b) aquarium company input is essential; and (c) a fishery management plan does not need to be a long treatise on the fishery/trade; a concise listing of the 'rules of the game' could be more appropriate.

10 In some places the requirements in draft management plans are selectively enforced.

Aquarium product export data

The recommendations to improve aquarium product export data are identical to two of those given in SPC's 2016 Benefish Study for improving coastal fishery export data.

- Government fisheries agency staff should scrutinise the volumes and values of fishery exports in the official customs department data for erroneous information and omissions. If major errors are detected, there should be close collaboration between the staff of fisheries and customs agencies to identify the causes of the errors and take mitigation measures.
- For the fisheries agencies that do independent monitoring of exports, the ability to produce accurate/timely export summaries should be evaluated. Where there are major deficiencies, those systems should be improved or abandoned.

Recommendation for aquarium companies

It is recommended that aquarium companies form a national association to be able to speak with a unified voice to the fishery agency and other government entities. Individual companies periodically complaining to government officers is not nearly as effective as an association that can present a common position. Even in countries where such associations have existed but have withered away, there is considerable justification for having a slimmed-down association that is periodically mobilised for important events.

Recommendations for future studies of the aquarium trade

Some excellent work has been done on the aquarium trade in the Pacific Island region in the past, including Pyle (1993), Kinch and Teitelbaum (2009) and Lovell (2010). Comparisons between the older works and the present study were constrained by the use of dissimilar terms, such as the use of FOB values in the present study and, in the older studies, the terms "export value", "annual value", "contribution to the economy", and "gross sales". It is recommended that future aquarium product studies in the region scrutinise past studies, determine the most appropriate metrics, and use terms that allow comparisons.

11.0 Concluding remarks

Despite the poor quality of Pacific Island aquarium product trade data and the difficulty of comparing the various studies of the trade over the years, some statement about trends and developments in the region can be made. The size of the trade is certainly larger now than it was in the early 1990s, but substantially smaller than it was in the late 2000s. Several countries that were active in the trade ten years ago are no longer involved. Aquaculture is responsible for an increasing share of production from the region and internationally, but the culturing of products is gravitating to locations where logistics and costs are more favourable.

The annual FOB value of aquarium products from the Pacific region in recent years is crudely estimated by the present study to be around USD 7.2 million. This can be compared to the value of other important coastal fishery commodities: trochus at USD 5 million (Gillett et al. 2019) and beche-de-mer at USD 22 million (CFWG 2019). A common feature of the regional trade in these three commodities is that the current export values are much less than they were ten or twenty years ago. This recent slump in the value of the three most important coastal fishery commodities of the region is remarkable – and deserves some additional examination.

Fisheries-related predictions for the future are rarely easy. Information gained during the present study suggests that there are no major constraints preventing the global market for aquarium products from continuing its expansion. Judging from the past, there is the potential for the aquarium trade (and the associated benefits) to grow to at least the size it was ten years ago in the Pacific Island region – and there is much that government fisheries agencies could do to assist that expansion, especially in the area of improving the government services required by aquarium companies.

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Appendix 1: Useful addresses related to aquarium products

Major wholesalers

- Quality Marine This business has been operating for over 35 years and is located near the Los Angeles airport, USA.
  Tel (1-833) 561-8841, fax (1-833) 561-8842. E-mail: sales@qualitymarine.com
- De Jong Marinelife This business has been operating for over 60 years and its main facilities are located in the Netherlands.
  Tel 31 (0)183 563 332. E-mail: info@dejongmarinelife.nl
- Tropical Marine Centre This business has been operating for over 50 years and is located in Hertfordshire, England, with a branch in Portugal.
  Website: https://www.tropicalmarinecentre.co.uk/

Useful contacts for specific Pacific Island countries

Cook Islands

- Chip Boyle, Cook Islands Aquarium Fish Ltd.
  Tel +682 22-150

Federated States of Micronesia

- Martin Selch (Kosrae) Micronesia Management & Marketing Enterprises (MMME)
  Tel 691-370-2069. E-mail clamfarm@mail.fm.
- Simon Ellis, MERIP (Pohnpei).
  E-mail microellis@gmail.com; www.meripmicronesia.org

Fiji

- Walt Smith, Walt Smith International.
  Tel (679) 7244331. E-mail walt@waltsmith.com
- David Oliver, Aquarium Fish Fiji.
  Tel (679) 9906886, (679) 9994443. E-mail aff@connect.com.fj

French Polynesia

- Tahiti Marine Aquarium: Manager: Moerani Lehartel.
  Tel (689) 87725039. E-mail moerani@icloud.com
- Tahiti Tropical Fish: Manager: Alex Zumbiehl
  Tel (689) 87318974. E-mail sales@tahititropicalfish.com
- Te Hotu Miti: Manager: Celestine Williams
  Tel (689) 40575164. E-mail tehotumiti60@yahoo.com

- Direction des ressources marine et minières, Georges Remoissenet [responsible for the aquarium trade]
  Tel (689) 40 50 25 50. E-mail georges.remoissenet@drmm.gov.pf

Kiribati

- Taratau Kirata (Head of MFMRD office on Kiritimati)
  E-mail taratauk@fisheries.gov.ki, tarataukirata@gmail.com

Marshall Is.

- Christian Colo, Manager, Marshall Islands Mariculture Farm.
  Tel 692-455-0157, 692-247-2562. www.orafarm.com.
- Mike Slinger, Owner, TSL Ltd.
  Tel 692-455-0500. E-mail tslrmi@yahoo.com
- Jessica Hsieh, Arro Corporation, Auntie Store Aquarium Fish Export, PO Box 4015 MH 96960.
  Tel 692-247-8889, 692-247-4777, 692-456-4777. E-mail jessicahsieh165@gmail.com
- Connor Larkins, Owner Kwajalein Fish Exporters. E-mail ebeye01@yahoo.com

New Caledonia

- Bernard Fao, Responsable du Bureau des Pêches, Province Sud, New Caledonia.
  Tel +687 203828. E-mail Bernard.fao@province-sud.nc
- Antoine Teitelbaum. Manager, SARL Aquarium Fish New Caledonia (AFNC), Mont-Dore.
  Tel +687 945444. E-mail: aquariumfish@gmail.com
- Bruno Dumet. Aquarium trade fisher and exporter.
  Tel +687 824503. E-mail: jsb.dumet@mls.nc

Palau

- Tom Bowling, BIOTA
  Tel 680-587-1680, 680-775-1680. E-mail tom@biotapalau.com. www.biotapalau.com
- Thomas Watson, Watson Mariculture. PO Box 379, Koror, Palau 96940

PNG

- Brian Kumasi, Fisheries Management Executive Manager, National Fisheries Authority, Port Moresby, National Capital District.
  E-mail bkumasi@fisheries.gov.pg
- Lorel Dandava, Inshore Fisheries Manager, National Fisheries Authority, Port Moresby, National Capital District. E-mail ldandava@fisheries.gov.pg
- Barnett Shutman, Director, Golden Ocean PNG Ltd. (RVS Fishworld Ltd.), Portion 3359, Motukea Island, Port Moresby, National Capital District.
  E-mail goldenoceanpng@gmail.com

Solomon Islands

- Rosalie Masu, Deputy Director Inshore Fisheries, Ministry of Fisheries and Marine Resources.
  Tel +677 39143. E-mail rmasu@fisheries.gov.sb
- Christopher Beta, Unique Coral Solomon Islands
  Tel +677 7330308

Tonga

- South Pacific Paradise Export, Mele Fangupo
  Tel 28239/8413606 E-mail idaretodream99@gmai.com
- Ecological Reef Fishing Int. Teau & Fane Faletau
  Tel 8714653/7759195. E-mail ecoreeftonga@gmail.com
- Quality Reef Life Marine Tonga , Paula Prescott
  Tel 7715389. E-mail aquarium@kalianet.to
- Nahau Reef Export, 'Ana Puta
  Tel 7742791/22578. E-mail anzy3076@gmail.com
- JLE International, Taufa Pahulu
  Tel 8442050/7786186. E-mail pahuluta@gmail.com

Vanuatu

- Sompert Gereva, Deputy Director, Vanuatu Fisheries Department
  Tel +678 23119 E-mail sgereva@vanuatu.gov.vu
- Grant Norton, Sustainable Reef Suppliers
  Tel +678 7382917. E-mail vmarinelife@gmail.com

Appendix 2: National aquarium products profiles

Information on aquarium products in Cook Islands

History of the aquarium products trade

- In 1988, one locally registered company, Cook Islands Aquarium Fish Limited (CIAF), was given permission to collect and export marine aquarium fish from Rarotonga. CIAF Ltd established a small fish-holding facility, containing pumps, UV filters, sterilising units and an array of plexi-glass tanks. The company was exempted from import levy/duty on aquarium fish packaging items for export and on warehouse and fishing equipment only on initial setup of its operation.
- The Rarotonga reef slope area accessible to the collection of marine aquarium fish is 7 square kilometres. No marine aquarium fish collecting has occurred on any of the other islands in Cook Islands.
- The operation utilises 1-3 divers annually and has two persons (owner, operator) managing the collection, holding, exporting of fish, infrastructure maintenance and business. Because it has been difficult securing local reliable divers on a permanent basis, the company has had to rely on foreign labour. The company has trained over 50 fish collectors and warehouse facility operators since its establishment.
- All fish are collected on the reef slope using small meshed barrier nets and hand scoop nets. Most fish are collected at depths ranging from 8 m to 35 m with occasional fish collected from depths of >50 m.
- Through careful handling, the operation has very low mortality rates after collection; any fish damaged during collection are returned to the reef slope.
- Between 10 to 40 finfish species have been collected annually. *Centropyge loriculus* (flame angel fish) and *Neocirrhites armatus* (flame hawkfish) comprise around 60% of the annual catch, followed by *Anthias ventralis* (longfin anthias), *Centropyge flavissimus* lemonpeel angel) and *Cirrhilabrus scottorum* (scotts wrasse), 25%. Very low numbers (<7 annually) of *Variola loti* (yellow-edged lyretail), a food fish species, was collected for export during the early years of the company operations.
- Fish are individually packed in sea water and pure oxygen filled plastic bags.
- Highest costs for the operator are labour, electricity and freight.
- Fish exports are limited by airline connections, air freight, availability of collectors, their skill level, weather conditions and market prices.
- Fish prices received for wholesalers / retailers range between NZD 1–15, some of the rarer, deeper species fetching more than NZD 200.
- Since 2003, cultured species of giant clams (*Tridacna maxima* and *Tridacna derasa*), supplied from the clam hatchery at Aitutaki were exported until 2016, when the Aitutaki Island council banned the exports of clams from Aitutaki.
- The operation is based on quality, not quantity. Fish and clams are inspected individually before packing.

Annual harvests during the previous decade of aquarium products by category of product

- The value of the Cook Islands aquarium fishery trade for the first decade of operation averaged NZD 200,000, with an average of 18,250 fish exported per year. Over the next decade, 1999–2008, average annual exports value was NZD 173,000, and NZD 107,000 over the period 2009–2016. No exports occurred in 2017–2019.
- No data on aquarium fish species and quantity are available from 2000–2008 and 2011–2019.
- The Ministry of Finance and Economic Management collects information on the value of aquarium exports but not on species or the number of fish exported.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Marine aquarium finfish export value										
Value (NZD)	220,000	147,000	96,000	19,000	91,000	49,000	22,000	-	-	-
Tridacna clams (pieces)										
	7,945	4,942	3,010	620	-	650	-	-	-	-

The readily available information on prices paid to harvesters for the various aquarium products

- CIAF Ltd pays a third of the price received from wholesalers / retailers to the aquarium fish collectors. The payments are dependent on the catch (species and numbers) for each collector.
- No individual species price list was available.

Companies involved in the harvest and/or export of aquarium products

- One company, Cook Islands Aquarium Fish Ltd

The number of people employed by the aquarium companies

- Over the years, people employed ranged from two to six.
- Since 2016, the company has reduced its staff to two. The owner does aquarium fish collection and exports as a hobby.

Domestic holding facilities of the aquarium companies

- CIAF Ltd operates from a purpose-built aquarium fish-holding facility (warehouse), which includes pumps, UV filters, sterilising units and racks of plexi-glass aquarium tanks that can hold up to 400 fish. Water is brought from the sea and runs through a semi-closed circulatory system.

Exports of aquarium products

- CIAF Ltd has operated for three decades and has established good relations and trust with wholesalers / retailers. Its main markets are in USA, Europe and Japan.
- Since establishment of the CIAF in late 1989, the marine ornamentals trade out of Cook Islands has benefited from a positive image and is associated with the export of high quality fish and clams.

Marketing arrangements

- The importing country landed price includes the price of fish, packaging, handling and freight cost.
- No species price list was available.

Management of aquarium product fisheries

- No stock assessment of any marine aquarium fish species for the aquarium trade has ever taken place.
- With only a single operator, few restrictions are necessary. Management is restricted to a ban on fishing inside the lagoon and on reef flats. In reality, the collection of marine aquarium fish occurs only in a few specific locations around Rarotonga as a result of rough sea conditions on the windward side of the island, avoidance of areas where locals fish for food, and an agreement between recreational dive operators and CIAF Ltd not to fish at and around recognised recreational dive sites.
- The operator was required to submit annually catch (by species) and effort (number of SCUBA tanks). However, in the past decade these data were not collected by the Ministry of Marine Resources (MMR).
- The company is required to undertake training programmes for local divers and warehouse operators.
- MMR has a draft marine ornamental fishery management plan since 2012. The purposes of this draft plan are to:
  - provide for the ecologically sustainable use and conservation of marine ornamentals;
  - generate sustainable livelihoods for local communities; and
  - establish an effective and enforceable management framework for the marine ornamentals fishery in Cook Islands.
- Proposed measures include:
  - licencing for collection, farming and export of aquarium commodities;
  - restrictions on the use of certain fishing methods and fishing in certain areas;
  - the requirement to submit catch, effort and export information; and
  - comply with Cook Islands Biosecurity Act 2008.

CITES issues

- Cook Islands National Environment Services (NES) issues export permits to comply with CITES for tridacna species. These permits are sent to the importing companies so they can apply for the country CITIES importing permit.
- There are no issues with obtaining export permits from NES.
- NES holds clam export data as far back as 2008. Earlier clam export data in this summary were provided by CIAF Ltd and MMR.

Biosecurity issues

- Exports to EU require biosecurity inspections of aquarium products. Due to this requirement, exports to EU have declined. Other than this, there are no major biosecurity issues experienced by the company.

Air freight issues

- All export products needs to transit through Auckland; air freight is therefore a major cost for exports of aquarium products.

Air freight capacity is not a problem. CIAF could not provide average freight costs for recent years.

Major aquarium product issues in the country

- During its initial years of operation, the public perceived the aquarium fishery operations as excessively damaging coral and significantly depleting both ornamental and reef food fish stocks. The removal of some branches of *Pocillopora verrucosa* is required to collect flame hawkfish. CIAF dismissed collectors with frequent destructive fishing practices and did not permit inexperienced collectors to harvest flame hawkfish. Through an agreement with some of the recreational dive operators, CIAF Ltd does not fish at and around recognised recreational dive sites.
- The profitability of the aquarium business relies on a few species: flame angel fish, flame hawkfish, longfish anthias, lemonpeel angel and scotts wrasse.
- It is difficult for the company to secure local divers; it has had to rely on foreign labour.
- The cost of aquarium fish collection and export operation (wages, facilities building, maintenance, fuel, electricity, price of goods, freight) are high.

Other relevant observations

- There appears to be a lack of interest and expertise by residents to be involved in the marine aquarium trade.
- There is limited potential for the development of marine aquarium exports from the outer islands.
- The high cost of living in Cook Islands makes exports of aquarium fish barely viable unless it is based on very high value aquarium finfish.

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- Passfield, K. and Evans, J. (1991). Aquarium fish profile, Ministry of Marine Resources Profile #7, Ministry of Marine Resources, Rarotonga, Cook Islands

Useful contacts

- Chip Boyle, Cook Islands Aquarium Fish Ltd. Phone +682 22-150

Information on aquarium products in Federated States of Micronesia

History of the aquarium products trade

- Dick Croft, an expatriate, operated an aquarium fish collection and export business at least as early as 1976. The business shut down when the owner took a government job with Marine Resources and the terms of employment did not allow him to continue private sector work due to a possible conflict of interest.
- Since the late 1980s Kosrae has housed the FSM National Aquaculture Center (NAC) which has received financial support from the national government and development partners (most of which have been derived from USA through Compact arrangements, and specific project grants from the Japan International Cooperation Agency (JICA). NAC is still owned by the national government, but Kosrae State has expressed a desire to take over ownership in 2020.
- In about 1995, an expatriate commercial tuna fisherman who was familiar with Pohnpei moved there and began an aquarium fish export business. He employed one local diver and one or two people to work in his small holding facility. The business was closed in a year or two and the owner moved off the island.
- Micronesia Management and Marketing Enterprises (MMME) was established in Kosrae in 2005 and operated out of the NAC facilities. In 2008 it took over the NAC. MMME eventually received a coral farm permit from Kosrae State and much later an aquarium fish collection and export permit. The first year of full production and export, including aquarium fish, was in 2013.
- In 1999, the Marine and Environmental Research Institute of Pohnpei (MERIP) based in Pohnpei, began hard and soft coral research that led to community-based farming for export, supported by MERIP, that is ongoing.
- MERIP took over and improved a small facility at the now defunct Pohnpei Agriculture and Trade School (PATS). Its first export was in 2008.
- The collection of aquarium fish was undertaken by MMME in around 2011 in Kosrae. The activity received support from an SPC survey undertaken in late 2013 that resulted in several recommendations to build a small industry. Collection of fish for aquarium use ceased around 2015. According to the owner, new laws and regulations in Kosrae prohibited the firm from moving forward in keeping the fish operation going and all activity ceased around 2015.
- In 2013–2014, MMME began importing small numbers of live clams from a commercial farm in Palau for further export. This activity ceased in early 2015.
- In 2019, Kosrae State asked MMME to assist in creating community farms because wild stocks of giant clams were being depleted. MMME provided 100,000 *Hippopus* seeds for the community to grow out.
- Also in 2019, MMME obtained a research permit to obtain five large live T. gigas clams (24 inches) from Palau. The clams were obtained in May and transferred to Kosrae. One died enroute when off-loaded in Pohnpei due to air freight weight restrictions. It is understood that an agreement between Palau and FSM facilitated the transfer and certain reporting requirements from FSM to Palau are part of the arrangement. The company intends to spawn and rear juveniles in its facilities in Kosrae and will begin reseeding in 2020.

Annual harvests during the previous decade of aquarium products by category of product

- MERIP reported coral exports in 2012 as 14,735 pieces and in 2013 as 21,392, an increase of 45%.
- A crude estimate of the annual giant clam production in 2014 in Kosrae was estimated to be 12,000 pieces.

(See exports section below)

The readily available information on prices paid to harvesters for the various aquarium products

- Exporters were reluctant to provide any information on prices paid to local producers.

Companies involved in the aquarium harvest and/or export of aquarium products

- Two companies in FSM are engaged in the export of aquarium products; one, MMME, is located in Kosrae, and the other, MERIP, in Pohnpei. Both companies are headed by expatriates.
- MERIP is a tax-exempt non-profit entity that provides support to local aquaculture farmers, as well as conducting research and outreach programmes. Its principal has had many years of experience in aquaculture research and development in FSM and elsewhere. He feels that the communities the organisation serves are their real clients and should benefit from MERIP's for-profit activities. The organisation of MERIP enables it to apply for various grants and assistance from USA and elsewhere. MERIP provides clam seeds and sponges to local aquaculture farmers who may sell back to MERIP or retain them for their own purposes. MERIP cultures about 30 coral species, both hard and soft, at its facility in Pohnpei through propagation of fragments from broodstock. Sponges are cultured for sale, but not for aquarium use.
- MMME is headed by an expatriate who has been in FSM for about 15 years and was in the aquarium trade in Europe before coming to FSM.

The number of people employed by the aquarium companies

- In late 2013 the export of fish for the aquarium trade from Kosrae provided jobs for 19 individuals. Most of these people lost their jobs when aquarium fish collection ceased around 2014.
- MMME in Kosrae now employs five full-time workers that have been with the company a long time. Others are hired from time to time with a total of up to 10. At one point two of the 10 were women but they are no longer employed.
- MERIP has a total staff of seven, but considers the community farmers as their partners. There are currently around six farmers growing clams in the Pohnpei lagoon and 15 or so growing out coral. All farmers are subsistence-level fishermen and farmers that use aquaculture as a part-time source of income.

Domestic holding facilities of the aquarium companies

- MERIP operates a small facility for raising giant clams and culturing corals at the former campus of Pohnpei Agriculture and Technical School (PATS).
- A much larger facility than that of MERIP exists at the NAC in Kosrae. A total of 34 raceways are used for the propagation of giant clams and corals.
- A 2014 survey report by SPC for Kosrae found that facilities operated by MMME at NAC were well maintained, with proper filtration, both mechanical and ultraviolet, and daily and weekly procedures to maintain high quality water were in place.

Exports of aquarium products

- Export values for live clams only are publicly available from the FSM Statistics Division (www.fsmstatistics.fm). Live clams are listed on the website as one of FSM's six principal exports. Export value data are said to be obtained from the FSM Quarantine Unit, Customs Unit, and enterprises.

2011	2012	2013	2014	2015	2016	2017
USD118,000	$177,000	$174,000	$202,000	$65,000	$325,000	$293,000

- Records of CITES permits issued by FSM R&D for export of live clams, 2013–2018 (2018 presumed to be provisional) (unit: pieces)

2013	2014	2015	2016	2017	2018
11,191	10,589	26,858	16,776	11,712	5,867

- Available records from FSM R&D show coral exports in 2018 to have been 16,851 pieces. These data are believed to be incomplete and may represent the exports from one exporter only.
- Destination of exports of live clams and corals are said to be wholesalers in Europe, USA, and occasionally Asia.
- Some domestic sales of aquarium products between the operations in Pohnpei and Kosrae take place but are not recorded in government statistics.
- Trade data from Marshall Islands show that in FY 2018, RMI re-exported 1,885 pieces of tridacna and 12,704 pieces of coral from FSM.
- Selectively using the above data, exports of aquarium products in 2018 are estimated to be:
  - 7,752 pieces of tridacna; and
  - 14,996 pieces of coral from one of the two exporters. In the absence of any coral export data from the second exporter, for the purposes of this study it is assumed that the country exported a total of 30,000 pieces of coral in 2018.

Marketing arrangements

- Exports from FSM are sent to wholesalers in Europe, Asia, USA and RMI.
- In 2013, for Kosrae, the vast majority of fish caught and held at the facility were specifically requested by importers (i.e. caught on order). Aquarium fish collection ceased around 2015.
- MMME's owner stated that, due to his long history in the industry, he has gotten to know customers personally and relies on them for repeat orders. Regular customers receive 'customer protection', i.e. refunds or credits for problems in shipments.
- In 2013, one company said that an arrangement between their buyer (a wholesaler) and a large pet store chain in USA had significantly improved the marketing of their products.

Management of aquarium product fisheries

- An initial survey of marine aquarium fish at Kosrae was conducted by SPC in 2007 to establish a baseline and provide recommendations before exports of aquarium fish were undertaken. A second survey in 2014 was undertaken to assess the sustainability of the aquarium fish trade fishery in Kosrae. The report was generally favourable for the development of an aquarium fish industry, with certain safeguards. For example, quota recommendations were made for certain commercially valuable species and it was recommended that only one licence be allowed to prevent over-harvesting.
- Strong local reef tenure systems exist in Yap State (Yap proper and Ulithi) and Chuuk. No such systems exist in Kosrae or Pohnpei, although there are some municipal controls in the former.
- The Kosrae State Code contains a specific exemption (Section 19.304) from regulations enacted under the code pertaining to species cultivated in an aquaculture centre operated or approved by the FSM National Government or the Kosrae State Government.
- Chuuk State Law 13-13-16 requires prior written permission from the Director of Marine Resources to export or import any live fish or viable fish eggs (Section 12); prohibits the harvesting of corals for commercial export (Section 18); and prohibits the commercial export of clams (Section 20).
- SPC personnel involved in the 2014 SPC aquarium fish survey took the opportunity to assist local divers in their understanding of best practices in the collection of aquarium fish, and made recommendations regarding the safety of divers using SCUBA in the collection of fish for the aquarium trade.
- MMME's owner has trained his employees by himself.
- MERIP obtained funding from the US Department of Agriculture to conduct training in marine ornamental farming for extension professionals in Micronesia in 2012–2013. In total, 53 people involved in the marine ornamental industry received training or outreach from this project.

CITES issues

- CITES permits are issued by the FSM Resources and Development office in Pohnpei. Permits issued are approved by quarantine and validated. To minimise any potential problems, MERIP lists all species exported, regardless of whether they are required by CITES.

Biosecurity issues

- The two exporters in FSM are well aware of biosecurity requirements and take pains to make sure that best practices are followed to ensure continuity of their markets.
- One operator thinks that they will have to comply with phytosanitary permit requirements of one of their export destinations soon. As yet, there have been no indications of how FSM might comply.
- Newly acquired *T. gigas* brought from Palau to Kosrae as breeding stock are segregated and water is not sent to the common drainage.

Air freight issues

- Air freight limitations are a big problem. To guarantee space on United Airlines, one exporter pays extra for a 'quick-pack' service, which enables shipments to gain a higher priority than mail. The higher costs are shared with the recipient. According to the exporter, it is the only way to guarantee air shipments will get on the plane.
- Shipments on United Airlines 'island hopper' from Guam are sometimes bumped due to weight limitations. Other times, space on a particular flight is said to be available by United Airlines, only to be withdrawn at the last minute.
- Kosrae has experienced a reduction in flights to just two per week. The current limited cargo capacity would not support the export of aquarium fish, should it be desired to re-start that activity.

Major aquarium product issues in the country

- Major coral bleaching events in 2016 and 2017 had an adverse effect on Pohnpei's reefs.
- The lease for the National Aquaculture Center that hosts the commercial operation in Kosrae is up for renewal in 2020. Kosrae State would like to take over the facility from the FSM national government, but nothing has yet been finalised. This gives some business uncertainty to the commercial operator who utilises the facility. He would like to see Kosrae take over the facility and has plans to expand in cooperation with Kosrae State if this eventuates.
- One operator said that implementation of laws and regulations can be an issue because the aquarium trade is not well understood by government officials.
- The 2013, report of training in marine ornamental farming for extension professionals noted that, while export of corals has been seen to grow significantly, there has been almost no evidence of new farmers entering the industry. Instead, it seems that existing farmers are growing more corals per farmer.

Other relevant observations

- The two exporters in FSM, although personable and willing to talk, expressed strong concern that providing any commercial information, including production and export totals, would compromise their businesses.
- In the conclusions of the SPC Kosrae aquarium fish survey published in 2014, the authors noted that the aquarium fish trade and other related activities, such as spawning and grow-out of Tridacna clams and coral farming, would not be viable without the export of wild caught aquarium fish to meet overheads, minimum freight volumes, and customer order requirements. This has proven not to be the case. Although the cessation of aquarium fish collection has meant the inability to share costs between wild capture and cultured species, the demise of the business based on clams and other aquarium products culture did not cease. Nevertheless, a large negative economic impact was felt by the divers and other employees, who lost their jobs when the wild fish collection ceased.

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- Dave Mathias, Department of Resources and Development, Marine Resources Division, FSM National government. 691-320-2620. dave.mathias@fsmrd.fm
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Contact information for aquarium product buyers, processors, exporters

- Martin Selch (Kosrae) Micronesia Management & Marketing Enterprises (MMME) clamfarm@mail.fm. 691-370-2069
- Simon Ellis, MERIP (Pohnpei). microellis@gmail.com; www.meripmicronesia.org

Information on aquarium products in Fiji

History of the aquarium products trade

- The evolution of the Fiji aquarium products trade is well documented: 41 reports over a 30-year period (Lovell 2019).
- Fiji Biomarine Pty Ltd started collecting aquarium fish in the mid-1970s, with the main area of operations being the area between Suva and Deuba. The company was granted an exclusive right to export aquarium fish from Fiji, but stopped operations in the early 1980s.
- A second company, Aquarium Fish Fiji, commenced operations in August 1984, working out of Pacific Harbour.
- The peak of the aquarium trade was in 2002 to 2003, when seven companies exported products.
- In 2005, an association to represent the interests of the trade was formed: the Marine Ornamental Traders Association (MOTA). It ceased in about 2009.
- A major shock to the aquarium products trade in Fiji was "the ban". A coral export ban was put in place on 28 December 2017, covering certain coral-based substrates: live coral, live rock and dead coral rock. The only exports remaining in late 2019 are fish, non-coral invertebrates, and artificial live rock (Sykes 2019).
- Currently there are only two companies with substantial operations: Aquarium Fish Fiji (AFF) and Walt Smith International (WSI).

Annual harvests during the previous decade of aquarium products by category of product

- Fiji exports several types of aquarium products, including finfish, corals, and other invertebrates.
- The major families of finfish are damselfish (Pomacentridae), angelfish (Centropyge), butterflyfish (Chaetodontidae), tangs (Acanthuridae) and wrasses (Labridae). The Fiji Fishery Resource Profiles (Lee et al. 2018) give the 17 most important species in Fiji. Sykes (2019) states that in recent years WSI has exported 120 species of fish.
- The non-finfish component of Fiji's aquarium products trade can be classified in various ways. The Ministry of Fisheries uses the categories of hard coral, soft coral, ornamental invertebrates, coral base rock & cultured rock, and live rock.
- Because virtually all aquarium products are exported, harvest amounts can be estimated by export data. The volumes exported in recent years, according to the Ministry of Fisheries export permit database, are shown below.

Item	Unit	2014	2015	2016	2017	2018
Hard coral	Pcs	71,418	127,974	90,552	69,959	8,628
Soft coral	Pcs	31,253	30,901	29,915	31,726	19,500
Ornamental fish	Pcs	140,654	265,819	253,193	133,600	326,659
Ornamental invertebrates	Pcs	29,664	58,980	48,385	127,040	160,709
Coral base rock & cultured rock	Kg		122,581	83,762	29,080	11,853
Live rock	Kg	576,020	463,148	419,118	257,720	38,338

- The volumes exported in recent years, according to the Custom Department export database, are shown below.

	Unit	2016	2017	2018
Ornamental fish volume	Kg	150,331	146,071	129,308
Ornamental fish value	F$	2,433,021	2,471,053	1,813,481

Notes: (1) The above Customs Dept data above are for HS codes 03011100 and 03011900, noting that the former is for freshwater ornamental fish which are rarely, if ever, exported from Fiji; (2) It is not clear what the 'volume' comprises for ornamental fish in the customs data. It is meaningless if it includes the water it is shipped in. Alternatively, if the customs data volume is actually the number of pieces, then it is both remarkably different from the Ministry of Fisheries data, and is inconsistent in the way it diverges.

- Independent aquarium specialists cast doubt on the accuracy of the data above for the 2018 exports for the fish and inverts.
- Additional insight on recent exports comes from a report on the environmental impact assessment done recently for WSI (Lovell et al. 2019):
  - in 2017, WSI exported 93,460 aquarium fish, 22,180 assorted invertebrates, 313,205 kgs of live rock, 33,604 kgs of cultured rocks, and 3,995 cultured corals.
  - the gross sales of WSI in 2017 were FJD 5,917,757, including FJD 1,080,928 for air freight and cartage, so the FOB value of WSI exports in 2017 is about FJD 4.8 million.[11]
- The available information is insufficient for making an estimate of the annual volume or value of aquarium exports of Fiji– but some crude speculation could be made. Using (a) the above information from the WSI EIA report, and (b) the (possibly dubious) assumption that WSI is responsible for 2/3 of the aquarium product exports of Fiji (i.e. AFF is responsible for 1/3), in 2017, the FOB value of all aquarium exports in 2017 was about FJD 7.3 million (USD 3.5 million).
- Additional work needs to be done to confirm the validity of the 2017 WSI exports.

11 It is unclear whether this amount covers all WSI collection activities – or just those in the Lautoka and Mamanuca areas.

The readily available information on prices paid to harvesters for the various aquarium products

- Due to normal commercial secrecy, the aquarium companies are reluctant to divulge much information on prices paid to harvesters.
- The available data on prices for specific aquarium products are limited to the value declared to customs (i.e. FOB prices). Although not statistically significant (and dependent on season, destination and other factors), inspection of several declarations showed a maximum price per fish (USD 15.75 for puffer: dogface, yellow belly) and a minimum value USD 1.05 (for pajama cardinalfish), with an average value for the shipments of USD 4.40 per fish.
- Prices for aquarium products are determined by the global supply and demand, rather than on the rarity in Fiji. In general, the profitability of exporting coral and live rock (before the ban) was much greater than for finfish.

Companies involved in the aquarium harvest and/or export of aquarium products

- Presently there are two substantial companies in Fiji's aquarium trade: Aquarium Fish Fiji and Walt Smith International.
- AFF is based in Pacific Harbour and collects in the Beqa-Serua area. The company ships products to the USA (normally two shipments per week), the United Kingdom (one shipment per week), Hong Kong, Japan and Germany. All shipments are to aquarium wholesalers rather than retailers. AFF considers that its affiliated divers are independent contractors, rather than employees of the company.
- WSI is based in Lautoka and collects off the northwest of Viti Levu and the north of Vanua Levu. The annual value of products exported by WSI is perhaps twice that of AFF. WSI ships globally. The company has an agent based near the airport in Los Angeles who breaks down large shipments for dispatch to individual wholesalers in various areas of the country.
- Until now, WSI has considered that its affiliated divers were employees of the company (rather than independent contractors), but this is likely to change in the future.
- Other minor players in the aquarium product trade in Fiji at present include Tropical Aquarium Fiji (based in Lautoka and beginning to export cultured rock) and Civa Pearls (based in Taveuni and culturing tridacna).

The number of people employed by the aquarium companies

- AFF currently has 20 people based on shore (half are female) and 12 divers (all male), perhaps 25 full-time equivalent (FTE) workers. All are Fiji citizens.
- WSI currently has 40 to 50 people on the payroll, most of whom are part-time, so the FTE is about 35. All the divers are male and the shore staff are about two-thirds female. WSI currently employs three Filipinos.
- For both companies, employment dropped off sharply after the December 2017 coral ban. For example, the number of people on the WSI payroll dropped from 130–160 down to the present 40–50.

Domestic holding facilities of the aquarium companies

- WSI: The facilities of the company are located in Lautoka, covering about 0.8 hectares. They are the largest of any aquarium company in the Pacific Island region.
- AFF: The facilities are located under the residence of the manager at Pacific Harbour.

Exports of aquarium products

- The above section on harvests contains information on exports. The various sources of information on exports (i.e. Customs Dept, Ministry of Fisheries, company records) show very different amounts exported.
- According to the aquarium companies, USA is the most important market, but products also go to Europe, Hong Kong, Japan, Canada and Australia.
- The Customs Dept data cannot be used for determining the destination countries, as several different types of commodities (e.g. trochus) are aggregated in the category for coral in the database (HS 05080000).
- WSI indicates that, before the ban, 60% of their product went to USA, but after the ban that increased to 80%.

Marketing arrangements

- Both exporters ship to wholesalers (rather than retailers) in the destination countries. Relationships with many of the wholesalers have been established for several decades.
- WSI has an agent based near the airport in Los Angeles who, after a shipment clears US customs, separates the shipment into smaller components for dispatch to individual wholesalers in various areas of the country. By doing so, the charges for clearing a large number of small shipments are avoided.

Management of aquarium product fisheries

- In Fiji, stock assessments for aquarium products have focused on corals; there has been much less assessment of the fish component. Fish assessment appears to be limited to a study titled *Effects of collection on ornamental reef fish populations in Fiji* (Sykes et al. 2003).
- In summarising past assessments, Sykes (2019) states that there have been many studies of the Fiji aquarium trade, particularly the section involving live corals and live rock, some of which have established the percentage of the resource being removed, and suggested sustainable export quotas. Overall, most studies have concluded that the amount of live coral and fish being exported fell within sustainable limits and was not damaging the resource above the level at which the reef could naturally recover.
- The document *Aquarium trade policy guidelines* was prepared in 2002 by the Fisheries Department and industry. The guidelines cover collection area management, collection practices, and monitoring and enforcement. Although these guidelines have not been officially adopted by any government agency, many of the elements are followed by the Ministry of Fisheries and by exporters.
- Although there is no formal national aquarium fishery management plan, there is the sentiment that all the current regulations and policies taken together could be considered a management plan. Several current and past participants in the aquarium trade have prepared company fishery management plans.
- Legal instruments:
  - On the fisheries side, the Fiji Fishery Profiles, Regulation 26 of the Fisheries Regulations (Cap.158 as amended) provides, in part, that "No person shall export from Fiji live fish of any kind whatsoever", although Regulation 27 provides that an exemption may be granted by the Permanent Secretary for Agriculture and Fisheries, or any person appointed by him/her. In effect, this allows as much stringency in the licence conditions for aquarium fish operators as is required.
  - On the environment side, relevant legislative measures include the Environment Management Act (2005) and the Endangered and Protected Species Act (2002). The latter stipulates the export permit requirements for CITES-listed species, which includes several categories of coral, live rock and tridacna.
  - Following from the above, the current rules of the aquarium trade in Fiji include a ban on the export of live rock, a (possibly temporary) ban on the export of coral, a quota system for coral harvesting by genera in pieces, and a requirement for companies to have an environmental impact assessment, a collection area management plan, an export permit from the Ministry of Fisheries, an export permit for species covered by CITES from the ministry responsible for the environment, a fishing licence for the operator of a collection vessel, and submission statistics to the Ministry of Fisheries.
- Compliance with the above rules is high, mostly because of the export nature of the business (i.e. no compliance, no export). However, an independent Fiji-based coral specialist states: "Compliance is expensive in terms of fees, employees' time, preparation of annual reports, and permitting administration".
- There have been training and capacity building activities related to the management of the Fiji aquarium trade. These have included some on-the-job training (i.e. attachment to specialists doing surveys) and many workshops, with the latter primarily related to coral. Some of the trained staff are still quite active (S. Sharma), some have retired (e.g. A. Batibasaga), some have been promoted to positions above active involvement in the management of the aquarium trade (e.g. M. Lakeba), and some have dropped out of government employment. Actual data on this subject are unavailable.

CITES issues

- Fiji became a signatory to the CITES Treaty in December 1997. The legislation covering the treaty was enacted in 2002 as the Endangered and Protected Species Act 2002 (Lovell 2019).
- Fiji has two bodies related to CITES: (1) The CITES Scientific Council, with membership by the government agencies for environment, fisheries, forestry and agriculture; and (2) the CITES Management Authority, with membership that includes environment/fisheries/forestry/agriculture/iTaukei, the Institute of Applied Science, and Conservation International. The Council provides scientific advice (e.g. quotas) and the authority gives its endorsement or otherwise to the advice.
- The relationship of CITES to the aquarium trade in Fiji is that it covers live rock, coral, and tridacna.
- In 2007, in the absence of firm data to prove the sustainability or otherwise of the export quotas, the Fiji CITES Scientific Council recommended a reduction of 25% in the coral export quota until a non-detriment finding (NDF) could be made to justify the return of the quota (Sykes 2019).
- A CITES NDF survey was conducted in 2008 by the Division of Fisheries, over a six-week period. This study included the collecting areas of AFF and WSI. It was concluded that the level of collection was conducive to sustainable exploitation, with export numbers very low when compared to the natural abundance (Lovell 2019).
- Lovell (2010) stated that there are problems with the CITES aspect of aquarium trade management in Fiji: (a) The CITES conservation mindset is appropriate for large, rare animals, but is less appropriate when applied to those which are highly abundant; and (b) there is consensus amongst the coral exporting industry and scientists that CITES quotas need to be revised and based on science.
- An examination of the CITES database shows that in 2018 there were 5,683 pieces of live anthozoa exported from Fiji. [Note: this was after the ban on coral exports but permits issued before the ban were still valid]. The database also shows that no live tridacna were exported from Fiji.

Biosecurity issues

- The major biosecurity issue in Fiji's aquarium trade is the cost of inspection by the Biosecurity Authority of Fiji, FJD 750 per consignment. After the EU decided that such inspections should be a requirement of sending aquarium products to EU, Fiji exporters sent less to that market. In addition to the EU, Japan and Korea also require biosecurity inspections.

Air freight issues

- The major airfreight issue is the high cost. Fiji exporters indicate that airfreight amounts to 40% to 50% of their total costs.

Major aquarium product issues in the country

- Discussion with industry participants and Ministry of Fisheries officials that deal with the aquarium trade suggest that one of the major issues in the aquarium products trade in Fiji is the unpredictability of the CITES-related decisions of the Ministry of Waterways and Environment, which leads to loss of trade due to periodic bans and constraining quotas.
- The industry participants and other stakeholders had various ideas on how to make the trade more viable in Fiji. The ideas that are especially common are: (1) faster responses/approvals related to government requirements; (2) realisation by government agencies that company viability is highly related to the ability to export coral; and (3) The Ministry of Fisheries and the Environment Department need to cooperate with each other better than at present.

Other relevant observations

- The review of the Asian Development Bank of the fisheries sector in Fiji several years ago is interesting as it places the aquarium trade in context with other fishery sub-sectors. The ADB report stated that the marine aquarium fishery represents possibly the best growth prospect for the fisheries sector in Fiji and that growth of the aquarium sector is inextricably linked to external perceptions about the effectiveness of management.

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Useful contacts:

- Walt Smith, Walt Smith International. Tel (679) 7244331. E-mail walt@waltsmith.com
- David Oliver, Aquarium Fish Fiji. Tel (679) 9906886, (679) 9994443. E-mail aff@connect.com.fj

Information on aquarium products in French Polynesia

History of the aquarium products trade

- The marine aquarium trade has been active in French Polynesia since the early 1970s. The trade started with the wild collection of aquarium fish and has evolved more recently to include exports of wild-caught tridacna, with expansion in 2013 to exporting spat-collected tridacna[12] (Nahacky and Wabnitz 2014)
- Currently, there are three active companies in the aquarium export business.
- In general, in terms of production for the aquarium trade, the island of Tahiti produces only finfish, while the Tuamotu Group produces both finfish and tridacna.

Annual harvests during the previous decade of aquarium products by category of product

- Officials of the government fishery agency, *Dirrection des resources marine et minieres*, (DRMM) state that, for most years, the annual amount of aquarium products exported (section below) is only slightly less than the annual harvests.
- The 'white list' suggested in Nahacky and Wabnitz (2014) gives about 100 aquarium fish, and generally equates to the aquarium fish species that are exported from French Polynesia.
- The largest exporter of aquarium fish indicates that important target species for him are achilles Tang (*Acanthurus achilles),* flame hawkfish (*Neocirrhites armatus*) and black tang (*Zebrasoma rostratum*).
- The species of tridacna present in French Polynesia are *Tridacna maxima* (by far the most common) and *Tridacna squamosa*.
- In 2018, 67% of the tridacna exported were wild-collected and 33% were spat-collected.
- Coral is not harvested by the companies in the aquarium trade. The only other aquarium product exported beside finfish and tridacna are zoanthids, albeit in small quantities.

The readily available information on prices paid to harvesters for the various aquarium products

- For commercial secrecy reasons, the exporting companies are understandably reluctant to share prices paid to harvesters.
- DRMM staff have access to declared FOB prices. In a summary report, the average declared value for finfish exported in 2018 was CFP 1,578 per fish, which is 2.6 times the value 20 years ago. The average declared FOB value for tridacna exported in 2018 was CFP 2,065 per clam.

Companies involved in the aquarium harvest and/or export of aquarium products

- In late 2019 there were three companies in French Polynesia that were actively involved in the aquarium trade:
  - Tahiti Marine Aquarium: The company has been in business since about 2010 and is located in Papara. It has a dual focus on fish and tridacna. The company obtains fish from Tahiti, fish from Makemo, and tridacna and fish from Reao. It exports products to USA, Asia and Europe.
  - Tahiti Tropical Fish: The company is located in Taravao, but also has facilities "in the islands", presumably in the Tuamotu Group. It focusses on fish but exports some clams. The company sends products to USA, Asia and Europe.
  - Te Hotu Miti: The company is located in Papara. One of the owners was formerly in the aquarium business in Hawaii. It focusses on the export of fish.
- Two other companies have been established but are not yet exporting aquarium products: (1) Tahiti Aquarium Life, located on Tahiti Iti, and (2) Tahiti Reef Passion, located in Papeete.

The number of people employed by the aquarium companies

- Tahiti Marine Aquarium: The company states that it has 12 people employed full-time, of whom three are female. All are citizens of French Polynesia. Some of the harvesters are company employees, while others sell to the company.
- Tahiti Tropical Fish: The company employs 12 people part-time, with the manager considering he has four or five full-time equivalent employees.
- Te Hotu Miti: The owner of this company was overseas during the period of this survey. Another aquarium company indicated that Te Hotu Miti probably now has about two or three full-time equivalent employees, which is less than in the past.

Domestic holding facilities of the aquarium companies

- Tahiti Marine Aquarium: The company's facilities are Papara. They have 25 tanks of various sizes, with the largest being three cubic metres. The company has the only hatchery in French Polynesia that is associated with the aquarium trade. The monthly electricity bill, about CFP 100,000/month, is indicative of the operation of the facility.
- Tahiti Tropical Fish: The company is located in Taravao, but also has other facilities, presumably in the Tuamotu Group.
- Te Hotu Miti: The owner of this company was overseas during the period of this survey. No information is available on their facilities.

12 Tridacna spat are collected and subsequently ranched. In this report it is referred to as spat-collected. This is called "collectage" in French.

Exports of aquarium products

- The value and volume of the exports of the main aquarium products from French Polynesia

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Value of aquarium fish (millions CFP)	9.4	7.2	8.8	9.7	23.8	25.3	36.8	29.5	43.1
Number of aquarium fish (numbers)	15.4	17.0	12.8	14.6	27.9	29.4	32.4	27.3	27.3
Value of tridacna (millions CFP)									31.2
Number of tridacna (numbers)				24,592	33,890	19,698	17,715	20,293	15,108

Source: DRMM (2018) and G.Remoissenet (per.com.)

- The origin of the exported tridacna (in numbers):

	Wild	Spat-collected		Reao	Tatakoto	Tubuai	Unknown
2009	774						774
2010	4,091						4,091
2011	9,619						9,619
2012	10,201			6,414		3,787	
2013	14,034	10,558		22,092	920	1,580	
2014	18,631	15,259		31,781	2,059	50	
2015	12,600	7,098		14,459	5,239		
2016	12,256	5,459		17,122	593		
2017	11,276	9,017		20,223	70		

Source: DRMM (unpublished data)

- The destination of the exports of aquarium fish from French Polynesia in 2018:

	Value (CFP)	Number (thousands)
USA	19,074,711	18,455
Hong Kong	15,245,807	4,799
France	3,383,677	1,913
Low countries	2,544,463	812
Taiwan	872,999	251
Other	1,947,214	1,061
Total	43,068,871	27,291

Source: DRMM (unpublished data)

- The destination of the exports of tridacna from French Polynesia in 2017 were USA (67% by number), France (23%) and Germany (6%).
- For fish exports, between 2017 and 2018 there was about the same number of fish but a large increase in value.
- Domestic sales of aquarium products are insignificant.
- In terms of restriction on exports of aquarium products, the most significant is a ban on the export of coral. Other restrictions that affect exports include a requirement for authorisation under CITES for the export of tridacna and island-specific bans/quotas.

Marketing arrangements

- The destination markets for aquarium fish and clams are given in the section above.
- The largest exporter indicates that he deals only with wholesalers in USA and Europe, but is unsure whether his Asian buyers are wholesalers or retailers. Another exporter declined to comment on his marketing arrangements.
- A study on the export of giant clams from French Polynesia (Hambrey Consulting 2013) has some comments on the competitive advantages/disadvantages in overseas markets.
  - In terms of colour, French Polynesia currently has an excellent reputation. Any attempt to offload poor colour clams at a lower price may solve a short-term problem but will not establish French Polynesia as the premier producer of high quality *T maxima*.
  - Overall, French Polynesia has significant advantages in Tridacna in terms of abundant wild stocks of a preferred species, relatively low export costs, and probably lower predation in grow-out. The main disadvantage is high labour costs.
  - Of great importance is the lack of fully commercial enterprises involved in giant clam production in most producing/competing countries. If French Polynesia can develop an efficient commercially-based production model, it is likely to be able to produce more reliably and efficiently and take a significant market share.

Management of aquarium product fisheries

- In terms of tridacna stock assessment, the tridacna management plan indicates that 10 atolls in the Tuamotu Group have been surveyed in the period 2010–2017 for total stock of tridacna in numbers and percentages of wild stock exploited. With respect to the latter feature, exploitation ranges from 0.3% to 3.7% at Reao and Raivavae, respectively.
- In French Polynesia there has been no stock assessment for the fish species in the aquarium trade.
- Although there are no regulations specific to the aquarium fish fishery, the fishery is subject to all the general fishery legislation of French Polynesia (e.g. ban on the use of scuba). Staff of DRMM indicate there is the intention of having a regulation that stipulates that only aquarium fish on a 'white list' may be exported.
- With respect to the aquarium tridacna fishery, there are several territory-wide regulations specific to the fishery. The main regulations include: (a) requirement for a licence to possess, transport or market any tridacna destined for the aquarium market; (b) a minimum size of 4 cm for spat-collected tridacna; (c) a minimum size of 12 cm for wild collected tridacna; (d) a requirement for CITES authorisation for export; (e) harvesting of tridacna only from those islands where it is authorised; and (f) a quota for those islands where it is authorised. In addition, there are some management measures that are specific to certain islands.
- A report by independent aquarium fishery specialists (Nahacky and Wabnitz 2014) recommended that DRMM consider seven management measures for the fishery, including daily catch reports, a ban on collection of fish species on the black list, and location-specific quotas for certain species.
- DRMM staff offer some thoughts on future development and management of the fisheries for aquarium fish and tridacna: continuously updating management interventions in accordance with tridacna abundance and exploitation; having on-line traceability from production to export; formulation of regulations appropriate for the aquarium fish fishery (e.g. a white list, declaration of all individual export consignments to DRM); and promotion of the fishery for aquarium export products based on the principle of sustainability.
- Enforcement of the regulations associated with the aquarium trade is thought by DRMM staff to be relatively good in the Austral Islands and the eastern atolls of the Tuamotu Group. It is suspected that some aquarium divers do not respect the scuba ban.

CITES Issues

- French Polynesia is an overseas territory of France and consequently has its CITES institutions based in Paris.
- The general government policy is that certain atolls of French Polynesia have an abundance of T. maxima that is among the highest in the world. Those stocks, together the practice of spat collection and ranching, results in a situation in which the sustainable export of wild and cultured tridacna is possible. This contention has been validated by the national CITES scientific authority based in Paris.
- In practice, the export of tridacna in French Polynesia is managed by DRRT-DIREN[13], a body established in French Polynesia in 2008 to which DRMM provides advice. In 2010 the first exports of tridacna from French Polynesia occurred. Currently, CITES export permits are issued by the High Commissioner's office.
- The staff of DRMM state that both wild-caught and spat-collected tridacna are considered 'wild' by CITES
- In 2018, 119 CITES permits were issued for a maximum of 28,975 tridacna. According to DRMM statistics, 15,108 tridacna were actually exported from French Polynesia in 2018.
- There appears to be a problem with the on-line CITES Trade Database – which shows 2,097 tridacna exported by French Polynesia in 2018, a fraction of the exports that DRMM records.

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Biosecurity issues

- According to the exporters, a biosecurity inspection is required for their shipments of aquarium products to the EU, China and Brazil. Each inspection costs CFP 6,000.

Air freight issues

- According to the exporters, the cost per kg for airfreighting aquarium products is: CFP 200/kg from Papeete to Los Angeles; CFP 300/kg from Papeete to Paris; and CFP 400/kg from Reao to Papeete. It can be seen that the freight cost from Reao to Papeete is twice that of Papeete to Los Angeles.
- In addition to the high cost of domestic airfreight, there is limited space on the important domestic flights and also problems of flight frequency, with sometimes less than one flight per week from the producing Tuamotu atolls.
- The low cost of the international airfreighting from French Polynesia is an advantage, along with the fact that to Los Angeles and Paris, the cargo does not have to switch aircraft. The latter is not the case for shipments to most Asian destinations.

Major aquarium product issues in the country

- The tridacna fishery appears well-regulated, but there is a lack of management measures specifically for aquarium finfish.
- There is currently a ban on the use of scuba for all fishery activity in French Polynesia, including for the collection of aquarium fish. A report by independent aquarium fishery specialists (Nahacky and Wabnitz 2014) gives five reasons for there being an exemption for the aquarium fishery. There are strong arguments, both pro and con, for such an exemption.
- There is a need to protect the reputation of French Polynesia in overseas aquarium markets, but it is controversial whether this is best achieved through legal instruments.

Other relevant observations

- Most of the fisheries management, hot issues, debates and controversies dealing with the aquarium trade in French Polynesia are about tridacna, rather than about finfish. This fish/tridacna situation in French Polynesia is similar to the fish/coral situation in some other Pacific Island countries.

Sources

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Useful contacts

- Tahiti Marine Aquarium: Manager: Moerani Lehartel, tel (689) 87725039, e-mail moerani@icloud.com
- Tahiti Tropical Fish: Manager: Alex Zumbiehl, tel (689) 87318974, e-mail sales@tahititropicalfish.com
- Te Hotu Miti: Manager: Celestine Williams, tel (689) 40575164, e-mail tehotumiti60@yahoo.com
- *Direction des ressources marines et minières*, Georges Remoissenet [responsible for the aquarium trade], tel (689) 40 50 25 50, e-mail georges.remoissenet@drmm.gov.pf

Information on aquarium products in Kiribati

History of the aquarium products trade

- The marine aquarium trade started on Christmas Island (also know as Kiritimati) in the late 1970s with a single exporter, specialising in the flame angelfish *Centropyge loricula,* which sold for USD 25 a fish. The status quo was maintained until the 1990s, with two companies trading profitably in flame angelfish and other highly sought-after species. The number of active operators increased from two to 10, then back to six by early 2000s and is currently at 13 in 2019.
- On Tarawa, the aquarium products trade started in 2009 with the export of 800 *Tridacna maxima* by the company, Atoll Beauties. Also on Tarawa, the Ministry of Fisheries and Marine Resources Development (MFMRD) has been involved with the culture of marine products, but not the export. The export of aquarium products from Tarawa has exclusively been for tridacna from the start to the present.
- Since the beginning of the aquarium fish exports from Kiribati, exports have come from only two islands, Tarawa (only tridacna) and Christmas Island (only fish).
- Independent consultancies and missions from SPC from the early 2000s initiated the process of trying to instill better management of the fishery on Christmas Island, which was badly run with numerous diving fatalities and injuries, poor quality of the fish being exported and declines in harvested species.

Annual harvests during the previous decade of aquarium products by category of product

- MFMRD has been collecting export data since 2006, which is archived on a database located at their office. Data are collected from exporters at the airport prior to shipping.
- The annual aquarium fish exports from Christmas Island 2006–2018, with the number of operators and contribution of three main species (only fish are being exported from Christmas):

	# operators	*Centropyge loricula*	*Pseudanthias bartlettorum*	*Centropyge flavissima*	Other	% Contribution Top 3
2006	10	109,606	16,335	8,261	11,915	91.8
2007	12	138,664	30,079	16,945	16,819	91.7
2008	12	99,040	25,787	13,367	11,981	92.0
2009	11	73,936	21,670	9,805	13,165	88.9
2010	10	64,368	21,561	8,466	8,689	91.6
2011	12	83,713	24,096	7,387	13,430	89.6
2012	11	85,819	27,291	9,830	8,939	93.2
2013	13	90,772	34,110	9,766	13,790	90.7
2014	13	102,404	35,569	11,794	15,849	90.4
2015	12	94,286	25,386	9,367	7,858	94.3
2016	10	83,218	29,384	5,523	10,911.5	91.5
2017	11	105,750	34,774	6,474.5	10,593.5	93.3
2018	10	70,050	20,386	3,470.5	7,369	92.7

- Annual aquarium exports from Tarawa 2009–2018 (only giant clams are being exported from Tarawa):

	Number of Pieces	Species
2009	800	*Tridacna maxima*
2010	1,500	*Tridacna maxima*
2011	3,500	*Tridacna maxima*
2012	5,000	*Tridacna maxima*
2013	8,000	*Tridacna maxima*
2014	12,000	*Tridacna maxima*
2015	14,000	*Tridacna maxima*
2016	500	*Tridacna maxima*
2017	800	*Tridacna maxima*
2018	1,750	*Tridacna maxima*
2019	3,550	*Tridacna maxima , T. gigas, H.Hippopus*

The readily available information on prices paid to harvesters for the various aquarium products

- On Christmas Island the prices vary between operators and for the same fish. Size and health or quality are main drivers of this, followed by the supply/demand. The top 10 export rankings based on 2006–2018 data are: (prices in USD)

Export ranking	Species	Min_price	Max_price	Median_price	Modal Price
1	*Centropyge loricula*	4.5	7	7	7
2	*Pseudanthias bartlettorum*	4	10	5	5
3	*Centropyge flavissima*	2	5.5	4.5	4.5
4	*Apolemichthys xanthopunctatus*	30	80	60	60
5	*Paracanthurus hepatus*	1	25	6	6
6	*Dascyllus auripinnis*	1	10	3	1
7	*Chaetodon declivis*	4	60	30	50
8	*Labrid* spp	2	5	3	3
9	*Zebrasoma rostratum*	10	200	100	100
10	*Pomacanthus imperator*	25	200	95	95

- On Tarawa, the sole exporter of tridacna stated that prices are linked to seed production costs, support costs to outer island farmers, cost of all equipment, etc. so it is misleading to quote the actual exact price paid to outer island farmers.

Companies involved in the aquarium harvest and/or export of aquarium products

- Ten companies were 10 licensed to export aquarium fish from Christmas Island in 2019, although there are 13 in the database showing export amounts for 2019. Export rankings are based on 2018 as 2019 data are still incomplete.

Export ranking for 2018	Exporter
1	Pacific International Pet Fish Provider
2	Rainbow Tropical Fish
3	Marine Beauties Export Co, Ltd
4	Tab's Divers Co Ltd
5	Willie and the Divers Inc
6	Rotin Tabakea
7	TarawaTropical Petfish Company
8	OTEE Marine Export Ltd
9	Moving Colors
10	PETIF Company
	Borita Aquatika Exports
	Kabua Petfish Services
	North Star Trading

- The sole exporter of aquarium products on Tarawa has been Atoll Beauties.
- Overseas affiliations of the fish exporters are limited to the importing companies that buy their product in Hawaii. There appear to be no professional affiliations beyond Hawaii.

The number of people employed by the aquarium companies

- On Christmas Island:
  - The only permanent employees of the aquarium companies are the owners, who are usually a married couple. People are employed weekly to prepare the fish for export but they are not considered permanent employees. Up to four 'packers' can be used to prepare shipments each week. They are working only on the afternoon/night of departure, as fish are packed to be ready at the required check-in time. Most companies are using two to four divers to catch fish for exporting. This equates to approximately 40 to 50 divers actively engaged in catching fish each week, depending on the number of companies shipping on any given week.
  - Most of the companies do not consider the divers collecting fish to be their employees. It is considered a transactional relationship only. Nevertheless, divers often only work for a particular company. Any equipment given to harvesters must be paid for, either up front or garnished from their fish sales to the exporting company. The companies take no responsibility for the qualifications and/or health of the divers doing the collecting.
  - All people working in the Christmas Island aquarium fishery are from Kiribati. All divers are men, with the only women usually being one of the owners.
- On Tarawa, the staffing of Atoll Beauties consists of the hatchery and farm staff of five women and three men (all full-time). In the outer islands, the company is affiliated with farmers in 16 households.

Domestic holding facilities of the aquarium companies

- On Christmas Island, only one company has onshore holding facilities, with all others keeping caught fish in the ocean, either attached to buoys or in some cases attached to the main wharf to make retrieval easier. Specific details of this have been reported multiple times.
- On Tarawa, Atoll Beauties has its hatchery at Abatao Islet.

Exports of aquarium products

- Total number of pieces shipped each year from Christmas Island 2006 and the earned value (i.e. price paid for the fish by the importers) are:

Year	# pieces	Value (USD)
2006	146,165	947,234
2007	203,286	1,373,230
2008	152,533	1,122,452
2009	118,675	868,686
2010	104,317	713,950
2011	128,806	928,583
2012	131,934	818,837
2013	148,716	980,522
2014	165,743	1,192,355
2015	136,988	985,541
2016	130,120	891,019
2017	158,404	1,402,412
2018	105,311	1,007,850
Total	**1,830,999**	**13,232,672**

- All fish from Christmas Island are shipped to Hawaii, where they are on-sold into the US mainland and Europe. Kiritimati exporters have no relationship with markets beyond Hawaii. Previous access to Asian markets through Fiji stopped when a biosecurity tariff /charge was imposed by Fiji, which made exports through this route uneconomical.
- The tridacna exports from Tarawa are:

	Details	Destination
2009	800 pc *Tridacna maxima* $6,400	Germany
2010	1,500 pc *Tridacna maxima* $12,000	Germany
2011	2,500 pc *Tridacna maxima* $28,000	Germany
2012	2,000 pc *Tridacna maxima* $20,000	Germany, France, Florida
2013	3,000 pc *Tridacna maxima* $30,000	France, Germany, USA, Italy
2014	2,000 pc *Tridacna maxima* $20,000	Los Angeles
2015	14,000pc *Tridacna maxima* 47,000	Marshall Islands and Kosrae
2016	500pc *Tridacna maxima* 2,500	Marshall Islands
2017	800pc *Tridacna maxima* 4,000	Marshall Islands
2018	1,750pc *Tridacna maxima* 17,500	Los Angeles and Marshall Islands
2019	1,500pc *Tridacna maxima*, 1,650pc *Tridacna gigas*, 400pc *Hippopus hippopus* $58,750	

Marketing arrangements

- The Christmas Island fish exporters have no elaborate marketing arrangements for their products. Their 'market' is direct selling to the Hawaii-based importers and that is it. There was no evidence that exporters attended trade shows or enquired about marketing beyond the existing arrangement.
- The Tarawa tridacna exporter supplies only reliable wholesalers, with payment within 14 days of receipt of product. Prices are based on the landed price of the importing country and all freight, packaging handling are included in the sales price to the wholesaler.

Management of aquarium product fisheries

- On Christmas Island there have been some in-water surveys done by visiting experts but they have been either too shallow to capture the species of interest or very limited in spatial scope and hence unable to provide a realistic assessment of the health of targeted species. SPC has, however, just completed (August 2019) a whole-of-atoll in-water survey of fish species targeted by the aquarium trade at depths more appropriate to the fish being targeted. Data still have to be analysed but preliminary investigations revealed that densities of the main target species, *C. loricula*, are still relatively high but closely correlated with distance (i.e. access to fishing grounds) from the main port.
- There has not been a formal management plan for the aquarium fishery up until this point, although it has been documented as needed for many years now (e.g. Kiritimati Integrated Fisheries Master Plan 2014–2017). There is now a draft management plan put together by the coastal fisheries management section at SPC.
- In terms of management plans for wild tridacna brood stock, MFMRD, the Ministry of Environment and Island councils have various plans and policies.
- The only form of regulation for the export of aquarium fish or tridacna is an annual registration fee that has to be paid by anyone wanting to ship aquarium fish. An application form is completed and lodged with MFMRD and, if accepted, an annual fee of AUD 1620 must be paid.
- There is no exporting of live rock or hard coral. Scuba is the standard equipment for collecting aquarium fish.
- The Kiritimati Pet Fish Association is supposed to be a collective organisation to facilitate the best outcomes for the aquarium fishery. Currently, this does not appear to be functioning.
- There have been multiple training/capacity-building events over the past 20 years that have sought to provide a framework for a sustainable and healthy aquarium fishery. These events have resulted in some changes to how the fishery is run but they are mostly related to getting their product to a healthy enough level to maintain business but no more.
- Formal training and capacity building started in the early 2000s through SPC's work on the live reef fish trade and was particularly well-focused during the period when SPC had a dedicated Aquarium Fishery expert Collette Wabnitz from 2011–2015.
- There are some individuals still in the industry who were part of earlier training/capacity building. This is especially true of the older companies and older individuals. What was interesting was that some could remember Beeing Yeeting conducting training from back in 2000 but many struggled to remember Collette Wabnitz, even though she spent much more time on Kiritimati teaching and assessing.

CITES issues

- MFMRD provides export permits which include CITES approval if relevant (i.e. for tridacna). According to the tridacna exporter, that export permit has been developed to meet US fish and wildlife import requirements at the point of arrival.
- For tridacna exports to Europe, the MFMRD export permit is sent to the European importer who applies for a CITIES import permit.
- On Christmas Island there is no recognition of CITES and what it means among the companies interviewed during the present survey. They appear to rely totally on feedback from the Hawaii importers with respect to what they can or cannot ship.

Biosecurity issues

- A biosecurity inspection certificate is required for shipments of aquarium products to the EU.
- According to the tridacna exporter, SPC has taken on the responsibility for the requirements of the World Organisation for Animal Health (OIE). Under that scheme, tissue samples must be supplied when requested by SPC for testing by CSIRO in Australia. Testing is for any disease or parasites.
- Fiji now requires a biosecurity transit permit for any shipments that transit Fiji, at a cost of FJD 127 per consignment.

Air freight issues

- There is only one flight a week from Christmas Island to Hawaii for shipping aquarium fish. The space available is subject to how much other cargo is on board. The share of available space is divided evenly among all companies on Christmas Island who are shipping products. It is currently at five boxes per company per flight, down from seven per company, as more companies have been allowed into the fishery.
- The limited air cargo space out of Christmas Island acts as a restraint on the amount of aquarium fishing that can occur. If space was no longer constrained, overfishing would quickly occur with concomitant negative outcomes.
- On Tarawa, the high cost of airfreight severely limits the possibilities of exports of aquarium fish or corals.

Major aquarium product issues in the country

- The major aquarium issues on Christmas Island
  - A common complaint from the companies interviewed was about the number of fish turning up in Hawaii classified as dead on arrival. This is apparently a long-standing gripe between the exporters and importers. It is impossible to accurately assess this issue without substantial time spent at the Hawaii end to see how the fish are when they arrive. Observation of the packing process at one of the more established companies in Kiritimati suggests that handling is rough.
  - Maintenance and purchase of diving equipment is a common issue amongst companies. There are only a few companies with dive compressors and other companies pay for their dive fills from them.
  - Dive equipment purchases seem to be undertaken through the importers in Hawaii and a common complaint is that they are being charged too much.
- The major aquarium issues on Tarawa
  - Unreliable airfreight service from the outer islands makes any outer island aquarium product operation unviable.
  - There is no financial assistance for establishing a new business and no real tax incentives to establish businesses on the outer islands.
  - Outer island councils do not have a realistic impression of the economics of the aquarium business and often kill any new business with unrealistically high licence fees.

Other relevant observations

- A James Cook University master's thesis was completed by a Kiribati national, Tebaua Sapolu, in 2005. This was an extensive analysis of the life-history of a few species of angelfish, one of which was the flame angelfish collected from Kiritimati Atoll. This work has not been formally published, nor has it been mentioned previously in any work, yet it contains pivotal information for making any realistic assessment on the sustainability of harvesting this fish.

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Useful Contacts

- Taratau Kirata (Head of MFMRD office on Kiritimati) E-mail : taratauk@fisheries.gov.ki, tarataukirata@gmail.com

Information on aquarium products in Marshall Islands

History of the aquarium products trade

- RRE (Robert Reimers Enterprises) established a giant clam farm at Wau Island, Mili atoll in 1988. Targeted species were *T. gigas*, and *T. squamosa*.
- Export operations of live rock began during the early 1990s. One company was headed by an American from Hawaii whose company, Black Coral-Hawaii, was actually based in Majuro. Several companies entered and exited the business thereafter.
- In 2000, the company RMI Marine was operating from a base in Woje, Majuro and exporting live rock and sometimes coral.
- A former mayor of Majuro was involved in live rock export in the early 1990s and reported sending out 10,000 lbs in one month.
- OK Davis, a locally based aquarium fish exporter operated from at least the late 1990s and employed local divers in Majuro. No longer in business due to owner's health.
- Arro Inc. eventually took over from OK Davis and has continued with some of his former divers.
- In 1995, Marshall Islands Mariculture Farm (MIMF) was operated by RRE in Majuro; exports included clams, as well as hard and soft coral. In 2003 the facility was sold to ORA, a Florida-based aquarium products company that still does business as MIMF.
- Companies or persons active in 1999 included RMI Marine Exporters, RRE, Journal Jilly, and Mid-Pacific Marine. Export products included live rock, giant clams and other invertebrates and aquarium fish.
- One local aquarium fish exporter, Journal Jilly, exited the business in 2002.
- MIMRA began a giant clam hatchery in Likiep atoll during the late 1990s. It operated by fits and starts until collapsing around 2014-2015. The facility was refurbished by MIMRA with assistance from Japan's Overseas Fisheries Cooperation Foundation (OFCF). New equipment, leadership and community involvement improved performance so that by 2018 it was in full production. Clams are raised by farmers that have formed a MIMRA-supported association in Likiep. According to MIMRA, there are 100 or so members of the association.
- MIMRA has also developed a clam hatchery on Arno atoll that is now in production, also with assistance from OFCF. About 40 farmers are associated with the farm.
- Collection/export of live rock from RMI ended in 2007.
- Anecdotal information indicates two local fish collection companies ceased operations in the early 2000s. Reasons included an inability to comply with packing and shipping conditions that resulted in financial losses.
- In 2014 six or seven firms in RMI were reportedly involved in the aquarium trade. By 2019 this number was reduced to four, one of which is based in Kwajalein.

Annual harvests during the previous decade of aquarium products by category of product

(See export section below)

The readily available information on prices paid to harvesters for the various aquarium products

- MIMRA indicated that an average price paid for clams from Likiep raised by farmers there is around USD 2.85.
- One aquarium fish exporter said that, on average, he may pay his divers a third of the wholesale value of fish they collect and survive for export. Sometimes he will pay more as an incentive to retain experienced crew.
- Another aquarium fish exporter mentioned that the company pays its divers around 40%–50% of the value of the most common fish caught, flame angels, for which the company receives about USD 5.
- Shore-based workers at one farm are paid USD 6 per hour, which is double the current minimum wage. The justification for the higher wages is the workers' experience and reliability, coupled with a desire to retain them and not have to train new workers with no experience.
- Most export declarations are said by MIMRA to contain a value of USD 1.
- No exporter of aquarium products was willing to divulge prices received for exports. One exporter said that prices can change with market conditions, both those affecting the importer and his own preferences for sometimes providing 'loss leaders' to gain future business.
- MIMF ships all its aquarium products to the parent company in Florida, which sells to distributors and others. The local manager says he is not involved in sales and has no knowledge of prices received for RMI aquarium products.

Companies involved in the aquarium harvest and/or export of aquarium products

- A total of four companies; three based in Majuro and one based in Kwajalein (Ebeye). Two companies export almost exclusively aquarium fish, one exports clams/corals and other invertebrates, and one exports aquarium fish, as well as clams and corals.
- Only one company purchases clams for grow-out from MIMRA-supported clam hatcheries in Likiep and Arno atolls. The company also imports clams and some inverts from FSM and to a lesser extent Kiribati, because of the difficulty of shipment from those locations to markets in USA.
- The two companies in Majuro involved in aquarium fish capture employ their own divers.
- One Majuro-based aquarium fish operation obtains its products by sending teams of divers to the outer islands and does not collect on Majuro. They take all their own equipment, compressor, food and a cook. The team typically stays on an atoll for up to a month or more at a time, diving at various sites around the atoll. Shipments back to Majuro are by the company's boat and are timed to coincide with flight schedules.

The number of people employed by the aquarium companies

- Divers: a total of 19 divers are employed by the two Majuro-based companies that dive for aquarium fish. One company has five divers, the other 14. They operate in teams.
- Collecting using "breathing apparatus with the appropriate certification" is allowed by the 2015 Aquarium Fishery Regulations. All companies pay their divers by the piece, with the company providing free air and tanks. Divers typically own and are responsible for maintaining their own equipment. One operator says that not all those hired are suitable for aquarium fish collection, even if they are competent divers. Some never get the "knack" of collecting and are let go if their performance does not improve.
- Shore based and support crew: One company has two part-time workers to assist in packing and monitoring the holding tanks, the other has four or five support staff that travel with divers to the outer islands and are responsible for maintaining the camp, as well as handling fish. An additional three employees assist in maintaining and packing aquarium fish, maintaining raceways and tanks, and preparing coral for grow-out.
- Each of the companies raising clams and corals (and exporting some other invertebrates) employs three people in addition to the manager or owner. Some casual labour may be employed by one farm for packing export shipments.
- All employees of the four companies handling aquarium products are men.
- Independent clam farmers (part time) in Likiep: up to 100 are supported by the MIMRA clam farm, according to MIMRA.
- Both companies that utilise divers to collect aquarium fish rotate divers to give them an opportunity to rest and expel the nitrogen that builds up in their bodies.

Domestic holding facilities of the aquarium companies

- Both aquarium fish companies on Majuro have holding facilities using filtered seawater, UV treatment and other means of treatment. No information from Kwajalein.
- The two companies culturing clams and corals in Majuro have above-ground fiberglass tanks as well as in-ground concrete raceways. One uses water from the lagoon; the other uses water from the ocean side of the atoll.
- Both companies in Majuro that grow clams and coral utilise trochus as cleaners in the concrete raceways.

Exports of aquarium products

- In 2000 there was an increase in export activity for several commodities over 1999

Company name	DESCRIPTION	1999 (QTY)	2000 (QTY)
RMI Marine Exporters	Live Rock	62,194 lbs	37,865 lbs
	Invertebrates	33,645	49,733
	Aquarium fish	-0-	1,439
Robert Reimers Enterprises	Live Rock	250 lbs	1,170 lbs
	Giant clam		
	Tridacna maxima (mejenwid) 3–20 cm	8,357 ea	15,690 ea
	Tridacna squamosa (tonale) 3–25 cm	768 ea	2,323 ea
	Tridacna gigas (kabor) 20–30 cm	8 ea	2 ea
	Hippopus hippopus (dimuj) 3–20 cm	84	101
	Hard and soft coral 3–17 cm	177 ea	2,374 ea
	Invertebrates	-0-	165 ea
Journal Jilly (no longer in business 2002)	Aquarium fish	1,204 ea	3,418 ea
Mid-Pacific Marine (OK Davis)	Aquarium fish	6,500 ea	8,064 ea

- RRE marine product exports, January 2002 (from a request to MIMRA for export clearance certificate). Destination: Sea Care Mariculture Products, Vancouver, Canada

T. maxima, 3-20 cm	600 pieces
T. squamosa	300
Acropora coral, staghorn 4–17 cm	50
Pocillipora coral, 4–17 cm	50
Coral 3–17 cm	100
Hermit crabs (*Dardanus* sp.)	5,000
Leather soft coral (*Sarcophyton*?)	100
Sea cucumber (*holothurian*), 2–20 cm	200

- The MIMRA 2014 Annual Report states that the marine ornamental trade saw significant growth in exports during FY 2014 with angel fish (Pomacanthidae) exports increasing from about 15,000 in FY 2013 to over 50,000 in FY 2014. Angel fish accounted for over half of exports (by piece) in the aquarium trade.
- Exports of aquarium fish have consistently outnumbered invertebrates by a factor of at least four in all years since at least 2014–2015.
- Increase in exports of aquarium fish and inverts (pieces) MIMRA data from the three exporters:
  FY 2016 104,101
  FY 2017 121,654
  FY 2018 123,335
- Increase in exports of clams and coral (pieces) MIMRA data from three exporters:
  FY 2016 25,196
  FY 2017 24,236
  FY 2018 35,374

Clams

- Main clam species utilised for aquaculture are *T. maxima, T. derasa, T. squamosa*. MIMF has a few *T. gigas* for broodstock obtained from Likiep atoll in Marshall Islands in 2019.
- Increase of export of *T. maxima* FY 2018 over FY 2017.

Coral

- Up to 18 species of coral (soft and hard) are being cultured for export from fragments. From MIMRA data the most popular appear to be the long polyp *Sarcophyton* sp. and *Zooanthus* sp.

Aquarium fish

- Top 10 RMI marine ornamental exports (number) FY 2017, FY 2018

	FY 2017	FY 2018
Flame angel (*C. loricula*)	50,119	43,125
Blue eye hermit crab (*Paguristes* sp.)	19,982	18,662
Blue leg hermit crab (*C. elegans*)	19,035	17,450
Bumble bee snail (*Pusiostoma* sp.)	12,400	15,280
Multicolor angel (*C. multicolor*)	1,954	7,825
Elongated giant clam (*T. maxima*)	1,491	5,862
Helfrich's goby (*N. helfrichi*)	972	8,410
Bartlett's antias (*P. bartlettorum*)	947	7,431
Long polyp leather soft coral (*Sarcophyton* sp.)	642	924
Majuro zooanthids (*Zooanthus* sp.)	222	945

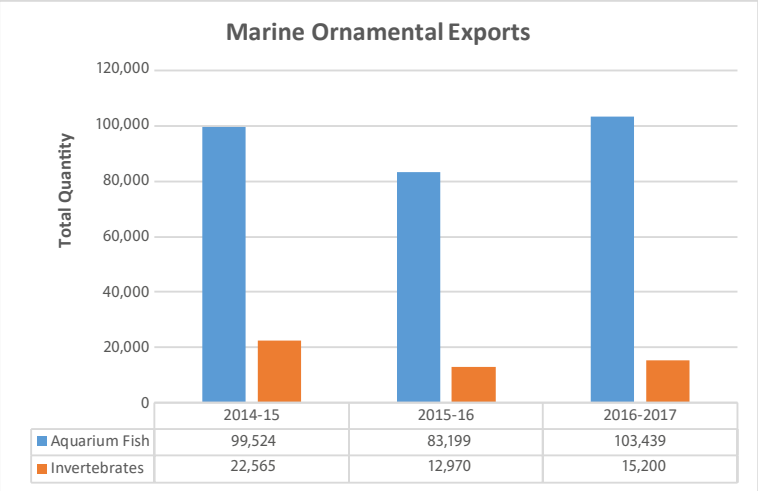
Source: MIMRA Annual Report FY2018

Others

- There are significant export numbers of hermit crabs and Pusiostoma snails that are used for aquarium cleaning (see table above).
- The table below from the MIMRA Annual Report FY2017 gives an indication of the order of magnitude for various species exported. Amounts for 2017 do not match the above table from a later report, possibly because the calendar year was used in the former.

Top 10 Aquarium Exports 2015 - 17			
Common Name	**2015**	**2016**	**2017**
Flame angel	56,684	40,367	64,032
Multicolor angel	683	8,377	9,315
Helfrich`s firefish	7,126	5,994	7,803
Bartlett`s anthias	5,914	4,153	5,793
Lemon Peel	2,669	4,055	4,855
Golden wrasse	4,879	3,656	3,852
Assorted anthias	6,887	3,124	3,128
Mystery wrasse	3,694	1,831	2,694
Fire Goby	530	632	1,617
Dispar Anthias	530	118	550

- A separate graph in FY 2017 annual report addresses invertebrates but no precise numbers are given. Aquarium fish totals have remained fairly constant during the three periods with a drop in 2015-2016.



- The export situation is complicated by re-exports. In FY 2018, the country re-exported 474 pieces of tridacna from Kiribati, 1885 pieces of tridacna from FSM and 12,704 pieces of coral from FSM.
- No recent price data are available. Using price data from other countries and older price and production data in Hambrey (2011), a crude estimate of the FOB value of aquarium product exports in FY 2018 is around USD 1 million.

Management of aquarium product fisheries

- MIMRA's involvement in management is focused primarily on the monitoring of exports. The MIMRA Act requires all exports of marine products to be exported under a permit from MIMRA. Providing export permits is the primary reason for MIMRA's involvement in collecting export data.
- MIMRA Aquarium Fishery Regulations 2015 require a licence for the export of marine ornamentals (USD 1,000 fee) and limits the number of active licences in the country to a maximum of seven at any one time. Total allowable catches may be established and implemented. Local governments in consultation with MIMRA may take conservation and management measures. Exporters are required to maintain logs and report on a monthly basis. Wild capture of giant clams for export is prohibited, as are coral species in the taxa Scleractinia, Antipataria, Heliopora, Tubiporidae, Milleporidae and Stylasteridae.
- MIMRA charges a nominal fee, USD 20 per export permit for each consignment. If permit issuance must be done on a holiday, weekend or after hours when overtime is required for MIMRA employees, the fee is USD 50.
- There are no export taxes levied on products in Marshall Islands. Customs does not collect information on exports and the RMI government has no export data other than those provided by MIMRA as part of their legal permitting practice undertaken pursuant to the MIMRA Act.
- This situation is expected to change, as there is a new draft customs act that will require licences for exporters and importers, as well as documentation to be presented to customs covering all exports. This is being done so that RMI can be aligned with the Revised Kyoto Convention. Currently they are now 26% compliant and do not use the Harmonized Commodity Description and Coding System (HS) yet. Consequently, they must rely on mirror data to find what RMI is exporting. The draft new customs regulations are awaiting action by cabinet but will wait for the next election.
- The local atoll governments are responsible for the monitoring of collection activities on their respective atolls. However, most only charge a business or collection permit fee. There are no limits at any atoll on the type(s) or numbers of animals that may be collected.
- The fees for business licences or collection permits on outer atolls can vary considerably. They are mostly charged on an annual basis and can range from a few hundred dollars up to USD 1000 or USD 2,000. The local government in Majuro charges USD 1,500 per year for a collection licence. The closest atoll to Majuro, Arno, was asking for USD 2000 for a licence but there were no takers.
- No stock assessments of aquarium products have been undertaken recently by MIMRA. SPC did do a stock assessment a while back, but they could not visit the atolls other than Majuro. Manpower, expertise and competition for MIMRA's time for such activities as monitoring sea cucumber collection and sale are cited as some of the reasons for a lack of focus on stock assessments.
- MIMRA recently completed an aquaculture stakeholders' consultation in preparation for the development of aquaculture regulations that will have an impact on cultured aquarium products. Overall, those in the aquarium products industry were satisfied with the outcome and understand that additional regulations will be in their best interest.

CITES issues

- In the late 2000s, RMI was placed on a CITES blacklist for giant clams because, even though they were monitoring the export of cultured clams, export records did not reflect imports into USA that were discovered by US Customs. This involved personal shipments or airline baggage that contained dried, salted or frozen clams collected in the wild that were being taken to USA for personal use. MIMRA obtained the services of an expert consultant who assisted MIMRA in sorting out the problem and RMI was taken off the blacklist.
- There are no current identified CITES issues. Exporters are well aware of the requirements. The public has been warned about not exporting wild clams through a publicity campaign and it seems to be working.
- According to one company, the paperwork requirements for USA and Asia are manageable. Exports to the EU require much more time to prepare the necessary documentation and other paperwork. The RMI exporter complies because he wants to develop markets in addition to his regular customers.

Biosecurity issues

- No major biosecurity issues were reported by those interviewed.

Air freight issues

- Most shipments are on APA, an air freighter that carries primarily fresh tuna. There is no guarantee that air freight space will be available in the four United Airlines flights per week to Honolulu (a five-hour flight). A new Sunday flight has freed up some cargo space, but there are increased costs associated with overtime that must be paid for weekend work. Even if overtime or holiday pay is paid, some workers do not want to work on Sunday, according to one fish exporter.
- Exporters indicated that if there was a significant reduction or cessation of APA air freight, their businesses would likely close. "APA makes it work." In this way, the export-oriented aquarium products trade is closely linked to the operation of Luenthai's longline tuna operation in Majuro.
- There is an overall limit of 3,000 lbs per flight for available air freight on the two flights per week that must be shared by all exporters. US mail is included in this limit and has priority over commercial exports.

Major aquarium product issues in the country

- The air freight issue cited above is felt by the largest fish exporter to be one of the constraints to his business growth. Shipments are sometimes bumped and the animals taken back to holding areas to await available transport.
- Both Majuro-based companies utilising divers say that labour is the biggest problem. Most divers are getting old and it is difficult to find younger people willing to learn the trade. One exporter pointed out that not everyone is suited to the business, as collection of fish at deeper depths is somewhat an art that is not easily learned.
- One aquarium fish company feels that Majuro is seriously over-fished and fish that were previously available at relatively shallow depths are now found only in deep waters.
- The timely issuance of permits by MIMRA to enable meeting air freight schedules can sometimes be a problem.
- The presence of large numbers of *Cymatium* snails in Majuro lagoon and the potential manpower requirements to keep cultured clams from damage and predation by these snails makes ocean culture in the lagoon impractical to undertake in Majuro.
- The manager of one company that raises clams and coral utilising seawater from the ocean side of the atoll said that he has experienced significant mortality of trochus and other animals in his raceways due to increased water temperatures this year. Warmer sea temperatures are also adversely affecting corals. He is very concerned about the future of the industry if water temperatures stay at levels higher than usual.
- One company said that all exporters in Majuro face problems because of recurrent power outages, poor water quality and king tides that appear to be more severe and frequent than before.

Other relevant observations

- The industry has operated 'under the radar' for a long time and is highly sensitive to the possibility of opposition from NGOs and others. They are operating within existing laws and welcome MIMRA's efforts to include them in discussions aimed at greater regulation because they feel that in the long run these will be beneficial.
- There is no government requirement for divers to be certified, even though there does exist in Majuro a certified instructor who could provide such certification. Divers are typically taught by others in the trade and by the company's managers.
- MIMRA estimates that 15% to 20% of staff time overall is devoted to aquarium products. It is expected that will increase to 25% or more when new aquaculture regulations that may affect the aquarium trade are adopted. There is currently a staff of six in the MIMRA Aquaculture Unit that supports the aquarium products industry as part of their overall work programme.

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Contact information

- Christian Colo, Manager, Marshall Islands Mariculture Farm, cell 692-455-0157 off 692-247-2562. www.orafarm.com.
- Mike Slinger, Owner, TSL Ltd. Cell 692-455-0500, tslrmi@yahoo.com
- Jessica Hsieh, Arro Corporation, dba Auntie Store Aquarium Fish Export, PO Box 4015 MH 96960, 692-247-8889,692-247-4777, cell 692-456-4777. jessicahsieh165@gmail.com
- Connor Larkins, Owner Kwajalein Fish Exporters. ebeye01@yahoo.com

Information on aquarium products in New Caledonia

History of the aquarium products trade

- In the 1980s, one company, NEMO, exported various species of aquarium fish to a company based in Los Angeles, USA. The operation was short lived.
- Since the late 1990s, the number of companies operating simultaneously has never exceeded three, all based in the south of New Caledonia, in or close to the capital city, Noumea.

  Operations based on captures

  - Mid to late 1990s: Two companies (one-man operations) – GRAND LAGON et LAGOON AQUATICS started exporting velvet angels (*Chaetodonplus conspicillatus*), a high value species. Both operations were solely based on the export of this species.
  - 2000 to 2006–2010: Three companies (one-man operations) – GRAND LAGON, LAGOON AQUATICS (still only based on the export of velvet angels) + JP Godot (export of velvet angels + small quantities of miscellaneous other species)
  - 2011–2016: Three companies. In addition to GRAND LAGON, which kept operating as usual, Antoine Teitelbaum started his company Aquarium Fish New Caledonia (AFNC) in 2011. It was the first NC aquarium trade operation based on the export of a wide spectrum of aquarium fish species (annual exports of 10,000–15,000 specimens), in addition to small quantities of velvet angels. LAGOON AQUATICS reduced operations, while building a new boat, to satisfy the marginal local market.
  - 2017–2018: Three companies (GRAND LAGON, LAGOON AQUATICS (velvet angels only) + AFNC (few velvet angels + miscellaneous fish species)
  - 2019: Two companies: (LAGOON AQUATICS (velvet angels only) + AFNC (few velvet angels + miscellaneous fish species)

  Operations based on aquaculture

  - In 2017, AFNC started aquaculture experimentations with seahorses, soft corals and giant clams.
  - 2018–2019: AFNC has exported about 1500 seahorse specimens per year. The culture of soft corals and giant clams remains experimental.

Annual harvests during the previous decade of aquarium products by category of product

- The only available data are provided by the Customs Department export database, which does not record the species or the number of fish exported but weights of shipments (which includes fish and water).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Weight (kg)	5,808	6,072	16,977	15,204	15,535	15,581	15,878	15,486	12,469	6,782
Value (XPF million)	15.7	11.9	27.8	31.2	33.1	38.7	40.2	37.2	32.8	20.3

The readily available information on prices paid to harvesters for the various aquarium products

- No information available.

Companies involved in the harvest and/or export of aquarium products

- Currently, two companies are still exporting products: AFNC and LAGOON AQUATICS

The number of people employed by the aquarium companies

- Over the years, four of the five companies that have exported aquarium fish were one-man operations. The fifth one, AFNC has employed four staff max (the manager/diver (a man), two divers/maintenance (men) and a person responsible for the holding facilities maintenance and the packaging for export (a woman).
- In 2019, the company reduced the permanent staff to three (manager + two maintenance/packaging) and contracts self-employed divers according to needs.

Domestic holding facilities of the aquarium companies

- GRAND LAGON and LAGOON AQUATICS are home-based operations with very basic infrastructure.
- AFNC operates from a specifically built warehouse, which includes 200 m^2 of space for aquarium tanks and 100 m^2 of space for storage. The dock houses 8000 litres of aquariums for fish and 3000 litres of aquariums for invertebrates, soft corals and seahorses. The warehouse is covered with solar panels that provide all the electricity needed by the operation.

Exports of aquarium products

- GRAND LAGON and LAGOON AQUATICS export velvet angels to Taiwan, Hong Kong, mainland China and occasionally to Japan and USA. Both companies have been operating for more than 20 years and have established reliable relations with their clients.
- AFNC uses velvet angels as a 'product of appeal', and only sells when importers accept to take other specimens together with the shipment of one or two velvet angels. Other species mostly include basslets, angel fish, damsels and wrasses.
- AFNC has developed a solid reputation for reliability (excellent survival of specimens exported), which, according to the manager, allows the company to obtain and maintain good prices.
- AFNC exports primarily to USA (one company), EU (one), Hong Kong (one) and Tokyo (one), and very occasionally to Melbourne.

Marketing arrangements

- Arrangements are known only for AFNC
  - The landed price includes the fish price + package cost + freight cost. Therefore, the landed price is acceptable or not according to the number of specimens per box. Here again, the relationship of trust established by AFNC with its buyers allows the company to obtain prices that make the operation profitable for both parties.

Management of aquarium product fisheries

- No stock assessment of any species fished for the aquarium trade has ever taken place.
- The aquarium trade fishery is not entitled to receive grants of financial aid from the government (apart from aid received by all other professional fishers, such as tax-free fuel). Sectors entitled to receive government grants are defined on a yearly basis.
- The aquarium trade fishers are professional fishers and must respect all rules applied to the professional fishers in general (navigation safety rules, health protection, etc.). The following rules are specific to the aquarium trade fishery. They have been translated from the Environmental Code of the New Caledonia South Province. The other two provinces have similar restrictions.
- Adapted from Article 341-2
  - The aquarium trade fishery is a "specific fishery", a professional fishery that may be subject to quantitative restrictions in relation to the overall fishing effort. To be allowed to fish for ornamentals, a fisher must obtain a "specific inshore fishing authorisation" in addition to the general inshore fishing authorisation that all professional fishers must hold.
- Article 341-34
  - As from 1 June 2011, all persons holding an inshore fishing licence wishing to carry out a specific fishing activity are subject to an authorisation issued by order of the President of the Provincial Assembly. The specific inshore fishing authorisation shall be issued in the name of the fishing-captain or shipowner.
- Article 341-28-1
  - The possession and use by professional fishers doing underwater fishing activities of any equipment enabling an immersed person to breathe without returning to the surface (SCUBA or UBA) are permitted only to holders of a specific fishing authorisation for marine aquarium organisms.
- Article 341-34 of the South Province Environment Code
  - On board a vessel holding a coastal fishing authorisation specific to marine aquarium organisms, the simultaneous possession of equipment enabling an immersed person to breathe without returning to the surface and any marine animals other than marine aquarium organisms is prohibited.
  - The harvesting of live coral (madrepores) and live gorgonians is prohibited.
  - The President of the Provincial Assembly may, by order, grant exemptions from the prohibitions provided for in the preceding paragraph, for the purposes of scientific studies or research or for coastal fishers holding a specific fishing authorisation for marine aquarium organisms, within the total limit of 10 kg per year for corals of the genus Anthipathes. The weight of harvested fragments of corals of the genus *Acropora* may not exceed 300 g.
- In addition, the South Province is preparing regulations to specifically manage the *Chaetodonplus conspicillatus* fishery. This fishery could become a "specific fishery" on its own, or specific rules related to this species could be added to the "specific aquarium trade fishery".
- Rules are well respected, and no infractions have been recorded so far.
- No training has been organised for this fishery.

CITES issues

- New Caledonia must comply with CITES export and import rules and regulations *(Journal Officiel de la Nouvelle-Calédonie, Arrêté n° 2019-1181/GNC du 30 avril 2019 définissant les annexes I, II et III de la CITES pour la Nouvelle-Calédonie).* Authorisations to export live animals are made by the *Service d'inspection vétérinaire, alimentaire et phytosanitaire (SIVAP)* (veterinary, food and phytosanitary inspection service), which is also the authority CITES certificates for NC *(Journal Officiel de la Nouvelle-Calédonie Arrêté n° 2019-1177/GNC du 30 avril 2019 portant désignation du service pour l'instruction des permis et certificats CITES en Nouvelle-Calédonie.* For CITES species, the scientific authority is the *Institut de recherche pour le développement (IRD)* (French Institute of Research for Development) *(Journal Officiel de la Nouvelle-Calédonie, Arrêté n° 2019-1179/GNC du 30 avril 2019 portant désignation de l'autorité scientifique CITES pour la Nouvelle-Calédonie).*
- AFNC is currently investigating ways to produce and export cultured hard corals, which are listed in CITES Annex II.

Biosecurity issues

- As SIVAP is the government body giving the permits to export live animals, it is also responsible for enforcing the biosecurity rules. In the case of the aquarium trade, the biosecurity check is compulsory for the European Union market and Australia.
- Biosecurity checks are done twice a month by SIVAP at AFNC facilities.

Air freight issues

- Air freight is a big issue for the NC aquarium trade.
  - No direct line to the main markets, except for Japan
  - No backup on certain flights
  - Packaging procedures must be planned for very long trips (AFNC plans for 60-hour trips to stay on the safe side)
  - High shipping costs (USD 6.00–10.00/kg or more)

Major aquarium product issues in the country

- The profitability of aquarium trade businesses in NC mostly relies on one species (velvet angel).
- This species is rare (hence its high value) and can be found only in a limited area. It can easily become overfished if the fishery is not well managed.
- There is nothing to protect businesses from other operators settling in and targeting the same species, although this is currently discussed at government level.
- Furthermore, the species has recently been successfully bred in captivity by a US company (Poma Labs, http://pomalabs.com/) and trials are taking place in Bali. The high value of the species could be greatly reduced if the species can be bred in large quantities.
- The cost of shipping is prohibitive, and the overall cost of operation (price of goods, wages, facilities building and maintenance, fuel, etc.) is extremely high when compared to other countries in the Asia-Pacific Region.

Other relevant observations

- According to fishing authorities, regulations that could be put in place to protect the *C. conspicillatus* stock include:
  - a maximum size limit (big individuals are lower value, do not always adapt well in aquariums and play an important role in reproduction as they are prolific breeders)
  - an overall quota per year, equally shared among a very limited number of authorised operators; and
  - a bag limit of six fish caught per fishing day is used to avoid big quantities of fish being put on the market at the same time.
- Aquaculture activities can support profitability by providing a diversity of commodities; 'catch and sell' alone is not profitable.
- There is a very limited potential for the development of the aquarium trade sector in NC, as the cost of living makes any business based on exports hardly viable there, unless it is based on very high value products. The aquarium trade sector has remained viable because it has relied on a high value species sent to specific niche markets. Developing the sector would mean putting more pressure on the fragile stocks of velvet angels.

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Useful contacts

- Bernard Fao, Responsable du Bureau des Pêches, Province Sud, New Caledonia. E-mail: Bernard.fao@province-sud.nc; Phone: +687 203828
- Antoine Teitelbaum. Manager, SARL Aquarium Fish New Caledonia (AFNC), Mont-Dore. E-mail: aquariumfish@gmail.com; Phone: +687 945444
- Bruno Dumet. Aquarium trade fisher and exporter. E-mail: jsb.dumet@mls.nc. Phone: +687 824503

Information on aquarium products in Palau

History of the aquarium products trade

- Giant clam production has been operational in Palau since the early 1970s, when the then Trust Territory government opened the Micronesian Mariculture Demonstration Center (MMDC), now the Palau Mariculture Demonstration Center (PMDC). For many years, giant clam culture has been Palau's most important aquaculture activity, both for income generation and food security.
- Technology for clam mass production was developed in the early 1980s at the center with support from the Pacific Fisheries Development Foundation and the US Dept of Interior's Office of Technical Assistance. By 1994, it had become the world's oldest and largest giant clam hatchery.
- MMDC began regular shipments of juvenile clams to aquarium wholesalers in Los Angeles, Chicago and Miami in 1987. By 1989, MMDC was making monthly or twice-monthly shipments, grossing about USD 30,000 per year on sales to the aquarium trade.
- Exports of aquarium products from Palau were started by a locally-owned company in 1991.
- During the early and mid-1990s the subject of collecting aquarium products in the wild for aquarium use became contentious, partly driven by the development and expansion of the tourism industry.
- In 1996, Regulations on the Collection of Marine Resources for Aquaria and Research were formulated by the Ministry of Resources and Development and became effective.
- Palau became a signatory of CITES in 2004.
- One company, Watson Mariculture, has operated a private giant clam and marine ornamental farm since at least 2008. In 2012–2013, it exported some clams to MMME in Kosrae for onward sale on world markets. Watson Mariculture ceased the commercial culture of giant clams a few years ago and now concentrates on soft corals and other invertebrates.
- A second private company, BIOTA Palau, is engaged in the culture and export of cultured aquarium fish, clams and corals.
- In 2014, Palau passed its extensive Biosecurity Act, which was aimed in large part at the aquarium products industry and other segments of import/export.
- According to one published report (Gillett 2016), there were apparently from five to ten small companies producing four different species of giant clams in 2015.
- The original facilities at PMDC were demolished, commencing in October 2017 and a new facility was built with aid from Japan. The new facility was handed over in September 2018 and is now open and actively raising clams for distribution to farmers in Palau. An expert from Japan provided by Japan's Overseas Fisheries Cooperation Foundation is currently assisting clam mariculture efforts at the center.
- In 2019 the Palau Mariculture Demonstration Center provided five large *T. gigas* clams (2 ft in diameter) that were air-freighted to FSM. Four clams survived the trip and are now being used as broodstock in Kosrae. The arrangement between the Palau and FSM governments that facilitated the transfer includes regular reporting by FSM on the growth status and other information relating to the clams.

Annual harvests during the previous decade of aquarium products by category of product

See exports section below

The readily available information on prices paid to harvesters for the various aquarium products

- According to one clam mariculture operator, the price paid to local farmers for aquarium clams for export ranges from USD 6 to USD 10, depending on species and size.
- PMDC has begun to charge clam farmers a nominal fee for the provision of clams. Prices range from USD 0.20 to USD 0.40 per clam, depending on size and species. Clams thus sold for re-seeding can be relatively large (some species 2–4 cm or 2–5 cm). The intention is to encourage re-seeding of reefs for food security, but the possibility that clams enter the aquarium export trade rather quickly cannot be discounted.

Companies involved in the aquarium harvest and/or export of aquarium products

- According to the Bureau of Marine Resources 2017 Annual Report (published in March 2019) there were around 60 giant clam farmers in Palau, rearing clams of different species, both for the aquarium trade and domestic consumption.
- There are five licensed buyers and exporters of giant clams in Palau, although it is believed that only one, BIOTA Palau, is actively exporting. Others who are licensed are Flying Clam (Kenneth Merep), Bernice Ngirikelau, Watson Mariculture, Belhaim Sakuma. Watson Mariculture is no longer exporting clams and focuses exclusively on the culture of corals.
- According to BMR, the Palauan buyers of aquarium products (except BIOTA and Watson Mariculture) typically have used the facilities of the Palau Mariculture Demonstration Center to pack their shipments for overseas buyers. These activities ceased in 2017, when the facility was demolished in preparation for the building of the new PMDC. BMR employees watch the packing for export to make sure that the clams are cultured. They can tell if they are wild or cultured, particularly crocea and others that grow in coral; the bottom of the shell is white with no growth.
- Biota Palau is headed by an experienced marine biologist who has perfected the culture of several important and valuable aquarium species. No wild fish collection is undertaken by the company. It also cultures and exports giant clams and soft corals. The company was recently the recipient of a grant from SPC that assisted in the purchase of a new water filtration system that has greatly assisted the research and development in the culture of several aquarium fish species.

The number of people employed by the aquarium companies

- The one exporter of aquarium fish employs eight people including three women, two of whom are Palauan. Most of the other employees are expatriates, all with advanced degrees and experience.
- Although there are reportedly 60 to 80 clam farmers in Palau, it is difficult to determine the number of active clam farmers because most are involved in other business activities or are government employees. Only one farmer was identified by PMDC as being full-time and relying on his clam farm for income. Not all farmers are engaged in the aquarium trade, but utilise their farms for the sale of clams as food.

Domestic holding facilities of the aquarium companies

- BIOTA's facility is the BIOTA Marine Life Nursery, located in Airai on the island of Babelthuap (Babeldaob) where the culture and raising of aquarium fish, giant clams, and soft corals takes place.
- Watson Mariculture reportedly has a facility where it cultures soft corals and has been used to raise giant clams.

Exports of aquarium products

- It was estimated that aquarium products exported in 1994 included 1,300 pieces of hard coral, 8,000 pounds of live rock and 8,000 pieces of soft coral.
- According to the CITES database, the quantity (pieces, species not identified) and destination of exports of live giant clams from Palau in 2013-2018 were as shown below.

	2013	2014	2015	2016	2017	2018
Quantity	19,720	14,613	12,795	7,351	9,893	2,514
Destinations	Switzerland Czech Republic Germany FSM France Great Britain, Korea Netherlands Singapore Taiwan USA UA Hong Kong Taiwan	Switzerland Czech Republic Germany France USA Hong Kong Japan Netherlands Singapore UAE	Germany France Korea USA Hong Kong Japan Ma- laysia	Germany France USA Hong Kong Korea Netherlands	Germany France USA Austria Singapore	Austria Germany Great Britain

- Data in the above table post-2016 may in part reflect the anticipation and subsequent closure of the government's Palau Mariculture Demonstration Center in October 2017 for renovation. The Center re-opened in 2019 and re-commenced providing seed clams to farmers in Palau.
- In the 2017 Annual Report, CITES permits were issued for the export of a total of 12,082 tridacna. Fifteen destination countries were 15 listed, with approximately 89% for the top three destinations: USA (5,994 pieces, 49%), China (2,566, 21%) and Germany (2,239, 19%).
- Information contained in the Palau Statistical Yearbook 2018 (below) reflects BMR's figures and further breaks down clam exports by species into live, meat, and shell.

Palau Statistical Yearbook, 2018

Clam Category	2015			2016			2017			2018		
	Live	Meat	Shell	Live	Meat	Shell	Live	Meat	Shell	Live	Meat	Shell
Total	**10,588**	**933**	**390**	**9,120**	**556**	**962**	**11,515**	**988**	**91**	**9,579**	**965**	**122**
Hippopus hippopus	104	366	116	158	261	449	358	781	6	111	840	53
Tridacana crocea	4,011		9	3,374		68	3,917	6	48	4,463	15	11
Tridacana derasa	4,392	537	189	4,710	272	363	5,210	190	18	3,000	110	46
Tridacana gigas			5			1			2	16		5
Tridacana maxima	1,436		22	373		5	1,307		9	358		6
Tridacana noae							12			52		
Tridacana squamosa	708	30	51	505	23	77	711	11	8	1,579		3

Source: Division of Coastal Fisheries, Bureau of Marine Resource Marine Export Report, Republic of Palau

Palau Statistical Yearbook, 2018 (contd)

Clam Category	2017				2018			
	Total	Commercial	Personal	Scientific	Total	Commercial	Personal	Scientific
Total	**12,772**	**11,450**	**1,248**	**74**	**10,666**	**9,528**	**1,102**	**37**
Hippopus Hippopus	**4,002**	3,882	95	25	**4,489**	4,462	26	1
Tridacana Crocea	**5,483**	5,200	262	21	**3,156**	2,984	171	1
Tridacana Derasa	**3**		1	2	**21**	5	4	12
Tridacana Gigas	**1,209**	338	865	6	**1,004**	110	893	1
Tridacana Maxima	**1,317**	1,307		10	**364**	357	6	1
Tridacana Noae	**12**	12			**52**	52		
Tridacana Squamosa	**746**	711	25	10	**1,582**	1558	3	21

Source: Division of Coastal Fisheries, Bureau of Marine Resource Marine Export Report, Republic of Palau

- The 2018 Marine Export Report compiled by the BMR Coastal Fisheries Division shows that a total of 20,535 aquarium fish and soft corals were exported for commercial purposes to USA in 2018. It should be remembered that all exported aquarium fish and soft corals have been cultured and none are captured in the wild.

Commodity	Pieces	Percentage of total
Aquarium fish	13,798	67.19
Soft coral	6,737	32.81
	20,535	

- Data in the 2018 Marine Export Report show that in 2018, 89% of giant clams exported were for commercial purposes. The majority of giant clam exports were for the commercial aquarium trade in USA (40%), France (35%), Germany (16%), China, Singapore, Austria and the UK (8%).
- In addition to the above, a total of 955 aquarium fish were exported in 2018 under permits for personal use: 949 (99%) were exported to Japan and 6 (>1%) were exported to China.

Marketing arrangements

- The major exporter of aquarium products sends his production of cultured fish to the parent or affiliated company in Florida, USA for distribution.
- BMR records indicate that, in 2018, shipments of giant clams and soft corals were sent to China, Germany, England, Japan and Singapore, in addition to USA.

Management of aquarium product fisheries

- BMR has no aquarium product management plan, *per se*. Companies must comply with all laws, have the required permits and report as required.
- Palau prohibits the commercial export of hard corals unless cultured. There were no cultured hard corals exported in 2018.
- Any person who takes more than five specimens or pieces of aquarium species in a single day must have an aquarium collecting permit issued by the minister or his designee. Only Palauan citizens can apply for an aquarium collecting permit. No person may export aquarium species unless they have an aquarium collecting permit or a marine research permit issued by the Minister for Natural Resources, Environment and Tourism or his designee.
- The Marine Protection Act authorises the national government to charge fees only for expenses incurred in administering the act, such as those associated with processing permits, inspections, and so forth. The annual fee for an Aquarium Collecting Permit is USD 100.
- All permit owners must submit quarterly catch reports on their activities to BMR, including total numbers of specimens or pieces taken, places where they were taken, and number of fishermen involved.
- Aquarium regulations were enacted in the mid-1990s.
- A marine export declaration obtained from BMR for a nominal fee is required for the export of any marine product.
- The states have clear authority to impose any additional permits, restrictions, conditions, or fees on fishing of any sort. Koror State in particular has been reluctant to issue permits for a variety of activities connected to the aquarium product industry. Whenever personnel from PMDC operate in the waters of Koror State they must be accompanied by a Koror State Ranger and fully disclose all activities undertaken.

CITES issues

- As part of Palau's CITES obligations, a permit is required for any export of species listed in Appendix I or II of CITES. In 2018, 154 CITES permits were issued with 132 permits used. CITES permits are processed at BMR and attached to the relevant marine export declaration form for shipment.
- The CITES database is at odds with data contained in the BMR 2017 Annual Report. The disparity in both numbers and destinations is large.

Biosecurity issues

- Palau's Biosecurity Act 2014 contains 61 pages covering a multitude of subjects, including export and import procedures.

Air freight issues

- According to an exporter, United Airlines is not good to work with and has been that way for years. They do not respond to inquiries and will not work with companies to increase the air freight business. As a result, shipments go via Korean Air direct from Palau to Seoul and from there to the USA and Asian and European destinations.

Major aquarium product issues in the country

- Poaching, primarily of giant clams, is a large problem that has driven at least one operation out of business. Poaching is driven by the existence of a ready market for clams from predominantly Chinese restaurants catering to the tourist trade in Koror and by local demand from residents. Ziplock plastic bags holding from 4 to 6 or more clams are a common site at markets selling marine products.
- An exporter said that internet via fiber optic cable is not available at his site and this is a large hindrance to the business. Arranging shipments of highly perishable commodities sometimes takes hours and communication problems arise that cost the business money.

Other relevant observations

- The Acting Chief of Aquaculture and Fisheries Development at BMR has increased his knowledge of various aspects of his work through attendance at several workshops in 2017, including training on aquatic biosecurity planning (SPC), development of aquaculture for food security (Bangkok), and Aquaculture in Small Island Developing States (Rome).
- Other than data on the export of live clams, it is difficult to determine how much of the clam-related activities (hatchery rearing, distribution to farmers, operations of farms, and later sales) is directly connected to the aquarium export trade.
- The existence of numerous Chinese restaurants in Koror catering to the tourist trade has created a ready market for clams and has contributed to increased (but unquantified) harvesting of clams from Palau's reefs. The use of fast motorboats in Koror, some with 200+ horsepower outboard motors has meant no reef is remote enough to be safe from clam harvesters.
- The owner of the BIOTA live aquarium products export company continues to conduct research on the captive spawning and rearing of aquarium fish that augers well for the country's aquarium products industry. The expatriate operator has apparently managed to convince people that his operation does not damage reef resources and as a result he appears to have a good working relationship with the government.
- Collection of accurate export data by BMR, Customs, Quarantine and others is a labour-intensive operation that takes place primarily at the airport and must be expensive for the government to undertake and sustain.

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Contact information for aquarium product buyers, processors, exporters

- Tom Bowling, BIOTA, office +680-587-1680, mobile +680-775-1680, tom@biotapalau.com. www.biotapalau.com
- Thomas Watson, Watson Mariculture. PO Box 379, Koror, Palau 96940
- Flying Clam, Kenneth Merep (inactive). PO Box 856, Koror, Palau 96940

Information on aquarium products in Papua New Guinea

History of the aquarium products trade

- An assessment of the feasibility of establishing a marine aquarium fish industry in Papua New Guinea was initially undertaken in 1989 by the South Pacific Forum Fisheries Agency (FFA), but no subsequent development occurred (Perino 1989).
- From 2007 to 2010, the National Fisheries Authority commissioned EcoEZ Inc. to undertake resource assessments and provide technical and project management services for the development of a marine aquarium industry in Papua New Guinea under a programme called SeaSMART. EcoEZE Inc. obtained USD 5 million from the National Fisheries Authority before it was closed down by the National Fisheries Authority. The shortcomings of the SeaSMART Program were reviewed by SPC (Yeeting and Batty 2010). The SeaSMART Program worked with fishers from Fisherman Island, just off Port Moresby in the National Capital District and other fisheries in several villages in Central Province.
- EcoAquariums Ltd. was the first private company to export organisms from Papua New Guinea for the marine aquarium trade. The company also worked with fishers from Fisherman Island. Eco Aquariums Ltd. operated from 2011 to 2012.
- Other companies in the past have expressed an interest in exporting aquarium organisms from Papua New Guinea. These were Dive Milne Bay and Seasmart (different from the above mentioned EcoEZE Inc. programme) in Milne Bay Province and the Cebu-Mactan Quality Marine Aquarium Fish (PNG) which wanted to operate out of Port Moresby.
- Two companies, Golden Ocean PNG Ltd., a subsidiary of RVS Fishworld and Ideal Fishery PNG Ltd., are currently proposing to export organisms for the marine aquarium trade, but are not yet active. Golden Ocean PNG Ltd. is based in Port Moresby, whilst Ideal Fishery PNG Ltd. wishes to obtain aquarium organisms from Tufi in the Oro Province.
- Despite suitable freshwater fish species in Papua New Guinea, there has been no exports of these fish for the aquarium trade, with exception of saratoga fingerlings. Saratoga fingerlings were first exported from Western Province in 2003, when Jodi Pty Ltd, in collaboration with Obo Fishing Company, exported 50,000 saratoga fingerlings (without an export permit) to Singapore (Kinch and Burgess 2008). Moreover, villagers from this region reportedly shipped 500,000 across the border to Indonesia during the same period.
- From 2013 to 2016, the main company exporting saratoga fingerlings was Sirong Marine Product Limited. There have been no recorded exports since 2016.
- There is a small domestic market in Port Moresby for aquarium fish, which is supplied by Paradise Aquariums (marine), Flower Shop (freshwater), and PNG Game Fishing (freshwater).

Annual harvests during the previous decade of aquarium products by category of product

- Much of the data pertaining to the harvest of marine aquarium organisms under the EcoEZE Inc. SeaSMART Program from 2008 to 2010 are considered lost. Available data lodged with the National Fisheries Authority cover only a six-month period of 2010 (reviewed by Militz et al. 2016, 2018c).
- Harvests of marine aquarium organisms by EcoAquariums Ltd from 2011 to 2012 are more complete (Militz et al. 2018b). Data show the following:
  - 14,615 individual fishes (99.4% of harvest) and 93 invertebrates (0.6%) harvested;
  - 99.3% of the fishery's total harvest was sourced from Fisherman Island; and
  - 97.2% of organisms were harvested by free diving, 1.8% by gleaning intertidal flats, and 1.0% through the use of scuba.
- Harvests of marine aquarium organisms for the domestic market in Port Moresby is currently unknown, as this information is not collected by the National Fisheries Authority.

The readily available information on prices paid to harvesters for the various aquarium products

- Prices paid to fishers for marine aquarium organisms under the EcoEZE Inc. SeaSMART Program from 2008 to 2010 are detailed below.
  - For the harvest of 10,526 fishes in 2010, harvesters were paid an average price of USD 0.55 per individual (range: USD 0.06–11.13).
  - For the harvest of 11,899 invertebrates in 2010, harvesters were paid an average price of USD 0.14 per individual (range: PGK 0.07–0.74);
  - For some species, the price paid varied, depending on the size of the organism harvested, with higher prices being paid for larger organisms.
  - For some species (e.g. *Premnas biaculeatus* and *Amphiprion percula*), the price paid depended on the phenotype (i.e. colour morph) of the organism, with higher prices being paid for aberrant or melanistic varieties (Militz et al. 2018a).

  Note: harvesters were paid in PGK, data reported were converted to USD, based on exchange rates on 1 January 2010. Prices may not reflect real market conditions, as the aquarium trade under the EcoEZE Inc. SeaSMART Program was heavily subsidised by the National Fisheries Authority (Schwerdtner Manez et al. 2014).
- Prices paid to harvesters for marine aquarium organisms under EcoAquariums Ltd from 2011 to 2012 are not available.
- Purchasing prices for Saratoga fingerlings in 2003 were USD 0.48 per individual fingerling, while younger fingerlings were bought at half and quarter price (Kinch and Burgess 2008).
- Average price reported for saratoga during the 2006 and 2007 fishing season was USD 0.52 per individual fingerling (Kinch and Burgess 2008).
- Current pricing structures for saratoga fingerlings are currently not available. The last year of recorded exports from Papua New Guinea was 2016.

Companies involved in the aquarium harvest and/or export of aquarium products

- At present, there are no companies exporting organisms for the marine aquarium trade, although the two companies mentioned above, Golden Ocean PNG Ltd and Ideal Fishery PNG Ltd, are proposing to export organisms for the marine aquarium trade, but are not yet active.
- Paradise Aquariums is based in Port Moresby and supplies the domestic marine aquarium market. Paradise Aquariums also offers aquarium installation and maintenance services to commercial businesses and private individuals.
- The Flower Shop and PNG Game Fishing are also based in Port Moresby and supply the domestic freshwater aquarium market.

The number of people employed by the aquarium companies

- As Golden Ocean PNG Ltd and Ideal Fishery PNG Ltd have not started operations as yet, it is unknown how many people will be employed.
- Paradise Aquariums is essentially a sole operator. The number of employees employed by the other domestic retailers based in Port Moresby, The Flower Shop, and PNG Game Fishing, is unknown.
- The EcoEZE Inc. project has four expatriate staff and a number of local Papua New Guineans employed as extension officers and facility staff.
- EcoAquariums Ltd was also headed by an expatriate and employed several of the same staff that had worked on the EcoEZE Inc. project.

Domestic holding facilities of the aquarium companies

- Golden Ocean PNG Ltd is currently building a designated facility at the Motokea Wharf complex in Fairfax Harbour.
- Ideal Fishery PNG Ltd at present has no facility.
- Paradise Aquariums has a small holding facility at the owner's residence.
- The Flower Shop and PNG Game Fishing are located at their designated business areas and have several fish tanks holding fish for sale.

Exports of aquarium products

- Commercial exports of organisms from Papua New Guinea for the marine aquarium trade occurred between 2008 and 2012 under the EcoEZE Inc. project, and later by EcoAquariums.
- The average price of marine fish and invertebrate exports by the EcoEZE Ltd SeaSMART Program from 2008 to 2010 were:
  - for the export of 29,658 fishes – USD 4.15 per individual (range: USD 0.30–150.00).
  - for the export of 26,411 invertebrates – USD 0.65 per individual (range: USD 0.15–8.00).
- During the EcoEZE Inc. SeaSMART Program, 99.6% of exports, by volume, were sent to USA, with the remaining 0.4% sent to Taiwan.
- The average price of marine fish and invertebrate exports by EcoAquariums Ltd from 2011 to 2012 were:
  - for the export of 10,329 fishes – USD 4.97 per individual (range: USD 0.60–150.00).
  - for the export of 1,621 invertebrates – USD 4.86 per individual (range: USD 0.60–16.00).
- EcoAquariums Ltd exported 37.0% of aquarium organisms by volume to Hong Kong Special Administration Region, 22.0% to Singapore, 19.9% to USA, 18.1% to UK, and 3.0% to Taiwan.
- No listed organisms in the Appendices of the Convention on the International Trade in Endangered Species have yet been exported from Papua New Guinea for the marine aquarium trade.
- In the period, 2008 to 2016, saratoga exports from Papua New Guinea averaged 12,025 individual fingerlings with a peak of 24,320 individual fingerlings exported in 2010.
- The average USD price for exported saratoga fingerlings declared by exporters to the National Fisheries authority between 2008 to 2016 was approximately USD 12 per individual.
- In 2016, 37,700 individual saratoga fingerlings were reported as exported from Papua New Guinea with a reported value of USD 148,100.

Marketing arrangements

- Both the EcoEZE Inc. SeaSMART Program and EcoAquariums Ltd shipped to wholesalers rather than retailers in the destination countries.
- The marketing approach of both companies was to develop a Papua New Guinea brand for quality, sustainability, equitability and reliability.
- As part of this marketing approach, EcoAquariums Ltd exported all fish with an identification tag that would allow the end consumer to determine the harvester, location of harvest, date of collection, and method of harvest via the company's website.
- A survey conducted in 2015 revealed that consumers of marine aquarium fishes would preferentially purchase fish harvested in Papua New Guinea over fish harvested in Indonesia, Vietnam, and the Philippines (Militz et al. 2017). This suggests some success of these marketing approaches.

Management of aquarium product fisheries

- The management of fisheries in Papua New Guinea comes under the Fisheries Management Act 1998 (amended in 2015) and the Fisheries Management Regulations 2000 (Government of Papua New Guinea, 1998, 2000, 2015).
- The National Fisheries Authority initially contracted EcoEZE Inc. to develop a national marine aquarium trade fishery management plan for Papua New Guinea. EcoEZE Inc. implemented several management practices to operate its SeaSMART Program:
  - harvesting restricted to demarcated marine aquarium fishery management areas;
  - harvesting restricted to a 5 m depth limit;
  - use of scuba and hookah equipment prohibited;
  - use of noxious substances or destructive fishing methods prohibited;
  - harvesting restricted to species listed on an approved species list developed for each marine aquarium fishery management area;
  - species-specific total allowable catch limits set annually for all approved species in each marine aquarium fishery management area; and
  - harvests of live rock, coral and CITES-listed species prohibited.
- With the closure of the EcoEZE Inc. SeaSMART Program, drafts of a marine aquarium management plan remained incomplete and far from operational.
- The same management practices employed by EcoEZE Inc. were also used by EcoAquariums Ltd from 2011 to 2012. The 5 m depth limit and prohibition of scuba restrictions were, however, rescinded for licenced scuba divers engaged by the company.
- A draft national marine aquarium fishery management and development plan was finally prepared by the National Fisheries Authority in 2014. This plan has licensing conditions, gear restrictions, and set Total Allowable Catches and reporting requirements. The draft plan still requires endorsement by the National Fisheries Authority Board and publication in the National Gazette in order to take effect.
- In 2007, the NFA Board tentatively approved the National Saratoga Management Plan. This plan also has licencing conditions, gear restrictions, set total allowable catches, and reporting requirements. The draft plan still requires endorsement by the National Fisheries Authority Board and publication in the National Gazette in order to take effect.

CITES issues

- Papua New Guinea became a signatory to the Convention on the International Trade in Endangered Species in 1976. The legislation covering this convention was enacted in 1979 as the International Trade (Fauna and Flora) Act and amended in 2003 (Government of Papua New Guinea 1979, 2003). The International Trade (Fauna and Flora) Regulation was then approved by the National Executive Council and came into effect in April 2009 (Government of Papua New Guinea 2009).
- The Conservation and Environment Protection Authority administers the International Trade (Fauna and Flora) Act.
- The harvest of listed species was prohibited under the management practices regulating the activities of the EcoEZE Inc. SeaSMART Program and EcoAquariums Ltd (see above). Consequently, no listed species have been exported from Papua New Guinea for the aquarium trade (though see note below).
- The National Fisheries Authority is currently farming listed giant clams (*Tridacna* spp. and *Hippopus hippopus*), seahorses (*Hippocampus* sp.), and hard corals (*Acropora* spp.) at its Nago Island Mariculture and Research Facility in New Ireland Province for the purpose of building capacity to support commercial aquaculture development for organisms of interest to the marine aquarium trade. In making progress towards trial exports, the following challenges are apparent:
  - long processing times for export applications (> 2 months); and
  - requirement for a ranger appointed under the Fauna and Flora (Protection and Control) Act (Government of Papua New Guinea 1966) Chapter 154 to inspect the proposed export once packed and ready to ship. The absence of a designated ranger in regional locations (e.g. New Ireland Province) limits the ability to export listed organisms from these locations.
- Note: The CITES Trade Database (trade.cites.org) has no records of commercial exports of live giant clams (*Tridacna* spp. and *Hippopus* spp.), scleractinian corals (Anthozoa), or seahorses (Syngnathidae) from Papua New Guinea between 2008 and 2018. A single commercial export of 210 live fish (*Cheilinus undulatus*) to Hong Kong was reported in 2008, and likely represents exports for the live reef fish food trade.

Biosecurity issues

- Export of live organisms for the aquarium trade requires an animal health certificate issued by the National Agriculture and Quarantine Inspection Authority to comply with the import conditions of some countries (e.g. New Caledonia).
- Animal health certificates are available at present only for giant clams (*Tridacna* spp. and *Hippopus* spp.), with those for finfish still needing development.
- Health certification involves screening the batch of organisms to be exported for diseases listed by the World Organisation for Animal Health (OIE). This requires submission of tissue samples from sacrificed organisms to an accredited laboratory.
- For the OIE-listed diseases of relevance to giant clams (*Perkinsus marinus*, *Perkinsus olseni*) and marine finfish (red sea bream iridoviral disease) this requires submission of tissue samples to the Australian Commonwealth Science and Industry Research Organisation Animal Health Laboratory, due the absence of an accredited laboratory in Papua New Guinea. This is a major barrier to trade for the following reasons:
  - results are received typically one to two months after submission;
  - international courier rates are around USD 85 and the laboratory fee for screening 10 samples is around USD 1,300; and
  - for giant clams, an export permit issued by the Conservation and Environment Protection Authority is required to export the tissue samples for screening, further delaying submission by one to two months.
- There is currently no epidemiological surveillance programme in Papua New Guinea for marine aquarium organisms (i.e. giant clams, marine finfish, corals or other invertebrates).
- The recently published National Aquatic Biosecurity Strategic Plan for Papua New Guinea 2019–2023 (Government of Papua New Guinea 2019) aims to address many of the challenges outlined above.

Air freight issues

- Papua New Guinea has one international airport located in Port Moresby in the National Capital District.
- Kinch (2008) conducted an economic feasibility study on the trade of aquarium organisms via domestic and international freight routes. Major air freight issues are listed below.
  - High domestic freight rates, insufficient freight capacity, flight irregularity, and poor flight connectivity limit feasibility of aquarium organism harvest outside National Capital District and Central Province. Security concerns and minimal road infrastructure limit ground transport options outside NCD and Central Province.
  - Poor international flight connections limit access to key markets (e.g. USA and the European Union).
  - High international freight rates are not competitive with neighbouring countries.

Major aquarium product issues in the country

- Supply-chain losses of organisms harvested and exported for the marine aquarium trade has been a major issue in Papua New Guinea (Militz et al. 2016, 2018b).
- In the third year of the EcoEZE Inc. SeaSMART Program, quality control rejections accounted for 24.2% of fish harvested (Militz et al. 2016). Mortalities, prior to export, of accepted harvest accounted for 27.3% of fish, and mortalities during international transit to importers accounted for 3.5% of fish exported. Similar supply-chain losses were reported for invertebrates (Militz et al. 2018b).
- During the operation of EcoAquariums Ltd, the quantity of fish exported was 70.7% of the quantity harvested, suggesting supply-chain losses prior to export continued to be problematic.
- The illegal movement of saratoga fingerlings from Western Province to the Papua Province of Indonesia is well known but unregulated.

Other relevant observations

- The absence of suitable legal frameworks and streamlined processes for obtaining permits continues to act as a deterrent to establishing aquarium organism export businesses in Papua New Guinea.
- The high cost of freight, lack of suitable infrastructure, the inability to supply regular electricity and water, security issues and the high cost of doing business in Papua New Guinea also hamper the establishment of aquarium organism export businesses in Papua New Guinea.

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- Lorel Dandava, Inshore Fisheries Manager, National Fisheries Authority, Port Moresby, National Capital District, ldandava@fisheries.gov.pg
- Barnett Shutman, Director, Golden Ocean PNG Ltd. (RVS Fishworld Ltd.), Portion 3359, Motukea Island, Port Moresby, National Capital District, goldenoceanpng@gmail.com

Information on aquarium products in Solomon Islands

History of the aquarium products trade

- The coral portion of the aquarium trade evolved from the collection and export of dead curio coral. It was started by Ian Gower in the 1980s at his Paruru plantation in the Marau Sound. For aquarium fish, the trade started in the mid-1990s, when David Palmer traveled around the Western Province, scouting appropriate places where an aquarium fishery might be viable (Kinch 2004a, 2004b).
- The history of farming aquarium products in Solomon Islands is covered by Hambrey (2011). In the 1980s and early 1990s ICLARM (now World Fish Center) had a large base at Aruligo outside Honiara, where research/development effort was originally targeted at production of giant clams for meat. The facility was destroyed in 2000 during the period of ethnic tensions. The operations were transferred to Nusa Tupe near Gizo in the Western Province. The skills developed by World Fish were built on through a New Zealand Aid Programme project (2005–2010), which focused on giant clams, cultured corals and post-larval capture/culture. Starting in 2005, coral farming for the ornamental trade was promoted heavily by several agencies, including New Zealand Aid, WorldFish, World Wide Fund for Nature, the Foundation of the Peoples of the South Pacific, and the Solomon Islands Development Trust. They found that a major constraint for coral culture was that the wild collection of coral was also allowed, which is easier and quicker.
- By the mid-2000s there were two commercial companies involved in the export of live aquarium organisms in Solomon Islands. Both were situated in the Ranadi industrial area of Honiara. The oldest was Solomon Islands Marine Export (SIME), run by Paul Saelea. It was started in 1995 with the assistance of David Palmer. In 1998, David Palmer left SIME to form Aquarium Arts Solomon Islands (AASI) with Simon Gower. SIME specialised in the coral ornamentals trade, while AASI handled mostly aquarium fish. SIME ceased operation in 2008 when its owner died. Simon Gower left AASI in 2007 to form a company focusing on corals for the curio trade. AASI continued until 2015, when it ceased operations (Kinch 2004a).
- Currently there are no companies exporting aquarium products from Solomon Islands. In late 2019, a new company, Unique Corals Solomon Islands, was preparing to enter the Solomon Islands aquarium business.

Annual harvests during the previous decade of aquarium products by category of product

- As there is no statistical system in place to monitor the harvest of aquarium products, the annual harvests must be inferred from the export data (section below). In general, the annual harvests equate to the exports plus mortality and rejects (i.e. Ah = Ex + Mo + Rj)
- Some of the features of the harvest of aquarium products are listed below.
  - MFMR considers the components of the aquarium trade as fish, coral, clams and other invertebrates.
  - In the mid-2000, AASI exported 55 species of aquarium fish. SIME exported around 70 coral species and a few assorted invertebrates (Kinch 2004a). A detailed list of the species harvested by the two companies is given in that reference.
  - The harvest/export of wild tridacna is prohibited, while the harvest/export of wild coral is allowed.
  - Harvesting/exporting of aquarium products by the aquarium companies ceased in 2015.

The readily available information on prices paid to harvesters for the various aquarium products

- It has been almost five years since companies stopped exporting aquarium products from the country, and consequently historical data on prices are not readily available.
- Kinch (2004) gives buying prices in Solomon Islands and selling prices in USA for about 45 species of fish and invertebrates. In general, the overseas selling price is about 6.6 times the buying price (the range is between 5 and 14.2). The highest and lowest buying prices given were SBD 55 for the black tip shark and SBD 0.15 for the engineer goby.
- With respect to coral, in 2005, prices paid to villagers for live and dead coral vary with size, quality and species. On average, the purchase price of SIME has remained constant since it began operation in the late 1990s, with the average price for corals being SBD 1.998/piece. The average price paid by AASI was SBD 4.02/piece. The 2005 FOB price for corals exported from Solomon Islands was around SBD 22/piece (Lal and Kinch 2005).

Companies involved in the harvest and/or export of aquarium products

- No companies are currently involved in the harvest/export of aquarium products. The approach taken in this section is to give some details on the last company that was involved in the trade (AASI) and some details on a company that is preparing to enter the trade.
- AASI was formed in 1998 and exported aquarium products for about 18 years. The company was based at Ranadi industrial area near Honiara. It targeted fish and any coral exported was cultured – as a condition of their licence. The main areas for collecting were the Marau Sound and the Nggela Islands. The main market was USA. One of the owners was affiliated with Walt Smith, an aquarium exporter in Fiji.
- Staff of the Ministry of Fisheries and Marine Resources (MFMR) indicate that at least part of the reason for the demise of AASI was that a licence for a fish-processing establishment (required for an aquaculture fish-holding facility) was denied in 2015 due to the company owing a substantial amount of taxes. Former staff of the company interviewed in October 2019 for the present survey stated that financial viability was constrained by cost/availability of air cargo space, the cost of electricity to run the holding facilities, and poor staff morale.
- A new company, Unique Corals Solomon Islands (UCSI), is building a warehouse and holding facilities in Ranadi in order to begin shipping aquarium products in early 2020. The main incentive for the new company seems to be that its affiliate firm in North America became unable to source coral from its historical supplier, Indonesia. The manager is from USA and worked for AASI in the past. According to two UCSI staff (who also worked for AASI), the company will focus initially on wild coral, but will promote coral farming.

The number of people employed by the aquarium companies

- In late 2019 there were no active exporters of aquarium products, and therefore no people were employed in the trade.
- In the mid-2000s, AASI employed two managers, 12 full-time staff, and six casual staff (Lal & Kinch 2005).
- According to MFMR staff, the collection of aquarium products by AASI was by village divers and company divers (including some Filipinos).

Domestic holding facilities of the aquarium companies

- Currently, there are no functional holding facilities dedicated to the export of aquarium products.
- In the mid-2000s, AASI had a warehouse near the seashore which had an area of 1,100 m^2. They had five self-contained holding systems. Blue tanks outside the main shed were used to hold and sort new fish arrivals before entering the main system inside. The holding tanks were made of acrylic material and were arranged in little cubicles to ensure segregation of fish (Kinch 2000a).
- In late 2019 the newly established company (UCSI) was building a warehouse and holding facilities in order to begin shipping aquarium products the following year.

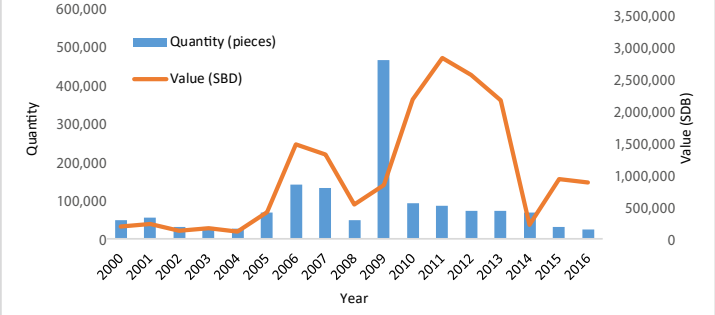
Exports of aquarium products

For export of aquarium products, there is a requirement that the shipper obtain an export permit from MFMR which must show values and volumes for each consignment. Those permits form the basis of the MFMR system to track exports – and are given in the table below.

		2014	2015
Coral	Pcs	26,416	8,344
	Value SBD	380,041	138,486
Giant clam	Pcs	1,043	684
	Value SBD	1,090	684
Starfish	Pcs	40	
	Value SBD	60	
Sea anemone	Pcs	1,374	541
	Value SBD	5,220	2,028
Aquarium fish	Pcs	38,620	13,735
	Value SBD	188,603	70,481
Other Invert	Pcs	186	
	Value SBD	186	

Source: MFMR unpublished data; Values are declared FOB values; Blank cells indicate no export

- There are some anomalies in the above table. It shows that, in 2015, the FOB value per piece of coral was SBD 16.60, whereas about 10 years earlier Lal and Kinch (2005) state that the FOB price for a piece of coral exported from Solomon Islands was about SBD 22. On the table, both the giant clams and the other invertebrates have a value per piece of precisely SBD 1, which seems too low.
- The figure below (from the Solomon Islands National Aquaculture Management and Development Plan 2018–2023) gives the 'export production' by aquaculture of hard and soft corals and sponges for the aquarium trade. The figure shows almost SBD 1 million exported in 2015 and again in 2016, whereas the table above shows only SBD 138,486 for both cultured and wild coral exports for 2015 and none for 2016. If no aquarium trade companies existed in 2016, it is hard to see how so many cultured aquarium products were exported.



According to the MFMR staff who dealt with the export permits, the vast majority of aquarium shipments went to USA, with a secondary market in Australia.

- There are several types of restrictions on the export of aquarium products.
  - CITES export permits are required to export hard corals and giant clams.
  - The Fisheries Management (Prohibited Activities) (Amendment) Regulations 2018 prohibit some activities related to the aquarium trade (see management section below).
  - The Customs and Excise Division of the Ministry of Finance collects taxes on several types of exports of Solomon Islands, including some fishery exports. The Ministry of Finance website states that the export duty rate for live fish and crustaceans is 10%. The rate for coral, giant clams, and other aquarium products (if any) is unclear (www.solomonbusinessregistry.gov.sb).
  - In practice, the export of wild clams is prohibited, while the export of most types of wild coral is allowed.

Marketing arrangements

- As the aquarium trade in Solomon Islands ceased in 2015, not much information is currently available on the marketing arrangements of the failed companies. The main market was USA, and AASI appeared to be affiliated with investors in the aquarium trade in that country. Kinch (2004) presents a list of companies in 12 countries that AASI shipped to in the early 2000s.

Management of aquarium product fisheries

- According to MFMR staff, there have been no recent stock assessments in Solomon Islands for the organisms in the aquarium trade.
- In the early 2000s the Global Coral Reef Monitoring Network programme (based at Gizo) did some biological assessments of reef conditions in areas where the aquarium fishery operated. At that time, the areas around Gizo and Munda had been surveyed, with assessments planned for Tetepare, Ngella, the Arnavons and the Marau Sound (Kinch 2004).
- According to the Solomon Islands National Fisheries Policy 2019–2029, there are management plans for coral and clams. According to MFMR staff, there are draft plans for coral[14] and clams[15] but they have not yet been submitted to the Attorney General's Office. Once approved/gazetted, they will become regulations and be legally enforceable.
- There are several regulations that apply to all fisheries in Solomon Islands, including the fisheries related to the aquarium trade. These include: (a) possession of underwater breathing equipment for the purpose of harvesting any fisheries resource; (b) a requirement for a licence to operate a fish processing, storage or export facility; and (c) a requirement for an export licence for each consignment of live fish or fish product (Fisheries Management Regulations 2017).
- Several regulations that have special application to the aquarium trade are in the Fisheries Management (Prohibited Activities) (Amendment) Regulations 2018. These include the following prohibitions: (a) fish for, sell, buy or export branching coral *Acropora humulis,* soft coral *Euphyllia glabrescens* and mushroom coral *Fungia fungites*; (b) sell, buy or export clam meat or clam products of the genus *Tridacna* and *Hippopus* not under a management plan; and (c) export all live and dead corals or live rock not under a management plan.
- In principle, those regulations applicable to the aquarium trade that can be enforced at the point of export are relatively easy to enforce. These include export prohibitions and the requirement for various types of licenses. Out in the provinces, there is little enforcement of regulations applicable to the aquarium trade and therefore compliance is poor, with the ban on the use underwater breathing equipment an example.
- In terms of training and capacity building for MFMR staff in the management of the fisheries for aquarium products, the most recent activity was the mid-2019 New Zealand funded course on inshore fishery compliance, in which 15 people participated. There have been other training activities for inshore fisheries management for MFMR staff, but none specifically targeted fisheries for aquarium products.

CITES issues

- Solomon Islands acceded to CITES in June 2007.
- According to the Deputy Director of Conservation, Solomon Islands Ministry of Environment, Climate Change, Disaster Management and Meteorology, that ministry is the CITES Management Authority and the MMRD is the CITES Scientific Authority for marine issues (J. Hurutarau, personal communication).
- MMRD staff feel that the CITES Management Authority has been quite reasonable with respect to the aquarium trade, as there are not many difficult issues as in, for example, the dolphin trade.
- The on-line CITES database shows that 113 *Tridacna derasa* and *T.crocea* were exported from Solomon Islands in 2014 and no tridacna were exported in 2015. This is very different from the 1,043 tridacna in 2014 and 684 tridacna in 2015 in the MFMR statistics (section above).

Biosecurity issues

- In Solomon Islands, animal health certificates are issued by the Chief Veterinary Officer of the Ministry of Agriculture and Lands and are only issued if the animal meets the health requirements of the importing country.
- As the EU was not a main destination for aquarium products when they were exported, obtaining animal health certificates was not a major concern for exporters.

Air freight issues

- The ex-staff of AASI indicate that the limited capacity and high cost of air freight out of Solomon Islands was a major factor in the demise of that company.
- The situation appears to have improved in recent years. There are now three airlines connecting Honiara with Nadi, there are flights each day from Nadi to two places in USA, and there is now an international airport in Munda with flights to Australia.

Major aquarium product issues in the country

- As there has not been an aquarium products trade in Solomon Islands for almost five years, there are few hot issues related to the trade. This contention is supported by the lack of even a mention of the aquarium products trade in the current National Fisheries Policy.
- A matter that may arise is how much effort should be put into reviving the trade.

14 The coral covered in the plan includes both living coral for the aquarium trade and dead coral for the curio trade.

15 The scope of the plan for clams is only for the shell.

Other relevant observations

- If the aquarium trade is revived, it needs to be managed to obtain the desired benefits, but the lack of enforcement in areas away from Honiara dictates that management can be only partially successful – the cost of assuring compliance in those areas may, however, be prohibitive.
- When there was an aquarium trade in Solomon Islands, it appears that there was some skepticism as to the benefits to the country, at least partially due to the high degree of foreign involvement in the aquarium companies.
- The three sets of data on aquarium exports cited above (MFMR export database, Aquaculture Management and Development Plan, CITES on-line database) seem all to have obvious errors and conflict with each other.
- A comment in the SPC review of aquaculture in the country (Hambrey 2011) seems especially relevant to efforts to promote the farming of coral. There is a fair demand for cultured corals, which are relatively easy to grow and require low investment, but wild corals can be collected even more easily/cheaply and there is little, if any, premium on cultured corals.

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Useful contacts

- Rosalie Masu, Deputy Director Inshore Fisheries, Ministry of Fisheries and Marine Resources, tel +677 39143, e-mail rmasu@fisheries.gov.sb
- Christopher Beta, Unique Coral Solomon Islands, tel +677 7330308

Information on aquarium products in Tonga

History of the aquarium products trade

- According to the current Tonga Marine Aquarium Fishery Management and Development Plan (herein, the "Management Plan"), the aquarium trade in Tonga began in 1988 with two operators harvesting live hard corals. In 1993, three operators joined the fishery, also targeting hard corals.
- In 1993, by Cabinet decision, the export of hard corals was banned. In 1994, SPC carried out an aquarium fishery resources assessment and, in 1997, Cabinet revoked the ban on live coral harvest, based on the SPC assessment.
- Between 2003 and 2005, several new aquarium operators started operations, but many found it difficult to remain viable. By the end of 2005, there was a total of five operators.
- Due to increasing concerns over the harvest and export of live rock, in late 2008 the government banned the exploitation and trade of live rock.
- In mid-2017, the Minister of Fisheries gave formal endorsement of the Management Plan.

Annual harvests during the previous decade of aquarium products by category of product

- The aquarium products that are exported from Tonga are categorised by the Ministry of Fisheries as invertebrates, live hard coral, live fish, shellfish and soft coral.
- According to the Management Plan, the most commonly exported species of invertebrates are nassarius snails (43.82%), assorted invertebrates (21.79%), hermit crabs (11.98%), ditrius snails (5.59%), and bubble anemones (5%). The most commonly exported groups of fish are other live fish (36%), damselfish (19%), wrasses (13%), angelfish (12%) and hawkfish (7%). For live hard coral, a total of 62 species are exported, with monitipora (8.8%), acropora (8.1%), miscellaneous species (7.8%), euphyllia (5.5%) and lopophyllia (53%) the most common.
- Cultured aquarium products are limited to tridacna (raised in the facilities of the Ministry of Fisheries) and a small amount of coral (raised in facilities in the ocean).
- The annual quantities of the harvest of aquarium products can be determined only by using the exports amounts (section below) and adding an estimate of the products harvested but not exported, due to factors such as mortality before shipment and rejects.
- The product category that is harvested most by piece is invertebrates and by value is hard coral.
- Live fish make up less than 10% of the volume or value of the aquaculture products harvested. According to the companies, this is due to scarcity of fish facilities, the low prices paid for fish and many unsold, and the scarcity of divers with aquarium fish capture skills. Currently, only one company exports a substantial amount of live fish.
- One company volunteered the view that Tonga is well known for small polyp stony coral (SPS coral), and 70% of the exports of that company are SPS corals.

The readily available information on prices paid to harvesters for the various aquarium products

- Due to normal commercial secrecy, the aquarium companies are reluctant to divulge much information on prices paid to harvesters.
- The Ministry of Fisheries has the declared FOB prices and the verified number of pieces for each individual shipment. The 2018 values per piece are shown below.

Product	Declared FOB value per piece (TOP)
Invertebrate	0.24
Live hard coral	9.98
Live fish	4.97
Shellfish	5.02
Soft coral	5.06

- The only other readily available information on actual prices at first sale is for the tridacna that the ministry sells to exporting companies. Examples of the pricing are TOP 10.92 for a 5 cm *T. maxima*, TOP 15.52 for a 5 cm *T. squamosa*, and TOP 14.95 for a 5 cm *T. derasa*.

Companies involved in the aquarium harvest and/or export of aquarium products

- There are currently five companies involved in the aquarium trade in Tonga.
  - Ecological Reef Fishing International: The company has been in business since 2011. It uses the holding facilities of the Ministry of Fisheries in Sopu and has 16 full-time equivalent (FTE) employees. Shipments are about 99% coral and 1% giant clam. About 2/3 of its shipments go to USA.
  - South Pacific Paradise Export: The company has been in business since about 2000. It uses the holding facilities of the Ministry of Fisheries in Sopu and has about three FTE employees. Export shipments were formerly made about twice a week, but are now on hold due to lack of divers. Shipments are 100% coral. About 80% of its shipments go to USA, with the rest to Asia.
  - Quality Reef Life Marine Tonga: This company was established in 2011. It emerged from the former Dateline Company that was established in Tonga in 1994. The company ships fish (60% by piece) and coral, mainly to USA but some to Hong Kong and Japan. It has its own holding facilities, has 12 FTE employees, and is based in Navutoka.
  - Nahau Reef Export: The company has been in business since 2013. It has its own holding facilities and also uses one tank of the Ministry of Fisheries. The company is based in Ma'ufanga. It has 15 FTE employees and ships mainly coral. About 75% of shipments are to USA.
  - JLE International: This company is the newest participant in the aquarium business, having started its operations in 2019. It is still testing the markets, with most shipments presently going to Asia. The shipments consist of about 99% coral and 1% clams. The company and its holding facilities are located in Halaleva. It has eight FTE employees, with the husband of the manager being a diver for the company.

The number of people employed by the aquarium companies

- The stated number of employees (full-time equivalent) for each company is: South Pacific Paradise: three; Ecological Reef Fishing – 16; Quality Reef Life Marine – 12; Nahau Reef Export – 16; JLE International – 8. Total – 55.
- 13 of the above employees are women.
- Three of the companies have non-Tongans as employees or affiliates. There is a total of about 10 non-Tongans.
- The divers seem to be considered as employees in most of the companies, but there is some uncertainty.

Domestic holding facilities of the aquarium companies

- Three of the five aquarium companies use the holding facilities of the Ministry of Fisheries at Sopu. The companies each pay TOP 25 a month for rental of one tank and electricity. A total of six tanks are rented to the three companies.
- Two companies exclusively use their own holding facilities and one company uses both ministry facilities and their own six tanks.
- The most sophisticated holding facilities are those of Quality Reef Life, which are located in Navutoka and leased from an aquarium company (Dateline) that terminated its Tonga operations about 10 years ago. They have a 40 ft container set up for fish holding and six outside tanks for coral.

Exports of aquarium products

- The Ministry of Fisheries export data are collected through its export permit system. The aggregate export data (2014–2018) and a breakdown of the 2018 data by product are:

Year	Pieces	FOB value (TOP)
2014	231,960	567,443.70
2015	150,673	464,756.75
2016	135,425	478,637.35
2017	109,268	392,200.80
2018	285,230	921,379.50

Product	2018 Exports	
	Exports by piece	Exports by FOB value
Invertebrate	60%	4%
Live hard coral	22%	67%
Live rock	0%	0%
Live fish	6%	9%
Shellfish	2%	3%
Soft coral	11%	17%

- Most of the companies focus on the USA market, with opportunistic shipments to Asia. Only JL International ships exclusively to Asia. Currently, no company ships to Europe.
- The 2017/18 Annual Report of the Ministry of Fisheries indicates that aquarium species are the third most important fishery export of the country, after tuna and deep-water snapper.
- Although the export of hard corals was banned in the past, the major export ban affecting the aquarium trade is that for live rock. In 2009, the aquarium products export value fell to one-third that of 2008 due to the live rock export ban.

Marketing arrangements

- Information on the marketing arrangements is fragmented and incomplete.
  - Most of the five companies presently operating sell to both wholesalers and retailers in USA and, to a much lesser extent, Asia.
  - One company has strong ties to an aquarium company in USA. The wife of the manager of one company above resides in USA and receives the shipments of aquaculture products. One company volunteered that their main USA buyer is Quality Marine, located close to the Los Angeles Airport.
  - Several of the companies indicate they have very good long-term relationships with their overseas buyers.

Management of aquarium product fisheries

- According to the Tonga Marine Aquarium Fishery Management and Development Plan 2017–2019, since the aquarium fishery was established in Tonga, two underwater surveys have been conducted to determine stocks and status of the resources. The 1996 survey determined densities of aquarium fish, while the 2005 survey studied both fish densities and bottom substrates. The results of the two surveys were incorporated into the Management Plan.
- The Management Plan was officially endorsed by the Ministry in mid-2017. In terms of legal status, it was prepared in accordance with Part II, section 7 of the Fisheries Management Act 2002 and contains the statement: "The Plan supplements, and does not in any way override, the provisions of the Act or regulations promulgated under the Act. The Plan is to be taken, as stated in the document, as "formal guidelines".
- Five types of management measures are specified in the Management Plan:
  - Marine Aquarium Resource Operator Requirements: This includes the requirement for a person/company to have a licence, a vessel licence, the completion of a logsheet, a fish processing licence, a limit on the number of operators (presently five), collection only on Tongatapu, and a fish export permit.
  - Prohibitions: There are bans on the export of live rock, cetaceans, certain fish species, collection close to a tourist dive site, night diving and the use of lights during collection, using techniques that may harm the environment, the use of noxious substances, collection in marine protected areas and special management areas (SMAs), and the collection of food fish.
  - Restrictions on collection methods and areas: This includes certification of any scuba divers, size limits on barrier nets, community permission for culture of products in SMAs, and a limitation on the export of tridacna to cultured specimens.
  - Catch limits per licensed operator: The limits are: fish (100,000 individual fish per year), invertebrates (30,000 pieces per year), hard coral (150 pieces per week), soft corals (5,000 pieces per year), and wild live rock (zero).
  - Monitoring and reporting requirements: Operators must fill out and provide to the Ministry aquarium fish log sheets, aquarium fish export log sheets, and packing lists.
- With respect to the compliance with the above management measures, it appears that the situation is fairly good, due in part to the ease of enforcing measures on export-oriented fisheries and through the licence conditions. Some problems are experienced for assuring compliance with those management measures that involve gear or area restrictions, due to the need for ministry staff to accompany the aquarium fishing operations.
- The Marine Aquarium Fisheries Management Committee was established under section 7(4) of the Fisheries Management Act 2002 and is primarily responsible for the implementation and review of the Management Plan.
- In terms of training and capacity building, staff of the Ministry's Fisheries Management Division indicate that no individuals presently serving in that division have attended any workshops or training courses related to the management of the aquariumfishery.

CITES issues

- Tonga acceded to CITES in October 2016.
- CITES issues for the aquarium trade are handled by the Compliance Division of the Ministry of Fisheries. The head of that division indicates that Tonga's CITES Scientific Council and CITES Management Authority are actually the same body, the membership of which is comprised of the Ministry of Fisheries and the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications. The Council/Authority does not meet often and, when it does, it is mainly in the margins of international meetings overseas.
- The Management Plan mentions of CITES are limited to the requirement that a coral or tridacna export permit is to be obtained from the Ministry of Fisheries for each shipment of coral or tridacna and must list all species and quantities, destination and other information as requested by CITES.
- The companies involved with the aquarium trade indicate that the Ministry of Fisheries efficiently issues the CITES permits.
- The on-line CITES database indicates that 2,662 *Tridacna derasa* and *maxima* were exported from Tonga in 2018. It is uncertain how this amount relates to the 5,460 "shellfish" exported in 2018, according to the Ministry's aquarium products export database.

Biosecurity issues

- Tonga has a formal national strategy on aquatic biosecurity that was endorsed by the minister in 2017. There are staff in the Ministry of Fisheries that handle biosecurity issues.
- The companies in the Tonga aquarium trade indicate that there are no major biosecurity issues, primarily because no company currently exports to Europe. Should they need a biosecurity inspection, veterinary specialists from the Agriculture Department would do the inspection.

Air freight issues

- Some of the companies in the Tonga aquarium trade report persistent problems with adequate air cargo space, especially during the holiday season in Tonga. One company, which exclusively uses the large Air NZ plane on Fridays, indicates no shortage of cargo space.
- Shipments out of Tonga are made via New Zealand (or to a lesser extent via Australia), but not via Fiji, due to past problems transiting Nadi.

Major aquarium product issues in the country

- There appears to be a sentiment among some ministry staff that the harvest/export of coral should be stopped to prevent habitat destruction. On the other hand, four of the five companies in the aquarium trade are heavily reliant on the relatively high profitability of selling coral. The only company whose shipments are made up of much fish (and therefore well-positioned to survive a ban on hard corals) is associated with significant foreign involvement.

Other relevant observations

- There are fairly amiable ministry/industry relations, which appear to be much better than in neighbouring countries.
- There appears to be little involvement of the ministry responsible for the environment in the management of the aquarium trade in Tonga. A fundamental principle of fisheries management is a thorough knowledge of the fishery being managed. This may at least partially explain the high satisfaction of the aquarium companies with the management of their fishery – considering the characteristic lack of fisheries expertise in government environment agencies.
- It is quite convenient that all 'rules of the game' for the aquarium trade are in a single document that has official ministerial endorsement.

Sources

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- MoF (2018). The 2017/18 Annual Report. Ministry of Fisheries.

Useful contacts

Company Name	Owner	Telephone	E-mail Contact
South Pacific Paradise Export	Mele Fangupo	28239/8413606	idaretodream99@gmai.com
Ecological Reef Fishing Int.	Teau & Fane Faletau	8714653/7759195	ecoreeftonga@gmail.com faneecoreef@gmail.com
Quality Reef Life Marine Tonga	Paula Prescott	7715389	aquarium@kalianet.to qualityrlmtonga@gmail.com
Nahau Reef Export	'Ana Puta	7742791/22578	anzy3076@gmail.com nahaureefexport@gmail.com
JLE International	Taufa Pahulu	8442050/7786186	pahuluta@gmail.com

Information on aquarium products in Vanuatu

History of the aquarium products trade

- The marine aquarium trade started in the early 1990s with small-scale exports, but increased dramatically after 2000. The trade has survived, despite high airfreight and investment costs (VFD 2009).
- Historically, Vanuatu's aquarium trade started when Vanuatu Marine Exports company began operations in 1992. This was followed in 1993 by AquaLife Exports Ltd (which later changed its name to Pacific Marine and Aquatic Exports). In 1999, another small operator, Reef Life (Vanuatu), commenced operations. In late 2002, a larger aquarium operation, Sustainable Reef Supplies, joined the trade (Amos 2007; F. Hickey 2002).
- The wild harvest of tridacna for the aquarium trade was high between 2000 and 2001. In 2002 tridacna were successfully produced at the Vanuatu Fisheries Department (VFD) to assess the potential for restocking and marketing. Hatchery-produced clams were sold live to aquarium operators. In 2005, Reef Life (a private aquarium operator) conducted its first successful spawning of *T. crocea* (VFD 2008).
- In 2003 the ornamental coral culture of several species of hard and soft corals was initiated by two aquarium operators in Vanuatu. This was encouraged by a ban on the trade of wild coral. In 2008 two aquarium companies commenced small-scale coral farming (VFD 2008).
- Shocks to the Vanuatu aquarium trade included: (a) the global economic recession starting in 2008 and; (b) the destruction caused by Cyclone Pam in March 2015. The last company in the Vanuatu aquarium trade, Sustainable Reef Suppliers (SRS), made its final shipment in the third quarter of 2017.

Annual harvests during the previous decade of aquarium products by category of product

- There have not been any shipments of aquarium products overseas since the third quarter of 2017 (see export section below for earlier exports), and therefore no harvesting since that period.
- Ten years ago, when the current Vanuatu National Marine Aquarium Trade Management Plan was formulated, fish represented the bulk of Vanuatu's marine aquarium exports, contributing about 66% of the total annual average export volume, followed by invertebrates (18%) and live rock (10%). In terms of value, fish contribute about 29% of the total value, followed by invertebrates (20%) and live rock (19%). Corals, which constitute only 2% of the total export volume, represent a significant portion (19%) of the total annual average value (VFD 2009).
- The six fish groups most commonly targeted by the marine aquarium trade are the angelfish (Pomacanthidae), gobies (Gobiidae), tangs (Acanthuridae), damsels (Pomacentridae), groupers (Serranidae) and wrasses (Labridae). Of the Pomacanthidae, the flame angel *(Centropyge loriculus)* has been the most exported fish species, representing 12.5% of Vanuatu's average total annual aquaculture fish exports (VFD 2009).
- The owner of the last company to operate in the Vanuatu aquarium trade (Sustainable Reef Suppliers) indicated that fish represented about 85% of his export volume in pieces. He also stated that the flame angel was the most sought-after fish.
- In terms of cultured products for the aquarium trade, recent data are not readily available. The Vanuatu Aquaculture Development Plan (VFD 2008) states that in 2007, 11,883 pieces of tridacna and 6,543 pieces of coral were cultured.

The readily available information on prices paid to harvesters

- The owner of the last company to participate in the Vanuatu aquarium trade was very cooperative with the present survey, but was reluctant to discuss prices.
- The declared FOB value of the exports of aquarium products (e.g. 116 million vatu in 2015) divided by the number of export pieces should give the average declared export value per piece, but unfortunately data on aquarium exports in pieces are not available from the Department of Customs and Inland Revenue
- The Vanuatu National Marine Aquarium Trade Management Plan (VFD 2009) states that about USD 19,000 per year is paid directly to resource owners (for access to fishing grounds) around Efate's west coast, especially the three main villages of Pango, Mele and Lelepa/Mangaliliu.

Companies involved in the aquarium harvest and/or export of aquarium products

- In the period 2015–2019 a total of five companies held licences for the export of aquarium products issued by VFD. These are shown below.

Company	Agent	Telephone	E-mail
SRS	Grant Norton	7382917	marinelife@gmail.com
Reef Life	Kalmet Kaltapang	7743377	reeflife@vanuatu.com.vu
Reef Solutions	Evelyn / Mako	5938567 (Evelyn)	rsv@telsat.vu
Pacific Island Aquatics	Henricks Taleo	5950734	
Vanuatu Aquarium Fish LTD	Bill Harris		oceanlife1@bigpond.com

Source VFD, unpublished data

- Some miscellaneous features of the companies involved in the aquarium trade:
  - SRS was the last company to export aquarium products from Vanuatu (stopped in 3rd quarter 2017). Reef Life was the second to last.
  - Reef Life was connected to an aquarium company based in Tonga.
  - Reef Solutions was established in 2004. The owner of Reef Solutions bought SRS in about 2006 from a Frenchman with aquarium experience in Bali. The height of SRS was in 2008, when the gross sales reached USD 1.2 million, according to the owner.
  - SRS is considering re-starting operations in early 2020.

The number of people employed by the aquarium companies

- There are no aquarium companies currently operating, and therefore no people are employed in the industry.
- SRS employed about 30 people full-time (including six Filipino divers) at its height in 2008.

Domestic holding facilities of the aquarium companies

- At present there are no operational aquarium holding facilities in the country.
- SRS originally had its operations at Black Sands but moved to Devil's Point. Its facilities are still there and include three tanks (6,400 gallons, 4,000 gallons, 2,000 gallons). Its monthly electricity bill was reported to be one million vatu at the height of its business.
- VFD staff explain that the other companies had leased premises and when those leases expired, the owners were required to move the tanks and other facilities. Consequently, whatever equipment existed is now not at the original company sites.

Exports of aquarium products

- Not much data are available on the recent exports of aquarium products. Older reports (e.g. Hickey 2002, VFD 2009) have aquarium export information, but even unpublished data for recent years are not readily available. It is likely that this is because of the moribund nature of the industry.
- The Vanuatu National Statistics Office, using data collected by the Department of Customs and Inland Revenue, provided information on the value (in millions of vatu) of 'live fish' exports as shown below.

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 YTD
146	324	166	136	88	142	116	53	53	6	0

- Although it is conceivable that 'live fish' could include items other than aquarium fish, VFD senior staff indicate that the quantities in the above table are all for the aquarium trade.

Marketing arrangements

- The owner of the last company to have exported aquarium products from Vanuatu (who was formerly an aquarium products retailer in Canada) indicated that, before the global financial recession in 2008, half of his exports went to USA, 25% to Europe, and the rest to Asia and Australia. After 2008, less than 15% went to USA. His shipments were all to wholesalers.
- "Vanuatu live rock" is featured on the website of a major USA wholesaler: "Vanuatu live rock has a very rugged appearance that is excellent for aquascaping a new reef aquarium or for adding to an existing aquarium" (www.aquariumcreationsonline.net).

Management of aquarium product fisheries

- Yeeting and Pakoa (2005) state that growth in Vanuatu's marine aquarium trade (in the absence of specific management measures to control the fishery) has triggered concerns. These have been mainly from tour and dive operators, who claim that the aquarium trade is causing considerable damage to the coral reefs and is depleting populations of the small, colourful, coral reef-dwelling fish in some of the popular dive sites.
- The Vanuatu Fishery Profiles (Amos 2007) states that recent assessment surveys by SPC, in collaboration with the Department of Fisheries, in 2004 indicate that only two sites on Efate (Tuktuk II and Hat Island) were affected by the collection of aquarium fish by exporting companies. The remaining islands within the archipelago have healthy aquarium fish stocks.
- The aquarium trade is covered by regulations under the Fisheries Act.
  - Marine ornamental products include fish, invertebrates, live rock, live coral, giant clam and any other organisms or products used for the purposes of marine aquarium trade.
  - A person must not export any marine ornamental products except with an export permit issued by the Director, and in accordance with such conditions as the Director may specify.
  - The annual total allowable catch for the flame angel (*Centropyge loriculus)* that can be exported from Efate and the surrounding islands is 12,250 pieces.
- Although the above is quite simple, the aquarium trade is largely managed through conditions attached to the export permit.
- The Vanuatu National Marine Aquarium Trade Management Plan is made in accordance with Part 2, Section 3 of the Fisheries Act, No. 55 of 2005. The plan gives 64 management measures in 11 categories: limitations, licencing, fishing methods and collection practices, prohibitions, facilities and husbandry, employment of foreign workers, use of underwater breathing apparatus, areas of operation, conservation, reporting, and observers.
- Some of the management measures are: only four export operators are allowed, a fishing licence is required, a contract with the reef owners is required, the export of wild-harvested tridacna and hard corals is prohibited, the collection of food fish is prohibited, a total of only four foreign workers (experienced fish collectors only) is allowed, and each operator is required to pay an 'observer fee' to the Fisheries Department.
- There is also the traditional fisheries management component. Hickey (2002:12) states: "Much of the emphasis on managing the aquarium trade in Vanuatu is based with the community and resource owners themselves. Regardless of any Government permits issued to aquarium operators, the resource owners always have the last say on whether it may proceed, and if so, under what conditions".
- In terms of capacity building for Fisheries Department staff in the management of the aquarium fishery, one person was attached to SPC for a year and during that year he went to Christmas Island to learn about the aquarium trade and its management.

CITES issues

- Vanuatu became a signatory to CITES in 1989.
- The Department of Environment Protection and Conservation is Vanuatu's CITES Management Authority. According to the CITES contact in that department, the Fisheries Department provides scientific input into the Management Authority for marine species (T. Tari, personal communication).
- Each year the CITES Management Authority establishes an export quota for species covered by CITES. No quotas have been established in recent years because there have been no aquarium exports.
- A former aquarium exporter has stated that the Vanuatu/CITES procedures are fairly smooth, except that there is only one person in the country who can sign a CITES permit – so considerable planning is required (G. Norton, personal communication).
- The amounts of Vanuatu's exports of tridacna and hard coral exports are available on the CITES website. In general: (a) the reported export amounts are much lower than the importing countries reported amounts; and (b) in 2015/16 only a tiny amount of hard coral was reported to have been exported.

Biosecurity issues

- There are no major biosecurity issues reported.
- A biosecurity clearance for the EU costs 5,000 vatu.

Air freight issues

- The high cost of airfreight out of Vanuatu and the limited capacity of the current airlines that service Vanuatu are major constraints on the aquarium products trade in the country.
- After Cyclone Pan in March 2015, Air New Zealand stopped flying to Vanuatu.
- Most aquarium shipments from Vanuatu to USA go via New Zealand.

Major aquarium product issues

- The reasons for the current lack of any company in the aquarium trade is a hot topic.
- Vanuatu is a high cost location for operating a business and the Fisheries Department cannot do much to improve the situation.
- The global economic recession in 2008/2009 was a major shock to the aquarium trade, and Cyclone Pam was a double shock: destruction caused by the storm and the subsequent reduction of airfreight capacity.
- Both the aquarium fishery and the tourism sector are geographically concentrated in the same part of the country.

Other relevant observations

- A study was carried out to estimate the value added (i.e. contribution to GDP) by certain fishery sub-sectors in Vanuatu. The valued added by the aquarium trade in 2013 (USD 150,000) was more than trochus (USD 100,000) or beche-de-mer (USD 50,000)[16], but much less than game fishing (USD 1,600,000) (MacBio 2015).

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Useful contacts

- Sompert Gereva, Deputy Director, Vanuatu Fisheries Department, tel +678 23119, e-mail sgereva@vanuatu.gov.vu
- Grant Norton, Sustainable Reef Suppliers, tel +678 7382917, e-mail vmarinelife@gmail.com

16 There was a partial moratorium on the export of beche-de-mer that year.

Information on aquarium products in other Pacific Island countries

The countries listed in this section are those PICTs that are known to have exported aquarium products in the past, but that presently have limited involvement in the trade.

Guam

- For at least the last 21 years it has been illegal to commercially export invertebrates.
- In 2015, staff of the Division of Aquatic and Wildlife Resources (DFWR) indicated that a New York based aquarium business exports small amounts of aquarium fish from Guam, probably around USD 10,000 per year.
- In October 2019, a local company collecting and exporting aquarium fish on an occasional basis put a hold on is activities as the Director of the Division of Agriculture and Wildlife Resources suspended all exports of aquarium fish.
- As of November 2019, two pet shops on Guam sell aquarium fish locally. It is believed that most, if not all, are imported freshwater species.
- Several large hotels on Tumon Bay that cater to mainly Asian tourists have aquariums that are maintained by at least one local company that provides aquarium services.
- DAWR records indicate the number of aquarium fish exported in recent years as:

  2010: 362
  2011: n.a.
  2012: 105
  2013: n.a.
  2014: n.a.
  2015: 431
  2016: 254
  2017: 1,566
  2018: 3,147
  2019: 2,119 (Jan-Sept)

- In recent years when the business has been active, aquarium fish have been sold primarily to a wholesaler in Los Angeles, California
- Management of aquarium product fisheries
  - Collectors must obtain an annual collecting permit, maintain monthly catch logs, and have all export shipments checked by DAWR.
  - There is currently a moratorium imposed on the export of aquarium fish.
  - The commercial harvest of tridacnid clams is prohibited. This does not include cultured clams in a Department of Agriculture-approved culture facility.
  - The export of other invertebrates is also prohibited.

- Air freight issues: United Airlines has raised cargo rates. Exporters must reserve space 48 hours prior to flight. Flights most commonly used require shipments to be at the airport between 2330 and 0200 the previous day. Guam DAWR officials must be at the airport at those times to certify the export shipments and receive a copy of the packing list for the shipment.
- Major aquarium product issues in the country
  - Collecting may take place at popular dive sites; causes friction with divers.
  - Sometimes find collectors in marine preserves.

- There is no indication when or if the current moratorium placed on the export of aquarium fish will be lifted.
- Some aquarium fish species, such as the Shephard's Angelfish (*Centropyge shepardi*, also known as the Mango Angelfish) is believed to be unique to Guam by DAWR and demands a relatively high price (retail on one aquarium website USD 230).

Northern Mariana Islands

- As a Commonwealth of the United States, CNMI has the same environmental standards as the US mainland and must comply with all federal environmental laws. Numerous federal and local CNMI laws regulate everything from facility siting, raw water sources, how and where wastewater is discharged, culture species, and preparation of final products for sale.
- The sale or export of marine aquarium fish is prohibited by local statute. An aquarium fish license is required by any person who captures aquarium fish for personal use or enjoyment. A non-commercial licence for the capture of aquarium fish is USD 10 for a resident, USD 100 for a non-resident.
- Several permits/licences are required for the export of live or dead animal or plant species for commercial purposes (not limited to aquacultured products):
  - Export of non-CITES species to any international destination requires an import/export permit from the Division of Fish and Wildlife (DFW), and an import/export license from the US Fish and Wildlife Service (USFWS)
  - Export of CITES-listed species to other US states requires only an import/export permit from DFW.
  - Export of Cites-listed species to any international destination requires a CITES export stamp and the receiving country's CITES import stamp, or in the case where the receiving country is not a signatory to CITES, their in-lieu documentation; an import/export permit from DFW; an import/export licence from USFWS; and a Designated Port Exception Permit (for when a shipment is not destined to one of nine designated ports of entry for fish and wildlife shipments).
- In the late 1990s and early 2000s, *T. derasa* was imported from Palau for the restaurant trade. Poaching of clams held before sale was a major problem. The business lasted a couple of years, but ended when the clam prices in Palau were increased and losses from poaching were too much for the company to bear.
- The CNMI Aquaculture Development Plan 2011–2015 includes a giant clam commodity development plan for giant clam seedstock production. The plan envisioned, among other milestones, the marketing of giant clams to the aquarium industry within five years.
- At a meeting of the Western Pacific Regional Fishery Management Council in Saipan in November 2017, it was mentioned that the infrastructure and techniques used at Northern Mariana College were suitable for rearing aquarium species, which are economically valuable, while sidestepping the environmental impacts associated with unregulated wild collection.

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Pacific Community
B. P. D 5 - 98848 Noumea Cedex, New Caledonia
Telephone: + 687 26 20 00
Email: spc@spc.int
Website: www.spc.int

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