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Analysis of the marine ornamental fish trade at Ceará State, northeast Brazil

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Abstract. Brazil is one of the leading exporters of ornamental fishes, mostly freshwater; however, monitoring of the trade is nearly non-existent in the country. This paper provides an initial assessment of a new venture, the marine aquarium fish trade at Ceará State, northeast Brazil, aiming to document the species traded, to provide preliminary estimates of numbers of specimens traded, and to identify priorities in data collection and monitoring. A total of 143 species and 199 304 fishes were traded. From the total, 109 species were native and represented 84% of the fishes traded. Thirty-four exotic species figured on the permits and amounted to nearly 16% of the exports; however, most of them consist of misidentified native species. Nearly 90% of the fish trade was directed to the international market. Official figures represent an underestimation of the total number of captured specimens.

Introduction

The ornamental fish trade is an expanding multi-million dollar market with considerable growth in the last two decades (Cheong 1996). The approximate global import value of ornamental fishes is US$ 321 million (Dawes 2001), from which US$ 21–48 million belong to the marine ornamental fish trade (Wood 2001).

Due to the considerable growth and diversification in the international ornamental fish trade, there is a concern about the possible effects on the conservation of wild populations (Andrews 1990). Although some initiatives have promoted the sustainable use of ornamental fish resources (Baquero 2001; Chao 2001), this concern is particularly relevant to the marine aquarium trade, as virtually all commercial fish species are collected in the wild (Wood 2001).

The largest suppliers of marine ornamental fishes are Indonesia and the Philippines (Wood 2001). Brazil is one of the leading exporters of freshwater ornamental

fishes (Prang 2001), but also appears as a consistent supplier of marine species (Wood 2001).

Despite the increasing demand for tropical marine fishes, monitoring of the trade is nearly non-existent in Brazil. Official records of the marine ornamental fish trade are not consistent from year to year and do not cover all coastal states. Conservation measures and catch quotas established by the national authority for the environment, IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), are ineffective due to the lack of baseline data. In a recent effort to overcome this gap, Nottingham et al. (2000) provided information about handling, keeping and transporting marine ornamental fish.

A substantial part of the marine ornamental fish trade is supported by fish collections in northeast Brazil. The city of Fortaleza, the state capital of Ceará, is becoming one of the main centers of the marine ornamental fish trade. Nevertheless, very little is known about the species captured, their population status, and collection areas.

This paper provides an initial assessment of the marine aquarium fish trade in Ceará State, northeast Brazil. The objectives are to document the species traded, to provide preliminary estimates of numbers of specimens traded, and to identify priorities in data collection and monitoring to support policies for the marine aquarium trade in Brazil.

Materials and methods

Data were obtained from trade permit forms filed by wholesalers for individual shipments at the regional IBAMA (Brazil's environmental agency) office at Fortaleza. Permit forms covered the periods between January 1995 and July 1997, and from August 1998 to October 2000. From August 1997 to July 1998, the permit form system was suspended. Information contained on permits included the name of the wholesaler, name of the buyer (national/international), country of destiny, a species list, the number of individuals/species being shipped, and the retail price.

Data were compiled on electronic spreadsheets, and double checked through interviews with the wholesalers. Species names compiled from the permit forms were compared to the available information in the literature to check for misidentifications based on geographical ranges (Lima 1969; Mayland 1976; Figueiredo and Menezes 1978, 1980; Menezes and Figueiredo 1980, 1985; Migdalski and Fichter 1983; Humann and Deloach 1994; Randall 1996; Froeser and Pauly 2001). Genera and species names were kept as originally listed on the permit forms.

Results and discussion

A total of 143 species and 199 304 individuals of marine ornamental fishes were traded through the Fortaleza market. From the total, 109 species were native and represented 84% of the fishes traded. Thirty-four exotic species represented nearly

Table 1. Species list and number of marine aquarium fishes traded at Fortaleza, Ceará, Brazil, from January 1995 to November 2000, including native and exotic species.

Species	No.	%	Species	No.	%
Native species					
Holacanthus ciliaris	43730	21.94	*Halichoeres* spp.	214	0.10
Pomacanthus paru	22969	11.52	*Acanthurus chirurgus*	210	0.10
Hippocampus erectus	12586	6.31	*Thalassoma* spp.	208	0.10
Pomacanthus arcuatus	12196	6.11	*Acanthostracion quadricornis*	205	0.10
Holacanthus tricolor	8756	4.39	*Microspathodon chrysurus*	165	0.08
Centropyge aurantonotus	5741	2.88	*Scarus* spp.	145	0.07
Acanthurus bahianus	5622	2.82	*Gymnothorax funebris*	140	0.07
Acanthurus coeruleus	5304	2.66	*Cantherhines macroceros*	137	0.06
Bodianus rufus	3716	1.86	*Antennarius multiocellatus*	131	0.06
Chaetodon ocellatus	3455	1.73	*Equetus lanceolatus*	129	0.06
Chaetodon striatus	3096	1.55	*Myrichthys oculatus*	128	0.06
Equetus acuminatus	2679	1.34	*Apogon pseudomaculatus*	125	0.06
Abudefduf saxatilis	2469	1.23	*Diodon* spp.	110	0.05
Selene vomer	2244	1.12	*Chromis multilineatus*	100	0.05
Cyclichthys schoepfi	2223	1.11	*Chromis* spp.	94	0.04
Halichoeres cyanocephalus	1978	0.99	*Ginglymostoma cirratum*	81	0.04
Stegastes variabilis	1883	0.94	*Sphoeroides spengleri*	81	0.04
Bodianus pulchellus	1658	0.83	*Paraclinus fasciatus*	75	0.03
Dactylopterus volitans	1648	0.82	*Ogcocephalus nasutus*	74	0.03
Balistes vetula	1607	0.80	*Rhinobatos percellens*	72	0.03
Trachinotus carolinus	1293	0.64	*Serranus baldwini*	70	0.03
Anisotremus virginicus	1254	0.62	*Cantherhines pullus*	69	0.03
Chaetodipterus faber	1137	0.57	*Myripristis jacobus*	65	0.03
Canthigaster rostrata	1065	0.53	*Parupneus* sp.	63	0.03
Chaetodon sedentarius	984	0.49	*Lutjanus analis*	60	0.03
Diodon hystrix	896	0.45	*Serranus flaviventris*	52	0.02
Haemulon plumieri	831	0.41	*Opistognathus aurifrons*	51	0.02
Ophioblennius atlanticus	668	0.33	*Pomacanthus* spp.	50	0.02
Scarus vetula	655	0.32	*Gymnothorax moringa*	49	0.02
Amblycirrhitus pinos	592	0.29	*Halichoeres garnoti*	49	0.02
Prionotus punctatus	570	0.28	*Scorpaena brasiliensis*	49	0.02
Halichoeres radiatus	567	0.28	*Sparisoma viride*	49	0.02
Pseudupeneus maculatus	541	0.27	*Serranus tortugarum*	40	0.02
Scarus coeruleus	535	0.26	*Acanthurus* spp.	35	0.01
Alphestes afer	516	0.25	*Stegastes* spp.	34	0.01
Lactophrys polygonia	516	0.25	*Gymnothorax vicinus*	27	0.01
Aulostomus maculatus	487	0.24	*Echeneis naucrates*	219	0.11
Halichoeres poeyi	485	0.24	*Eupomacentrus* spp.	26	0.01
Aluterus scriptus	458	0.23	*Antennarius* spp.	24	0.01
Narcine brasiliensis	467	0.23	*Muraena miliaris*	24	0.01
Stegastes pictus	397	0.19	*Monacanthus hispidus*	14	–
Halichoeres maculipinna	346	0.17	*Scorpaena plumieri*	13	–
Halichoeres bivittatus	334	0.16	*Cephalopholis cruentata*	10	–
Apogon maculatus	305	0.15	*Chilomycterus antillarum*	10	–
Xyrichthys novacula	303	0.15	*Malacanthus plumieri*	7	–
Gymnothorax spp.	289	0.14	*Lactophrys* spp.	6	–
Chromis scotti	283	0.14	*Dasyatis guttata*	5	–
Ogcocephalus spp.	283	0.14	*Canthidermes maculatus*	4	–

Table 1. (*continued*)

Species	No.	%	Species	No.	%
Cephalopholis fulva	259	0.13	*Lactophrys quadricornis*	4	–
Rhinobatos spp.	245	0.12	*Bodianus* spp.	3	–
Ogcocephalus vespertilio	240	0.12	*Centropyge* spp.	2	–
Bathygobius soporator	236	0.11	*Epinephelus guttatus*	2	–
Chromis flavicauda	227	0.11	*Trachinotus goodei*	2	–
Xyrichthys splendens	226	0.11	*Lactophrys trigonus*	1	–
Exotic species					
Gramma loreto	8797	4.41	*Chromis cyaneus*	122	0.06
Gobiosoma evelynae	8283	4.15	*Rhinobatus armatus*	102	0.05
Hippocampus kuda	7558	3.79	*Zapteryx exasperata*	84	0.04
Apogon aurolineatus	1187	0.59	*Aluterus schoepfi*	50	0.02
Sphoeroides marmoratus	1085	0.54	*Pomacanthus maculosus*	25	0.01
Hippocampus mohnikei	965	0.48	*Gymnothorax castaneus*	24	0.01
Ogcocephalus radiatus	716	0.35	*Halichoeres nicholsi*	22	0.01
Lactoria cornuta	510	0.25	*Prionotus ophryas*	15	–
Stegastes leucostictus	288	0.14	*Halichoeres bathyphilus*	12	–
Bothus leopardus	282	0.14	*Centropyge acanthops*	10	–
Antennarius biocellatus	276	0.13	*Chilomycterus affinis*	10	–
Thalassoma bifasciatum	217	0.11	*Myrichthys maculosus*	7	–
Pseudopleuronectes americanus	206	0.10	*Pomacentrus vaiuli*	7	–
Ogcocephalus corniger	168	0.08	*Labrisomus bucciferus*	5	–
Sparisoma atomarium	142	0.07	*Antennarius hispidus*	2	–
Apolemichthys xanthurus	135	0.06	*Pomacanthus zonipectus*	2	–
Caulolatilus chrysops	126	0.06	*Pterois volitans*	2	–
Total species	143		Total abundance	199.304	100.00

16% of the exports (Table 1), but most of these represented native species misidentified by untrained wholesalers (e.g. *Hippocampus kuda* ≈ *Hippocampus erectus* or *H. reidi*).

Five native species, *Holacanthus ciliaris*, *Pomacanthus paru*, *Hippocampus erectus*, *Pomacanthus arcuatus* and *Holacanthus tricolor*, made up 50% of the total trade between 1995 and 2000. The top two species together represented 33% of this total (Table 1). Among the misidentified exotic species, *Gramma loreto* (≈*Gramma brasiliensis*), *Gobiosoma evelynae* (≈*Elacatinus figaro*) and *Hippocampus kuda* (≈*Hippocampus erectus* or *H. reidi*) together represented 12% of the exports. One hundred and twenty-five species were traded occasionally and each represented less than 1% of the total trade (Table 1). Although the total number of native species exploited was probably correct, the total number of fishes harvested and exported was underestimated. When the cargo is ready for shipment, wholesalers often declare fewer fishes than they are actually exporting, to pay less taxes and keep annual shipments within their individual allowable quota of 5000 fishes per year.

During the period 1995–1997, between two and six wholesalers were operating in the market, and sales remained around 13 000 and 15 000 fishes per year (Figures 1 and 2). In 1999–2000, the number of fishes traded drastically increased to values around 60 000–80 000 fishes per year, with a total of eight traders in the market (Figure 1). These figures indicate that the trade in tropical marine aquarium fishes at

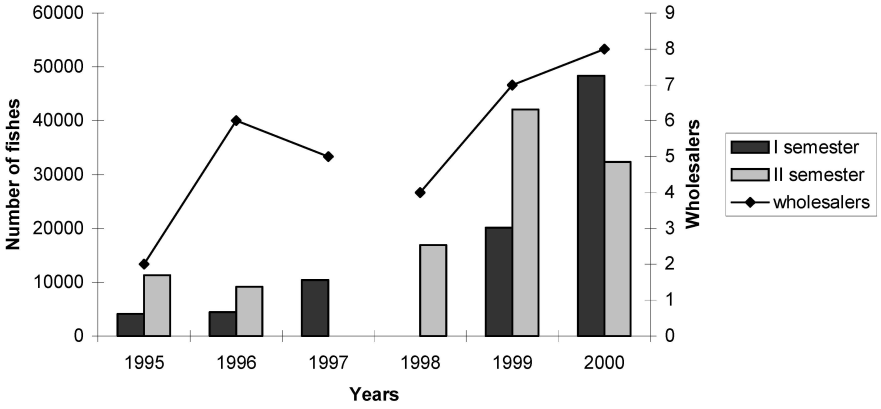

Figure 1. Number of fishes traded and number of wholesalers per semester, in the marine ornamental fish market at Ceará State, Brazil, from 1995 to 2000.

Ceará is a growing business, attracting both businessmen and fishers into the market. However, only a few keep their production steady for more than 1 year. During the period covered in this study only three companies traded fish consistently. Problems related to the high investments to keep up the quality control during capture and handling (Nottingham et al. 2000), and the market demand for top quality fish, probably discouraged entrepreneurs after their first year of operation.

The trade was usually higher in the second half of the year (Figure 2). Monthly production was lowest during January but gradually increased towards the end of the year, reaching its peak in October, and decreasing again in November and December (Figure 2). This pattern was consistent between years, and probably reflected a higher demand from the international market during the northern hemisphere Fall and early Winter. During the colder Winter months hobbyists usually spend more

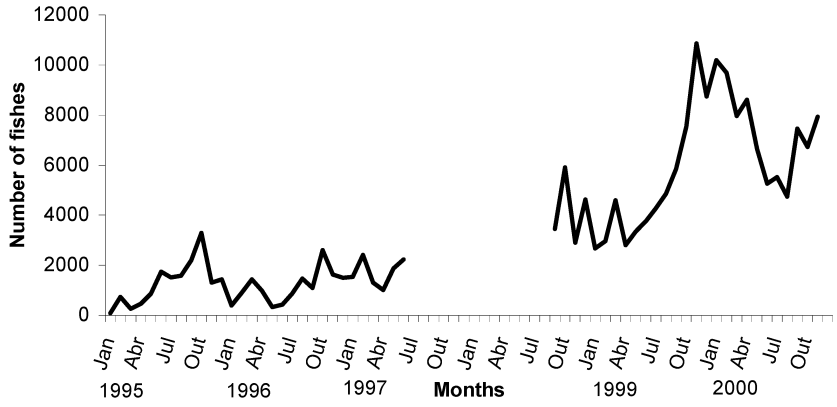

Figure 2. Number of fishes traded per month in the marine ornamental fish market at Ceará State, Brazil, from 1995 to 2000.

time indoors taking care of their aquaria (Hudson Crizanto, personal communication). Similarly, Cheong (1996) observed that the largest quantities of freshwater fishes were exported from Singapore towards the end of the year.

Holacanthus ciliaris and *Pomacanthus paru* were the top target species in the marine ornamental fish trade at Ceará, and together represented nearly 75% of the total fish traded in 1995 (Figure 3). However, after 1997 there was an increase in the relative abundance of other species, such as *Pomacanthus arcuatus* (grey angelfish), *Acanthurus bahianus* (ocean surgeon), *Gramma loreto* (fairy basslet), and *Hippocampus erectus* (seahorse) (Figure 3).

Fish groups at risk may include endemic species such as *Gramma brasiliensis* (≈*G. loreto*), those species with restricted distribution (Andrews 1990) and subjected to localized fishing pressure (Wood 2001), and species which are already threatened (*Hippocampus erectus*, *Balistes vetula*), due to other forms of commercial exploitation (Hilton-Taylor 2000). Removal of key species is another aspect of the trade that deserves attention. At Ceará and other northeastern Brazilian states the neon goby (*Elacatinus figaro* ≈ *Gobiosoma evelynae* in Table 1), a cleaner species, is traded in large numbers. Cleaner species play an important ecological role in reef areas, and their removal may negatively affect other fish species, including commercially important ones. For instance, it is known that the cleaner wrasse, *Labroides dimidiatus*, maintains cleaning stations which are loci of high 'point diversity' on the reef. As noted by Wood (2001), the secondary effects of the removal of this species for the fish trade are unknown.

Nearly 90% of the fish trade was directed to the international market, involving 123 buyers from 19 countries. Considering the number of fishes traded, the USA was by far the largest market, and accounted for 44.8% (89 207 fishes) of the total international trade, followed by Japan and Italy (Figure 4a). Previous authors had already observed that aquarists in North America, Europe and Japan buy the bulk of ornamental fishes traded in the world (Andrews 1990; Davenport 1996; Chapman et al. 1997).

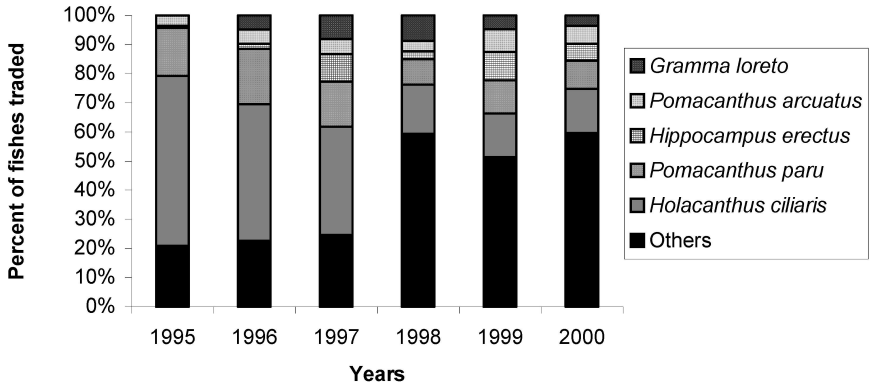

Figure 3. Relative percent abundance of the five most abundant species traded in the marine ornamental fish market at Ceará State, Brazil, from 1995 to 2000.

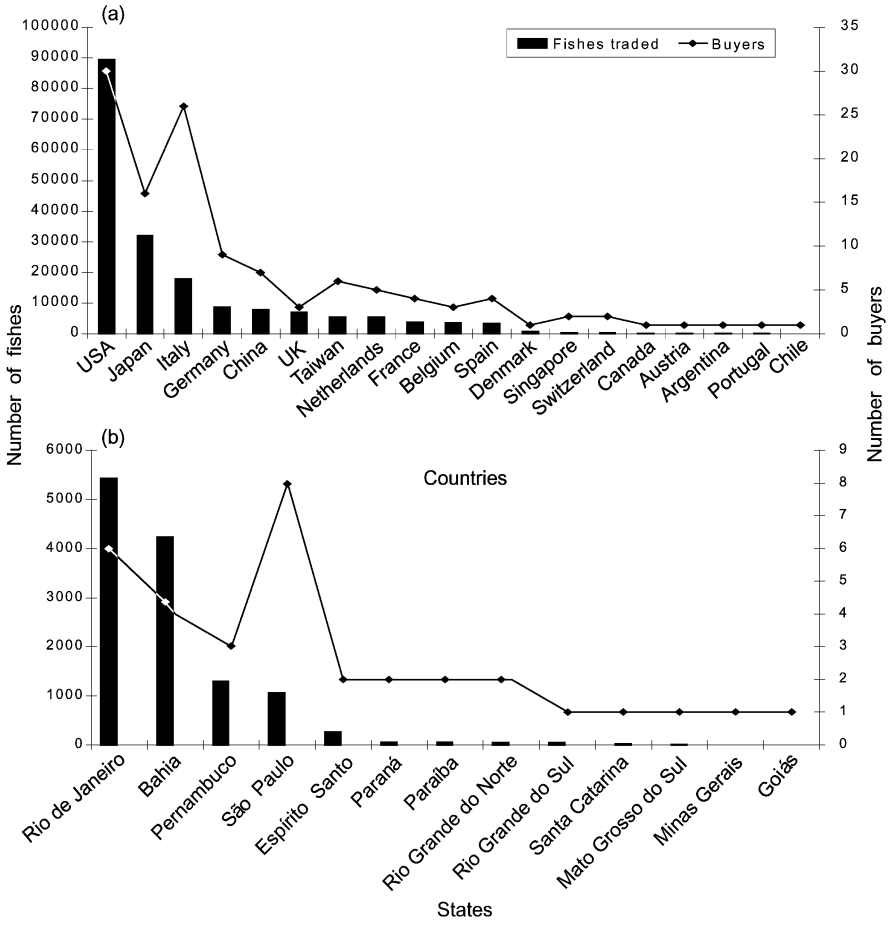

Figure 4. Number of buyers and number of fishes sold to the international (a) and national (b) marine ornamental fish markets.

Thirty-four buyers from 13 states in Brazil bought fish from Ceará traders. Most of the shipments were forwarded to Rio de Janeiro and Bahia, which also had the largest numbers of buyers (Figure 4b).

Population estimates for species in the aquarium trade are not available for Ceará or elsewhere, and the number of fishes traded is the only available information to date. Nevertheless, Nottingham et al. (2000) reported fish mortalities and losses during the collection process reaching as much as 10% of the total harvest. The high mortality in the collection process indicates that the official figures represent an underestimation of the total number of captured specimens. This aspect of the trade should be closely monitored to reduce losses and to guarantee that mortality rates are taken into account when collection quotas are established.

In conclusion, the marine ornamental fish trade at Ceará is a growing business

which should be more carefully monitored. Fish lists supplied by the dealers to IBAMA often contain misidentified species and underestimate the numbers of exported fish to reduce costs and circumvent the established quotas. IBAMA officials involved with permit issuing should receive training in marine fish identification and have access to updated fish identification guides. Lastly, the biology of target species should be investigated. The information generated should provide additional elements to the permit issuing process.

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