REVIEW OF THE AQUARIUM FISH TRADE OF THE MALDIVES

WITH PROPOSALS FOR MONITORING AND REGULATION OF THE TRADE

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EXECUTIVE SUMMARY

The export oriented fishery for the tropical aquarium fish started in Maldives in 1979. At present there are more than 12 exporters exporting to Sri Lanka, Europe and to Far Eastern Countries. In 1994 more than 300,000 fish were exported earning more than MRF 7 million (approx. US$ 0.6 million).

At present over 65% of the fish are exported to Sri Lanka where they are sold at quite low prices and then re-exported by Sri Lankan businessmen. It is recommended that Ministry of Fisheries and Agriculture work closely with the proposed "Exporters Association" to develop export markets, especially for the new companies.

The experience gained from the giant clam and the sea-cucumber fisheries shows that, reef resources have be to be carefully monitored and management measure taken at an early stage to avoid conflict with other user groups and to avoid serious over exploitation of the resource.

After reviewing the present state of the fishery and of holding facilities, proposals for the monitoring and regulation of the trade were given.

- The present system of value based quota system should be abolished. New licenses should be given clearly stating the number of fish that can be exported, and including details of fishes that are subjected to quota.

- The present list of species quota should be revised.

- In order to monitor the fishery, the use of Proforma Aquarium Fish Forms" and "Collection Log Forms" should be made mandatory for every consignment and for every collection trip respectively.

- To assist Customs and their officials, a Catalogue of Aquarium Fishes of the Maldives should be prepared, clearly indicating the it status; i.e. whether it is banned, subjected quota etc. together with the scientific name and common trade names.

- Guidelines for minimum standards for holding facilities should be established.

- Use of environmentally unfriendly methods of collection should be discouraged or banned, and early steps should taken to avoid proliferation of such methods

- Future management should include some form a zoning scheme. This should be drawn after consultations between interested parties, e.g., Ministry of Planning and Human Resources and Environment, Ministry of Tourism, Ministry of Fisheries and Agriculture etc.

1. INTRODUCTION

The exploitation of marine resources in the Maldives has increased dramatically in recent years. With the increase in economic development of the country as whole and the export business, the trade of marine production has intensified as never before. There is an increasing need for proper management measure to be enforced for the resources that are being exploited. An export oriented fishery for the giant clam fishery started in 1990. But the resource was rapidly overfished and the fishery had to be banned in 1991. The ***Beche-de-mer*** (sea cucumber) fishery, which started in 1985, has also been grossly overfished and collection by SCUBA diving was banned from 1993 in an attempt to prevent complete exhaustion of the resource. The grouper fishery, which started in 1993, is now expanding rapidly. A recent status review (Shakeel, 1994) has shown that the fishery is already showing signs of overfishing and will require some of management and regulation in the near future.

The export of aquarium fish that appears to have stared in 1979 is also experiencing rapid increase. At present there are 12 licensed exporting companies. More than 120 species of fish are being exported, which includes species that are rare in the Maldives and are vulnerable to over exploitation. The tourism and fishing industry which both depend heavily on coral reefs provide more than 70% of the total government revenue and foreign exchange earnings. Tourism, which is the most important source of foreign exchange earning, has a prime attraction of rich pristine coral reefs and associated rich colorful fish, which are exported in the aquarium fish trade. The pole and line tuna fishery, which exploits surface swimming tuna, require daily supply of baitfish, some of which are exported in the aquarium fish trade.

Since its inception the aquarium fish trade has been carefully monitored by the Government. Exporters are allowed to export aquarium fish only under a valid export license issued from the Ministry of Trade and Industries. Based upon a study carried out by Edwards (1988) a blanket quota of 100,000 fish was set for 1988 and 1989 by the Ministry of Fisheries. However, this seems to have not been implemented effectively. A species based quota was also set for certain species that were thought to be subjected to over exploitation or were close to maximum sustainable level of exploitation. The species quotas were set by the Ministry of Fisheries in consultation with the Marine Research Section. Although these quotas were in place since 1988, they are not being properly implemented by the Customs, largely due to lack of coordination among the responsible authorities.

In recent years the export trade has diversified and companies stared to operate from islands around Malé and from nearby

atolls. It is generally prohibited to collect aquarium fish from the house reefs of tourist resorts and therefore these areas are effectively protected. Recently tourism diver operators have claimed that fish collectors were targeting popular diving sites. This has caused concern for the responsible government authorities, especially MOFA who has the legal responsibility for the management of the marine living resources.

The Marine Research Section of the Ministry of Fisheries and Agriculture recognizing the need to formulate a long-term management strategy, decided to assess the current status of the trade and the status of the holding facilities. This report summarizes the finding by the author and MRS staff and discusses some of the points that may be considered for monitoring and regulation of the trade. A preliminary stock assessment is also carried using the methods used by Edwards and Shepherd (1992).

2. TRADE REVIEW

2.1. The Export Business

Relatively few people are employed in the aquarium fish export business (Table 1). At present, it is estimated that about 80-100 people are employed in this business. These include fish collectors, boat handlers, holding facility and managerial staff.

Table 1: List of names of aquarium fish exporters as on January 1995. Source: Ministry of Trade and Industries.

Name	Address
Union Enterprises Ltd.	G. Thundi
Oriental Express Pvt. Ltd.	No. 4 Chandhanee Magu
Marine Fish Pvt. Ltd.	M. Madiheraa
Shabeeru Ahmed, S. Hulhudhoo	M. Maayaa
Tropical Aquarium Fish Exports	MHA Shop No. 1
Abdul Razzak Adam	M. Medhelmaage
Ahmed Arif	M. Zillion
Polu Link Malidves Pte. Ltd.	M. Faaga
Aquastart Investments Pvt. Ltd.	G. Suthulige
H.M.F. Maldives Pvt. Ltd.	H. Haajee Edhuruge

From an economics point of view aquarium fish exports accounts about 1.2-1.7% of the total marine export value at present (Table 2). The FOB value of aquarium fish exported in 1994 was 7.03 million. In 1994 major exports were to Sri Lanka (65.17%) followed by Europe (17.38%), USA (10.56%) and the Far East (6.37%). Exports to Sri Lanka are mostly re-exported by Sri

Lankan businessmen to European and American markets. Sri Lanka has good connection to these destinations.

2.2. Recent Trends in Trade

The quantity of fish exported per year has risen steadily since 1980. From 1980 to 1994 a seven-fold increase in the quantity of exported and 45 fold increase in the export value has occurred.

Table 2: Quantity of live tropical fish exported from the Maldives and export values from 1980-1994.

Year	Nos. of Fish Exported	FOB Value (MRf.)	FOB Value (US$)*	% Tot. Mar. Exp. Value
1980	42,128	153,958	n/a	0.53
1981	43,929	214,607	n/a	0.78
1982	38,322	242,014	n/a	0.96
1983	44,921	372,699	53,243	0.75
1984	37,255	296,823	42,102	0.50
1985	65,065	555,290	78,210	0.50
1986	86,312	805,078	112,598	0.69
1987	69,216	902,758	97,913	0.52
1988	68,102	1,589,212	181,004	0.60
1989	53,925	1,312,037	145,137	0.42
1990	54,572	1,216,000	127,865	0.35
1991	112,918	3,450,000	334,302	0.92
1992	161,918	3,156,000	298,580	0.95
1993	184,233	3,746,171	341,804	1.19
1994	312,483	7,028,295	606,630	1.65

** Note: Annual average exchange rates obtained from the Statistical Year Book of Maldives, 1995. Source: Customs, Complied by EPCS/MOFA*

At the start of the business in the early 1980s fish were mainly exported to Sri Lanka. Edwards (1982) noted that from 1983-1986 about 85% of the fish were exported to Sri Lanka followed by Europe (13.3%) and with small numbers to USA, Japan and Singapore. Maldives now exports to between 25-30 countries around the world. But the majority of the countries take less than 1% of the total exports. The most important markets are Sri Lanka, United Kingdom, Netherlands, Germany, Belgium, Japan and USA. Figure 1 shows the total numbers of fish exported and their FOB value from 1980-1994. Figure 2 gives a breakdown of the quantities exported, and their FOB value to major destinations by year for the 1989-1994.

Unlike the situation in the mid 1980s, it appears that the situation had changed in the late 1990s. In 1989 the majority of the fish were exported to Europe (70.12%) earning about 80% of the total value. From 1989-1994, even though the annual quantity of fish exported to Europe have increased (largely due to increase in volume exported by the companies), the quantity in terms percentage however, have declined. Figures for Sri

Figure 1: Export of aquarium fish (nos.) and their export value in MRF (1980-1994). Source: Customs, compiled by MOFA/EPCS

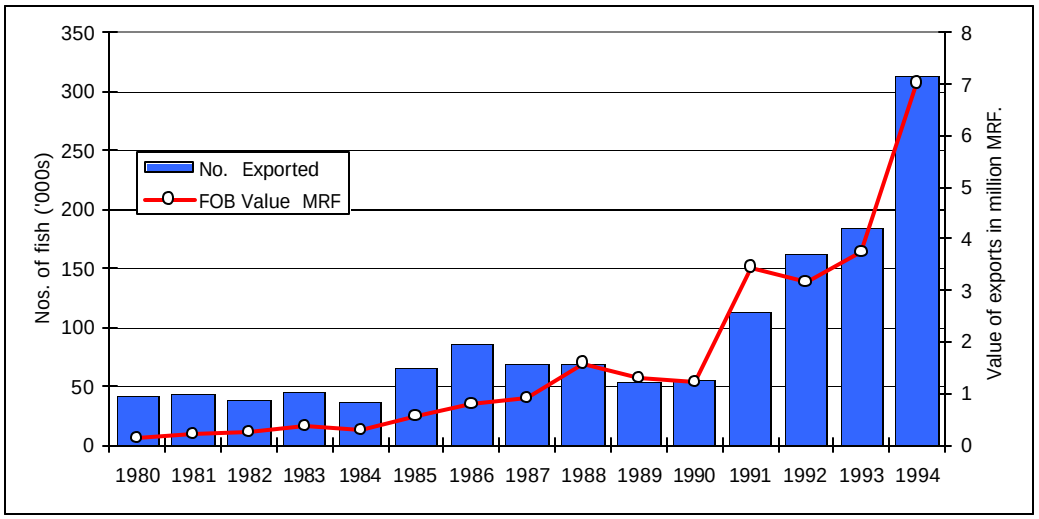
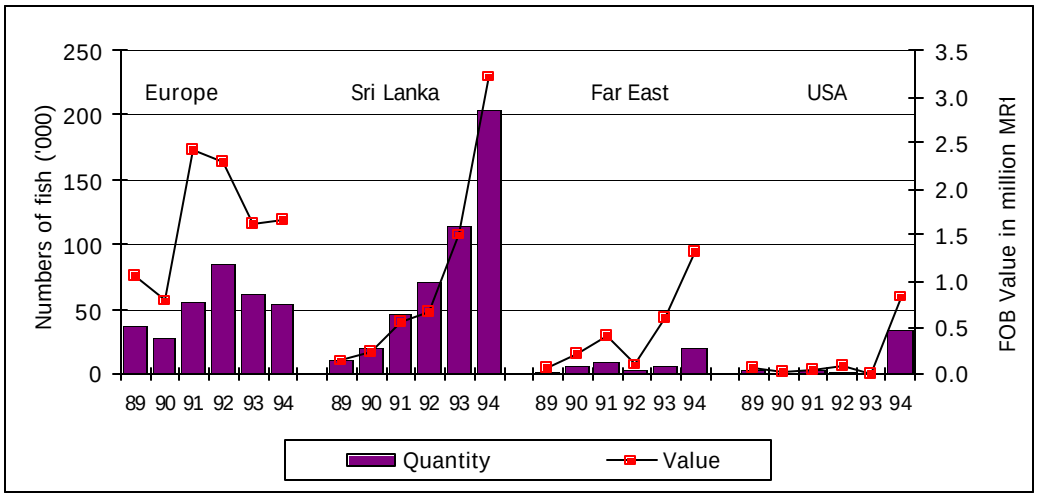


Figure 2: Aquarium fish exports, numbers and FOB value by major destinations for the years 1989-1994. Source: Customs. Compiled by EPCS/MOFA (see Appendix B and C for more details)



Lanka shows a dramatic increase in 1993 and in 1994. The explanation for this sudden increase could be recent increase of newcomers to the business who are exporting mainly to the easily accessible Sri Lankan market. In recent years the USA and Far Eastern markets are becoming an important destinations. In 1994 33,023 fish were exported to USA alone (10.6% of the total) earning MRF 831,341 (11.8%).

Table 3. Average Unit Prices for aquarium fish offered for major destination (prices in MRf.)

Destinations	1989	1990	1991	1992	1993	1994
Europe	27.82	28.14	43.76	26.66	25.73	30.52
Sri Lanka	11.63	11.56	12.40	9.41	13.11	15.75
Far East	30.75	39.90	46.68	42.47	96.91	66.16
USA	27.60	67.74	18.95	47.54	----	25.17
Others	---	----	----	----	----	9.09

Source: Customs, Compiled by EPCS/MOFA

The unit prices for aquarium fish export by major destinations for 1989-1994 is given Table 3. The average unit price per fish offered fro European markets were in the range of MRF 26-44, the highest were during 1991 with an average of MRF 43.76. Average prices for Sri Lanka were low and remained more or less constant throughout the period, but show a slight increase in 1994. The highest prices offered were from the Far Eastern markets, mostly by the Japanese buyers.

Table 4: Numbers of fish exported and FOB value claimed by company form 1993.

Exporter's name	Qty (nos.) exported	FOB value (US$)	% Total Qty exported	% Total FOB Value
Union Enterpriese Pte Ltd.	76,639	254,560.30	42.05	55.51
Sub Tropical Aquatic Paragon	26,457	70,534.75	14.52	15.38
Zillion Mohamed Arif	19,456	27,328.58	10.67	5.96
Sunny Tours Maldives	14,611	13,236.73	8.02	2.89
Marine Life Services	13,994	25,120.00	7.68	5.48
Tropical Aquarium Fish Exports	10,846	44,054.73	5.95	9.61
Oriental Express Pvt. Ltd	7,905	10,201.10	4.34	2.22
ZSS Oceans Pvt. Ltd.	5,371	4,304.73	2.95	0.94
Zaina Exports	4,943	6,186.00	2.71	1.35
HMF Maldives Pte. Ltd.	1,243	1,800.00	0.68	0.39
H. Zeeniya, Male	806	1,242.40	0.44	0.27
TOTAL	182,271	458,569.32	100.00	100.00

Source: Customs. Note that total quantity exported and the FOB value does not tally to what has been reported by the Customs to MOFA due to unavailability of few invoices.

Table 4 gives aquarium fish exports by company for 1993. Union Enterprises took about 42% of the share in the market earning about 55% of the total FOB value declared for the Customs. Companies that have access to more lucrative markets such as the Far East and the USA sell at high prices are evident from the table. For example Tropical Aquarium Fish Exports took 9.61% of the total value by exporting about 6% of the total quantity, where as Sunny Tours were on able to claim about 3% of the total value, exporting 8% of the total quantity.

2.3. Methods of Collection

Collectors are employed directly by the company which generally has its own holding facilities. Most of the divers are from Sri Lanka and are often paid on piece-rate basis on what they collect. SCUBA divers receive no formal training and carry little in the way of basic emergency equipment. Divers often work singly underwater and the boat handler spot them whey they surface. During calm weather night dives are carried out as is easy to collect fish during nighttime.

Sessile organisms and invertebrates are taken by hand, if necessary prized apart or dug out in the case of soft corals and sea anemones. Fish are collected using hand nets, which is the normal collecting technique. Each diver carries a small net (about 10cm mouth diameter) and two large nets (about 50 cm in the mouth diameter). Mesh sizes may vary from 3-5mm. Fish are driven into the net whichever net is the most appropriate. As the fish are collected they are transferred to plastic bag secured at the diver's waist. Invertebrates are sometimes kept in separate bags. When fish are collected by snorkeling, a large plastic container is towed behind the divers to which the collected fish are transferred. The container is holed, and has rubber tyre attached mid-container to keep it upright and afloat. More valuable fish are kept singly in polythene bags secured to the snorkeler's waist.

Some companies use 'moxy' nets which is a new technique that is being introduced to the Maldives by Sri Lankan divers. This is a cone shaped net (more like the Maldivian traditional cast net, *laandhaa*) is closed at the top. The bottom is about a meter or more in diameter. A float is attached on the top and lead weight are fastened around the perimeter of the base. Moxy net is often used in shallow reef tops by snorkellers. The net is spread on top of the oral heads where the fish take refuge. Fish are then chased out by banging the coral heads with the tickler stick until they are caught in the net. Fish caught using this technique are severely stressed and more often die in the first few weeks of capture compared to the fish caught by hand nets.

2.4. Holding facilities

Most holding facilities have standard concrete tanks, but a few have large plastic holding tanks. Smaller glass tanks are also used. The tanks are piped with compressed air, which is centrally connected to an electric blower. Water in the tanks is renewed weekly or as often as required depending on the numbers of fish in the tanks and quantity of through put. Several companies had open systems whereby the water is pumped in from the sea. One company had a sand filter and paper cartridges attached to the incoming pipeline to filter any debris and to mop up the bacteria. It appears that open systems

are more cost effective and better, compared with the closed systems with complicated filtering and sterilization systems.

At the Union Enterprises facility on Malé a modern central circulatory filtration system is used. The overflow water from the tanks are skimmed to remove any nitrogenous waste products and is filtered through an ultra violet sterilization system before the water goes to the tanks for the second time. The water (about 33 tons) is partially renewed (thrown to the sea) once a week with about 10 tons of fresh seawater. Apart from the usual large concrete tanks and the medium sized (1.5 x 3 x 1.5 ft) glass tanks, Union Enterprises had several much smaller sized standard tanks for holding individual fish. These are arranged as small compartments within large shallow tanks.

A few holding facilities were not properly maintained. These facilities do not even have an aeration system. Water is changed as required to keep the water fresh and oxygenated. Several fish were seen dead in the tanks in such places.

Recently some companies have started to extend the area of collection and have moved to nearby atolls. As a result they have started using holding cages at the out stationed collection sites. Once enough fish are collected, they are packed and brought back to the central holding facility (located close to airport) for conditioning before being exported. These cages which are framed in PVC pipes (2.5" and 1.5" dia.) are about 10'x5'x5' in size, rigged with plastic netting. The airtight PVC piping helps the cages to keep afloat.

2.5. Packaging and Exporting

Conditioning of fish at the holding-facilities prior to export is a general practice carried out by all exporters. Most companies collect fish to meet a specific requirement for a client. Few companies collect fish routinely and stock them at holding facilities. The companies that do this appear to be exporting mainly to Sri Lanka where the importers have no particular preference of species. Packing starts just in time for the flight and fish are packed singly in double polythene bags to ensure that fish are not stranded without water should one bag be holed. Polythene bags are packed in cardboard boxes for short journeys (mainly to Sri Lanka). For European and other long haul journeys they are packed in styrofoam/regifoam boxes with ice to keep the temperature down. A layer of old newspaper is inserted between bags containing aggressive species such as tangs to ensure adjacent fish do not catch sight of each other. Packaging methods have improved considerably over the years due to feed back from the customers and many exporters now guarantee almost 100% survival for most destinations provided that good connecting flights are available.

2.6. Species Composition in the Trade

The Customs are required to maintain running totals of the number of fish subjected to quota. However, examination of packing lists for 1992 and 1993 at the Customs showed that only a few companies provided detailed list of species and their numbers in the consignment. The Customs officers apparently were not aware of the species quotas for some species that have been imposed by the Ministry of Trade and Industries.

From a sample of 29 invoices from 1993 picked at random from the available detailed packing lists, estimates were made on the quantity of fish exported by species for 1993 and 1994. About 120 species of fish and invertebrates from 23 families were exported. Commonest ones include wrasses (Fam: Labridae, 22 species), butterflyfish (Fam: Chaetodontidae, 19 species), damselfishes (Fam: Pomacentridae, 10 species), and angelfishes (Fam: Pomacanthidae, 9 species).

Table 5: Table 3. List of species exported in the trade with estimated of numbers (nearest 50) exported in 1993 and 1994. Column A = number of species in the sample of 29 packing lists picked at random from detailed invoices.

SPECIES	LOCAL NAME	A	1993	1994
CHAETODONTIDAE, Butterflyfishes				
Chaetodon auriga	Threadfin	173	2150	3700
C. collare	Collare or Pakistani	27	350	600
C. falcula	Saddleback	426	5350	9100
C. guttatissimus	Spotted	135	1700	2900
C. kleinii	Klein's or Sunburst	141	1750	3000
C. lunula	Racoon	8	100	150
C. madagascariensis	Madagascar or Pear Scale	38	500	800
C. melannotus	Black-backed	163	2050	3450
C. meyeri	Meyer's	32	400	700
C. unimaculatus	Teardrop	26	350	550
C. xanthocephalus	Yellowhead or Goldring	265	3350	5650
Forcipiger spp.	Long-nosed	73	900	1550
Hemitaurichthys zoster	Pyramid	10	150	200
Chaetodon mitratus	--	72	900	1550
Chaetodon lineolatus	--	7	100	150
Chaetodon bennetti	--	7	100	150
Chaetodon oxycephalus	---	83	1050	1750
POMACANTHIDAE, Angelfishes				
Apolemichthys trimaculatus	Flagfish	32	400	700
Centropyge multispinis	Bluefin Dwarf	75	950	1600
Pomacanthus imperator	Emperor	86	1100	1850
P. xanthometopon	Yellow-faced	1	<50	<50
Pygoplites diacanthus	Royal	321	4050	6850
Centropyge spp.	--	11	150	250
Apolemichthys xanthurus	--	47	600	1000
A. armitagei	--	2	50	50
SCORPAENIDAE, Lionfishes				
Dendrochirus brachypterus	Shortfin	2	50	50
Pterois antennata	Broadbarred Firefish	23	300	500
P. miles	Devil Firefish	20	250	450
P. radiata	Radial Firefish	179	2250	3800

Dendrochirus zebra	--	1	<50	<50
GOBIIDAE, Gobies				
Gobiodon citrinus	Poison or Yellow Goby	1346	16900	28700
Paragobiodon microlepis	Green Goby	5	50	100
Nemateleotris magnifica	Fire (tail) Goby	28	350	600
Valenciennea strigata	Watchman Goby	11	150	250
Nemateleotris decora	Decora	199	2500	4250
Fusigobius spp.	--	8	100	150
Unspecified gobies	--	30	400	650
BLENNIDAE, Blennies				
Cirripectes stigmata	--	3	50	50
Unspecified blennies	--	8	100	150
POMACENTRIDAE, Damselfishes				
Amphiprion nigripes	Maldives Clown	358	4500	7650
A. clarkii	Sebae Clown	54	700	1150
Clown Fish	Clown Fish	263	3300	5600
Chromis viridis	Green Damsel	451	5650	9600
Dascyllus aruanus	Three-stripe Damsel	673	8450	14350
Pomacentrus pavo	Jade Damselfish	385	4850	8200
MONACANTHIDAE, Filefishes				
Oxymonacanthus longirostris	Longnose	479	6000	10200
CIRRHITIDAE, Hawkfishes				
Cirrhitichthys oxycephalus	Coral Hopper	2	50	50
Oxycirrhites typus	Longnose Hawkfish	17	200	350
Unspecified hawkfishes	--	2	50	50
SERRANIDAE, Anthias, groupers				
Pseudanthias dispar	Longfin Wreckfish	373	4700	7950
P. evansi	Purple Wreckfish	1200	15050	25550
P. kashiwae	Silver-streak Goldie	80	1000	1700
Nemanthias carberryi	--	304	3800	6500
Variola louti	Lyretail Grouper	16	200	350
Anthias sp.	--	678	8500	14450
BALISTIDAE, Triggerfishes				
Balistoides conspicillum	Clown Trigger	37	450	800
Rhinecanthus aculeatus	Picasso	511	6400	10900
ACANTHURIDAE, Surgeonfishes				
Acanthurus leucosternon	Powder Blue	1347	16900	28700
Naso lituratus	Lipstick	31	400	650
Paracanthurus hepatus	Regal Blue	2	50	50
Zebrasoma scopas	Brown Sailfin	163	2050	3450
Z. veliferum	Sailfin	992	12450	21150
Naso valmingii	--	18	250	400
Naso spp.	--	134	1700	2850
Acanthurus tennenti	--	76	950	1600
--	Yellow eye surgeon	56	700	1200
Ctenochaetus striogosus	--	1	<50	<50
LABRIDAE, Wrasses + SCARIDAE, Parrot fishes				
Anampses lineatus	Leaf or Deep-sea Wrasse	114	1450	2450
A. meleagrides	Marble or Yellowtail	43	550	900
Bodianus axillaris	Polkadot	18	250	400
Coris formosa	Red Wrasse	1	<50	<50
Gomphosus caeruleus	Green Birdmouth	81	1000	1750
Halichoeres leucoxanthus	Yellow Wrasse	8	100	150
Labroides bicolor	Yellow Diesel, Cleaner	231	2900	4900
L. dimidiatus	Blue Diesel, Cleaner	223	2800	4750
Macropharyngodon bipartitus	Rare Wrasse	259	3250	5500
Novaculichthys taeniourus	Dragon Wrasse	224	2800	4750
Pseudocheilinus hexataenia	Pyjama	32	400	700

Bodianus bimaculatus	--	20	250	450
--	Blue Wrasse	36	450	750
--	Blue Parrot	14	200	300
Coris spp.	--	81	1000	1750
--	Parrot fish	56	700	1200
Halichoeres cosmetus	--	2	50	50
--	Bicolor Parrot Fish	1	<50	<50
--	Commet Wrasse	10	150	200
Parachelinus mccoskeri	--	20	250	450
TETRAODONTIDAE, Pufferfishes				
C.valentini	Saddleback	59	750	1250
Arothron spp.	Puffer Fish	73	900	1550
OSTRACIDAE, Boxfishes				
Ostracion cubicus	Yellow Boxfish	48	600	1000
DIODONTIDAE, Porcupinefishes				
Diodon liturosus	Shortspine Porcupine	12	150	250
MULLIDAE, Goatfishes				
Parupeneus cyclostomus	Yellow Goatfish	23	300	500
HEAMULIDAE, Sweetlips				
Plectorhinchus spp.	Oriental	5	50	100
CALLIONYMIDAE, Dragonets				
Synchiropus stellatus	Starry Dragonet	3	50	50
INVERTEBRATES				
	Pink star	4	50	100
	Red Star Fish	48	600	1000
	Anemone	40	500	850
	Sea Urchin	51	650	1100

Exported species are listed in Table 5 along with the number of each species in the sample of 29 packing lists and estimates of numbers (nearest to 50) exported in 1993 and 1994. Among the 14,465 "fish" in the sample were 143 invertebrates. Most of these were sea urchins (Echinodermeta: Echinoidea), starfish (Echinodermeta: Asteroidea) which include *Linkia, Formia* and *Culcita* and sea anemone (Class Anthozoa, *Radianthus* and *Stoichactis*)

3. ESTIMATES OF ABUNDANCE AND SUSTAINABLE YIELDS

Estimates of stock size and potential maximum sustainable yields (MSY) are important for purposes of policy making and management. Edwards and Shepherd (1992) have made first attempts to estimate the abundance and potential sustainable yields of some of the collected species from around an area of one hours dhoni journey (about 7 nautical miles) from Malé.

In this study the calculations made by Edwards and Shepherd (1992) have been extended to include entire Malé Atolls and Vaavu Atoll where most collection occurs at present. In their method of estimating potential yields, first, the virgin biomass (B_v) of the species in the collected area is calculated by multiplying the numbers of fish per hectare (estimated by visual assessment surveys) with the total exploited area. Assuming instantaneous natural mortality (M) as 0.2 (i.e. 18% dying per year) for large species, and M as 0.5 (i.e. 40%.

dying per year) for smaller species (growing to less than 15 cm), potential yield (PY) is calculated using the equation of Gulland (1971). See Edwards and Shepherd (1992) for the assumptions and references cited there in for the underlying principle of the method.

$$PY = M \times 0.5 \times B_V$$

Here PY is the potential maximum sustainable yield, M is the coefficient of natural mortality and B_v is the virgin biomass equivalent to virgin biomass in numbers.

The reef areas used for calculations in this study have been taken from Anderson et al. (1992) who give reef areas (starting from the beach to the edge of the reef) for the atolls of Maldives. After interviews with the collectors and from observations, it was thought that only 15% of these reef areas are being customarily used for aquarium fish collection. The reef areas used for calculations are as follows.

Atoll	Total reef area (km^2)	15% of the total area (km^2)	15% of the total in hectares
North Male Atoll	270	40.50	4,050
South Male Atoll	120	18.0	1,800
Vaavu Atoll	290	43.5	4,350

For the values of M used, potential yields are equivalent to $0.1 \times B_v$ for larger species and $0.25 \times B_v$ for the smaller species (Edwards and Shepherded, 1992). Table 6 gives the estimates of potentials maximum sustainable yields from the three atolls for the species for which the visual assessments surveys have been carried out.

Table 6: Estimated annual maximum sustainable potential yield from South Male, North Male and Vaavu Atoll. First column gives the numbers of fish per hectares (from Edwards and Shepherd, 1992) calculated from visual assessment surveys. Estimated numbers are nearest to 50.

SPECIES	Avg. per hectare	S. Male	N. Malé	Vaavu	Total
CHAETODONTIDAE					
Chaetodon auriga	11	4,450	2,000	4,800	11,250
C. citrinellus	15	6,100	2,700	6,550	15,350
C. collare	8	3,250	1,450	3,500	8,200
C. falcula	43	17,400	7,750	18,700	43,850
C. guttatissimus	96	38,900	17,300	41,750	97,950
C. kleinii	61	24,700	11,000	26,550	62,250
C.lunula	2	800	350	850	2,000
C. madagascariensis	6	2,450	1,100	2,600	6,150
C. melannotus	6	2,450	1,100	2,600	6,150
C. meyeri	11	4,450	2,000	4,800	11,250

C. triangulum	48	19,450	8,650	20,900	49,000
C. unimaculatus	1	400	200	450	1,050
C. xanthocephalus	17	6,900	3,050	7,400	17,350
Forcipiger spp.	102	41,300	18,350	44,350	104,000
Hemitaurichthys zoster	277	112,200	49,850	120,500	282,550
POMACANTHIDAE					
Apolemichthys trimaculatus	4	1,600	700	1,750	4,050
Centropyge multispinis	220	89,100	39,600	95,700	224,400
Pomacanthus imperator	17	6,900	3,050	7,400	17,350
P. xanthometopon	5	2,050	900	2,200	5,150
Pygoplites diacanthus	70	28,350	12,600	30,450	71,400
SCORPAENIDAE					
Pterois antennata	1	400	200	450	1,050
P. radiata	1	400	200	450	1,050
GOBIIDAE					
P. evides	40	40,500	18,000	43,500	102,000
Nemateleotris magnifica	13	13,150	5,850	14,150	33,150
BLENIIDAE					
Meiacanthus smithi	41	41,500	18,450	44,600	104,550
POMACENTRIDAE					
Amphiprion nigripes	18	18,250	8,100	19,600	45,950
A. clarkii	30	30,400	13,500	32,650	76,550
Chromis viridis	850	860,650	382,500	924,400	2,167,550
Dascyllus aruanus	170	172,150	76,500	184,900	433,550
D. carneus	53	53,650	23,850	57,650	135,150
D. trimaculatus	16	16,200	7,200	17,400	40,800
Pomacentrus philippinus	710	718,900	319,500	772,150	1,810,550
MONOACANTHIDAE					
Oxymonacanthus longirostris	47	47,600	21,150	51,100	119,850
SERRANIDAE					
P. evansi	808	818,100	363,600	878,700	2,060,400
P. squamipinnis	1045	1,058,050	470,250	1,136,450	2,664,750
Cephalopholis miniata	35	14,200	6,300	15,250	35,750
Variola louti	5	2,050	900	2,200	5,150
BALISTIDAE					
Balistoides conspicillum	1	400	200	450	1,050
Melichthys indicus	37	15,000	6,650	16,100	37,750
Odonus niger	93	37,650	16,750	40,450	94,850
Rhinecanthus aculeatus	4	1,600	700	1,750	4,050
ACANTHURIDAE					
Acanthurus leucosternon	318	128,800	57,250	138,350	324,400
A. lineatus	6	2,450	1,100	2,600	6,150
Naso lituratus	82	33,200	14,750	35,650	83,600
Zebrasoma scopas	288	116,650	51,850	125,300	293,800
Z. veliferum	28	11,350	5,050	12,200	28,600
LABRIDAE					
A. meleagrides	5	5,050	2,250	5,450	12,750
Bodianus axillaris	4	4,050	1,800	4,350	10,200
Cheilinus trilobatus	5	2,050	900	2,200	5,150
Coris formosa	1	400	200	450	1,050
Labroides bicolor	29	29,350	13,050	31,550	73,950

L. dimidiatus	118	119,500	53,100	128,350	300,950
Macropharyngodon bipartitus	3	3,050	1,350	3,250	7,650
Novaculichthys taeniourus	5	2,050	900	2,200	5,150
Pseudocheilinus hexataenia	75	75,950	33,750	81,550	191,250
Thalassoma hardwicke	393	397,900	176,850	427,400	1,002,150
T. lunare	122	123,550	54,900	132,700	311,150
TETRAODONTIDAE					
Canthigaster janthinoptera	3	3,050	1,350	3,250	7,650
C. solandri	9	9,100	4,050	9,800	22,950
C.valentini	30	30,400	13,500	32,650	76,550
OSTRACIDAE					
Ostracion cubicus	5	2,050	900	2,200	5,150
ZANCLIDAE					
Zanclus canescens	58	23,500	10,450	25,250	59,200
DIODONTIDAE					
Diodon liturosus	1	400	200	450	1,050
MULLIDAE					
Parupeneus cyclostomus	1	400	200	450	1,050
HEAMULIDAE					
Plectorhinchus orientalis	5	2,050	900	2,200	5,150

The potential yields calculated here are very crude which may only useful to give an idea of the yields that can be exploited from the areas under consideration. These estimates are useful for allocating total allowable catches from the area.

4. MANAGEMENT ISSUES

4.1. Monitoring and Regulation

Experience in the giant clam fishery, sea-cucumber fishery and now the grouper fishery has proved that monitoring and regulation is important at an early stage in the development of the resource (Barker, 1992; Joseph, 1992; Shakeel, 1994). The giant clam fishery which started in 1990 is now effectively banned for fear that last remaining stocks may be depleted. The sea cucumber fishery, which started in 1985, is now grossly overfished and requires urgent regulatory action. The export oriented grouper fishery, which started only in 1993, is already showing symptoms of overexploitation and there is danger that individual atolls may be fished out one by one (MRS, 1994).

From the beginning of the aquarium fish trade, government authorities have closely monitored the levels of export. Unlike the other reef fish export business, the export business of live tropical fish requires heavy capital investments and technical expertise and therefore the number of people who can enter into business is somewhat limited. As a result, the aquarium fishery has been in some control. However, recent expansions and diversification of the business have prompted the stepping up of monitoring and regulation of the trade to

avoid overfishing and potential conflict with the tourism industry.

The primary aim of regulation of the aquarium fish trade would be to ensure that collection rates are sustainable in the exploited areas. At the same time it should also ensure the activity is not having any adverse environmental effect or any potential conflicts with other major economic activities. Regulations should also aim to maximize the survival of captured fish and restrict collection of rare and endemic species and species which survive poorly in aquaria (Wood, 1988; Randall, 1987).

In the Maldives coral reefs are heavily used by the tourism and fisheries sectors. The construction industry also uses coral reefs for coral and sand mining. All these user groups have potentially conflicting use with each other. Therefore the regulatory measures enforced for the aquarium fish trade should ensure minimal conflict with other user groups. As a first step towards regulating the trade, monitoring of the aquarium fish export business should be stepped up. The aim of a monitoring program would be to discover whether existing levels of exploitation really are sustainable. As monitoring programs require considerable time and money and given the often severe constraints and lack of qualified staff at MRS, major part of the monitoring could be done by the exporters themselves. Regulatory strategies can be made to facilitate such monitoring (Edwards and Shepherd, 1992) and hence provisions of data can be made compulsory for the exporters.

4.2. Potential conflicts

By law it is prohibited to carry out any form of fishing from the house reefs of tourist resorts and so these areas are effectively protected from any such activities. Both tourism and aquarium fish export business require the close proximity of an international airport and therefore it is not surprising that most of the holding facilities are centered close to the airport and in the tourism zone. At present most collection occurs in the north and south Ma1é Atolls where highest concentration of tourist resort occurs. Conflicts occur when aquarium fish collectors happen to collect fish from a popular boat dive site. In the recent past there have been such conflicts between dive schools and the aquarium fish collectors. It is likely this problem will exacerbate in future if necessary regulatory measures are not taken now. The recent initiative for protecting some popular dives will go some way in the management of the coral reef resources in the Maldives.

Pole and line tuna fishing requires a daily supply of small-bodied fish, which are collected from the reef. Fortunately only one species of bait fish used in the tuna bait fishery is being collected by the aquarium fish exporters. This is the Pomacentrid, *Chromis viridis,* which is of minor importance as a bait. It is estimated about 1.5% of the total live bait

requirement is of this species (Anderson and Saleem, 1994), which is estimated as 166.5 tonnes per year (Anderson, 1994). Almost 10,000 individuals, collected in 1994 in the aquarium export business is an insignificant number compared to this quantity.

Edwards and Shepherd (1992) note five species of edible reef fish of minor importance which are also being collected by the aquarium fish exporters. These are *Plectorhincus orientalis* (sweetlip), *Cheilinus trilobatus* (tripletail wrasse), *Cephalopholis miniata* (coral grouper), *Parupaneus cyclostomus* (goat fish) and *Variola louti* (lunar tail grouper). The amounts collected by the aquarium fish collectors are very low compared with the quantity of fish species landed in Ma1é and therefore should not be problem.

One of the species caught by the recently developed export oriented grouper fishery is *Cephalopholis miniata* and *Variola louti*. The grouper fishery at present is developed only in the central atolls which is not very far from the aquarium fish collection areas. However, it is thought that present levels of exploitation of this species from both fisheries do not cause any problem of over exploitation of the stock.

4.3. Quotas and Licensing Scheme

Since its inception, export of aquarium fish requires export licenses from the Ministry of Trade and Industries. The export licenses are issued on value basis and are generally valid for a year. The value of fish exported under the license should not exceed the export value of the license (generally in the range of 200-300 thousand MRF). The export value for the license is determined by the exporters themselves. A nominal charge of MRF 1.00 in the form of revenue stamp is levied for each MRF 1000.00 worth of exports. This system of licensing has been misinterpreted as export quotas by Edwards (1988) and Edwards and Shepherd (1992). This system of licensing allows the exporter to undervalue the invoices to export more fish per given export value, which was evident in the invoices made for Sri Lanka.

In response to the findings of a preliminary report (Edwards, 1988) on the aquarium fish trade, Dr. A. D. Shepherd (then the ODA Technical Consultant based at MRS) proposed a species based quota system for 22 species (Edwards and Shepherd, 1992). These selective quotas were to be reviewed annually by the Marine Research Section in consultation with the Ministry of Fisheries and Agriculture, Ministry of Trade and Industries and Malé Customs. Ministry of Trade and Industries maintains running totals of the species for which the quotas are enforced. With every new license issued (based on export value) a list of species subjected to quota and their quantity allowed to export is attached with the license, which is handed to the Customs by the exporter. In allocating the quantity, due consideration is given to the numbers of people applying for export licenses and

the export volumes of the companies. Interviews with the Customs officials however, revealed that they were not aware of this species based quota. Even if they were to enforce this species based quota, necessary rules and the administrative setup was not there. It was obvious that customs officers require training on this whole issue and rules and regulations should be in place facilitating the enforcement of the quotas and collection of the required data.

It is suggested therefore, the export licenses should be based on numbers of fish and should only allow to export a pre agreed amount of fish per license. In this way it will be easy to control the numbers of fish exported per year. A list of allowable amounts for the export of species which are subjected quota can also be included in the license.

At present most of the invoices and packing lists produced by the companies do not give the list of species and their quantities in the shipment and hence there is no way of knowing which species are exported. However, every packing list/invoice has total number of fish and the number of boxes in the shipment which is the minimum requirement by the Customs. The names of species used in the packing lists (only few companies regularly produce a detailed packing list) were not all consistent and many were referred to under several names even by the same company.

It is suggested therefore to prepare a photographic catalogue of the aquarium fish species that are likely to be exported (about 130 species- at present) including the scientific name, common trade name and the code number which should be distributed (or sold) to all the aquarium fish exporters and to the Customs. As suggested by Edwards and Shepherd (1992) a "Proforma Aquarium Export Form" can be made which includes all scientific names, local trade names of the species in the catalogue. These forms will be filled by the exporters for each consignment and will be produced to Customs as the packing list. The exporter will also enter the numbers of each species and the prices etc. of fish species included in each shipment. This would involve little more effort to exporting companies than preparing packing lists as it is done at present.

The running total of the numbers of fish and of species subjected to quota can than be maintained with ease by the Customs. Once the Customs have finished with these forms these could be sent to MRS where the data can be computerized for detailed analysis.

4.4. Provision of Collection Data to MRS

Detailed information on the collection sites, numbers collected, where it was collected, time spent on collection, etc. are vital information for the detection of symptoms of over exploitation at an early stage. "Collection Log Forms" which will provide above information can be filled by the boat

crew for every collection trip. Number of each species (including the dead ones) collected may be filled at the holding facility while the fish are being transferred to the holding tanks. Obviously this will require close monitoring which may involve field trips going away from Malé where most holding facilities are established. This activity may be monitored by the MRS staff in close collaboration with the "Aquarium Fish Exporters Association" which is going to form in the near future.

The kind of information generated from this form together from the Proforma Aquarium Fish Export Forms will allow to estimate the mortalities of the fish species and will provide very important information for proper regulation of the trade.

4.5. Regulation of the Holding Facilities

Regulating the standards of the holding facilities, and of standards of packing is important to ensure minimum mortalities of fish. Mortalities at collection and at the holding facilities are poorly known. Interviews carried out with the exporters and collectors indicate that at both these stages mortality may be as little as 3-5%. Wood (1985), relying primarily on her experience of Sri Lankan aquarium fish trade estimated that mortalities before arrival in the country of destination approached 25% with 15% dying at holding facilities in the country of origin and 10% dying during transport. Fortunately the fish collected from the Maldives do not require long domestic transport times as in Sri Lanka as the collecting areas and the air port are very close to the holding facilities.

A preliminary study carried out by MRS (1994) showed that the standards of some facilities are not adequate for keeping live fish. Guide lines for the minimum standards of holding facilities could be established which would be handed to each exporter when issuing the export licenses. Ministry of Trade and Industries may consult Ministry of Fisheries and Agriculture on this matter for inspecting the holding facilities before the export license may be issued. Here again the Aquarium Fish Exporters Association could play a lead role in the checking the facilities to ensure that the standards are maintained.

4.6. Designated Areas

The effects of aquarium fish collection on coral reefs are not well documented. Known levels of exploitation of aquarium fish from designated areas over several years will provide valuable information on sustainable yields and effects of exploitation on coral reefs. At present, sustainable levels will have to be estimated from simple methods, such as the type used here. The method used here may underestimate the potential yield, but until better data on which to base sustainable yield estimates become available from the monitoring studies, such cautionary

approach is essential to avoid the risk of inadvertent overexploitation.

The abundance of coral reef fish populations is known to vary widely in space and time (Doherty and Williams, 1988; Jones, 1991). This is largely a consequence of their life histories which involve pelagic dispersal of offspring. Hence the recruitment dynamics of populations will be strongly influenced by the natural conditions that bring the larvae on to the reef. Many reef fish populations are not self-recruiting and may be seeded from within Maldives or from nearby areas. Preliminary assessment studies of exploited species of aquarium fish around Malé area (within 13 km radius) indicated that several species may be locally overexploited (Edwards and Shepherd, 1992). Experience in Sri Lanka also shows that populations of many species may be significantly depleted on a seasonal basis (Wood, 1985), which means that they are seasonally replenished by recruitment. Therefore in future it may be necessary to have protected spawning areas or ban collection from dive sites.

4.7 Endemic and rare species

Aquarium fish collection is a selective exploitation process of well sought after species that fetch high prices in the market. Of the 130 of so species exported in the trade, 20 species make more than 75% of the total numbers exported (Table 7).

Some of the species that are being exported are quasi-endemic with only limited geographic distribution, Maldives being the center of the abundance. Therefore, these populations are extremely important reserves for maintaining biodiversity.

Table 7: Commonest 20 species of fish exported in the trade and the estimate (nearest 50) of quantity exported in 1994. Source: Customs.

Species	Common Name	1994 Export
Acanthurus leucosternon	Powder Blue	28,700
Gobiodon citrinus	Poison or Yellow Goby	28,700
Pseudanthias evansi	Purple Wreckfish	25,550
Zebrasoma veliferum	Sailfin	21,150
Anthias sp.	Anthias	14,450
Dascyllus aruanus	Three-stripe Damsel	14,350
Rhinecanthus aculeatus	Picasso	10,900
Oxymonacanthus longirostris	Longnose	10,200
Chromis viridis	Green Damsel	9,600
Chaetodon falcula	Saddleback	9,100
Pomacentrus pavo	Jade Damselfish	8,200
Pseudanthias dispar	Longfin Wreckfish	7,950
Amphiprion nigripes	Maldives Clown	7,650
Pygoplites diacanthus	Royal	6,850
Nemanthias carberryi	Anthias	6,500
Chaetodon xanthocephalus	Yellowhead or Goldring	5,650
Clown Fish	Clown Fish	5,600
Macropharyngodon bipartitus	Rare Wrasse	5,500

Labroides bicolor	Yellow Diesel, Cleaner	4,900
Novaculichthys taeniourus	Dragon Wrasse	4,750
Total of 20 Common Species		236,250
Total exported in 1994		312,483
Percent of 20 Commonest		76

One of the species commonly exported is the Maldive Clownfish (*Amphrion nigripes*) which fits well under this category. Although this species occurs in the neighboring Sri Lanka and Laccadives, it is considered to be very rare in these areas. The clown fish lives symbiotically with the anemones that gives protection from its natural predators. At the same time the clown fish helps the anemones by removing parasites and providing food for them. They occur in family groups consisting of an adult pair and a number of sub-adults and juveniles. The life history pattern of this species is such that eggs are laid on to the anemone and eggs remain several days there before being released into the water column. In the water column the larvae then spend only a few days before settling to an anemone. As a result of limited dispersal of their larvae, anemone fish show the phenomenon of local endemism. For these reasons anemone fish are particularly susceptible to over exploitation. In 1994 it is estimated that about 5700 Maldives Clown and about 850 anemones were exported.

There may be several other species which are rare in the Maldives which warrant strict control on numbers collected. The recently "discovered" angelfish, *Apolemichthys armitagei* is also very rare in the Maldives and should be included in the species quota list. It is thought that many species of Wrasses (fam: Labridae) and Gobies (fam: Gobiidae) that are popular among the collectors are not fully described from the Maldives and therefore the extent of the distribution or rareness in Maldives are not known (Anderson, pers. comm.) One way to avoid heavy exploitation of deep sea wrasses may be to have maximum collection depth, that is to have a strict rule maximum dive depth. This may also reduce the risk of serious dive accidents that have happened in the past.

4.8. Business Considerations

The management of aquarium fish trade should not be taken only from a biological point of view. Economic considerations should also be taken in account when rules and regulations are being made to manage the fishery. In 1994 the export business earned about US$ 0.67 million which is worth about 2% of the total marine exports value. It is worth noting that from 1989-1993 the value of total export earning increased 1.7% where as in the same period the value of aquarium fish export earnings increased almost 65% (Anon, 1994).

To develop and expand the fishery in future, due consideration should be given (together with biological and environmental points discussed) to the following:

- the relatively large capital cost required to set up the holding facilities.
- the ongoing costs of packaging
- necessity of competitive freight charges for the consignments

For the exporting companies which have invested large amounts of capital in terms of holding facilities, collecting gear and transport vessels, a restricted quota system may discourage them. If more "small timers" were to enter the business the quota has to be distributed among all parties reducing the numbers that can be allocated for exporters with considerable capital tied up in their business. It may therefore be better in the future to consider licensing of the exporters and have designated areas for collection which could be closely monitored.

The costs of packaging takes a considerable amount, especially for the European markets and USA markets. Packaging requires Styrofoam boxes, oxygen, high quality polythene bags which all have to be imported for reexportation within a very short period. From a sample of invoices with full information (i.e., with breakdowns of packaging and freight costs) for 1993 shows that packaging costs about 11% for Sri Lanka and about 6% for Europe. However, the average packaging cost per box is about a dollar and half more for the European market.

Waiving of import duties on these exported items of packaging would partly solve the high packaging cost problem. Alternatively, styrofoam box manufacturing could be started in Malé The demand for styrofoam/regifaom boxes are high at the moment as many of the reef fish exporters use them. One major Singapore manufacturer considers that this could be manufactured in the Maldives quite cheaply.

Table 5. Comparison of packaging and freight costs for a sample of live tropical fish exports to Sri Lanka with those of Europe (Belgium, England, Netherlands, Switzerland, Germany, France) for 1993.

Packaging costs

Destination	Number of Boxes	Number of Fish	Packaging Costs US$	Total FOB [US$]	% Total in packaging	Packaging cost / box US$
Sri Lanka	1767	41260	8173	77281.60	10.58	4.63
Europe	1772	44745	10470	183945.95	5.69	5.91

Freight costs

Destination	Number of Box	Number of Fish	Freight cost US$	Total FOB [US$]	% Total in freight	Freight cost /box US$
Sri Lanka	1767	41260	16446.45	77281.60	21.28	9.31
Europe	1772	44745	70871.70	183945.95	38.53	40.00

Source: Customs

Freight cost also takes a considerable amount of the total FOB value. Average freight costs for Europe are in the range of 38%

and that of Sri Lanka is about 21%. Exporters claim that freight charges are not very competitive due to limited choice they have. As the chartered flights that fly direct to Europe does not carry any consignments they are limited to only few airlines. Connecting flights via Sri Lanka appears to be expensive. It is thought that special discounted rates from the airlines may be bargained for through an Exporters Association. But it appears that freight charges will come down as more airlines start to operate and direct connections to European destinations improve.

At present about 65% of the total exports are being to export to Sri Lanka gaining only about 40% of the total value (Figure 2). These figures are likely to go higher in the future as new exporters join the industry. The new comers often do not have access to European markets and their exports are mainly to Sri Lanka. MOFA with close collaboration with the proposed Aquarium Fish Exporters Association can play an active role here in trade promotions and finding new markets e.g., by participating in international trade fares such as the Aquarama and Interzoo that is held annually.

Table 9: Comparison of returns if the Sri Lankan exports were to be exported to European market. Figures are for 1994. Note the average European price of MRF 30.2 per fish was used to calculate FOB value for Europe.

Amount exported to Sri Lanka in 1994	FOB value of Sri Lankan exports	FOB value IF exported to European markets	Amount lost exporting to Sri Lanka
203,587	3,205,986	6,213,475	3,007,489

It is estimated that if the 1994's Sri Lankan exports had been exported to European markets there would have been an gain of extra 43% of the total export value (Table 9).

5. RECOMMENDATIONS

1. Fish collection using moxy nets should not be encouraged as this is a destructive method and cause considerable mortality at capture and in holding facilities.
2. A minimum standard for holding facilities should be established soon. Licensing of holding facilities and permanently moored holding cages could ease the work of monitoring of the holding facilities.
3. Before implementing 2, guide lines for the standards of holding facilities should be prepared
4. The Proforma Aquarium Fish Export Forms should be introduced soon in order to get the numbers of fish exported by species. This will considerably ease the burden of monitoring exports and provide systematic information on the trade.

5. Daily Log Forms of aquarium fish collection should also be introduced to get detailed information on collection areas, hours spent on collection etc. The data generated by this form will be valuable in detecting the symptom of overexploitation at an early stage.
6. Assigning of designated areas for aquarium fish collection should be initiated to start the build up of scientific data for the future management of the trade. This could be done in consultation with the aquarium fish exporters, MATI and other relevant government authorities.
7. Collection of rare and quasi-endemic species should be banned or controlled.
8. The present list of species subjected to quota should be reviewed urgently. The list should include rare and quasi-endemic species and species that survive poor in captivity.
9. In the short term regulations should be enforced banning collection of aquarium fish form proposed "protected" dive sites.
10. It is recommended that MOFA should encourage the formation of Aquarium Fish Exporters Association.

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APPENDIX A:

List of species that are subject to quota and the numbers allowed be exported in the period Jan 1995- June 1995.

Code	Species	Quota
DAM-B1	*Amphiprion nigripes*	1500
DAM-B2	*Amphirpion melonopus*	1500
DAM-B3	*Amphiprion sebae*	2500
DAM-B4	*Chromis viridis*	64000
DAM-B5	*Dascylus aruanus*	8500
DAM-B6	*Dascylus carneus*	5000
DAM-B7	*Dascylus trimaculatus*	8500
DAM-B8	*Pomacentrus brachialis*	58500
DAM-B9	Unspecified Damselfish	500
WRA-B1	*Anampses lineatus*	500
WRA-B2	*Anampses melagrides*	500
WRA-B3	*Bodianus axillaris*	500
WRA-B4	*Chelinus trilbatus*	500
WRA-B5	*Coris formosa*	50
WRA-B6	*Gomphosus caeruleus*	12000
WRA-B7	*Halichores leucoxanthus*	--
WRA-B8	*Labroides bicolor*	1000
WRA_B9	*Labroides dimidiatus*	8500
WRA-B10	*Macropharyngodon bipartitus*	500
WRA-11	*Novaculicthys taeniourus*	500
WRA-B12	*Pseudochelinus hexataenia*	500
WRA-B13	*Thalassoma hardwickie*	6000
WRA-B14	*Thalassoma lunare*	1000
WRA-B15	*Cirrhilaburs spp.*	500
SUR-B16	*Zebrasoma veliferum*	750
BUT-B17	*Chaetodon xanthocephelus*	500
Code C	Open	

APPENDIX B:

Quantity of aquarium fish (nos.) exported from the Maldives by country from 1989-1994. Source: Customs, Compiled by EPCS/MOFA

Country / Region	1989	1990	1991	1992	1993	1994
EUROPE						
United Kingdom	19938	7506	23262	25127	32059	29706
Italy	1771	381	7329	13808	4554	6486
Germany	3453	3107	6170	10177	6935	5973
Austria	0	0	927	0	0	445
Switzerland	189	605	224	5597	337	297
France	3029	1960	1538	5179	1380	770
Netherlands	9421	12655	10470	21083	15210	10666
Spain	9	0	0	0	0	0
Belgium	0	1681	4343	5034	2749	0
Denmark	0	0	1021	155	0	0
Sub Total	37810	27895	55284	86160	63224	54343
SRI LANKA	11940	21025	46308	71586	114643	203587
FAR EAST						
Thailand	0	0	0	0	0	338
Hong Kong	0	0	0	0	330	7500
Singapore	517	4	1673	29	88	704
Japan	1401	4890	7219	2483	5984	11196
Australia	51	19	0	0	0	0
Taiwan	0	450	0	0	0	180
Sub Total	1969	5363	8892	2512	6402	19918
OTHER COUNTRIES						
India	0	0	0	0	0	65
Bahrain	0	0	0	0	0	1410
U.A.E.	0	0	0	0	0	68
South Africa	0	0	0	0	0	69
Sub Total	0	0	0	0	0	1612
U.S.A.	2206	289	2214	1660	0	33023
GRAND TOTAL	**53925**	**54572**	**112698**	**161918**	**184233**	**312483**

APPENDIX C:

Value of aquarium fish (in MRF) exported from the Maldives from 1989-1994. Source: Customs, Compiled by EPCS/MOFA

Country / Region	1989	1990	1991	1992	1993	1994
EUROPE						
United Kingdom	455755	176100	583316	544179	765521	831298
Italy	59492	13236	225049	364067	125992	221443
Germany	67996	61158	1085083	275852	164512	240028
Austria	0	0	16927	0	0	14949
Switzerland	5498	21248	5117	166319	15354	7108
France	104890	59843	65861	185222	53381	6801
Netherlands	357355	417806	315109	603330	439564	336918
Spain	830	0	0	0	0	0
Belgium	0	35464	86590	151289	62430	0
Denmark	0	0	35989	6646	0	0
Sub Total	1051816	784855	2419041	2296904	1626754	1658545
SRI LANKA	138804	242989	574449	673325	1502780	3205986
FAR EAST						
Thailand	0	0	0	0	0	27965
Hong Kong	0	0	0	0	284724	853973
Singapore	8268	3093	78493	2146	9730	30568
Japan	51359	194978	336607	104537	322482	396480
Australia	915	1591	0	0	0	0
Taiwan	0	14333	0	0	0	8789
Sub Total	60542	213995	415100	106683	616936	1317775
OTHER COUNTRIES						
India	0	0	0	0	0	2650
Bahrain	0	0	0	0	0	10207
U.A.E.	0	0	0	0	0	655
South Africa	0	0	0	0	0	1139
Sub Total	0	0	0	0	0	14651
U.S.A.	60876	19576	41959	78911	0	831341
GRAND TOTAL	**1312038**	**1261415**	**3450550**	**3155824**	**3746471**	**7028295**

Additional Notes:

M E M O R A N D U M

DATE: 15 June, 1995

TO: Mr. Jadullan Jameel

FROM: M. Shiham Adam

RE: Key issues and recommendations of the aquarium fish report

CC: Hon. Minister Hassan Sobir, Maizan Hassan Maniku, Dr. Charles Anderson, Ahmed Hafiz, Mohamed Rasheed

As requested by you yesterday, I have attached with this memo a condensed version of the key issues raised in the aquarium fish report and their justifications for you to distribute to the Fisheries Advisory Board members before the meeting.

Should you need any more information regarding the report please let me know.

M. Shiham Adam
Enc/..

Key issues and recommendations of the Aquarium Fish Report to be discussed in the Fishery Advisory Meeting

- The present system of value-based quotas should be abolished and quotas based numbers should be introduced.

  The present aquarium fish export license does not stipulate the number of fish that can be exported but only gives the value of .fish that can be exported for a given period. The numbers of fish exported per given license solely depends on the value of invoice that an exporter declares to the customs. The system is open to abuse. To control the total number of fish exported, licenses should be based on numbers and exporters should fill the "Proforma Aquarium Fish Export Forms" (see below) as a substitute of packing lists. Custom officials can than easily maintain running totals of numbers of fish exported for a given license and the total exported. A system for allocating quotas to exporters will have to be set up.

- Proforma Aquarium Fish Export Forms should be introduced soon in order to get the numbers of fish exported by species. This will considerably ease the burden of monitoring exports and provide systematic information on the trade.

  Knowledge of the different numbers of species exported is important for updating the species quota list and avoiding possible over-exploitation of rare species. It can also simplify the monitoring procedure of the total number of fish exported and hence to enforce the species based quota and total quota for the aquarium fish trade. These forms will have a list of all species (scientific names and trade names) that are likely to be exported. The exporter will have to submit this form instead of the packing list. The only thing that the exporter have to fill is the number of fish and the price by species.

- Coordination between MOFA, Customs and Ministry of Trade and Industries should be strengthened in order to better regulate the fishery.

  It is apparent that Customs Officials were not aware of the present species based quota. Their rules and administrative setup were not adequate to record such information. In the past MOFA was under the impression that licenses were issued on number based quotas and that limits set by MOFA was properly enforced. MOFA announced that only 300,000 fish will be allowed to export during 1994 yet more than 300,000 were exported during this year. Regular meetings and proper communication should reduce these misunderstandings.

- Importance of setting a Fisheries Products Export Unit at the Customs.

  Although this issue is not mentioned in the report, setting up a Fisheries Products Export Unit at customs should be considered to get accurate fishery statistics. The export of fishery products in the form of live and frozen fish are increasing and the varieties of fishery export products are becoming diverse. At the same time MOFA is strengthening it regulatory and monitoring capacity of the fishery resources. To strengthen its regulatory and monitoring capacity, accurate and reliable data is crucial. By having trained fishery officials at the customs, MOFA can guarantee information on new fishery export products / items are reported and hence MOFA will have time to act to accommodate its data collection system to include such new items. A good example is export-oriented fishery of the grouper, which went out of control before MOFA knew much of the exporters activities!

- a: A minimum Standards for holding facilities should be established soon. Licensing of holding facilities and permanently moored holding cages œuld ease the work of monitoring of holding facilities.
- b: Before implementing a, a guide line for the standards on holding facilities should be prepared.

  This in my opinion is not a serious issue in the short term. It is thought that mortality is quite low (about 2-4% of the total catch) at the holding facilities. This is a very small amount compared with that of Sri Lankan trade which is estimated at about 25%. However, one way to ensure minimum mortality at holding cages is to have a regulation on the minimum standard, required before an export license can be issued. This will also limit the number of people entering to the trade. Guidelines for the standards of holding facilities are being prepared by MRS; this will take some time.

- MOFA should encourage the formation of an "Aquarium Fish Exporters Association".

  It is important for MOFA as a regulating body to have close dialogue with the exporters. One way to communicate and know what is happening in the trade is to have close relation with such an organization. Through this association it will be easy for MOFA to assist in securing new markets to avoid the heavy loss incurred to the trade by exporting to Sri Lankan markets at low rates

- A catalogue of aquarium fish should be prepared and distributed or sold to the Customs and all exporters.
  It is important that the Customs Officials know which species are being exported and the names referred to

species are consistent. At present MRS is working on a Preliminary Aquarium Fish Catalogue by duplicating published photographs.

- Fish collection using "moxy" nets should not be encouraged as this is a destructive method and causes considerable mortality at capture and in holding cages.

  This method of fish collection has been identified at about the end of last year. The matter was raised at an internal meeting at the Ministry. As a result, a general circular (attached with this memo) has already been sent to the exporters. A specific circular was also sent to the people who were identified using this method of fish catch. As a result of this circular, Mr. Saleem (representing the Union Enterprise) confirmed in writing to the Ministry that he has dismissed all Sri Lankans who were apparently using this technique for fish collection. It is strongly recommended that this method of collection or any other destructive method should be completely banned.

- a: Collection of rare and quasi-endemic species should be banned or controlled.
- b: The present list of species subjected to quota should be reviewed urgently. The list should include rare and quasi-endemic species and species that survive poorly in captivity.

  The fish fauna of the Maldives is said to be poorly described. The most compressive and up to date taxonomic work on Maldivian fish fauna is that of by John E. Randall and R. C. Anderson (1993). They have described about 900 epipelagic and shore fishes from the Maldives of which 201 of these are new records. According to Dr. Anderson more new fishes are being "discovered" and described. Some of the species that are exported in the trade are quasi-endemic with centers of population occurring in the Maldives and hence these will be important reserves for maintaining biodiversity. It is therefore recommended that these species should be banned or should have a strict quota. Some other species have very specific eating requirements that cannot normally be met in aquaria. These include some coral polyp eating butterfly fishes. The export of these species should be banned.

- In the short term regulation should be enforced banning collection of aquarium fish from proposed "protected" dive sites.

  15 dive sites have now been officially declared as protected sites. Collection of fish apart from bait fish is prohibited from these areas.

- "Daily Log Forms" of aquarium fish collection should also be introduced to get detailed information on collection areas, hours spent on collection etc. The data generated by this form will be vital in detecting symptoms of over-exploitation at an early stage.

  The form should be filled for every collection trip. This will have information on where the fish was caught, how much of each species caught, time spend in collection, method of catch etc. This is the kind of information required for the scientist which will help to detect symptoms of over-exploitation at an early stage. This is also and excellent way to generate data for the proposed Integrated Reef Resources Management Program (IRRMP) which will be important for future projects.

- Assigning of designated areas for aquarium fish collection should be initiated to start the build up of scientific data for the future management of the trade. This could be done in consultation with the aquarium fish exporters, MATT and other relevant government authorities.

  This recommendation is intended to get collection information from specific sites, which is important for the scientist in proposing long-term management regimes of the aquarium fish trade. It may also ensure minimum conflict with other user groups. This will be a medium term goal and could again be integrated in the IRRMP if zoning is going to be proposed for reef resource management.

M. Shiham Adam
15 June 1995