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AN INDUSTRY ANALYSIS OF THE FRESHWATER ORNAMENTAL FISHERY WITH PARTICULAR REFERENCE TO THE SUPPLY OF BRAZILIAN FRESHWATER ORNAMENTALS TO THE UK MARKET

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RESUMO

A proposta desta pesquisa foi desenvolver e entender o mercado potencial e a viabilidade para estabelecer um comercio sustentável de peixes ornamentais na Reserva de Desenvolvimento Sustentável Mamirauá, Brasil. Esta análise complementará e ajudará nas pesquisas e nos planos de negócios de outros paises. O objetivo principal da análise foi o mercado exportador (especificamente da UK) de peixes ornamentais. O projeto foi primariamente iniciado numa pesquisa bibliográfica, complementada por entrevistas com vários interventores e a participação em diferentes oficinas sobre o tema especifico.

PALAVRAS-CHAVE

Comercio de peixes ornamentais. Peixes amazônicos. Mercado de exportação de peixes ornamentais amazônicos.

ABSTRACT

The purpose of this research was to develop an understanding of the market potential and viability of establishing a sustainable ornamental fish trade in the Mamirauá Sustainable Development Reserve in Brazil. This analysis will complement and advise the project's in-country investigations and business plan. The focus of the analysis was the export market (specifically UK) for ornamental fish. The project was undertaken primarily by desk research, complemented by interviews with a number stakeholders and participation in workshops.

KEY WORDS

Ornamental fish trade. Amazon fishes. Export market of ornamental amazon fishes.

[1] Project Sustainable Management of Ornamental Fish Species in Mamirauá, Brazil
Conservation Programmes. Zoological Society of London

INTRODUCTION

Review of global market

Size

The worldwide aquarium industry, including live ornamental fish equipment, accessories, supplies and publications, etc., has grown considerably during the last 35 years. Andrews (1992) estimated that in 1971, the total world market for aquarium fishes, equipment and accessories was worth $4 billion1, increasing to $7.2 billion in 1986. Dawes (2001) estimated the entire industry to be worth about $15 billion. The fish themselves represent only a fraction of the overall industry, maybe as little as three percent (WATSON, 2000). About 90% of the ornamental fish products originate in captivity, and the other 10% is wild-caught fish (ANDREWS, 1990; OLIVIER, 2001). Of the total of wild-caught fishes, 4-10 % are of marine origin and 90-96% are of fresh water origin (OLIVIER, 2001).

Over the last ten years the value of global exports of ornamental fish has averaged just over $183 million/year, while global imports have averaged just over $281 million/year (Figura 1).[2] Between 1985-1999, the international commerce of aquatic organisms had an average annual growth of around 14% (Figure 2). In 1996 and 1997 the global value of ornamental fish exports peaked around $200 million, dropping to just under $160 million in 1999. The drop in exports during the years 1998 and 1999 may be explained as repercussions of the strong El Niño of 1997-8 (CHAO, pers. comm.). Since then, export value has increased steadily by about 14%/year, setting a record of $211,546,000 in 2003. Basleer (1994) estimates that the global wholesale trade value of ornamental fishes is near $900 million, excluding freight and packing, and the total retail value may reach $3 billion.

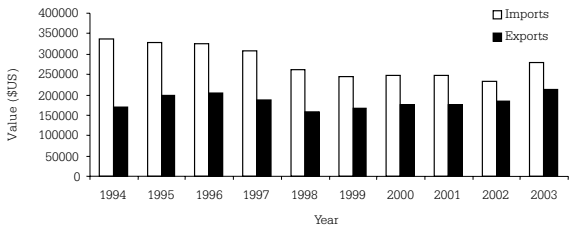

Figure 1. Value of global ornamental fish market. (Source: FAO Fishstat, 2005).)

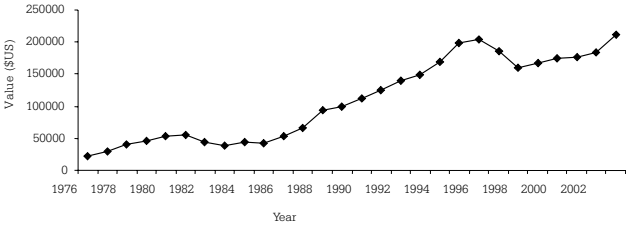

Figure 2. Evolution of ornamental fish export value. (Source: FAO Fishstat, 2005).

It is difficult to calculate the quantity of fishes traded annually with any accuracy due to reporting irregularities. Statistics provided by FAO do not clarify the number utilized in the their downloads as Figure 3 indicates. If numbers are given in thousands, then the number of individuals exported annually reaches just over 20 million. If numbers are given in ten thousands in order to reflect Brazilian exports as reported by FAO, which would thus total 11,000,000, then the global total reaches over 2 billion individuals. Fitzgerald (1989) has estimated that 350 million fishes are sold annually. Andrews (1992) estimated that only 150 million ornamental fishes were sold in the world market.

[1] All values in this paper are expressed in US$.

[2] There are several reasons for the discrepancy in export and import figures. The principal reason is that freight charges are frequently included in import values. Additionally, there is no uniform nomenclature for reporting import and export statistics; there are no real standard units of volume for reporting imports and exports; and the various reports

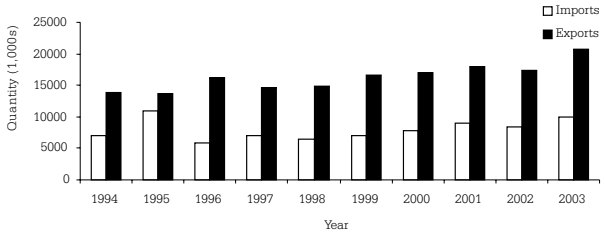

Figure 3. Global imports/exports (number of individuals). (Source: FAO Fishstat, 2005).

End markets

The principal end markets for ornamental fish are located in Europe, North America and Asia (Figure 4). The largest markets are in the major industrialised countries: the USA (17%), Germany (8%), the UK (7%), Japan (7%), and France (6%) (Figure 5; Table 1). The size of their national markets, and their higher mean level of education and income seem to be indicative of the correlation with highest volumes of imports. Despite

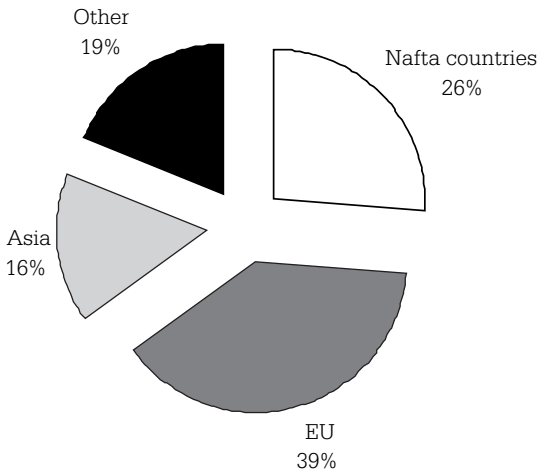

Figure 4. Percentage of import value by region in 2003. (Source: FAO Fishstat, 2005).).

oscillations in imports from year to year in these five countries, their percentage of ornamental fish imports have remained relatively stable since FAO began compiling statistics in 1976.

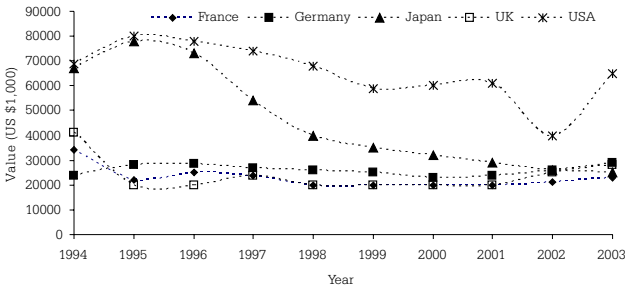

Figure 5. Evolution of imports for the largest importers of ornamental fish in 2003. (Source: FAO Fishstat, 2005).

Typical supply chain

1. Collectors - Are generally organized in family units, utilizing artisanal technology and methods.

2.Breeders – As was mentioned above, ornamental fish culture provides about 90% of all ornamental fish in the market and, thus, serve as direct competition to those involved in the trade of wild-caught species.

3. Intermediaries – For wild-caught fish as many as three intermediaries may be involved in the chain between collectors and exporters.

4. Exporter – Buys fish from intermediaries or directly from collectors and breeders. Fish are generally quarantine for some period, although the time and husbandry methods vary, most likely in direct correlation with the number of exporters. Singapore exporters are a special case as they are specialized in conditioning and transporting fishes bred on farms throughout Southeast Asia.

5. Importer – Receive stock from exporters throughout the world, depending on the demand from their clients who may be wholesalers and/or retailers. Some may also be exporters as well transhippers. The importer must pay the freight costs associated with importation.

6. Transhippers – Consolidates orders from various buyers (importers, wholesalers or retailers) at airports and distributing them. Often they don't

Table 1. Principal exporting and importing countries

Top exporters of ornamental fish				Top importers of ornamental fish			
Rank	Country	2003	Increase from 2002	Rank	Country	2003	Increase from 2002
1	Singapore	41,427	-1%	1	USA	64215	38%
2	Czech Rep.	16,183	18%	2	Germany	28662	15%
3	Malaysia	14,147	-24%	3	UK	26506	11%
4	Spain	14,046	75%	4	Japan	24724	-4%
5	Indonesia	13,372	5%	5	France	22042	5%
6	Japan	12,395	33%	6	Singapore	13334	15%
7	USA	8,561	2%	7	Netherlands	11925	16%
8	Israel	8,525	34%	8	Belgium	11602	12%
9	Thailand	7,392	29%	9	Italy	11506	10%
10	Philippines	6,816	5%	10	Hong Kong	9663	2%
11	Morocco	6,475	90%	11	Spain	6756	22%
12	Sri Lanka	6,459	14%	12	Canada	6588	1%
13	Belgium	5,275	18%	13	Malaysia	3971	-12%
14	Hong Kong	4,871	2%	14	Switzerland	3174	15%
15	Colombia	4,599	7%	15	Sweden	2734	16%
16	France	3,62	16%	16	Mexico	2655	-6%
17	Peru	3,102	-107%	17	Australia	2568	-9%
18	China	3,025	28%	18	Korea, Rep.	2558	11%
19	Netherlands	2,971	42%	19	Austria	2517	26%
20	Brazil	2,379	-36%	20	Denmark	2297	12%

even possess installations. They are common where air routes are limited and/or shipping rates are high. Singapore, the USA, and Germany are known as key points of transhipment.

7. Wholesaler/Jobber – Wholesalers consolidate shipments from various importers to provide retailers in regional markets with stock. Jobbers serve the same function as wholesalers, but like transhippers, don't maintain permanent installations. They are specialized in consolidating stocks according to retailer needs and making direct deliveries.

8. Retailer – Retailers can buy fish directly from importers, transhippers, wholesalers or jobbers. Buying from transhippers and jobbers carries risks and additional costs as the retailer must acclimatise the fish before sale. Olivier (2001) claims there is a growing tendency in the retail segment to bypass the wholesalers.

9. Consumer – Consumers are fish-keepers with varying degrees of skill and preferences.

10. Key stakeholders

a) Animal rights groups.

b) CBD - 1992 Convention on Biological Diversity. The CBD promises to promote of the rights of countries of origin to retain some of the benefits of their biodiversity resources that have entered the marketplace via other countries

c) CITES - Convention on Trade in Endangered Species. CITES works by subjecting international trade in biodiversity of selected species to certain controls. All import, export, re-export and introduction of species covered by the Convention have to be authorized through a licensing system.

d) FAO - Helps developing countries and countries in transition modernize and improve agriculture, forestry and fisheries practices; Monitors world fisheries.

e) Governments-Environmental agencies, ministries of agriculture, etc

f) IATA – International Air Transport Association. The body responsible for the regulation of international airfreight, including live animals.

g) IUCN - The Union's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. The IUCN links research and results to local, national, regional and global policy by convening dialogues between governments, civil society and the private sector.

h) OIE - World Organisation for Animal Health. There are 167 member countries participating in the OIE. The OIE ensures transparency in the global animal disease and zoonosis situation; to collect, analyse and disseminate scientific veterinary information; and provide expertise and encourage international solidarity in the control of animal diseases. Within its mandate under the WTO SPS Agreement, it seeks to safeguard world trade by publishing health standards for international trade in animals.

i) OFI - Ornamental Fish International. The worldwide trade body for the ornamental fish industry.

j) WTO - World Trade Organisation. The Agreement on Technical Barriers to Trade (TBT) states that members do not use technical regulations or standards as disguised measures to protect domestic industries from foreign competition. Thus, certification programs must recognize this agreement.

Key competitors

Most captive bred ornamental fishes originate from fish farms in Singapore, Malaysia, Japan, Israel, Czech Republic, Thailand, Hong Kong, and the US (Figure 6; Table 1). Although much of the exports of ornamental fish originating from these countries may be a consequence of some transhipping, their combined share of the global trade represents 53%. It should be noted that Singapore does breed ornamental fish, but typically imports fish from Malaysia, Thailand, and Indonesia and other Southeast Asian countries, and conditions them; adding value to the product and taking advantage of low freight costs to provide the market with high quality (according to Olivier (2000), it is now suffering from fish diseases however), low cost fish. Thus, if it imports $13,334,000 and exports $41,427,000, then it would gross $28,093,000 during 2003. What percentage of this total is comprised of internally bred fish I was unable to ascertain. Percentual

Legislative environment: welfare and conservation

The only international legislation affecting the global trade in ornamental fish is CITES. Appendix 1 specimens cannot be used for commercial purposes. Appendix 2 and 3 specimens require an export permit or re-export certificate issued by the Management Authority of the State of export or re-export. The specimen must be obtained legally and not negatively affect the survival of the species. Any risk of injury, damage to health or cruel treatment must be minimized. Import permits are only needed if required by the importing country. The only the species that might be considered ornamental in the Brazilian Amazon that appears on the 2006 IUCN Red List of

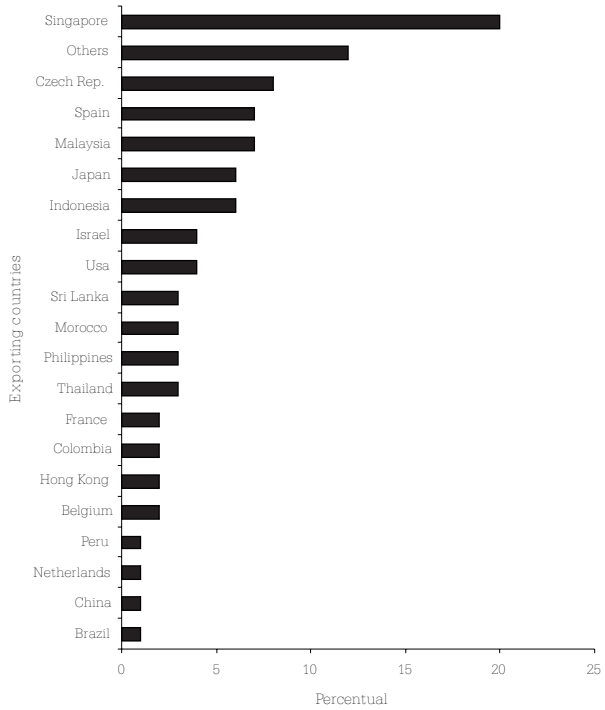

Figure 6. Principal exporting countries of ornamental fish in 2003. (Source: FAO Fishstat, 2005).)

Threatened Species is the *Arapaima gigas*. This species has been on Appendix 1 since 1975.

Increasingly, the World Organisation for Animal Health (OIE) is becoming a major actor regarding welfare in the ornamental fish trade. Exporting countries must now be certified as free from specific pathogens associated with certain cold-water species in the carp and salmon families common in aquaculture. Although these diseases are not presently found in tropical climates, the testing required is extensive and expensive. The problem is that there exists no laboratory in Brazil with the equipment to test for such diseases, but according to Brazilian law, only Brazilian certified laboratories can test for the diseases. As of today, Brazilian exporters are unable to export ornamental fishes to Spain. This issue may become more complicated as gold fish are now being raised on farms in some Amazonian countries such as Colombia and Brazil. According to some exporters there is also the possibility that, with the avian flu epidemic, OIE and its member states may be frightened sufficiently to apply stringent welfare guidelines for all shipments of live animals.

Current status and key trends

As of 2003, the value of ornamental fish exports were at their highest on record (FAO Fishstat, 2005). Unfortunately it is not possible to present more current data is there is a lag of two years in reporting by FAO.

According to Olivier (2001), two trends in the fish-keeping hobby are worth noting. The first is that marine aquariums are becoming more popular as technology necessary to maintain marine ornamentals becomes more available and less expensive. The quality of marine ornamentals has also improved as many NGOs such as the Marine Aquarium Council (MAC) and Ocean Voice have moved to eliminate harmful fishing practices. This trend can also be observed in the data provided by FAO (Fishstat, 2005). Since about 1989, and particularly since the mid-1990s, countries that exported next to nothing now have meaningful ornamental fish exports. In the South Pacific, countries such as Kiribati, Marshall Islands, Cook Islands, Fiji Islands, French Polynesia, Micronesia, New Caledonia, and Tonga are now present in FAO's report. In the Middle East, Iran, Egypt, Libya, Morocco, Saudi Arabia, United Arab Emirates, and Yemen are now ornamental fish exporters. In the Indian Ocean, Maldives, Mauritius, and Sri Lanka, as well as Mexico, Costa Rica, Haiti, Martinique, Netherlands Antilles, and Trinidad and Tobago in the Caribbean have all shown growth in ornamental fish exports.[3]

[3] MAC has a nice map of the marine ornamental fish trade: http://mac.inets.com/uploads/docs/1/image/map_large.jpg .

The second trend, according to Olivier (2001), is that the fish-keeping hobby has broken down social barriers. She claims that the hobby is now open to all and that fish are being treated as standard consumer products. As such, she concludes that consumers are in search of low prices without thinking about quality. She does not offer any proof of her position however, so I am dubious of her claim.

A third trend can be identified as the growing recognition that wild-caught ornamental fish have socio-economic and environmental value (CHAO *et al*., 2001; TLUSTY, 2002; ROSSER, 2003). This trend is also reflected in the very project we are presently undertaking.

A fourth trend is the growth of large pet stores such as Petco and PetSmart and Wal-Mart in the US. There is some debate on what the effects of these super stores are exactly. Many trade participants feel that the small pet/aquarium store has benefited from their growth, as fish quality is low, causing the consumer to seek the local pet/aquarium store, as the staff is more knowledgeable. Others claim that the low prices for equipment is creating more hobbyists who then look for more variety offered at the local pet/aquarium store.

Lastly, with regard to freshwater fish species, personal communication with industry participants and with Dr. Chao of Project Piaba (who has intimate contact with many importers in Asia and Europe) indicate that consumer interest in specialty fishes such as stingrays

(Potamotrygonidae), Loricariidae, Apistogrammas and corydoras continues. He also noted that importers are interested in introducing new species verities that can often stimulate the enthusiasm of the hobby.

THE AMAZONIAN EXPORT MARKET

Size

In the ten years between 1994 and 2003, the average value of Amazonian ornamental fish exports was about $11.5 million/year (Figure 7). Together, the countries of Brazil, Colombia, Ecuador, Guyana, Peru and Venezuela represent about 6% of the total global export value of ornamental fish. The largest exporting country is Colombia (46%) followed by Peru (30%), Brazil (23%)[4], Guyana, Venezuela and Ecuador (Figure 8).

Colombia is currently the largest exporter of ornamental fish in South America. Between 1991 and 2004, Colombia has exported an average of 18,185,357 individual fish per year (Figure 9). Over

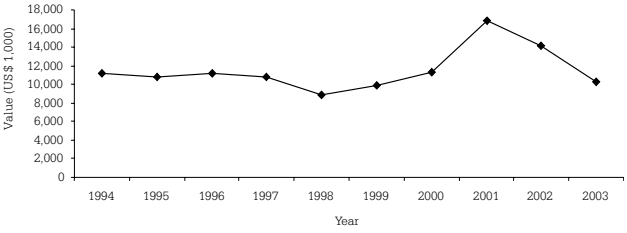

Figure 7. Total value of ornamental fish exports from Amazonian countries. (Source: FAO Fishstat, 2005)

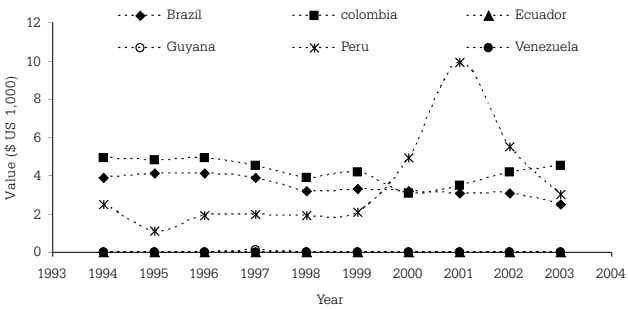

Figure 8. Ornamental fish export value from Amazonian countries. (Source: FAO Fishstat, 2005).

[4] Market data for Brazil will be treated in forward.

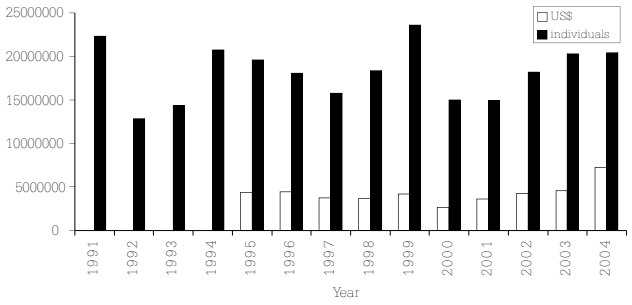

Figure 9. Evolution of Colombian exports of ornamental fish. (Source: SANABRIA, 2005).

the last two years, exports have amounted to just over 20 million individuals. Although exports remained stable during 2003 and 2004, profits rose by $2,709,000 or roughly 61%.

Peru is the second largest exporter of the Amazonian countries. Export statistics present an anomaly for as export quantities tended to decrease since 1994, export values tended to increase (Figure 10). In fact, they rose to such an extent that in 2001, the average selling price per individual was just under $1.00. Much of this great increase in exports is due largely to sale of large, high value species such as stringrays, *Osteoglossum bicirrhosum, Zungaro zungaro,* and *Phractocephalus hemioliopterus* (CAMPOS, 2005). It should be noted here that Peru has 'negative list' of 41 fish species which are not permitted to be exported (Appendix 2). Price lists obtained from

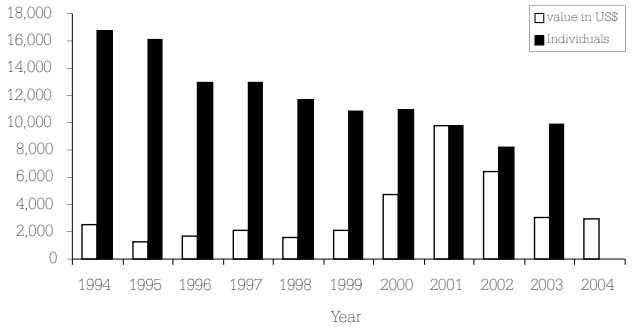

Figure 10. Evolution of Peruvian exports of ornamental fish . (Source: FAO Fishstat, 2005; HUANQUI, 2005)

exporters out of Iquitos indicate that several prohibited species are offered for sale anyway.

The combined exports of Guyana, Venezuela and Ecuador only reach 1.4% of ornamental fish exports from Amazonian countries. Of these three countries, Guyana is the largest exporter (Figure 11).

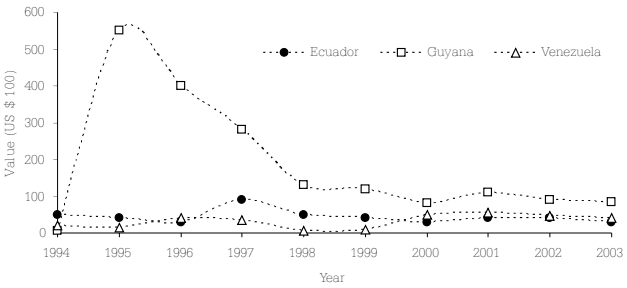

Figure 11. Evolution of exports of ornamental fish from other Amazonian countries. (Source: FAO Fishstat, 2005).

End Markets

The United States is the largest importer of Colombian ornamental fishes, followed by the European Union and Asia (Table 2). While the United State is the largest importer, imports fell 36% between 1984 and 2004. The reason for this precipitous drop is due to the growing Asian market, and an increase in direct flights to Europe from Colombia that has reduced the number of transhipments through the USA (CASTRO, 2005).

Within Europe (Figure 12), Germany is the largest importer of ornamental fish, followed by UK, and

Table 2. Destinations of Colombian Ornamental Fish

Destination	1984	1994	1999	2004
USA	73%	69%	58%	37%
Europe	27%	24%	23%	22%
Japan		6%	13%	12%
Others			5%	11%
Asia (other)				10%
Central America				8%

(Source: SANABRIA, 2005)

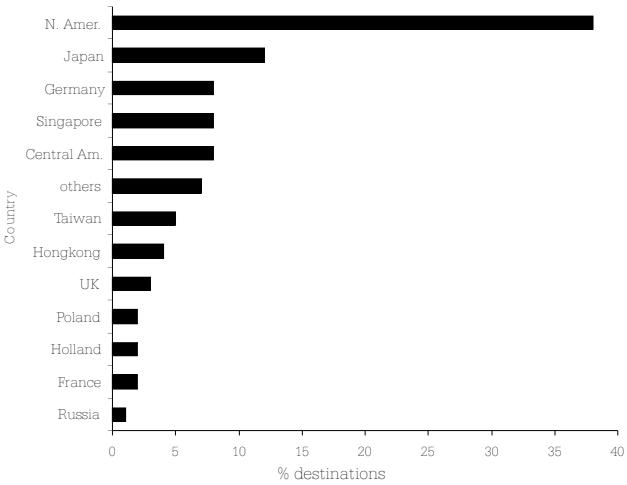

Figure 12. Destinations of ornamental fish exports from Colombia in 2004. (Source: CASTRO, 2005)

France. However, it should be noted that Frankfurt is a key transhipping point in Europe, and many ornamental fish imports into Germany are re-exported. In Asia, Japan is the largest importer, followed by Singapore, and Taiwan and Hong Kong, the latter two may be transshipping to China. Colombian exporters believe that it is in the Asian market that future sales growth will be the highest.

Peruvian ornamental fish are shipped to about 70 cities around the world. However, air routes out of Lima are not very extensive. Consequently, transhipping via Miami is very common. Peruvian exporters complain that transhipping negatively effects the prices of Peruvian fish as each carrier utilized increase the price/individual fish. Transhipping was common for shipping to some points in Europe. The US is the main importer of Peruvian ornamental fish (Figure 13). However, since 2001 Peruvian exports to Asia have increased from about 25% to over 50%, with Hong Kong and Taiwan nearly doubling their imports (HUANQUI, 2005). This increase is attributed to improved air routes, but might also result from the liberal export laws.

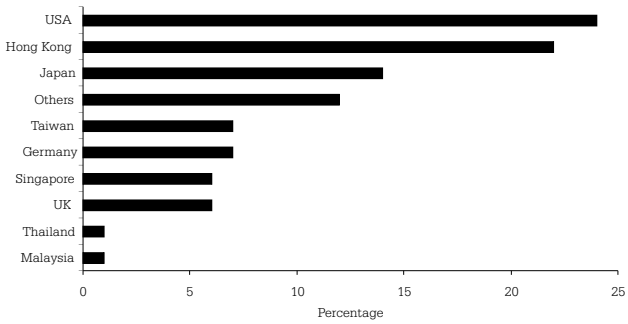

Figure 13. Ornamental fish imports from Peru by world region in 2004. (Source: HUANQUI, 2005)

The largest importer of Venezuelan ornamental fish is also the US, followed by Germany, the UK, and Denmark (Figure 14). In 2003, Venezuela exported about $28,000 worth of ornamental fish (FAO, 2005). I was unable to obtain any more end market data for Venezuela, and found nothing for Ecuador. Exports from Guyana have declined in recent years for reasons are not clear. Watson (2005) attributes the decline to the lack of direct air routes to Europe, competition from other South American exporting countries, competition from fish farms, and the absence of a coherent marketing strategy by Guyanese exporters. Only the UK and Germany import fishes directly from Guyana.

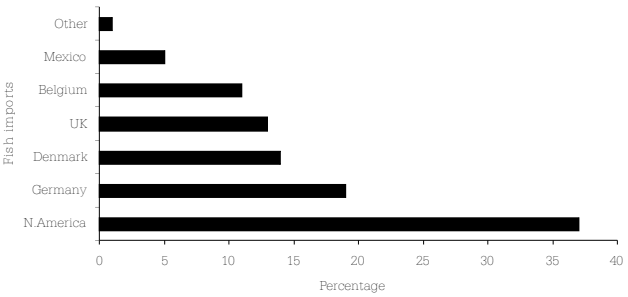

Figure 14. Ornamental fish imports from Venezuela by world region in 2004. (Source: MONAGAS, 2005).

Principal Product Offerings

Colombia's principal exports are composed of species from the Characidae (49%), Loricariidae

(19%), and Callichthyidae (10%) families, representing around 78% of the total volume in 2004 (Table 3). Although the Characidae family represents the highest volume of exports, only 16 species are exported. The Loricariidae and Callichthyidae families, however, are represented by greater diversity, with 61 and 29 species exported respectively.

Of the 19 characins, as well as overall, the *Paracheirodon axelrodi* is most popular ornamental fish export, representing nearly 32% of exports and more than 6.5 million individuals (SANABRIA, 2005). Other important characins include the *Paracheirodon innesi* (10%) *Hemigrammus rodwayi*, which may in fact be *Poecilocharax weitzmani* (7%), *Hemigrammus rhodostomus* [sic, *bleheri*] (6%), and *Hyphessobrycon sweglesi* (6%). Eleven genera of Loricariidae are permitted for export. In 2004, 61 varieties of Loricariidae were exported (Table 3). The *Otocinclus* genus contributes the second most to Colombian exports, representing 46% of the category. In addition to *Otocinclus*, *Hemiancistrus*, *Farlowella*, and *Chaetostomas* genera, there are a variety of species exported from the genera *Hypostomo*, *Panaque*, *Peckoltia*, and *Ancistrus*. Among the 29 Callichthyidae exported from Colombia are 6 genera: *Bunocephalus*, *Brochis*, *Callicthys*, *Corydoras*, *Dianema*, and *Hoplosternum*. Although Colombia permits the export of at least 14 species of *Corydoras*, 3 species (*C. metae*, *C. melini* and *C. aeneus*) represent 15% of all exports from the Callichthyidae family (SANABRIA, 2005).

Table 3. Principal Families of Fish Exported from Colombia in 2004.

Family name	# of species	% of exports 2004
Characidae	19	48.55
Loricariidae	61	18.52
Callichthyidae	29	9.9
Pimelodidae	3	4.16
Gasteropelecidae	4	3.46
Osteoglossidae	2	3.23
Cichlidae	3	2.73
Serrasalmidae	3	2.57
Doradidae	3	1.48
Ariidae	1	1.28

(Source: SANABRIA, 2005).

According Campos (2005), at least 361 species of fish are exported as ornamentals (Appendix 3). Peru exports relatively high-priced fishes such as stingrays (Potamotrygonidae), aruanã, electric fishes (Gymnotiformes) and large catfishes (Pimeloidae), in large numbers, to international markets (MOREAU; COOMES, 2007). Based on price lists I obtained and the principal species of ornamental fish exported from Peru (Table 4 & 5), two species, *Osteoglossum bicirrhosum* (aruanã - 1,257,112 x $.68/each[5] = $852,043) and *Phractocephalus hemioliopterus* (red tail catfish - 76,647 x $4.00/each = $306,588), represent of 37% of exports in 2003; probably more. The most commonly exported species in terms of quantity are the *Otocinclus affinis*, *Osteoglossum bicirrhosum*, *Hyphessobrycon erythrostigma* and the callichthyid catfish *Corydoras julii* (Table 4).

I was unable to locate specific export data regarding product offerings for Guyana and Venezuela, but a list of species exported by each country is provided in Appendix 4.

Table 4. Export values of Peruvian ornamental fish in 2003. (Source: CAMPOS, 2005)

Specie	Value ($1,000)
Otocinclus affinis	32,511
Osteoglossum bicirrhosum	852,043
Corydoras julii	20,882
Hyphessobrycon eryrostigma	15,588

Typical supply chain

[5] The price lists I obtained indicate that export prices range between $1.80-2.20 for juveniles and $6.00 for larger individuals. Thus, export revenues may reach near $2.5 million/year.

Table 5. Principal species of ornamental fish exported from Peru in 2003.

Specie	Individuals
Otocinclus affinis	2,421,184
Osteoglossum bicirrhosum	1,257,112
Corydoras julii	649,461
Hyphessobrycon erythrostigma	620,865
Paracheirodon innesi	455,930
Carnegiella strigata	404,292
Corydoras hastatus	325,735
Corydoras punctatus	280,017
Boehlkea fredcochui	273,881
Corydoras arcuatus	210,965
Brochis splendens	69,749
Leporinus fasciatus	142,469
Carnegiella marthae	132,218
Ancistrus dolichopterus	99,917
Pimelodus pictus	99,160
Hyphessobrycon bentosi	87,824
Corydoras elegans	86,025
Nannostomus trifasciatus	80,388
Phractocephalus hemioliopterus	76,647

1. Collectors – In Peru collectors have 250 fishing areas located along 21 rivers, with three rivers—the Nanay, Itaya and Ucayali—supplying over 80% of all fishes received at exporters' facilities (CAMPOS, 2005). Moreau & Coomes (2007) estimate that there may be as many as 4,500 year-round collectors, and possibly 3-9,000 part-time collectors (probably a very generous estimate). The number of collectors in Colombia is not known precisely, but Perdomo (2005) estimates 2,309 collectors in all of Colombia. Collectors are active in the following river basins: Orinoco, Amazonas, Pacific, Magdalena, and Atlantic. 88 percent of exports in 2004 originated in the Orinoco basin (SANABRIA, 2005).

2. Intermediaries – There may be as many as 300 intermediaries working in the Peruvian Amazon (MOREAU; COOMES, 2007). In Peru intermediaries are known as *proveedores*, and there are two levels. Intermediaries consolidate the production of collectors and/or other smaller-scale intermediaries transactions may involve cash or debt-merchandise contracts, termed locally as *habilitación* (*aviamento* in Brazil). According to Perdomo (2005), there are approximately 65 intermediaries involved in the ornamental fish trade in Colombia. Fish can pass through as many as three levels of intermediaries before reaching exporters' facilities in Bogotá: primary intermediary; regional intermediary; national intermediary.

3. Exporter – There are eleven exporters operating in Iquitos (HUANQUI, 2005). Moreau & Coomes (2007) identify two categories of exporters: '*miamero*' companies, whose main clients are importers in the US, and '*destino final*' (DF) companies that ship fish directly to clients across the globe. DF companies, in contrast to *miameros*, specialise in supplying specific varieties of quality fishes. There are about 16 exporters operating out of Colombia. Logistics in both countries are estimated at between 18-25% of the price of fish sold. There are two exporters currently active in Guyana, and 6 in Venezuela. In each of these countries, generally one to three firms dominate in export volume. Packing costs for exportation are about $12.00 per each double box. Boxes are made of Styrofoam inside a cardboard box, with dimensions of 42 x42 x 40 cm (16 x 16 x 15 inches). Each box holds 9-15 kg of water, depending on the number and size of fish being shipped. Shipping agent expenses from Iquitos and Bogotá are about $100.00/box. I was unable to obtain freight costs for Peru, but freight costs from Colombia (discussed later) are provided in Table 9. Freight may cost 100-500% of the cost of the fish themselves.

Key stakeholders

1. Venezuela

a. The National Institute of Fisheries and Aquaculture (INAPESCA)

b. Ministry of Agriculture and Land
c. Ministry of Environment and Natural Resources (MARN)
d. Ministry of Production and Commerce
e. Ministry of Foreign Relations

2. Peru

a. Ministry of Production
b. National Fishery Development Fund (FONDEPES)
c. Institute of Fishery Technology (ITP)
d. Peruvian Amazon Research Institute (IIAP)
e. Agricultural Ministry
f. National Institute of Natural Resources (IRENA)
g. State and Municipal Governments
h. State Production Centres
i. State and municipal secretaries of environmental protection
j. Foreign Relations Ministry (RR EE)
k. Commission for Export Promotion (PROMPEX)
l. Customs Agency (ADUANAS)
m. Public Fishery Certification Company of Peru (CERPER)

3. Colombia

a. Colombian Association of Producers and Exporters of Ornamental Fish (ALCOPECES)
b. Ministry of Agriculture
c. National Institute of Renewable Natural Resources (INDERENA)
d. Environmental Ministry
e. National Institute of Fisheries and Aquaculture (INPA)
f. Colombian Institute of Animal Husbandry (ICA)
g. Colombian Institute of Rural Development (INCODER)
h. State and Municipal governments
i. State and municipal environmental protection secretaries

j. Colombian Customs and Tax Agency (DIAN)

Key competitors

The key competitors in the Amazonian countries are Colombia, Peru, Brazil, Guyana, Venezuela and Ecuador. Among this group of countries, Colombia, Peru and Brazil, as the largest exporters, compete the most. Although each country has a number of species endemic only with in their geopolitical boundaries, many of the same species have distributions in more than one country. In Appendix 5 I have listed species which are permissible for export from both Brazil and Colombia and are also exported from Peru. Exporters in each country, depending on the quantities and quality they have available, may price these species attractively in order to fill orders of more rare and valuable species, with the effect of lowering the price of species for which a competing country may depend on as a sales leader.

Legislative environment: welfare and conservation

The legislative environment varies from country to country. The Ministry of Production is the principal authority of legislation affecting the ornamental fish trade in Peru. With regard to conservation, the Ministry is responsible for: prohibition of certain species; setting the maximum volume of capture; establishing fishing zones and times of prohibition; stipulating equipment and methods of capture; establishing necessary actions for the conservation of species.

With regard to welfare, the Ministry establishes the minimum requirements ornamental fish export facilities, such as: system of treatment and distribution of the water; illumination and appropriate ventilation; deposits, aquariums or pools suitable in number and capacity to the volume of operation; implements for the

manipulation of the species; material and equipment for the feeding, prophylaxis and boarding.

The Peruvian Ministry of production also requires that exporters obtain a Sanitary Certificate granted by CERPER before exportation; that fish remain in the commercial aquarium a minimum of 72 hours from their entrance for their adaptation and/or treatment, in case of the presence of diseases, before their packing for export; and a Certificate of Origin from the Ministry of Fisheries.

In Colombia, the Colombian Institute of Rural Development (INCODER) is responsible for establishing management measures and ensuring conservation of ornamental fish. It also establishes the species that can (8 genera and 131 species) and cannot be considered ornamentals (Appendix 1), and the prohibition of fish resources in such areas as Puerto Carreño, Puerto Inirida and Rio Arauca during May and June, as well as periods of prohibition for aruanã (*Osteoglossum bicirrhosum*) in the Basin of the Ríos Amazonas (Sept.1-Nov.15), Putumayo (Nov. 1-Mar.15), Caqueta (Nov. 1-Mar.15).

The Colombian Institute of Animal Husbandry (ICA) is responsible for fish welfare. It has created measures for sanitary treatment of importation and exportation of live animals (and fish) and their by-products taken from the natural environment. Further, it establishes the registration of foreign firms that desire to export live Colombian aquatic (cultivated) and terrestrial animals to ensure their health.

In Venezuela, the capture of ornamental fish in the tributaries of Lakes Valencia and Maracaibo is prohibited. Between the period May 15 and July 15 ornamental fishing is prohibited in all the national territory. Venezuela has a short list of fish that may not be exported (Appendix 2; see Appendix 4 for species that are exported).

Current status and key trends

The price of fuel has been increasing worldwide during the past several years. Exporters throughout Amazonia lament that a consequence of this fact is the rise in international freight costs. Rising freight costs lead to importers to demand decrease in prices to maintain stable consumer demand. Exporters appear to suffering from a lack of direct air routes to some key destinations within importing countries. In the case of Brazil and Peru the issue seems to be more severe where the exporters are established in more remote areas and thus enjoy the benefits of major international air hubs.

Peru and Colombia, however, seem to be benefiting from an increase of routes to Asia (Table 2; Figures 12 & 13). A consequence of this development is the increasing importance of the Asian market for both countries. These routes are important for the Peruvian exporters who can more easily supply the large, charismatic fishes such as stingrays (Potamotrygonidae), aruanã and catfishes (Pimeloididae) that are of increasing demand in that pat of the world. Although Colombia has a more conservative legal environment with regard to ornamental fish exportation, not permitting the exportation of the large catfishes for example, it has benefited from the ability to sell rays and aruanã.

Most exporters agree that there is continuing demand for rare and novel species. Further, some importers believe that it is the new species introductions to the market that maintain consumer interest in the hobby. Demand for species of Corydoras, Apistogrammas, Loricariidae main popular according to exporters. One key global trend in market preferences seems to the increasing demand for stingrays. Demand for these fishes is high in Europe, Asia and North America.

ANALYSIS OF SUPPLY CHAIN OF BRAZILIAN FRESH-WATER ORNAMENTALS TO UK MARKET[6]

Size

Brazil at present represents only 1% of the volume of ornamental fishes in the world market (Figure 6), and 23% of the Amazonian market. The State of Amazonas contributes approximately 60% of the total exported from Brazil (Figure 15). Most of the remaining volume originates in the State of the Pará, exporting about 32% of Brazilian ornamental fish exports (LACERDA, 2005). Although the quantity of exports has tended to fall in recent years (Figure 16), the demand of ornamental fishes from Amazonas has remained relatively stable along the last 30 years (Figure 17), oscillating between 10 and 20 million. The value of ornamental fish exports has averaged about $3.5 million/year, but has declined by 45% from the period 1995-2003 (Figure 16). Although we have yet to receive the export statistics from IBAMA-AM for the last five years, exporters have assured me that exports have continued to fall from 2004 to present. The reasons for this decline are provided below under the heading, Key competitors.

End Markets

In terms of exports of ornamental fish from Amazonas to global regions, Europe is the largest importer (40%), followed by North America (28%) and Asia (18%) (Figure 18). Europe is the principal importer of ornamental fish from Brazil, while North America is the largest importer from Colombia and Asia the largest importer from Peru (Figure 19). The principal European importing

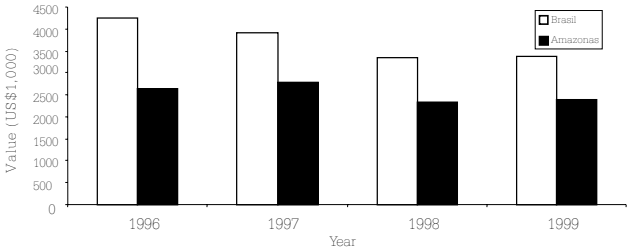

Figure 15. Amazonian contribution to Brazilian ornamental fish exports. (Source: SOUZA, 2001)

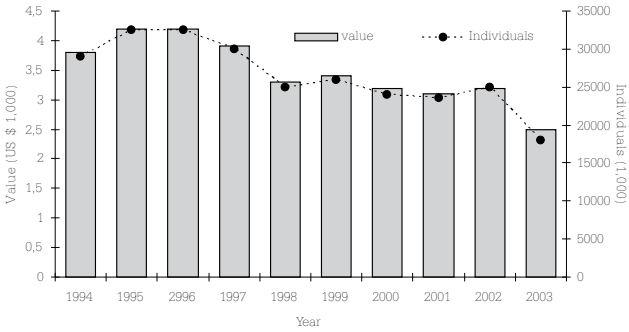

Figure 16. Evolution of ornamental fish exports from Brazil. (Source: FAO Fishstat, 2005).

countries of ornamental fish from Amazonas are Germany (56%), the Netherlands (17%), France (6%), Belgium (6%) and the UK (4%) (Figure 20). The value of UK ornamental fish imports from Amazonas until 2000 were about $200,000/year (Figure 21).

Principal Product Offerings

The export potential of ornamental fish is probably much higher than is currently realized in Brazilian Amazonia, principally due to the restrictive measures (limit on the number of species) imposed by the Brazilian environmental authorities, specifically 'Normative instruction number 3, 9 of

[6] Although I will make reference to other regions of Brazil, data presented refers mostly to the situation of the state of Amazonas. Additionally, as I have not yet received more recent export data from IBAMA, most statistical data is current as possible.

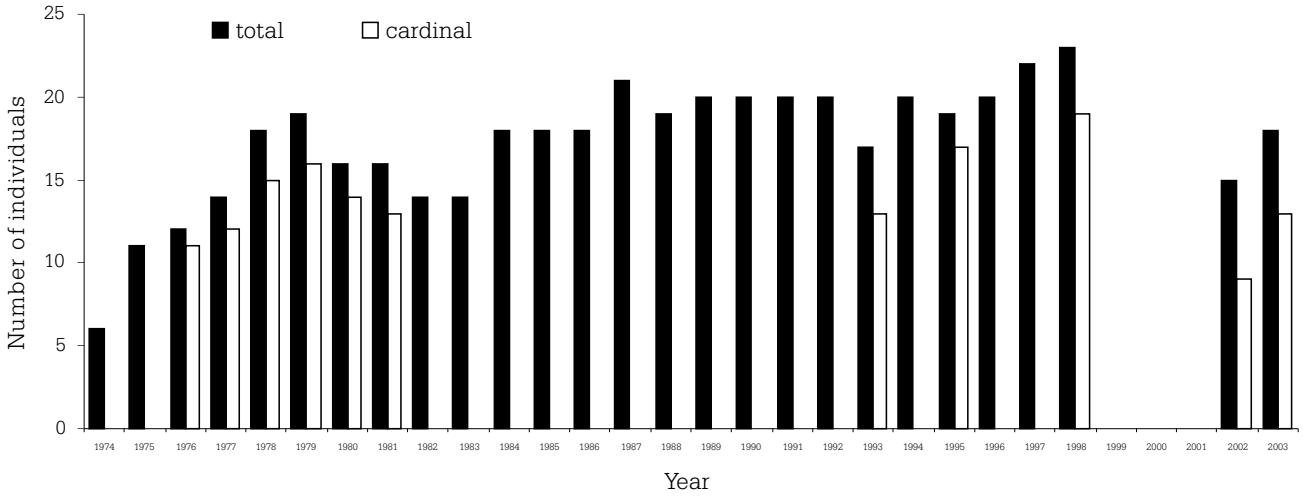

Figure 17. Ornamental fish exports from Amazonas. (Source: SOUZA, 2001; IBAMA N/D).

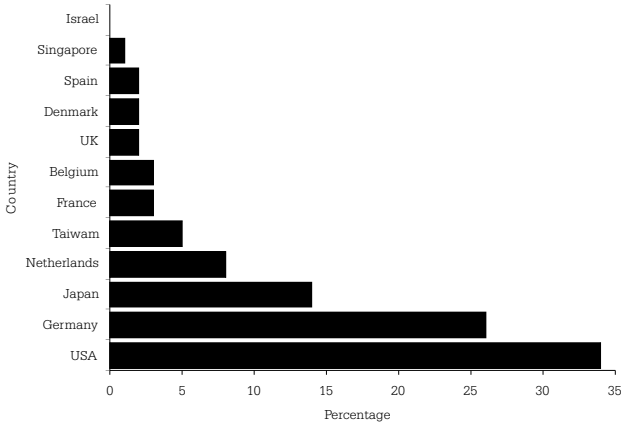

Figure 18. Principal importing countries of ornamental fish from Amazonas, Brazil in 1999. (Source: SOUZA, 2001)

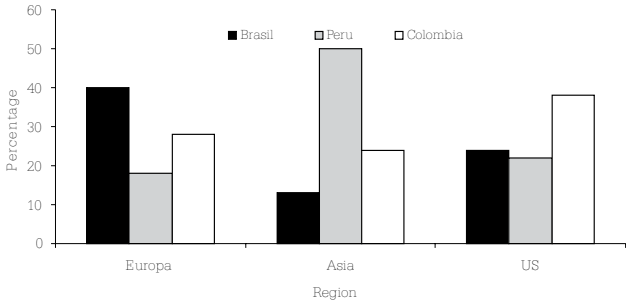

Figure 19. Percentage of exports ornamental fish by destination. (Source: CASTRO, 2005; HUANQUI,2005; SOUZA, 2001

June 2005,' of the MMA (Appendix 1). Rational planning for the use of a greater number of species of ornamental fish still not exploited, linked to the establishment of measures that generate an improvement in handling technology, may lead to an increase in the current production potential of this extractivist activity.

There are 800 species of fish registered for the Rio Negro (CHAO, 2001), but only around 70 species of fish from the basin are currently permitted for exportation. The principal species, cardinal tetra (*Paracheirodon axelrodi)* represents 76 to 89 % of the total of fishes exported from the state of Amazonas annually (Figure 16)[7]. Other important species include the green neon (*Paracheirodon simulans*), *Aspidoras poecilus*, *Otoncinclus* spp., *Peckoltia* spp., Bleeding heart tetras (*Hyphessobrycon* spp.), and rummy nose tetras (*Hemigrammus bleheri*) (Figure 22).

At present, the state of Pará is the principal producing centre of ornamental fishes of the family

[7] The cardinal tetra represents 32% of exports in Colombia (SANABRIA, 2005), and 34% in Venezuela (MONAGAS, 2005).

Loricariidae. The popularity of these fishes increased extraordinarily in the international

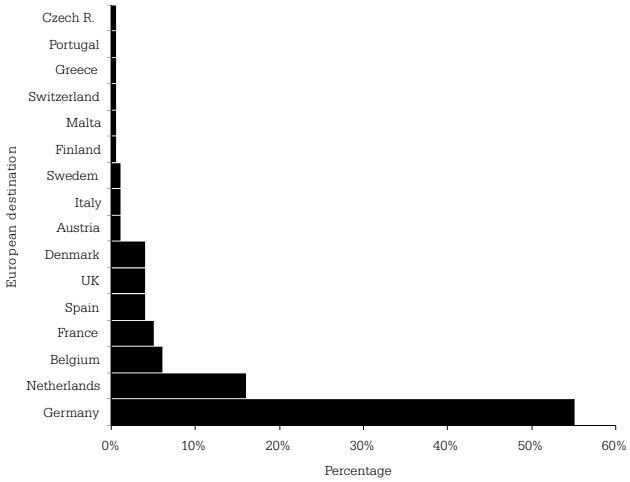

Figure 20. European destinations of Brazilian ornamental fish in 1999. (Source: SOUZA, 2001)

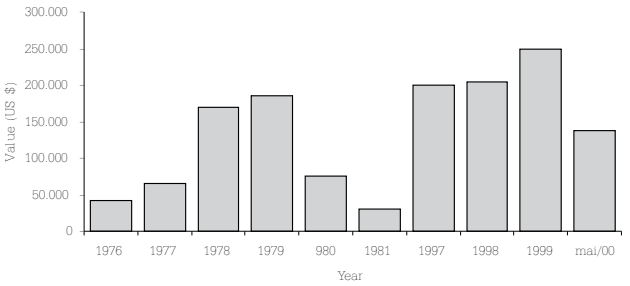

Figure 21. Ornamental fish exports from Amazonas to UK. (Source: SOUZA, 2001).

hobby market at the end of the 1980s when the first species of intense colouring were found in the Rivers Tocantins and Xingu. The Loricariidae present greater value when compared with other species of ornamental popular fishes like cardinal tetras, rummy nose tetras or Corydoras.

I was unable to gather much data for the rest of Brazil, but I can make some general comments. In the south of Brazil, particularly in the Rio Paraguay basin, varieties of Corydoras are available. There are also several species that originate in the Pantanal and are sold from Goiania, São Paulo and Rio de Janeiro.

Stingrays (*Potamotrygon* spp.) are another important export because of their high demand and value, although I have no export data on them. They are exported through quotas controlled and distributed by IBAMA (Brazilian Institute of the Environment and Renewable Resources) to ACEPOAM (Association of Breeders and Exporters

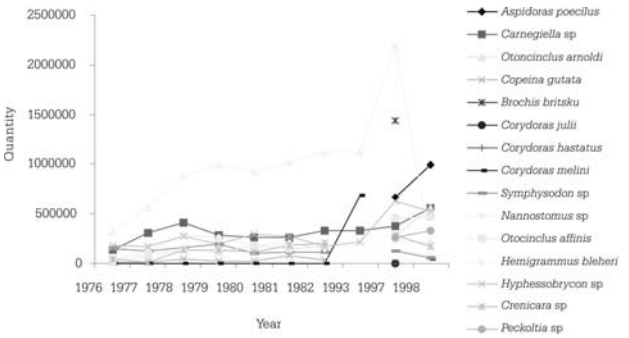

Figure 22. Other ornamental fish exports from Amazonas by species. (Source: SOUZA, 2001).

of Ornamental fish of Amazonas), ACEPOPA (Association of Breeders and Exporters of Ornamental fish of Pará) and ACEPOAT (Association of Breeders and Exporters of Ornamental fish of Altamira). The current legislation 'Normative instruction number 27, 31 of August 2005, of the MMA) regarding the quota has expired and has yet to be renewed this year.

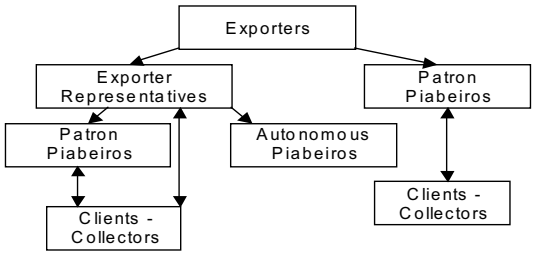

Figure 23. Amazonas ornamental fish chain of custody

BRAZIL: THE SUPPLY CHAIN

Typical supply chain

As is the case in other Amazonian countries ornamental fish pass through at least one level of intermediaries (Figure 23). The socioeconomic organization of the ornamental fish trade, from the collectors to the exporters, has strong undertones of family and kinship. Table 6 provides a general view of the product chain originating in the state of Amazonas. The table contemplates the prices paid an a general description of the main expenses involved in the commerce process of the cardinal tetra. This table should be adapted to reflect the species of Mamirauá and Amanã, as well as importation into the United Kingdom.

Collectors

In State of Pará, the Rios Tapajós and Xingu are the principal locations of ornamental fish collection. Loricariidae are the principal targets in these regions where collectors must dive in order to capture them. Data of the ACEPOAT (Association of Creators and Exporters of Ornamental Fishes of Altamira) demonstrate that in the region of the Rivers Xingu and Iriri there are more than 500 families of fishermen involved in the fishing of Loricariidae (ABREA, 2005).

In the state of Amazonas, collectors are concentrated in various municipalities (see Table 7). The highst concentration of fish collectors is in

Table 6. Price of the cardinal tetra along the product chain (Manaus-Detroit)

Point in distribution of fish	Price per thousand cardinal tetras sold (US$ = R$2.25)	Markup as percentage	Principle expenses involved in commerce, and other considerations
Piabeiro	$6.7/1,000 or $0.007/fish		Canoe, knife, machete, nylon mosquito netting., and fuel
Intermediary	$11.00/1,000 or $0.01/fish	100%	Boat, fuel and oil, repairs non-payment of advances, mortality of fishes, and possibly transport of fish to Manaus
Exporter	$100.00/1,000 or $0.10/fish	900%	Transport of fish to Manaus, mortality, water, utilities, installation, labor, food and medical treatment of fish, customs, taxes, packaging and marketing.
Importer	$300.00/1,000 or $0.30/fish	300%	Transportation (Manaus-Miami), same as exporter.
Wholesaler	$750/1,000 or $0.75/fish	250%	Transportation (Miami-Detroit), same as exporter & importer.
Retailer	$3,000/1,000 or $3.00/fish	400%	Mortality, water, utilities, installation, labor, food and medical treatment of fish, customs, taxes, packaging; buying in small lots and selling on a small scale.

Table 7. Principal entreposts of ornamental fish in the State of Amazonas

Municipality	Ornamental fish varieties	Number of intermediaries
Lábrea	*Corydoras schwartzi* , otocinclus	4
Maués	Discus, Corydoras, Apistogramma	4
Nhamundá	Discus, Corydoras, Loricaridae	4
Novo Airão	Discus	4
Carauari	Discus,Corydoras	4
São Gabriel da Cachoeira	Corydoras, Apistogramma	From S. Isabel
Barcelos	Many varieties	60
Santa Isabel	Many varieties	10
Tapauá	Discus	4
Tefé	Discus, Apistogramma	6
Manacapuru, Careiro da Várzea, Coari from Manaus, Codajás, and Silves, fished from Manaus	Discus	4

the Rio Negro basin, in the municipalities of Barcelos and Santa Isabel, where as many as 1,000 families might be involved. Other than in these two municipalities, most collection areas are quite limited in the varieties of species sought: discus, corydoras, apistogrammma, loricaridae and otocinclus.

Methods and equipment

The methods and equipment utilized in the capture of ornamental fish are rudimentary and artisanal. The technology, and the collecting method employed, depends on environmental features and the species targeted.

1. Species of *Geophagus* and *Apistogramma* - Seine nets are used for in the leaf litter on stream margins and on sandy beaches. Fishing with a seine net requires at least two people (Figure 24).

2. Discus – Discus like to hide in downed trees or flooded vegetation. Discus collection, like most fishing for cichlid species in the region, occurs in the evening. Collectors fashion flashlights on their heads or in their mouths for spotting the fish and then scooping them with nets of about 8 inches of diameter. Dip nets are made of one of two types of filament: soft (Figure 25) for fishing against the current, and firm (left) for fishing with the current. The latter causes much more abrasion on the fish than the former.

3. Loricariidae – In most areas, collectors look for downed trees and logs by walking along the surface or diving to river/stream bottom when the water is at its lowest level. The only equipment used, if any, is a diving mask. If possible, the logs are dragged with to beaches or other shallow

Figure 24. Seine net used on sandy beaches.

Figur 25. Dip nets for fishing against the current.

locations. Pieces of wood are stripped by hand or machete in order to locate the species. In areas of rocky outcrops (i.e., Xingu), downstream from rapids, divers use masks and place fish in bags to bring them to the surface.

4. Stingrays used to be collected by stabbing a trident in the back of females, which then abort their fetus. The collector would then scoop the 1-2 young with a dipnet. Today, they use rapichês and toll (long) lines, and do not kill the female. Most are sought on beaches and stream margins during the low water season.

5. *Corydoras* – Are sought when water levels are at their lowest, varying according to geographical location, between November and February along the Rio Negro. They are collected with seine nets or large dip nets (Figure 26). The dip nets are employed, the *Corydoras* as they come to the surface for air. The pots in the photo are used to carry fish back to camp.

6. Tetras and most varieties – Most Characoides can be located most easily when water level drops most precipitously. Again, this varies with geographical location. There are two basic methods of collection of *piabas* (small characins): *cacurís* or traps, and *rapichês* or dip nets (Figure 27). Each collector fabricates his own fishing equipment using polyester mosquito netting. Both fishing methods require that the presence of fish be ascertained visually since the species targeted are

Figure 26. Dip nets employed for catch *Corydoras*.

determined *a priori* (Figure 28). In addition, the amount of time spent paddling to and from the fishing areas may account for half of the time spent in the collection process.

Whether collecting with *cacurí* or *rapichê*, most collectors share the same preferences for the fishing gear that they carry to fishing areas: shotgun and ammunition for killing game and fowl; a plastic bowl (*cubico* or *cuia*) for scooping

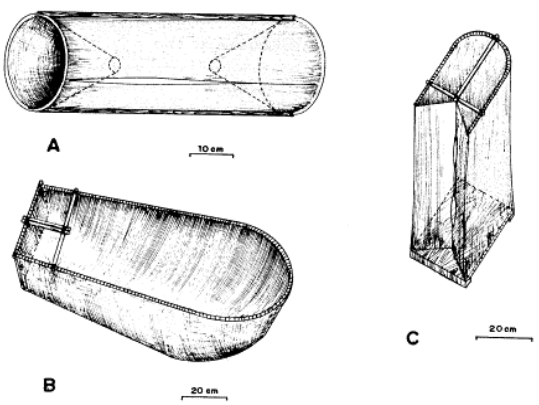

Figure 27. Fishing gear. A. Armadilha (collapsible minnow-trap); B. rapichê (dip-net); C. cacurí (trap).

Figure 28. Fishing gear –rapichê (dip nets).

fishes and changing water; a *terçado* or machete for clearing trails, etc.; a *zagaia* or trident for killing large fish; fishing line and hooks; a knife; an *arpoeira* or harpoon designed to penetrate the shell of turtles on the stream bottom; and *esticadeiras* or *espinheis,* or long lines for the capture of food and bait fish, particularly in the igapó. Each fish collector also carries one or two *paneiros* (hand woven baskets) lined with plastic bags, or *rodas* (a twig formed into a ring) supporting a plastic bag, placed between two canoe benches. The *paneiro* and roda are the principle means of transporting the fish from the fishing areas.

Dip nets (*rapichê*) are the fishing method of choice in the open flooded forest streams, and stream banks, particularly in tributaries of the left margin. In the left margin tributaries fishing is generally done from dugout canoes in which the collector is seated in the bow, with the stern being weighted down with sand, rocks, or old car batteries. Canoes are generally larger than those used in the rivers of the right margin of the Rio Negro, measuring as little as three meters, but most commonly about 4 - 4.5 meters long, by 80 cm to a meter wide.

The method of capture using the rapichê involves the location of a school of the desired species, which often requires more time than the actual netting of the fish. After the fish have been located, the collector gently extends the net horizontally into the stream, cutting off the downstream path of the cardinal tetras. He then carefully coaxes the fish down stream into the net with a canoe paddle. Although the collector generally fishes from the canoe, if necessary he will walk along the shore in order to capture the fish. It is also not uncommon for fishing partners to collaborate in the capture of fish by means of corralling fish into one or the other's rapichê. Some species which are not rapid swimmers are relatively easy to capture.

Once the fish have been captured in the rapichê, the collector uses the plastic bowl to scoop out the fish. In this process the fish desired (or not desired, depending on the number of each) is isolated in the net, then the net surface is dipped into the water, and the bowl is then quickly slipped between the fish and the net. *Piabeiros* (ornamental fish collectors) go to great lengths to ensure that the volume of fish they transport back to the temporary storage facilities is as homogeneous as possible. The two basic reasons for this are that oxygenation of water is simplified, and more aggressive species must be separated from the selected species. The fish are then placed in the paneiro, where fresh water has been placed. Depending on the amount of detritus and the temperature of the water, the collector will use the bowl to throw out the old water and replace it with fresh water. This process is repeated at regular intervals, as the collector finds necessary, until they arrive at their place of residence, temporary or permanent. The fresh water is usually thrown in from about 20 – 50 cm above the paneiro in order to oxygenate the water. The water change process in the canoe, however, is the same whether fishing with a cacurí or rapichê.

The typical day of fishing by rapichê can vary from 6 – 10 hours, depending on the availability of fish, pressing domestic obligations, and personal

motivation. Generally, the collector must paddle his canoe for 1 – 2 hours to the fishing area. He will then collect fish 2 – 3 hours, stopping to lunch for about an hour. After lunch, he may fish for another 1 – 3 hours, or return to his camp or home. The day of fishing is generally mixed with efforts to obtain protein in the form of game or fish, but this really depends upon whether there is a large enough assemblage of collectors in one place, either a permanent community, or temporary fishing camps. In these locations, fish collectors may assign certain individuals to concentrate more on obtaining food, than fish. Food getting may be a specialization for some, while for others it is part of a rotation; for others still, it is a daily task that is performed alongside fish collection activities.

The *cacurí*, a trap is a more passive means of capture. It is the preferred fishing method for cardinal tetras in the floodplain of the larger tributaries where the fishery is located in dense vegetation and shallow water (Figure 29). The *cacurí* is also commonly employed in left margin *igarapés* of the Rio Negro at the beginning of the fishing season (*safra* or harvest) when the fish have not yet begun to appear in the *igarapés*, and is the preferred method for collecting rapid swimming fish such as the *Hyphessobrycon* spp., *Hemigrammus bleheri* wherever they may be collected.

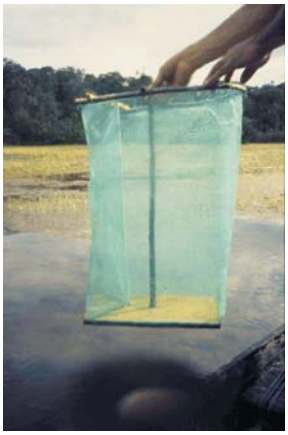

Figure 29. The *cacurí*, a trap passive means of capture.

The dugout canoes used by collectors on the rivers of the right margin of the Rio Negro differ from those used by collectors along the left margin streams. They are generally about three meters in length, by 80cm in width, with three benches. Unlike the canoes used on the left margin igarapés of the Rio Negro where the paddler sits in the front, the middle bench is used. The reason for this is that the igapó vegetation is very dense, or '*fechado*.' Sitting in this position allows the *piabeiro* to have more balance to pull himself between small trees that are ubiquitous in the *igapó* (flooded forest) of the rivers.

Each collector utilizes about 20 - 25 cacurís on a normal day of fishing. The collector employing cacurís to capture fish differ from those who use a rapichê in the preferred fishing equipment in that they also carry an aluminum pan or plastic bucket of bait. They look for cardinals in areas close to the margin, in about 30cm - 60 cm in depth. Where the cacurí is used, the piabeiro '*chama os peixes*' (calls the fish) by flicking his finger onto the surface of the water (as if shooting a marble), to replicate the sound of palm fruit hitting the water. If 5 - 10 fish appear, they clear an area (*limpar, roçar*) with a machete. The collector pulls out the cacurí; measures it up with a stick cut from branches, bush or young trees (arumã is the preferred stick); places the stick vertically in the cacurí to give it support; cuts 1 - 2 more sticks (*escora*) which are sliced at an angle at one end to secure the *cacurí* into the ground. The thickness of the escora determines the size of the fish that enters the trap. The cacurís are generally set in about 20 – 50 cm of water.

Bait (*pitiú*), salted fish that is bathed (*escaldado*) in hot cooking oil, is then placed in the bottom of the cacurí. Baitfish is salted again when it is brought

back to camp/boat to use again the next day. Consequently, salt comprises a large portion of collector expenses. It appears that not just any fish can serve as bait. According to fish collectors, the bait is the flesh of the *reco-reco* fish (*Amblydoras* spp.). The oil rises immediately to the surface and flows with the current. Generally, the collector assists in dispersion of the oil by splashing the surface of the water around the cacurí. He then moves on to find another favorable area until all his cacurís are set, forming a *varadouro* (path). The cacurís are left for 1 – 3 hours, and may be left for additional 1 – 3 hours, depending on the productivity. The collection phase is rapid. The piabeiro simply retraces his route, dumps the fish into a paneiro, throws the bait back into the bucket, and paddles back to camp, changing water regularly.

Fishers of the major tributaries make intensive use of the rabeta motor. The rabeta allows the fishers to move easily from paragem to paragem along sections of the river courses in order to locate more productive areas, and to deliver their production at a central location identified by the patron. This is not true of the left margin streams where the fishers can easily paddle to fishing areas, as high concentrations of fish are readily located as the igapó drains. Consequently, the gasoline expense is an important issue for many fishers along the major tributaries.

The basic handling process is the same for collectors who use either the rapichê or the cacurí. When they get back to their camp or residence, fishes are immediately placed into stackable *bacias* (*caixas* or boxes, plastic tubs which measure 58 x 38 x 18 cm), ranging from 300 – 600 fish. Water is then added, and the collector, or family members, removes (*catar*) the *piabas doidas* (unwanted fish) and *piabas brabas* (aggressive fish) that remain. If the fish are thought to be *batido* (beaten, stressed, or in poor condition), a tablespoon or two of table salt is added to the water. The following day, any dead fish are removed and remaining fish are placed in *viveiros* or *gaiolas*, reservoirs made of mosquito netting (Figure 30).

The viveiro can be set into a floating frame, or *grade*, which vary in size, but the average size is 1.5 m x 2.5 m x 80 cm. Reservoirs may hold more than

Figure 30. *Viveiros* or *gaiolas*, reservoirs made of mosquito netting.

5,000 fish, and are placed along the river bank by the encampment where a gentle current renews the water passively. If the fish are kept more than a couple of days, they are fed with foods including manioc flour, eggs, and cooked fish, but are not fed on the days preceding transport. Each day the dead fish are removed. Viveiros are cleaned once a week, generally Sunday, or when dirty. Fishes may remain in the viveiros for periods ranging from three days to three weeks, depending on when they are to be shipped to Barcelos or Santa Isabel, before making the journey to Manaus.

Intermediaries

There are over 100 intermediaries in the state of Amazonas, and I would estmate another 50 or so in

the state of Pará. At a predetermined date, the intermediary will visit the riverine communities/fishing camps to pick up the fish and transport them to Santa Isabel or Barcelos. The patron may also be present during the entire collecting period as well. Transactions may be realized with the exhange in currency and/or debt/merchandise (*aviamento*).

How often fish are taken to the cities for transshipment to Manaus depends on the quantity of fish available for shipping, and/or economic necessity. The process of embarking the fish (*embarque*) involves the following activities: one end of the viveiro is lifted from the water; fishes are put into a paneiro; 400-1,000 fish are placed in the bacias, depending on their size; about 5 cm of water is poured into the bacias. The bacias are then loaded onto the boat; tetracycline and/or table salt may added; and the total for each collector is noted in the patron's *caderno*, or notebook; the fish are transported to Barcelos or Santa Isabel. Once the fish are placed in bacias, water changes (about 50%) are made every 24 hours or so, until they shipment reaches Manaus. Shipment from entreposts varies with distance. Fish are shipped via regional vessels called *recreios*. The cost of transportation varies with the distance traveled. Transportation varies between R$1.50-2.50/*bacia*. The trip from São Gabriel, Lábrea or Tefé to Manaus takes two days, while the trip from Barcelos or Tapuá requires only a one-day voyage. Water used for the change is obtained directly from the river. Depending on the water parameters in the location where water is obtained, intermediaries or transport personnel may opt not to make water changes at all. Along the Rio Negro, once water storage tanks on regional boats are replenished after passing the white, less acidic, waters of the the Rio Branco, many intermediaries will not change water for the rest of the voyage.

Exporters

There are five principal exporters, and three smaller ones, currently active in Manaus:

- Aquário Corydoras Tetra
- Edson Perreira Corrêa (affiliated)
- Shopping do Peixe (affiliated)
- K-2 Aquário
- Prestige Aquário
- K.M. de Oliveira Comercial (affiliated)
- Tabatinga Aquarium
- J. A. Loureiro
- Turkys Aquário
- Aquaneon Ltda.
- Aqua Fish Importação e Exportação

The largest four exporters control a slightly more than 90 percent of the value of ornamental fish exports from Manaus, Amazonas. Turkys Aquário has over 48% of the Amazonas market, followed by Tabatinga Aquário 20%, Aquário Corydoras Tetra 16.5%, and Prestige Aquário has about 7.5% (PRANG, 2001). K-2 Aquário is owned by a man of Japanese descent. He differs from most other exporters in Amazonas in that he is mostly interested in the export of *Symphysodon* spp. and varieties of apistogramma. Often he is accused of approaching the intermediaries of other exporters and offering a higher price for select specimens.

As Table 7 demonstrates, exporters obtain their supplies from various intermediaries in a number of locations throughout the state of Amazonas; most have buyers in the state of Pará as well. Although three exporters pay their buyers upon delivery, the rest do not pay transportation costs, paying only for those fishes that arrive alive in Manaus the next week or later. Exporters pay their intermediaries in cash for the fishes requested, albeit not always on time. Exporters claim that what happens to the money once it gets to their commercial agents is not their responsibility.

The international demand for fish determines exporter supply requirements. Exporters then discipline production by controlling the distribution of *bacias* to their intermediaries. When exporters' supplies are greater than demand, they withhold the distribution of *bacias* to avoid stocking unnecessary quantities of fish. On the other hand, for certain species, exporters frequently procure sufficient stocks to account for fluctuations in the supply due to the annual flood cycles.

Although there is a lot of variation in the handling practices of each exporter, generally conditions and treats fish before exportation. The bureaucratic process of ornamental fish exportation is as follows (see also Table 8.):

1. The exporter emits an invoice (*fatura commercial*);

2. Shipping agent emits bill of lading to SISCOMEX;

3. Bill of sale (*Nota Fiscal*) with a seal from the Ministry of the Treasury;

4. IBAMA – must hand deliver 'Bill of transit of fish of continental waters for ornamental ends, ID aquarist' to the State Superintendent of IBAMA. The process takes 1-2 days. The exporter must then pick up the bill. The same information is required for the bill of lading sent to SISCOMEX;

5. Sanitary inspection (*Atestado sanitário*) – Shipments must be verified for health by a veterinarian; certified by the Ministry of Agriculture. This certificate is then passed to the Ministry of Agriculture.

6. Exporter must obtain a Sanitary Certificate (*Certificado sanitário*) by filing an agricultural inspection petition (*requerimento para fiscalização agropecuarial*) with the Ministry of Agriculture. This certificate is emitted upon inspection at the airport.

7. Copies of all of the above documents must accompany shipments of ornamental fish in order to be loaded by air carrier. The shipping agent/customs broker oversees this process. At the airport, inspections of shipments are performed by the following federal organs: IBAMA; Ministry of Agriculture; Receita Federal – customs

Key stakeholders

Key competitors

Over the last 30 years, Brazil has lost a substantial portion of the international ornamental fish market to Asian countries like Singapore, Thailand and Malaysia, as well as breeder in the U.S. and Europe. These countries that possess breeding technology are able to supply the global market with some Brazilian species that are of higher quality and lower prices. Such a threat is exemplified in the cases of *Symphysodon aequifasciatus* and *Pterophyllum scalare* that are already produced in great numbers, and hybrid varieties not found in nature (CHAO, 2001) (Table 8). These varieties are basically substituting wild-caught fish from Amazonia. Although these cultivated varieties dominate the marketplace, there remains a dependence on the varieties captured in the nature to prevent in-breeding, or to introduce new genetic characteristics into old ancestries in captivity. As such, there will always be a space for some number of wild-caught species (as is the case for the Tefé discus). However, the problems generated by the cultivated species outside of Brazil in industrial scale cannot be understated. While wild-caught discus fish represent less than 10% of the volume of the category commercialised worldwide, the aggregate value of these specimens is very low when is compared with the same product reproduced and exported from Asian countries.

Table 8. Role and function of principal organisations involved in the commercialisation of ornamental fish from Brazil

Role	Name of organisation	Mandate	Area of influence	Key services provided or requirements
Represents members concerning common issues, particularly economic and legal ones	ACEPOAM- Association of Breeders and Exporters of Ornamental fish of Amazonas	Voluntary trade org., NGO	State of Amazonas	Financial support for research community and municipalities where activity occurs
Social services, maintain fisheries statistics and provision of credit	SEAP-Secretary of Aquaculture and Fishing	Federal regulatory agency	Federal	Payment of unemployment insurance during periods in which fishing is prohibited
Tax collection and customs	SFR-Secretariat of the Revenue Service	Federal regulatory agency	Federal & State	Requires Bill of sale
Formulate, execute and regulate international commerce policy in Brazil	MDIC-Ministry of Development, Industry, and Foreign Trade	Federal trade agency	Federal & State	Represent exporters in international trade disputes
Integrates the activities of the Secretariat of Foreign Commerce - SECEX, Secretariat of Customs - SRF and the Brazilian Central Bank– BACEN	SISCOMEX – Integrated System of Foreign trade	Federal trade agency	Federal	Requires bill of lading to register transaction
Coordinate and execute promotional policies of Brazilian government	APEX-Agency for the promotion of exports and investments	Federal trade agency	Federal	Stimulate and facilitate the insertion of small and medium size firms in the international market
Regulation, inspection, & issuing of fishing and export licenses.	IPAAM-SDS- Institute of Environmental Protection of Amazonas/ Secretary of the Environment and Sustainable Development	State regulatory agency	Amazonas	Licensing & apprehension, & policy development for the activity
Policy	Secretary of the Environment of Tefé	Municipal agency	Tefé	Policy development for the activity
Formulate, coordinate & implement State policy regarding fisheries and aquaculture development	SEPA, Secretary of Fisheries & Aquaculture SEPROR, Secretary of Rural Production	State	Amazonas	Promotes the growth of all segments of the product chain of fisheries and aquaculture , in order to balance the well-being of the environment and
Controls navigation, licensing and safety	Amazonas Port Authority	State	Amazonas	Licensing of vessels, enforcement of laws
Represents its members concerning economic and political matters	Fishing colonies and fisher associations	Voluntary trade association	Municipal, state, & federal levels	Assist members with licensing, and represent the sector concerning economic and political matters

The cardinal tetra is now being reproduced in captivity in the Czech Republic, Southeast Asia and the U.S as well. As indicated above, the cardinal tetra is principal export for Brazil, Colombia and Venezuela. The only reason the cultivated varieties have not yet replaced wild-caught fish is that the prices still are not competitive with ones the captured in the Amazon basin. Complicating the case of cardinal tetra, as with many other Amazonian fishes, is the violation of the Convention on Biodiversity (CBD), because the countries involved in the cultivation have not respected the premises of the treatise that calls for the sharing of profits of products originated from the use of genetic resources. Sanctions are difficult to apply however as the United States have failed

to sign the treatise, giving violators a sense of impunity.

Brazil also faces competition with other Amazonian countries. Exporters from Peru and Colombia are Brazilian exporters' most important competitors. Exporters in Manaus claim that there are two key reasons that prevent them from competing effectively with the exporters of neighboring countries: limited air routes and freight costs; and IBAMA's 'positive' list of species (Appendix 1) contemplates only a very small portion of the requests from customers.

The only direct international air route from Manaus is to Miami. Until recently this route was served by Lloyd's Aero Boliviano (LAB). Beginning in June of this year, TAM Airlines (Brazilian) will have a daily flight to Miami, originating in São Paulo. To destinations in Asia and Europe, connections must be made in Recife, Brsaília, São Paulo or Rio de Janeiro. These routes prolong the time that fish must remain in packaging, increasing health risks. As Table 9 indicates exporters in Manaus experience a disadvantage compared to Colombian exporters who enjoy lower international freight rates. Exporters in Manaus explain that these lower freight costs from Colombia are linked to the limited number of species that can be exported legally from Brazil.

Brazil has more than 2,000 potential species (CHAO, 2001), but only six genera and 174 species, and a few entire families of species, can be exported legally. The biggest point of contention is that Colombia, with its low freight charges and its ability to export high value fishes, principally rays and aruanã, has led to a loss of their customer base. As many of the same, or similar, species permissible in Brazil are also found in Colombia and Peru (Appendix 5), importers who wish species of rays and aruanã can fill their orders completely in Colombia for example, without requiring the placement of orders from exporters in Manaus.

Legislative environment: welfare and conservation

Table 6 provides the actors, and their roles and function, of the commercialisation of ornamental fish is Brazil and the State of Amazonas, and in section 2.2.1-Exporters, the legal export process is defined. In terms of conservation, IBAMA/MMA is the key regulator of the activity through the emission of licenses, transport bills, collection of environment taxes, establishment of installations, and fishery practices. The regulation of fishery practices is limited to three laws. The first is the 'positive' ('clean') list of species that can be exported: 'Normative Instruction MMA nº 13 of 9 of June of 2005 - IN013/2005' (Appendix 1). The list inludes six genera and 174 specific species. Legally, the extraction and commercialisation of edible species is forbidden as ornamentals, based on the argument that fish is a major source protein for Amazonians. It also prohibits the capture of cardinal tetras during the period of May to July (reproductive period) along the Rio Negro (IBAMA Decree Nº. 28, March 10, 1992). Finally, 'Normative Instruction MMA IN027/2005' allows for the export of a quota of fresh water rays (ARAÚJO, *et al*., 2005). This quota expired in January of this year, and a new Normative Instruction is presently being negotiated.

The Ministry of Agriculture certifies the health of the ornamental fish through the inspection of ornamental fish shipments in airports and export installations. The Ministry of Agriculture requires that a certified veterinarian verify the welfare of fish before shipment. This certificate is then passed to the Ministry of Agriculture in order to must obtain a Sanitary Certificate (*Certificado sanitário*). This certificate is emitted upon inspection at the airport.

Table 9. International freight Costs

Destination	Additional charges	Carrier: Brazil	Price/kg Brazil	Carrier: Colombia	Price/kg Colombia
Frankfurt	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$4.57/kg if >100kg $3.90/kg if <100kg	Lufthansa	$2.90/kg
Paris	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box Certificate of origin: $30	Varig	$4.57/kg if >100kg $3.90/kg if <100kg	Air France to Lyon	$4.45/kg
Madrid	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$4.57/kg if >100kg $3.90/kg if <100kg	Avianca	$4.48/kg
Los Angeles	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$3.40/kg	Delta	$1.48/kg
Miami	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$2.57/kg	Tampa	$1.31/kg
New York	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$3.10/kg	Continental to Newark,	$1.60/kg
Montreal	Shipping Agent: $130/box Fuel surcharge: $0.30/kg IATA: $20/box	Air Canada	$4.60/kg		
Toronto	Shipping Agent: $130/box Fuel surcharge: $0.30/kg IATA: $20/box	Air Canada	$4.73/kg	Air Canada	$2.20/kg
London	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Varig	$4.57/kg if >100kg $3.90/kg if <100kg		
Manchester	Shipping Agent: $130/box Fuel surcharge: $0.60/kg IATA: $20/box Veterinary inspection: $68	Lufthansa	$4.24/kg		
Taiwan	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Japan Airlines	$6.60/kg	Lufthansa	$4.55/kg
Hong Kong	Shipping Agent: $130/box Fuel surcharge: $0.60/kg IATA: $20/box Veterinary inspection: $68	Lufthansa	$6.78/kg	Lufthansa	$4.55/kg
Japan - Narita	Shipping Agent: $130/box Fuel surcharge: $0.55/kg IATA: $20/box	Japan Airlines	$6.30/kg	Lufthansa	$4.55/kg
Osaka	Shipping Agent: $130/box Fuel surcharge: $0.60/kg IATA: $20/box Veterinary inspection: $68	Lufthansa	$6.28/kg		

Note: from Bogotá, KLM flies to Amsterdam for $2.55/kg and Alitalia to Rome for $3.30/kg.

At the state level, SEPA/SEPROR– AM (Special Secretary of Fisheries and Aquaculture/Amazonas State Secretary of Rural Production) is developing the following project: 'Development of the Product Chain of Ornamental Fish'. This project is one element of the policy of the current administration, and falls within the Program 'Green Free Zone -Productive Chain of Fisheries and Aquaculture'. This project may have implications for the implementation of Project SMOFSM in the future. The goal, according to the executors of the project is to stimulate and assist the Secretary of Sustainable Development (SDS-AM) in the creation and implemetation of public policies regarding ornamental fish resources in the State of Amazonas, particularly related to environmental policy, taxation and sanitary concerns). Below is a list actions proposed within the project:

- Promote and support studies of the ornamental fish product chain;
- Support research of ornamental fish through the Foundation of Research Support of the State of Amazonas (FAPEAM);
- Construction and simplified units of reception of ornamental fish;
- Stimulate the certification of ornamental fish, seal of quality;
- Project to operate a receiving station, for selection, conditioning, prophylactic treatment, and distribution of ornamental fish from Barcelos;
- Project to establish a museum of ornamental fish in Barcelos;
- Project to increase the areas of collection and the number of ornamental fish in the state of Amazonas, jointly with associations and municipalities;
- Support a seminar about the ornamental fish product chain;
- Training concerning the capture, preservation, and transport of ornamental fish;
- Support programs of credit lines for the activity;
- Have a conclusive debate regarding extractive reserves for ornamental fishes;
- Support the acquisition of boats for transportation of ornamental fish.

Current status and key trends

According to exporters the key market trends are related to the following fishes: stingrays, aruanãs, cichlids, apistogrammas, loricariidae and corydoras. Generally, serious hobbyists specialize in the keeping and and breeding of one variety or another. A small portion like 'tank busters', or large fish that require more space than the aquarium supplies, stingrays and aruanãs, fit this profile. These groups of fish are currently in high demand everywhere, particularly in Asia. The fresh water stingrays correspond to a group of species of special interest, and represent less than 1% of the total of fish exported. Exporters are currently particularly keen in securing a quota for the exportation of aruanã as the contribution to profits is near immediate and they are loosing sales to other Amazonian countries that can provide the same species as Brazil.

Apistogrammas, which reach a maximum size of 5 cm, present another trend. The density of these species is low, except during the breeding season, and its distribution more limited than its larger relatives and is thus rare, and therefore more valued. In addition, given its length, they need smaller aquariums (10-20 litres). Hobbyists choose cichlids, as they are very easy to reproduce. According to information collected from the collectors, the cost (effort to capture)/benefit (value of the species) of collecting apistogrammas is not financially compensatory. However, there are a great many varieties which might provide significant opportunities.

Two other families of fish that represent market niches are the *bodós/acaris* (Loricariidae) and corydoras. Many specimens of the Loricariidae family have relatively high values when compared with most species exported, ranging from $1-100.00/fish, depending on the rarity. The most sought after varies originate in the Rios Xingu and Tapajós. The value of this niche can be appreciated by the great number of species which have been given sequential numerations, 'L' (Loricariidae family) and 'C' (Corydoradinae sub-family: species *Corydoras* and *Aspidoras*). This cataloguing system was created at the end of the decade of 1980 (system 'L') by the specialized German publication *Die Aquarien und Terrarien Zeitschrift* (DATZ) and later accepted and adopted by aquarists and publications throughout the whole world. *Aqualog* (Aqualog Verlag: A.C.S. GmbH, Germany) distributes popular catalogues on these fish. These numbers represent species still unknown to science, and that is important in the breeding competitions within aquarium clubs. One of the criteria of for gaining points in this competition is the domesticity level, F0, F1, F2, F3, F4, where F0 represents wild fish. Thus, F0 fish gain more points because they are less domesticated, and this fact, in part, explains the great demand for these species by the most experienced aficionados.

Many of the niches of market above cited could be taken care of through additions to the list of the ornamental fish species that can be commercialised (Appendix 1). Despite the export sector having proposed an increase in the list of species to IBAMA, no concrete measure was ever taken by the agency. The potential of ornamental fish could be improved with the diversification of the species exported (maximum use of biodiversity). Although the list is sufficiently conservative, assuring the protection of national biodiversity, it also restricts the economic and social development of the Amazon region. For example, the majority of cichlids are forbidden for exportation due to their value as edible fish. However, the value of some species of cichlids as an alimentary source is negligible when compared to its ornamental potential.

The UK: the demand

• Market overview

• Comprehensive description of supply chain from importer to end consumer. To consider importers, wholesales, retailers and consumers.

1. Identification of key players including competitors

2. Understanding of purchasing process at each stage of chain including:

2.1 Product – price type (species/variety, country of origin, wild-caught versus captive bad "quality," significance of conservation and welfare issues

2.2 Seasonality of purchasing decisions

2.3 Regional trends

- Legislative environmental market conservation
- Other key stakeholders
- Logistics

Alternative markets of Mamirauá product

Ornamental fish imports to the United Kingdom from the Brazilian Amazon represent less than 2% of total exports, totalling about $200,000/year (Figures 18-21). If the price paid to collectors averages about 19% of export value, then the UK only contributes about $38,000 (R$85,500) directly to the productive sector in the state of Amazonas. If there are at least 1,000 fish collectors in the state

(PRANG, 2001), then each collector averages about R$85.5 ($38)/year from the UK market for ornamental fish. If collection activities are to be established in the Mamirauá and Amanã reserves, it must be assumed that if they are unable to increase the size of the UK market through the introduction of new species, they must share the benefits of this relatively small market with collectors from other regions, particularly the Rio Negro. As such, it may be necessary to consider additional markets for products from Mamirauá and Amanã. By servicing additional markets, such as the US, Japan, and Germany, the possibility of providing additional income to the residents in Mamirauá and Amanã Reserves may be greatly enhanced (Appendix 6).

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Appendix 1. Ornamental fish approved for export

Brazil Instrução normativa no 13, de 9 de junho de 2005, MMA	**Colombia** Resolución no 80 de 1991, INPA
Abramites hypselonotus	*Abramites eques*
Acanthodoras spinosissimus	*Abramites hypselonotus*
Acarichthys heckelii	*Acanthodoras*
Amblydoras hancockii	*Acanthodoras spinosissimus*
Ancistrus spp.	*Achirus* spp.
Anostomus anostomus	*Bujurquina mariae*
Anostomus ternetzi	*Aequidens pulcher*
Apareiodon affinis	*Aequidens tetramerus*
Aphyocharax anisitsi	*Amblydoras hancockii*
Apistogramma agassizii	*Anableps anableps*
Apistogramma borellii	*Ancistrus brevipinnis*
Apistogramma commbrae	*Ancistrus lineolatus*
Apistogramma ortmanni	*Ancistrus temminckii*
Apistogramma pertensis	*Ancistrus triradiatus*
Apistogramma trifasciata	*Anostomus anostomus*
Apteronotus albifrons	*Pseudanos trimaculatus*
Aspidoras poecilus	*Hyphessobrycon axelrodi*
Astyanax bimaculatus	*Aphyocharax erythrurus*
Astyanax fasciatus	*Apistogramma agassizii*
Austrolebias nigripinnis	*Apistogramma commbrae*
Baryancistrus spp.	*Apistogramma ortmanni*
Biotodoma cupido	*Apteronotus albifrons*
Brochis britskii	*Apteronotus* spp.
Brochis splendens	*Sciades seemanni*
Bryconops caudomaculatus	*Astronotus ocellatus*
Bujurquina mariae	*Boehlkea fredcochui*
Bunocephalus amaurus	*Boulengerella spp.*
Bunocephalus coracoideus	*Brochis splendens*
Callichthys callichthys	*Bunocephalus coracoideus*
Carnegiella marthae	*Bunocephalus* spp.
Carnegiella strigata	*Caenotropus labyrinthicus*
Catoprion mento	*Callichthys callichthys*
Chalceus erythrurus	*Carassius auratus auratus*
Chalceus macrolepidotus	*Carnegiella marthae*
Characidium fasciatum	*Carnegiella strigata*
Charax condei	*Chaetostoma* spp.
Charax gibbosus	*Chalceus macrolepidotus*
Chilodus punctatus	*Characidium fasciatum*
Cichlasoma festae	*Charax gibbosus*
Cichlasoma portalegrense	*Chilodus punctapus*
Colomesus asellus	*Cichlasoma bimaculatum*
Colomesus psittacus	*Cichlasoma octofasciatum*
Copeina guttata	*Archocentrus nigrofasciatus*
Copella arnoldi	*Hypostomus plecostomoides*
Copella metae	*Colomesus psittacus*
Copella nattereri	*Copella arnoldi*
Copella nigrofasciata	*Copeina eigenmanni*
Corydoras acutus	*Corydoras* spp.
Corydoras adolfoi	*Corydoras aeneus*
Corydoras aeneus	*Corydoras agassizii*

Brazil Instrução normativa no 13, de 9 de junho de 2005, MMA	Colombia Resolución no 80 de 1991, INPA
Corydoras agassizii	*Corydoras arcuatus*
Corydoras ambiacus	*Corydoras hastatus*
Corydoras arcuatus	*Corydoras axelrodi*
Scleromystax barbatus	*Corydoras elegans*
Corydoras burgessi	*Corydoras julii*
Corydoras caudimaculatus	*Corydoras melanistius*
Corydoras davidsandsi	*Corydoras melanotaenia*
Corydoras elegans	*Corydoras rabauti*
Corydoras griseus	*Corydoras punctatus*
Corydoras haraldschultzi	*Corydoras reticulatus*
Corydoras hastatus	*Dicrossus maculatus*
Corydoras julii	*Crenicichla* spp.
Corydoras melini	*Ctenolucius hujeta*
Corydoras narcissus	*Curimatus* spp.
Corydoras nattereri	*Dianema urostriatum*
Corydoras paleatus	*Dormitator maculatus*
Corydoras parallelus	*Eigenmannia virescens*
Corydoras punctatus	*Exodon paradoxus*
Corydoras rabauti	*Farlowella acus*
Corydoras reticulatus	*Gasteropelecus sternicla*
Corydoras robineae	*Satanoperca acuticeps*
Corydoras robustus	*Geophagus brasiliensis*
Corydoras schwartzi	*Satanoperca jurupari*
Corydoras sterbai	*Gymnocorymbus thayeri*
Crenicara punctulatum	*Rhamphichthys rostratus*
Crenicichla alta	*Gymnotus carapo*
Crenicichla notophthalmus	*Helogenes marmoratus*
Crenicichla regani	*Hemiancistrus* spp.
Crenuchus spilurus	*Hemigrammus rodwayi* ** *[Poecilocharax weitzmani]*
Dekeyseria pulcher	*Hemigrammus ocellifer*
Dianema longibarbis	*Hemigrammus pulcher*
Dianema urostriatum	*Hemigrammus rhodostomus [bleheri]*
Dicrossus filamentosus	*Hemigrammus unilineatus*
Dicrossus maculates	*Hemiodus gracilis*
Eigenmannia spp.	*Hemiodus* spp.
Exodon paradoxus	*Heros severus*
Farlowella spp.	*Hoplosternum littorale*
Gasteropelecus levis	*Hypoptopoma thoracatum*
Gasteropelecus sternicla	*Hyphessobrycon peruvianus*
Geophagus altifrons	*Hyphessobrycon rosaceus*
Gymnocorymbus ternetzi	*Hyphessobrycon erythrostigma*
Hemigrammus bleheri	*Hyphessobrycon sweglesi*
Hemigrammus erythrozonus	*Hypostomus plecostomus*
Hemigrammus marginatus	*Laemolyta taeniata*
Hemigrammus ocellifer	*Leporinus affinis*
Hemigrammus pulcher	*Leporinus fasciatus*
Hemigrammus ulreyi	*Leporinus maculatus*
Hemigrammus unilineatus	*Leporinus striatus*
Hemiodus gracilis	*Dasyloricaria filamentosa*
Hemiodus sterni	*Rineloricaria uracantha*

Brazil Instrução normativa no 13, de 9 de junho de 2005, MMA	Colombia Resolución no 80 de 1991, INPA
Hopliancistrus tricornis	*Mesonauta festivus*
Hyphessobrycon spp.	*Metynnis maculatus*
Hypostomus spp.	*Microglanis* spp.
Inpaichthys kerri	*Mikrogeophagus ramirezi*
Laemolyta taeniata	*Moenkhausia oligolepis*
Laetacara curviceps	*Poecilia caucana*
Laetacara dorsigera	*Monocirrhus polyacanthus*
Leporacanthicus galaxias	*Myloplus rubripinnis*
Leporacanthicus joselimai	*Nannostomus eques*
Leporellus vittatus	*Nannostomus marginatus*
Leporinus agassizii	*Nannostomus trifasciatus*
Liosomadoras oncinus	*Nematobrycon palmeri*
Brachyplatystoma tigrinum	*Nematobrycon palmeri*
Mikrogeophagus ramirezi	*Osteoglossum bicirrhosum*
Moenkhausia affinis	*Osteoglossum ferreirai*
Moenkhausia barbouri	*Otocinclus affinis*
Moenkhausia collettii	*Otocinclus arnoldi*
Moenkhausia dichroura	*Panaque nigrolineatus*
Moenkhausia gracilima	*Paracheirodon axelrodi*
Moenkhausia hasemani	*Paracheirodon innesi*
Moenkhausia intermedia	*Peckoltia* spp.
Moenkhausia jamesi	*Pimelodus albofasciatus*
Moenkhausia lepidura	*Pimelodus pictus*
Moenkhausia megalops	*Poecilia reticulata*
Moenkhausia oligolepis	*Potamotrygon ssp.*
Moenkhausia sanctaefilomenae	*Pristella maxillaris [maxillaris]*
Monocirrhus polyacanthus	*Pseudancistrus* sp.
Myloplus rubripinnis	*Pterophyllum altum*
Nannostomus beckfordi	*Pterophyllum scalare*
Nannostomus digrammus	*Glyptoperichthys gibbiceps*
Nannostomus eques	*Rivulus elegans*
Nannostomus espei	*Rivulus hartii*
Nannostomus marginatus	*Rivulus urophthalmus*
Nannostomus trifasciatus	*Sturisoma dariense*
Nannostomus unifasciatus	*Synbranchus marmoratus*
Oligancistrus punctatissimus	*Symphysodon aequifasciatus*
Otocinclus affinis	*Symphysodon discus*
Otocinclus flexilis	*Thoracocharax stellatus*
Otocinclus vittatus	*Ancistrus dolichopterus*
Paracheirodon axelrodi	
Paracheirodon simulans	
Parancistrus aurantiacus	
Parodon suborbitalis	
Parotocinclus maculicauda	
Peckoltia spp.	
Petitella georgiae	
Poecilia reticulata	
Poecilocharax weitzmani	
Polycentrus schomburgkii	
Prionobrama filigera	
Pristobrycon calmoni	

Brazil Instrução normativa no 13, de 9 de junho de 2005, MMA	Colombia Resolución no 80 de 1991, INPA
Pseudacanthicus leopardus	
Pseudanos gracilis	
Pseudanos trimaculatus	
Pterolebias longipinnis	
Pterophyllum scalare	
Pygocentrus nattereri	
Pyrrhulina brevis	
Pyrrhulina laeta	
Pyrrhulina rachoviana	
Pyrrhulina vittata	
Rineloricaria fallax	
Rineloricaria lanceolata	
Rineloricaria lima	
Rineloricaria parva	
Rivulus punctatus	
Rivulus urophthalmus	
Satanoperca jurupari	
Scomberomorus spp.	
Serrapinnus notomelas	
Serrasalmus hollandi	
Spectracanthicus murinus	
Sturisoma barbatum	
Symphysodon aequifasciatus	
Symphysodon discus	
Tatia aulopygia	
Thayeria obliqua	
Thoracocharax stellatus	
Trigonectes strigabundus	
Uaru amphiacanthoides	

Appendix 2. Fish species prohibited for export ("Negative list")

Note: Those entries marked indicate species found in Iquitos exporters price lists I obtained and the prices/individual are listed.

Peru, Resolución Ministerial: 147-2001-PE	Resolución de la Dirección General de Pesca y Acuicultura No 52	Colombia, Resolución No.80 de 1991, Artículo Segundo
Anodus elongatus	*Cichla* spp.	*Colossoma [macropomum]*
Arapaima gigas	*Pseudoplatystoma tigrinum*	*Piaractus brachypomus*
Astronotus ocellatus	*Pseudoplatystoma fasciatum*	*Brachyplatystoma* spp.
Brachyplatystoma filamentosum	*Brachyplatystoma vaillantii*	*Brycon* spp.
Zungaro zungaro	*Brachyplatystoma rousseauxii*	*Salminus* spp.
Brachyplatystoma juruense	*Phractocephalus hemioliopterus*	*Myloplus* spp.
Brachyplatystoma vaillantii	*Brycon whitei*	*Mylossoma duriventre*
Brycon cephalus	*Salminus hilarii*	*Arapaima gigas*
Brycon melanopterus		*Hydrolycus scomberoides*
Calophysus macropterus		*Haplotaxodon* spp.
Cichla monoculus		*Sorubim lima*
Colossoma macropomun		*Cichla ocellaris*
Curimata vittata		*Phractocephalus hemioliopterus*
Hemisorubim platyrhynchos		*Pseudoplatystoma fasciatum*
Hoplias malabaricus		*Pseudoplastystoma tigrinum*
Hypophthalmus edentatus		
Hypophthalmus marginatus		
Leporinus trifasciatus		
Brachyplatystoma tigrinum		
Myloplus rubripinnis		
Myleus schomburgkii		
Mylossoma duriventre		
Zungaro zungaro		
Pellona castelnaeana		
Piaractus brachypomus		
Pinirampus pirinampu		
Plagioscion squamosissimus		
Potamorhina altamazonica		
Potamorhina latior		
Prochilodus nigricans		
Psectrogaster amazonica		
Psectrogaster rutiloides		
Pseudoplatystoma fasciatum		
Pseudoplatystoma tigrinum		
Glyptoperichthys punctatus		
Rhaphiodon vulpinus		
Schizodon fasciatus		
Semaprochilodus insignis		
Sorubimichthys planiceps		
Triportheus angulatus		
Triportheus elongatus		

Appendix 3. Ornamental fish species exported from Peru. (Source: CAMPOS, 2005)

Family	Species
POTAMOTRYGONIDAE	*Paratrygon* spp.
STRINGRAYS	*Paratrygon aiereba*
	Platax orbicularis
	Potamotrygon hystrix
	Potamotrygon motoro
	Potamotrygon orbignyi
	Potamotrygon sp.1
	Potamotrygon sp.2
	Potamotrygon sp.3
	Potamotrygon sp.4
ARAPAIMIDAE	*Arapaima gigas*
OSTEOGLOSSIDAE	*Osteoglossum bicirrhosum*
BATRACHOIDIDAE	*Thalassophryne amazonica*
ANOSTOMIDAE	*Abramites hypselonotus*
	Anostomus anostomus
	Laemolyta taeniata
	Leporellus vittatus
	Leporinus agassizii
	Leporinus desmotes
	Leporinus fasciatus
	Leporinus friderici
	Leporinus maculatus
	Leporinus moralesi
	Leporinus striatus
	Leporinus trifasciatus
	Pseudanos trimaculatus
	Rhytiodus argenteofuscus
	Rhytiodus microlepis
	Schizodon fasciatus
CTENOLUCIDAE	*Boulengerella maculata*
	Boulengerella lucius
CURIMATIDAE	*Cyphocharax spilurus*
	Curimata vittata
	Curimatella alburna
	Curimatopsis macrolepis
	Potamorhina latior
	Psectrogaster amazonica
CYNODONTIDAE	*Hydrolycus scomberoides*
	Rhaphiodon vulpinus
CHARACIDAE	*Acestrorhynchus falcatus*
	Acestrorhynchus falcirostris
	Acestrorhynchus heterolepis
	Acestrorhynchus lacustris
	Acestrorhynchus microlepis
	Aphyocharax alburnus
	Aphyocharax anisitsi
	Astyanax abramis
	Astyanax bimaculatus
	Astyanax fasciatus
	Astyanax kennedyi
	Axelrodia stigmatias
	Bario steindachneri
	Boehlkea fredcochui
	Bryconops caudomaculatus
	Bryconops melanurus
	Creagrutus beni
	Creagrutus cochui
	Crenuchus spilurus
	Ctenobrycon hauxwellianus
	Ctenobrycon spilurus
	Cynopotamus amazonus
	Chalceus erythrurus
	Chalceus macrolepidotus
	Characidium fasciatum
	Charax gibbosus
	Elachocharax pulcher
	Gymnocorymbus thayeri
	Hemibrycon polyodon
	Hemigrammus hyanuary
	Hemigrammus luelingi
	Hemigrammus marginatus
	Hemigrammus ocellifer
	Hemigrammus pulcher
	Hemigrammus rodwayi
	Hemigrammus schmardae
	Hemigrammus unilineatus
	Hyphessobrycon sp.
	Hyphessobrycon bentosi
	Hyphessobrycon copelandi
	Hyphessobrycon erythrostigma
	Hyphessobrycon loretoensis
	Hyphessobrycon minimus
	Hyphessobrycon peruvianus
	Hyphessobrycon eques
	Hyphessobrycon spp.
	Iguanodectes spilurus
	Knodus breviceps
	Metynnis hypsauchen
	Metynnis luna
	Metynnis maculates
	Moenkhausia agnesae
	Moenkhausia collettii
	Moenkhausia chrysargyrea
	Moenkhausia dichroura
	Moenkhausia lepidura
	Moenkhausia melogramma
	Moenkhausia oligolepis
	Moenkhausia robertsi
	Moenkhausia simulata
	Myloplus rubripinnis
	Myleus asterias
	Mylossoma aureum
	Mylossoma duriventre
	Paracheirodon innesi

Family	Species
	Paragoniates alburnus
	Petitella georgiae
	Phenacogaster pectinatus
	Prionobrama filigera
	Pygocentrus nattereri
	Roeboides affinis
	Roeboides myersii
	Serrasalmus elongatus
	Serrasalmus rhombeus
	Stethaprion erythrops
	Tetragonopterus argenteus
	Tetragonopterus chalceus
	Thayeria boehlkei
	Thayeria obliqua
	Triportheus albus
	Triportheus angulatus
	Triportheus culter
	Triportheus elongatus
	Triportheus rotundatus
	Tyttocharax cochui
CHILODONTIDAE	*Chilodus punctatus*
ERYTHRINIDAE	*Erythrinus erythrinus*
	Hoplerythrinus unitaeniatus
	Hoplias malabaricus
GASTEROPELECIDAE	*Carnegiella marthae*
	Carnegiella myersi
	Carnegiella strigata
	Gasteropelecus sternicla
	Thoracocharax stellatus
HEMIODONTIDAE	*Hemiodus gracilis*
	Hemiodus microlepis
	Hemiodus atranalis
LABIASINIDAE	*Parodon pongoensis*
	Copeina guttata
	Copella metae
	Nannostomus digrammus
	Nannostomus eques
	Nannostomus trifasciatus
	Pyrrhulina brevis
	Pyrrhulina laeta
	Pyrrhulina lugubris
	Pyrrhulina spilota
	Pyrrhulina vittata
PROCHILODONTIDAE	*Prochilodus nigricans*
	Semaprochilodus insignis
	Semaprochilodus insignis
LEPIDOSIRENIDAE	*Lepidosiren paradoxa*
CICHLIDAE	*Acarichthys heckelii*
	Acaronia nassa
	Aequidens diadema
	Aequidens tetramerus
	Aequidens sp.
	Apistogramma eunotus
	Apistogramma agassizii
	Apistogramma bitaeniata
	Apistogramma cacatuoides
	Apistogramma cruzi
	Apistogramma luelingi
	Apistogrammoides pucallpaensis
	Astronotus ocellatus
	Biotodoma cupido
	Cichla monoculus
	Cichlasoma amazonarum
	Cichlasoma festae
	Heros severus
	Crenicara punctulatum
	Crenicichla anthurus
	Crenicichla cincta
	Crenicichla celidochilus
	Crenicichla johanna
	Crenicichla lucius
	Crenicichla reticulata
	Crenicichla sedentaria
	Chaetobranchus flavescens
	Hypselacara temporalis
	Mesonauta festivus
	Pterophyllum scalare
	Satanoperca jurupari
	Symphysodon aequifasciatus
NANDIDAE	*Monocirrhus polyacanthus*
SOLEIDAE	*Achirus achirus*
	Apionichthys dumerili
AGENEOSIDAE	*Ageneiosus inermis*
	Ageneiosus pardalis
	Ageneiosus ucayalensis
	Ageneiosus vittatus
ASPREDINIDAE	*Amaralia hypsiura*
	Bunocephalus aleuropsis
	Bunocephalus coracoideus
AUCHENIPTERIDAE	*Auchenipterichthys longimanus*
	Auchenipterichthys thoracatus
	Auchenipterus nuchalis
	Centromochlus heckelii
	Entomocorus benjamini
	Pseudepapterus hasemani
	Tatia creutzbergi
	Tatia intermedia
	Tatia perugiae
	Trachelyichthys exilis
	Trachelyopterichthys taeniatus
BELONIDAE	*Potamorrhaphis guianensis*
	Pseudotylosurus microps
CALLICHTHYIDAE	*Brochis multiradiatus*
	Brochis splendens

Family	Species
	Callichthys callichthys
	Corydoras acutus
	Corydoras aeneus
	Corydoras agassizii
	Corydoras ambiacus
	Corydoras amphibelus
	Corydoras arcuatus
	Corydoras armatus
	Corydoras atropersonatus
	Corydoras copei
	Corydoras elegans
	Corydoras fowleri
	Corydoras lamberti
	Corydoras leopardus
	Corydoras leucomelas
	Corydoras loretoensis
	Corydoras melini
	Corydoras napoensis
	Corydoras panda
	Corydoras pastazensis
	Corydoras pygmaeus
	Corydoras rabauti
	Corydoras reticulatus
	Corydoras semiaquilus
	Corydoras stenocephalus
	Corydoras sychri
	Corydoras trilineatus
	Corydoras zygatus
	Corydoras weitzmani
	Dianema longibarbis
	Hoplosternum littorale
	Megalechis thoracata
CETOPSIDAE	*Cetopsis coecutiens*
	Cetopsis candiru
DORADIDAE	*Acanthodoras spinosissimus*
	Agamyxis albomaculatus
	Agamyxis pectinifrons
	Amblydoras hancockii
	Anadoras grypus
	Hemidoras stenopeltis
	Leptodoras acipenserinus
	Leptodoras linnelli
	Liosomadoras morrowi
	Megalodoras uranoscopus
	Nemadoras humeralis
	Nemadoras leporhinus
	Opsodoras morei
	Opsodoras stuebelii
	Oxydoras niger
	Physopyxis lyra
	Pimelodella cristata
	Platydoras costatus
	Pterodoras granulosus
ELECTROPHORIDAE	*Adontosternarchus balaenops*
	Adontosternarchus sachsi
	Apteronotus albifrons
	Apteronotus bonapartii
	Apteronotus leptorhynchus
	Electrophorus electricus
	Sternarchella spp.
	Sternarchogiton spp.
	Sternarchorhamphus muelleri
	Sternarchorhynchus oxyrhynchus
GYMNOTIDAE	*Gymnotus carapo*
	Gymnotus coatesi
HYPOPOMIDAE	*Brachyhypopomus brevirostris*
	Hypopygus lepturus
	Steatogenys elegans
LORICARIIDAE	*Acanthicus hystrix*
	Ancistrus cirrhosus
	Ancistrus hoplogenys
	Ancystrus teminckii
	Farlowella amazonum
	Farlowella knerii
	Farlowella oxyrryncha
	Hemiodontichthys acipenserinus
	Hypoptopoma gulare
	Squaliforma emarginata
	Hypostomus plecostomus
	Lamontichthys filamentosus
	Loricariichthys maculatus
	Pseudorinelepis genibarbis
	Otocinclus macrospilus
	Otocinclus vestitus
	Panaque albomaculatus
	Panaque dentex
	Panaque gnomus
	Panaque nocturnus
	Peckoltia arenaria
	Peckoltia ucayalensis
	Pseudohemiodon lamina
	Pseudorinelepis genibarbis
	Pseudorinelepis genibarbis
	Glyptoperichthys gibbiceps
	Pterygoplichthys multiradiatus
	Pterygoplichthys pardalis
	Rineloricaria konopickyi
	Rineloricaria lanceolata
	Rineloricaria morrowi
	Rineloricaria wolfei
	Spatuloricaria evansii
	Spatuloricaria puganensis

Family	Species
	Sturisoma nigrirostrum
	Sturisoma rostratum
PIMELODIDAE	*Zungaro zungaro*
	Brachyplatystoma filamentosum
	Brachyplatystoma juruense
	Brachyplatystoma vaillantii
	Calophysus macropterus
	Platysilurus mucosus
	Duopalatinus peruanus
	Goeldiella eques
	Brachyplatystoma platynemum
	Hemisorubim platyrhynchos
	Leiarius marmoratus
	Leiarius pictus
	Brachyplatystoma tigrinum
	Microglanis zonatus
	Phractocephalus hemioliopterus
	Pimelodella cristata
	Pimelodella gracilis
	Pimelodus maculatus
	Pimelodus ornatus
	Pimelodus pictus
	Pinirampus pirinampu
	Platynematichthys notatus
	Platysilurus mucosus
	Platystomatichthys sturio
	Batrochoglanis raninus
	Zungaro zungaro
	Pseudopimelodus zungaro
	Pseudoplatystoma fasciatum
	Pseudoplatystoma tigrinum
	Rhamdia quelen
	Sorubim lima
	Sorubimichthys planiceps
	Zungaro zungaro
POECILIDAE	*Poecilia reticulata*
RHAMPHICHTHYIDAE	*Gymnorhamphichthys rondoni*
	Rhamphichthys rostratus
RIVULIDAE	*Rivulus atratus*
	Rivulus ornatus
	Rivulus peruanus
	Rivulus urophthalmus
STERNOPYGIDAE	*Distocyclus conirostris*
	Eigenmannia macrops
	Eigenmannia virescens
	Rhabdolichops troscheli
	Sternopygus macrurus
TRICHOMYCTERIDAE	*Henonemus macrops*
	Pareiodon microps
	Pseudostegophilus nemurus
SYNBRANCHIDAE	*Synbranchus marmoratus*
TETRAODONTIDAE	*Colomesus asellus*

Appendix 4. Ornamental fish species exported from Venezuela (MONAGAS, 2005) and potentially exported from Guyana (WATSON, 2005)

Guyana	Venezuela
Acaronia nassa	*Agamyxis pectinifrons*
Acestrorhynchus falcatus	*Ancistrus brevipinnis*
Acestrorhynchus microlepis	*Apistogramma agassizii*
Aequidens paloemeuensis	*Astronotus ocellatus*
Aequidens tetramerus	*Bunocephalus coracoideus*
Parotocinclus spp.	*Caquetaia kraussii*
Ancistrus hoplogenys	*Chaetobranchus flavescens*
Ancistrus temminckii	*Chaetostoma* spp.
Ancistrus leucostictus	*Cichla ocellaris*
Aphyocharacidium melandetum	*Cichla temensis*
Apistogramma gossei	*Thorichthys aureus*
Astronotus ocellatus	*Cichlasoma bimaculatum*
Jupiaba abramoides	*Cichlasoma* spp.
Astyanax bimaculatus	*Colossoma macropomum*
Jupiaba keithi	*Colossoma* spp.
Jupiaba keithi	*Crenicichla lugubris*
Astyanax leopoldi	*Crenicichla strigatta*
Jupiaba maroniensis	*Crossoloricaria venezuelae*
Jupiaba meunieri	*Farlowella* spp.
Jupiaba ocellata	*Geophagus surinamensis*
Astyanax validus	*Geophagus taeniopareius*
Brycon falcatus	*Geophagus* spp.
Brycon pesu	*Hemigrammus rhodostomus*
Bryconamericus hyphesson	*Hemiodopsis* spp.
Bryconamericus stramineus	*Hemiodus orthonops*
Bryconops affinis	*Heros severus*
Bryconops caudomaculatus	*Hoplarchus psittacus*
Bryconops cyrtogaster	*Hoplosternum littorale*
Bryconops melanurus	*Lamontichthys llanero*
Callichthys callichthys	*Leporacanthicus triactis*
Carnegiella strigata	*Mesonauta festivus*
Chaetobranchopsis australis	*Metynnis luna*
Chaetobranchus flavescens	*Metynnis hypsauchen*
Chalceus macrolepidotus	*Mikrogeophagus ramirezi*
Charax pauciradiatus	*Myloplus rubripinnis*
Cichla monoculus	*Cichla monoculus*
Cichla ocellaris	*Nannostomus unifasciatus*
Cichlasoma amazonarum	*Panaque nigrolineatus*
Cichlasoma bimaculatum	*Paracheirodon axelrodi*
Cleithracara maronii	*Paracheirodon innesi*
Copella carsevennensis	*Trachelyopterus galeatus*
Copella arnoldi	*Peckoltia* spp.
Corydoras aeneus	*Pimelodus ornatus*
Corydoras amapaensis	*Potamotrygon hystrix*
Corydoras approuaguensis	*Potamotrygon motoro*
Corydoras baderi	*Potamotrygon orbignyi*
Corydoras brevirostris	*Potamotrygon schroederi*
Corydoras condiscipulus	*Oxydoras niger*
Corydoras geoffroy	*Cephalosilurus albomarginatus*
Corydoras guianensis	*Pseudoplatystoma fasciatum*
Corydoras heteromorphus	*Pseudoplatystoma* spp.
Corydoras nanus	*Gnatholebias zonatus*
Corydoras oiapoquensis	*Pterophyllum altum*
Corydoras punctatus	*Pygocentrus cariba*
Corydoras sipaliwini	*Pygocentrus cariba*
Corydoras solox	*Rhamdia quelen*
Corydoras spilurus	*Satanoperca daemon*
Creagrutus melanzonus	*Sturisoma barbatum*
Creagrutus planquettei	*Thoracocharax stellatus*
Crenicichla albopunctata	
Crenicichla johanna	
Crenicichla multispinosa	
Crenicichla saxatilis	
Crenicichla ternetzi	
Cteniloricaria fowleri	
Cteniloricaria maculata	
Ctenobrycon spilurus	
Cynodon gibbus	
Cynopotamus essequibensis	
Farlowella reticulata	
Farlowella rugosa	
Fluviphylax palikur	
Galeocharax gulo	
Gasteropelecus sternicla	
Geophagus camopiensis	
Geophagus harreri	
Geophagus surinamensis	
Guianacara geayi	
Guianacara oelemariensis	
Guianacara owroewefi	
Pseudancistrus brevispinis (appeears in ref. as *Lasiancistrus brevispinis)*	
Pseudancistrus longispinis (appears in ref. as *Lasiancistrus longispinis)*	
Pseudancistrus niger (appears in ref. as *Lasiancistrus niger)*	
Harttia surinamensis	
Harttiella crassicauda	
Peckoltia braueri	
Peckoltia braueri	
Hemibrycon surinamensis	
Hemigrammus schmardae	
Hemigrammus bellottii	
Hemigrammus boesemani	
Hemigrammus guyanensis	
Hemigrammus ocellifer	
Hemigrammus rodwayi	
Hemigrammus unilineatus cayennensis	
Hemiloricaria cf. *platyura* (appears in ref. as *Rineloricaria* cf. *platyura)*	

Heptapterus stewarti (appears in ref. as *Rineloricaria stewarti)*
Hemiodontichthys acipenserinus
Heros efasciatus
Hoplosternum littorale
Hyphessobrycon sovichthys
Hyphessobrycon copelandi
Hyphessobrycon eques (appears in ref. as *Hyphessobrycon callistus)*
Hyphessobrycon roseus (appears in ref. as *Megalamphodus roseus)*
Hyphessobrycon takasei
Hypostomus ventromaculatus
Hypostomus gymnorhynchus
Hypostomus ventromaculatus
Hypselecara temporalis
Knodus heteresthes
Krobia guianensis
Krobia guianensis
Krobia itanyi
Laetacara curviceps
Lithoxus boujardi
Lithoxus planquettei
Lithoxus stocki
Loricaria cataphracta
Loricaria nickeriensis
Loricaria parnahybae
Megalechis thoracata
Mesonauta guyanae
Metaloricaria paucidens
Micropoecilia parae
Micropoecilia bifurca
Micropoecilia picta
Moenkhausia grandisquamis
Moenkhausia intermedia
Moenkhausia simulata
Moenkhausia lata
Moenkhausia chrysargyrea
Moenkhausia collettii
Moenkhausia georgiae
Moenkhausia grandisquamis
Moenkhausia hemigrammoides
Moenkhausia inrai
Moenkhausia moisae
Moenkhausia oligolepis
Moenkhausia surinamensis
Nannacara anomala
Nannacara aureocephalus
Nannostomus beckfordi
Nannostomus bifasciatus
Odontostilbe gracilis
Otocinclus mariae
Panaque dentex
Phenacogaster megalostictus
Piabucus dentatus
Poecilia vivipara
Poptella brevispina
Pristella maxillaris
Pseudacanthicus serratus
Pseudancistrus barbatus
Hyphessobrycon simulatus
Pterophyllum scalare
Pyrrhulina filamentosa
Retroculus septentrionalis
Rivulus agilae
Rivulus cladophorus
Rivulus geayi
Rivulus igneus
Rivulus lungi
Kryptolebias ocellatus
Rivulus xiphidius
Roeboexodon guyanensis
Satanoperca jurupari
Hypostomus watwata
Tetragonopterus chalceus
Thayeria ifati
Tomeurus gracilis
Triportheus rotundatus

Appendix 5. Permissible ornamental fish species found in Colombia, Brazil and Peru and which are present in Amanã

Colombia	Brazil	Peru	Venezuela	Amanã
Abramites hypselonotus	X	X	X	
Acanthodoras spp.		X		
Acanthodoras spinosissimus	X	X		
	Acarichthys heckelii	X		X
Achirus spp.		X		
Amblydoras hancockii	X	X		*Amblydoras affinis*
Ancistrus brevispinis	*Ancistrus* spp.	*Ancistrus* spp.	X	*Ancistrus* cf. *brevipinis*
Ancistrus lineolatus				
Ancistrus temminckii				
Ancistrus triradiatus				
Anostomus anostomus	X	X		X
Apistogramma agassizii	X	X	X	
Apistogramma corumbae	X			*Apistogramma* sp.1.
Apistogramma ortmanni	X			*Apistogramma* sp.2.
Apteronotus albifrons	X	X		*Apteronotus macrolepis*
Brochis splendens		X		
Bunocephalus spp.	*Bunocephalus amaurus*	*Bunocephalus amaurus*		*Bunocephalus amazonicus*
Bunocephalus coracoideus	X	*Bunocephalus* spp.	X	*Bunocephalus verrucosus*
Callicthys callicthys	X	X		X
Carnegiella marthae	X	X		X
Carnegiella strigata	X	X		
Characidium fasciatum	X	X		*Characidium* spp.
Charax gibbosus	X	X		*Charax unimaculatus*
Chilodus punctatus	X	X		X
Colomesus psittacus	X			*Colomesus asellus*
Copella arnoldi	X	X		*Copeina guttata*
Corydora spp.				*Corydoras* spp.
Corydoras aeneus	X	X		
Corydoras agassizii	X	X		
Corydoras arcuatus	X	X		
Corydoras elegans	X	X		
Corydoras julii	X	X		
Corydoras melini	X			
Corydoras punctatus	X	X		
Corydoras reticulatus	X	X		
Dianema urostriatum	X	*Dianema longibarbis*		X
Eigenmannia virescens	X	*Eigenmannia* spp.		*Eigenmannia* spp.
Exodon paradoxus	X			
Farlowella acus	*Farlowella spp.*	*Farlowella* spp.	X	

Colombia	Brazil	Peru	Venezuela	Amanã
Gasteropelecus sternicla	X	*Gasteropelecus levis*		
Hemigrammus bleheri	X	X	X	
Hemigrammus ocellifer	X	X		X
Hemigrammus pulcher	X	*Hemigrammus* spp.		
Hemiodus gracilis	X	*Hemiodus unimaculatus*	*Hemiodus orthonops*	
Hyphessobrycon peruvianus	*Hyphessobrycon* spp.	*Hyphessobrycon* spp.		
Hyphessobrycon rosaceus				*Hyphessobrycon bentosi*
Hyphessobrycon erythrostigma				*Hyphessobrycon erythrostigma*
Hyphessobrycon sweglesi				*Hyphessobrycon* spp.
Hypostomus plecostomus	*Hypostomus* spp.	*Hypostomus* spp.		*Hypostomus hoplonites*
Laemolyta taeniata	X			*Laemolyta taeniata*
Mikrogeophagus ramirezi	X		X	
Moenkhausia oligolepis	X	X		X
Monocirrhus polyacanthus	X	X		X
Myloplus rubripinnis	*Myloplus rubripinnis*		X	*Myleus torquatus*
Nannostomus eques	X	*Nannostomus* spp.		X
Nannostomus marginatus	X	X		X
Nannostomus trifasciatus	X	X		X
			Nannostomus unifasciatus	*Nannostomus unifasciatus*
Otocinclus affinis	X	X		*Otocinclus hoppei*
Paracheirodon axelrodi	X	X	X	
Paracheirodon innesi	X	X	X	X
Peckoltia spp.	X	X	X	
Poecilia reticulatus	X	*Perrunichthys perruno*		
*Hemigrammus armstrongi** [Poecilocharax weitzmani]*	*Poecilocharax weitzmani*	*Poecilia* spp.		
Pseudancistrus spp.	*[Pseudancistrus] Pseudacanthicus leopardus*			
Pterophyllum scalare	X	X	*Pterophyllum altum*	
Rivulus urophthalmus	*Rivulus urophthalmus*			*Rivulus ornatus*
Symphysodon aequifasciatus	X	X		X
Symphysodon discus	*Symphysodon discus*			
Thoracocharax stellatus	X	X		X

Appendix 6. Selling prices of ornamental fish species that are present in Mamirauá and Amanã and are approved by IBAMA for export. Note: * indicates similar species.

SPECIES NAME	Msdr	Asdr	No/box	Colombia	Peru 1	Peru 2	Peru 3	Peru 4	Pará 1	Pará 2	Manaus 1	Manaus 2	Recife & RJ
Abramites hypselonotus	Y		40-70		.40	.50		.50				.80	
Acanthodoras spinosissimus	Y	Y	180-200		.10*	.10		.10		.50			
Acarichthys heckelii	Y	Y	60-80				1.99	1.00				.70	3.36-3.84
Amblydoras hancockii	Y												
Amblydoras spp.		Y										.20	
Ancistrus Hoplogenys	Y		100		.25*								
Ancistrus spp.	Y	Y	80-100		1.00	2.40	12.00	.40-1.00	.60-1.50	9.00-12.00			1.50-80.00
Anostomus spp.		Y	20-35			.50		.35					
Aphyocharax spp.		Y											
Apistogramma agassizii	Y		60-250			.35-1.35	.39	1.30	.80	.50-.90		1.40	1.50
Apistogramma sp. 1	Y	Y	80-300		.60	1.30-2.50	1.29	1.40-1.80			.12	.10	
Apteronotus albifrons	Y		out/40		2.20	1.50		1.70	1.20	.90			
Apteronotus spp.		Y											
Astyanax bimaculatus	Y												
Astyanax spp.		Y											
Biotodoma cupido	Y	Y	15-80			1.00	.60	.85					
Bryconops spp.		Y											
Bunocephalus spp.		Y	50-100		.10*			0.30-1.60					
Callichthys callichthys	Y	Y	60*					.40-.45					
Carnegiella strigata	Y		150-200			.12		.10					12
Carniguiella marthae		Y	150-300		.07	.12		.12			.25	.08	
Carniguiella strigata		Y	150-220	.15		.12		.10			.15		
Catoprion mento		Y											
Chalceus erythrurus	Y												
Chalceus macrolepidotus	Y		16-25		.50	.50		.50					
Characidium (fasciatum) sp. 1			100-200		1.00	0.12		.13					
Characidium (fasciatum) sp. 2	Y		200					.40					
Characidium spp.		Y	100-150		1.00	.40							
Charax gibbosus	Y		30-40			.70		2.50-3.50					
Charax spp.		Y											
Chilodus punctatus	Y		50-80			.20		.20					.30
Chilodus punctatus		Y	50-80			.20		.20					
Colomesus asellus	Y	Y	60-100			.50		.50					
Copeina spp.		Y	80-90			.30*		.35*					
Copella arnoldi	Y		100-250		.10	.15							
Copella nattereri	Y												.22
Copella nigrofasciata		Y	90-100			.15							
Copella spp.		Y	100-150		.30*		.22*	.38*					
Corydoras sp. 1	Y	Y	80-200		.10		12.00	1.00-2.90		.20-2.00	.12-1.50		1.80*
Crenicara spp.		Y	100		.40*								
Crenicichla notophthalmus		Y	4		3.00*								
Crenicichla spp.			4-100	.50*	.20	.50	18.00	.35-.70					2.50-21.60
Dekeyseria scaphirhyncha	Y												
Dianema longibarbis	Y	Y											
Dianema urostriatum		Y											
Eigenmannia macrops (A)	Y												
Eigenmannia . virescens (A)	Y												.35
Eigenmannia macrops (B)	Y												
Eigenmannia virescens (B)	Y					10.00							

SPECIES NAME	Msdr	Asdr	No/box	Colombia	Peru 1	Peru 2	Peru 3	Peru 4	Pará 1	Pará 2	Manaus 1	Manaus 2	Recife & RJ
Eigenmannia limbata	Y	Y											
Eigenmannia sp. 1	Y	Y	60						.30				
Eigenmannia trilineata		Y				1.50							
Farlowella amazonum	Y												
Farlowella henriquei	Y												
Farlowella nattereri	Y												
Farlowella spp.		Y	20-30			1.50							
Gasteropelecus sternicla	Y		220*	.15*						.12*			.12
Hemigrammus pulcher	Y	Y	120-150			.10		.40					
Hemigrammus Ocellifer sp. 1	Y												
Hemigrammus ocellifer	Y		120-150			.10							
Hemigrammus spp.		Y	150					.50					
Hemiodus gracilis	Y	Y											
Hyphessobrycon copelandi	Y		100-200			.12			.70				
Hyphessobrycon erysthrostigma		Y	120-150			.15		.10					
Hyphessobrycon bentosi	Y	Y	120-150			.09		.08					
Hyphessobrycon heterorhabdus	Y												
Hyphessobrycon spp.		Y	100		.50			.90					.18-1.30*
Hypostomus carinatus	Y		60-100*								.50-.60		15.00*
Hypostomus emarginatus	Y		15					1.50					
Leporinus agassizii	Y		60-70		.40*	.40*		.45*					
Hypostomus carinatus		Y											
Moenkhausia dichroura	Y	Y											
Moenkhausia lepidura sp. 1	Y												
Moenkhausia lepidura sp. 2	Y												
Moenkhausia intermedia	Y	Y											
Moenkhausia lepidura	Y	Y											
Moenkhausia oligolepis	Y	Y	100-120			.20							
Moenkhausia spp.		Y	40-100			2.20		.60					2.00* blue eye
Monocirrhus polyacanthus	Y	Y	25-40		1.50	2.00		2.50					
Myloplus rubripinnis	Y		20		1.50					1.50*			1.00
Nannostomus digrammus		Y											
Nannostomus eques	Y	Y	250-300						.10		.12	.09	.12
Nannostomus spp.		Y	200-160		1.50*	.80*	2.90	2.50					.08*
Nannostomus trifasciatus	Y	Y	150-250			.15		.10	.10				.14
Nannostomus unifasciatus	Y	Y	200-250			.15						.09	
Nannostomus marginatus	Y	Y	160				1.89						.10
Otocinclus		Y											.08
Peckoltia brevis	Y		20-30		1.50	1.90							
Petitella georgiae		Y											
Prionobrama filigera	Y												
Prionobrama spp.		Y											
Pseudanos trimaculatus	Y	Y											
Pseudanos gracilis	Y	Y											
Pterophyllum scalare	Y		20-100	3.00*	.50	.35-1.00	.89	.50-.80		12.00			1.50
Pygocentrus nattereri	Y	Y	out/40				1.49-4.99						
Pyrrhulina spp.		Y											
Pyrrhulina sp. 1	Y		80-100			.25*		.38				.35	
Pyrrhulina sp. 2	Y		100*					.38					
Rineloricaria lanceolata	Y												

SPECIES NAME	Msdr	Asdr	No/box	Colombia	Peru 1	Peru 2	Peru 3	Peru 4	Pará 1	Pará 2	Manaus 1	Manaus 2	Recife & RJ
Rineloricaria spp.	Y	Y	mai/40				1.89	7.00					
Rivulus sp. 1	Y		100		.50					.80			
Rivulus sp. 2	Y		100		.60					.80			
Satanoperca jurupari	Y	Y	dez/20						1.50-2.00			.35	2.40-3.00
Satanoperca spp.		Y											2.80*
Serrasalmus spp.		Y	10			.50-40.00		5.50-6.00		2.50-10.00*			1.50-35
Symphysodon aequifasciatus	Y	Y	out/25			5-30.00	11.00					3-6.00	9.00
Tatia intermedia	Y												
Tatia sp. 1	Y	Y	60-70			1.50		.55					.80-5.00
Uaru amphiacanthoides	Y	Y											4.80-18.00