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Collaborative monitoring of the ornamental trade of seahorses and pipefishes (Teleostei: Syngnathidae) in Brazil: Bahia State as a case study

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Many species of seahorses and pipefishes (family Syngnathidae) are traded for medicinal purposes and aquaria; some are also sold as souvenirs or curiosities. Brazil is one of the main suppliers of seahorses for the international aquarium trade, nevertheless, little is known about the magnitude of that trade in the country. With regards to pipefishes, virtually nothing is known about their captures for ornamental purposes in Brazil. The present study assesses the magnitude of captures and trade of seahorses and pipefishes, based on data obtained through a collaborative monitoring program established with the main retailer of marine ornamental organisms in the State of Bahia. The syngnathid fishery is conducted in shallow waters never exceeding 7 m, generally by breathhold diving. Both seahorses and pipefishes are mostly caught by hand, and only rarely hand-nets or plastic bags are used. From January/1997 to June/2005, 152 fishers recorded their daily catches of syngnathids. Two species of seahorses, *Hippocampus reidi* and *H. cf. erectus* (9,793 specimens captured from 1997 to 2005) and three species of pipefishes, *Cosmocampus albirostris*, *Micrognathus* sp. and *Syngnathus* sp. (143 specimens captured from 1999 to 2005) were traded. *H. reidi* was the most heavily exploited species.

Muitas espécies de cavalos-marinhos e peixes-cachimbo (família Syngnathidae) são comercializadas para fins medicinais e de aquarismo; algumas são também vendidas como suvenires ou curiosidades. O Brasil é um dos maiores fornecedores de cavalos-marinhos para o comércio aquarista internacional, porém pouco se sabe sobre a magnitude das capturas no país. Com relação aos peixes-cachimbo, praticamente nada se conhece acerca das suas capturas para fins ornamentais no Brasil. O presente estudo avalia a magnitude das capturas e do comércio de cavalos-marinhos e peixes-cachimbo para fins ornamentais, a partir de dados obtidos através de um programa de monitoramento desenvolvido em colaboração com o principal comerciante de organismos ornamentais marinhos no estado da Bahia. A pesca de cavalos-marinhos e peixes-cachimbo é realizada em águas rasas, nunca excedendo 7m de profundidade, geralmente em apnéia. Tanto cavalos-marinhos como peixes-cachimbo são coletados manualmente, e apenas raramente redes ou sacos plásticos são usados. Entre Janeiro de 1997 e Junho de 2005, 152 pescadores registraram suas capturas diárias de cavalos-marinhos e peixes-cachimbo. Duas espécies de cavalos-marinhos, *Hippocampus reidi* e *H. cf. erectus* (9.793 espécimes capturados entre 1997 e 2005) e três espécies de peixes-cachimbo, *Cosmocampus albirostris*, *Micrognathus* sp. e *Syngnathus* sp. (143 espécimes capturados entre 1999 e 2005) foram comercializados. *H. reidi* foi a espécie mais fortemente explorada.

Key words: Ornamental trade, *Cosmocampus, Hippocampus, Micrognathus, Syngnathus*.

Introduction

The family Syngnathidae includes fishes commonly known as seahorses, pipefishes, pipehorses and seadragons. Many syngnathids are heavily collected for medicinal purposes, aquaria, and some are traded as souvenirs or curiosities (Lourie *et al*., 2004). Additionally, some seahorse species are incidentally caught in shrimp trawls (Baum *et al*., 2003; McPherson & Vincent, 2004; Rosa, 2005).

Both in volume and in number of species traded, seahorses (genus *Hippocampus*) are the most heavily exploited syngnathids. Nearly a decade ago, Vincent (1996) pointed out that the high levels of exploitation were significantly reducing seahorse populations, and that there was circunstantial evidence of both recruitment and growth overfishing. Since that initial assessment of the magnitude of the international seahorse trade, the number of trading countries has risen from 32 (Vincent, 1996) to approximately 77 (http://www.projectseahorse.org).

Concern over the sustainability of the seahorse trade culminated with the listing of all species of *Hippocampus* in Appendix II of the Convention on International Trade in En-

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dangered Species of Wild Fauna and Flora (CITES), a listing that requires exporter countries to demonstrate that captures are non-detrimental to the persistence of wild populations. There is a recognition that seahorses may now be the most voluminously trade CITES animal species, and that the listing thus requires significant work in source countries, the CITES Animal and Nomenclature committees, academia and the conservation community (Bruckner *et al*., 2005), and as pointed out by McPherson & Vincent (2004), it is critical that the international community gain a better understanding of seahorse exploitation globally as soon as possible.

Brazil is one of the world's leading exporters of marine ornamental fishes (Fritzche & Vincent, 2002; Wood, 2001), one of the main suppliers of seahorses for the aquarium trade (Wood, 2001; Monteiro-Neto *et al.* 2003), and the only major exporter and the main domestic consumer of live seahorses in Latin America. Offical statistics, however, severely underestimate the magnitude of the that trade (Rosa, 2005). With regards to pipefishes, little is known about their capture and trade for ornamental purposes in the country. Data on species traded, captures and trade routes are virtually non-existent.

The State of Bahia is one of the pioneers in the capture and trade of marine organisms for ornamental purposes in Brazil, and possibly the principal source of animals sold as part of the marine acquarium trade in the country in 2005. Within Bahia State, Salvador City is the focal point for their collection and trade of marine organisms for ornamental purposes.

The present study represents the first attempt to quantify the captures of syngnathids for ornamental purposes in Brazil, and was centered around the following questions: which syngnathid species are traded? What is the magnitude of the trade? How has the trade evolved over nearly a decade?

Given Bahia's significant role in the marine aquarium trade in Brazil, the present analysis constitutes a useful case study to increase our knowledge of the live syngnathid trade in the country as a whole, and can be used to increase our understanding of the international trade of seahorses for aquaria - thus assisting the Brazilian government in meeting the demands created by the listing of seahorses in Appendix II of CITES.

Moreover, by fostering dialogue among relevant stakeholders, this investigation may contribute to the development of a monitoring program for the marine fish aquarium trade in Brazil.

Material and Methods

Records of daily landings of marine ornamental fishes (January/1997-June/2005) were obtained from the main retailer of marine ornamental fishes in the State of Bahia, NE Brazil, except for January, February, August and September/1998, November/1999, and February, March and July/2004. Additionally, landings were monitored daily at the main retailer of marine ornamental organisms at Salvador city, from June/2001 to July/2002. Catches were monitored during nine collecting trips, during which *in situ* data were recorded and photographs were taken.

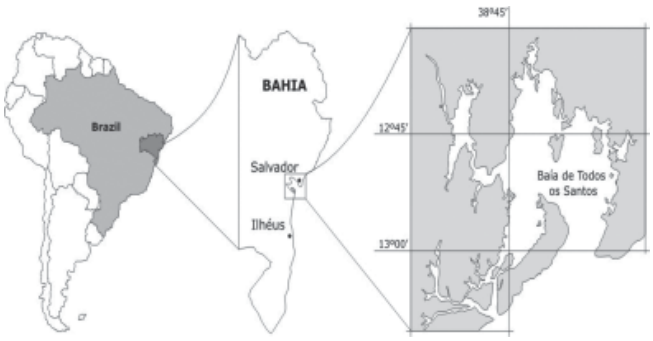

Fig. 1. Map showing the Baía de Todos os Santos, the main area of collection of live syngnathids in Salvador, Bahia State, NE Brazil.

Both seahorses and pipefishes were categorized according to base color, following the system adopted by collectors and retailers. Species identification followed Dawson (1985), Kuiter (2003) and Lourie *et al.* (2004). Voucher specimens were deposited at the following fish collections: Laboratório de Ictiologia da Universidade Estadual de Feira de Santana (LIUEFS) and Universidade Federal da Paraíba (UFPB).

Results

Description of the fishery

The monitored fishery is located in Salvador city, in the Northeastern Brazilian State of Bahia, generally within the limits of the Baía de Todos os Santos (Fig. 1). Syngnathids were harvested during the day, in shallow waters never exceeding 7m, generally by breathhold diving. Boats or surface-supply breathing apparatus were only occasionally (7.1% of fishers) used. Both seahorses and pipefishes were mostly caught by hand (only rarely hand-nets or plastic bags were used), and kept in plastic bags. Syngnathid fishers also col-

Fig. 2. *Hippocampus reidi*. Photo (inverted): Ary Amarante.

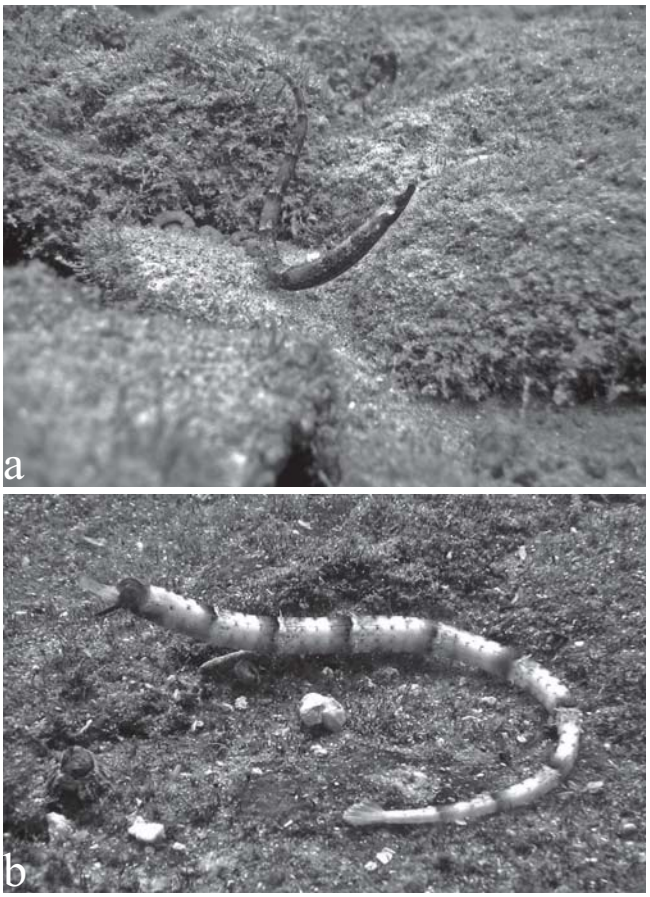

Fig. 3. a) Specimen of *Micrognathus* sp., Baía de Todos os Santos, Bahia State, Brazil. b) Specimen of *Cosmocampus albirostris*, Baía de Todos os Santos, Bahia State, Brazil. Photos: Cláudio L. S. Sampaio.

lected other marine ornamental species (invertebrates and fishes) and spearfished for food fish, lobster and octopus.

Two nominal species of seahorses (*Hippocampus reidi* Ginsburg, 1933 and *H. cf. erectus* Perry, 1810), and three species of pipefishes (*Cosmocampus albirostris* Kaup, 1856; *Micrognathus* sp. and *Syngnathus* sp.) were harvested for ornamental purposes in Bahia), *Hippocampus reidi* being the most heavily exploited species (Fig. 2). Although three species of pipefishes have been historically collected in the State of Bahia, seahorses constituted the bulk (96.9%) of the catches from 1997-2005.

Pipefishes (Fig. 3) only became a target of the fishery in 1999, and the number of specimens captured never exceeded 3.1% of the number of seahorses caught per annum.

Specimens of *Hippocampus* were harvested both in estuarine and reef areas, while the captures of *Syngnathus* sp. only occurred in estuarine areas. *Cosmocampus* albirostris and *Micrognathus* sp. were exclusively harvested in reef areas.

Catches and trade

Between January/1997 and June/2005, 152 fishers (150 males) (Fig. 4) recorded their daily catches of syngnathids at the main marine ornamental fish retailer in Salvador, Bahia

Fig. 4. Hooka-diver using hand-nets to collect marine ornamental fishes. Baía de Todos os Santos, Bahia State, Brazil. Photo: Leo Dutra.

State, totalling 1,301 days of collection (n = 9,793 seahorses). With regards to pipefishes, captures were recorded from 1999 to 2005, totalling 1,062 days of collection (n = 143 pipefishes). In 2005, 22 syngnathid fishers recorded their daily catches, totalling 89 days of collection. Figs 5 and 6 summarize the evolution of the syngnathid fishery in the study area.

In the years 1997, 1999, 2001, 2002 and 2003, the number of fishers who collected syngnathids was relatively stable (mean = 47 ± 1.0). The number of days of collection, however, peaked in 2002 and the number of harvested seahorses increased accordingly. Nevertheless, in 1997, although the number of fishers was equivalent to that of 2002, the number of seahorses captured was higher (despite the fewer days of collection). In 1998, the lower number of harvested syngnathids possibly was related to the decrease in the number of days of collection and of fishers.

Between 1999 and June/2005, the number of fishers increased, while the number of days of collection decreased. The higher number of fishers possibly explains the marked increase in the number of harvested seahorses and pipefishes observed in 2000. Fishers' experience and knowledge also constitute important elements to assess the impact of the

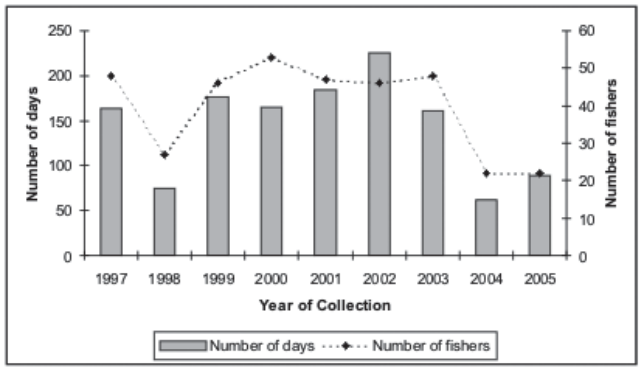

Fig. 5. Number of days of collection and number of fishers involved in the syngnathid fishery in Salvador, Bahia, Brazil, from January/1997 to June/2005.

fishery. As an example, from 1997 to 2005, captures of seahorses per fisher represented 0.06% to 49.7% of the total number of seahorses harvested. In 2004, the year in which regulatory measures which affected the seahorse trade were implemented, there was a sharp decrease in the number of fishers, of the days of collection and of the number of harvested seahorses.

In 2005, there were four retailers of marine ornamental organisms in Salvador city. As shown in Table 1, the amount paid to fishers by the retailer whose stocks were monitored in this study ranged from R$ 0.20 or 0.30 (pipefishes) to R$ 1.00 or 1.30 (seahorses). The main criteria used by retailers to price the specimens were colour and, occasionally, size (seahorses only). In Salvador city, the live syngnathid trade involved two levels of traders: fishers and retailers. Other levels of trade were represented by retailers within Brazil (mostly located in Ceará State), and more rarely, importers in Europe.

Maintenance and shipment

Seahorses and pipefishes were generally kept in 80x40x40 cm tanks, except for the colourful seahorses and pipefishes, which were kept in a smaller tank (40x40x40 cm). Tanks had few or no holdfasts, and seahorses either grabbed the aeration hoses or other seahorses. The latter could lead to mortality in the tank, when the seahorses' prehensil tail encircled the gill area of the seahorse used as a holdfast.

Seahorses and pipefishes were individually packed in transparent plastic bags which received oxygen, and were filled with water up to 1/3 of its volume. Two other plastic bags were used in the packaging, one black and one transparent. After being sealed, the bags were organized on the floor of the warehouse and then transferred to cardboard boxes which were shipped to buyers via airline cargo.

To avoid contamination of water by feces during transportation, seahorses and pipefishes were not fed at the monitored retailer, a procedure generally applied to the other marine ornamental fish species.

Although the retailer whose stocks were monitored in the present study was making an effort to avoid the capture of "pregnant" male seahorses, this practice still existed in the study area. "Pregnant" seahorses were brought to the retailer's facility in all months during which the monitoring program took place (June/2001 to July/2002), while no brooding pipefishes were brought to the retailer's facility over the same period.

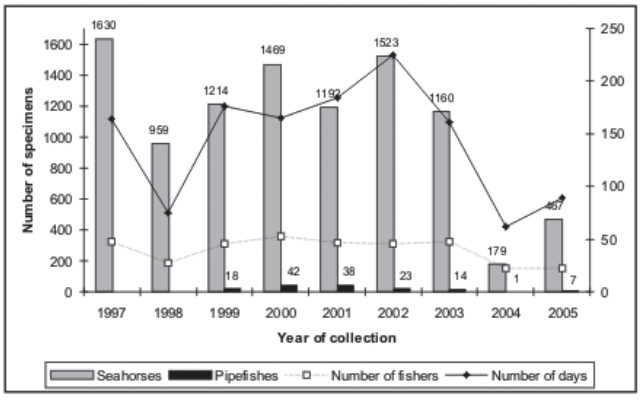

Fig. 6. Number of fishers and of syngnathids captured for ornamental purposes in Salvador, Bahia, Brazil, from January/1997 to June/2005.

Discussion

Some life-history traits of seahorses, such as low reproductive rate, parental care by males, sedentary behaviour and patchy distributions make them very vulnerable to over-exploitation (Vincent and Sadler, 1995; Lourie *et al*., 2004). Findings of a decade ago suggested that all exploited populations of seahorses were in decline (Vincent, 1995), and very recently, detailed studies of *H. comes* in the central Philippines found evidence of both recruitment and growth overfishing (Martin-Smith *et al*., 2004). Currently, 33 species of seahorses and six pipefish species are listed in the World Conservation Union (IUCN) Red list of Threatened Species (IUCN, 2004).

With regards to pipefishes, Burhans & Melechinsky (2004) pointed out that the demand for these fishes is currently being met by collection from the wild, and that if this practice continues, we may see the same decline of pipefish populations that we have seen with seahorses. Pipefishes, which share some aspects of the behaviour and ecology of seahorses, possibly are equally vulnerable to over-exploitation; therefore the evolution of their trade should be closely monitored.

Proper taxonomy emerged as a pressing issue for monitoring the captures and trade of pipefishes. Although only *Cosmocampus albirostris* figures in the Brazilian list of authorized marine fishes that can be exported for ornamental purposes (IBAMA, 2004), two other pipefish species whose captures were not authorized were harvested in the study area, and lumped by fishers in a single trading category. Regardless of the present level of exploitation, unreported catches due to species misidentification may seriously mask population declines, particularly for species with restricted geographic distribution and/or naturally low densities. Reassessment of the identity of the pipefish species currently traded is therefore a necessity.

Seahorses, on the other hand, possibly represent the only group of marine fish species whose captures and trade have been investigated in the country (Rosa, 2005; Rosa *et al*., 2005). Nevertheless, further collaborative work between re-

Table 1. Number of syngnathids bought by retailers in Salvador, Bahia, from 2001 to 2005, and price (in Brazilian currency) paid by retailers in May/2005. Exchange rate: R$ 1.00 approximately US$ 2.35.

Price (R$) /Colour	.20	.30	.50	1.00	1.20	1.30	1.50
Seahorse (colourful)				2	2	2278	5
Seahorse (black)	50	6		2162		16	
Pipefish (brown)		4	1			1	
Pipefish (colourful)	11	62	1				

searchers, environmental agencies and traders is necessary, so that reliable databases can be generated throughout Brazil.

As an example, although official records indicate that between January/95 and July/1997, and August/1998 and October/2000, 20,144 seahorses were exported from Ceará State (Monteiro-Neto *et al*. (2003), import data plus *in situ* data collection showed that the official statistics clearly underestimated the trade (Rosa, 2005).

Among other relevant issues, the captures of "pregnant" seahorses recorded in the present study needs to be urgently addressed by all stakeholders involved in the seahorse trade in Brazil, particularly buyers (who reinforce the non-selective captures by purchasing brooding specimens), and the environmental agencies which issue export permits and are responsible for enforcing existing legislation. Captures of "pregnant" seahorses (subsequentely sold live or dried) have been recorded in many parts of Brazil (Rosa, 2005; Rosa *et al*., 2005), and may severely impact wild populations.

Brazil, however, has advanced with regards to regulatory measures to control the seahorse trade. Export quotas have been progressively reduced since 2002, and in 2004, the country produced its first List of Endangered, Overexploited or Threatened of Exploitation Aquatic Invertebrates and Fish Species (MMA, 2004), a listing that requires the elaboration of a recovery plan for a number of species, including seahorses.

On the international scenario, the inclusion of all seahorse species in Appendix II of CITES certainly will lead Brazil (a signatory of the Convention and an exporter country) to address issues relevant to the persistence of the wild populations of seahorses.

Most marine ornamental fisheries remain unquantified in Brazil, despite their importance from a socio-economic-environmental perspective. Although captures for ornamental purposes occur in many Brazilian coastal States, catch data are only available to Ceará (Nottingham *et al*., 2000; Monteiro-Neto *et al.,* 2003) and Bahia (Sampaio, 2003).

The virtual non-existence of fisheries-independent data, the peculiarities of the marine ornamental trade at different localities along the Brazilian coast (*e.g.*, different species targeted, varying number of traders, local characteristics of the industry), the innacuracy of official statistics, and the gaps in knowledge should be taken into account when extrapolating locally obtained results to Brazil as a whole.

Attention should be paid to the sources of data used to assess the magnitude and impacts of the marine aquarium trade in Brazil. Otherwise, trade may be wrongly categorized as small or incipient in an area as a result of analyses based on poor databases, or as a result of varying approaches to quota enforcement among different State-level environmental agencies. This should be particularly observed when contrasting trade data obtained in Bahia, the only Brazilian State where daily monitoring of catches and trade has ever taken place (see Sampaio, 2003), or in Ceará, the only State where official statistics of the marine fish ornamental trade have been critically analyzed in Brazil (Monteiro-Neto *et al.*, 2003).

Integration of data collection throughout Brazil is a necessary step to increase our understanding of trade routes, and to the development of more accurate systems to regulate the trade. Collaborative monitoring programs (see Goffredo *et al*., 2004) and enforcement are critical not only to the conservation and management of wild populations of seahorses and pipefishes, but also to ensure the sustainability of the marine ornamental trade in Brazil.

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