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Trade in seahorses and other
syngnathids in
countries outside Asia
(1998-2001)

Fisheries Centre, The University of British Columbia, Canada

Trade in seahorses and other syngnathids in countries outside Asia
(1998-2001)¹

Edited by

Amanda C.J. Vincent, Brian G. Giles, Christina A. Czembor and Sarah J. Foster

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DIRECTOR'S FOREWORD

This volume provides the first synthesis of information on the trade in syngnathid fishes (seahorses, pipefishes and seadragons) in countries outside of Asia. Their consumption for use in traditional medicine, aquarium displays and curiosities is thought to threaten the persistence of many syngnathid species. The trade was originally documented in 1996, when it was shown that Asian countries contributed substantially to the international trade in seahorses.

Project Seahorse researchers undertook a broad geographic survey of the syngnathid trade in 1998-2001 to ascertain its full international scope. The ensuing analyses for the surveyed countries outside Asia are compiled in this report, which reveals that syngnathids are (often newly) traded by nations from every continent in the world, outside Antarctica, including most non-Asian countries surveyed.

This report provides a very important tool in support of a new international instrument. Since 2004, seahorse exports have been regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Their listing on Appendix II obliges the 175 signatory nations to limit exports to levels that will not damage wild populations. The data in this report, never before brought together in a volume, contributed to that decision and would continue to inform countries' actions in implementing CITES.

I congratulate the authors of the report for this important piece of work.

U. Rashid Sumaila

Director and Associate Professor

UBC Fisheries Centre

EXECUTIVE SUMMARY

INTRODUCTION

Our research on the trade of seahorses and syngnathids has revealed that – far from being limited to Asia as usually inferred – it is global in scope, with exports and/or imports occurring in at least 53 out of 70 (75 %) of the countries outside Asia for which we obtained information. The trades for dried and live seahorses involved at least 15 species sourced from a variety of target and non-target fisheries, particularly those employing trawling gear. Most countries outside Asia involved in the trade were net exporters of seahorses – with the majority of dried specimens destined for Asia for use as traditional medicine. Live individuals from countries outside Asia were, however, destined for Europe and the USA, which (along with Canada) were net consumers of seahorses. The impacts of this documented non-Asian trade on seahorse populations may be considerable, especially when combined with the extensive damage to their vulnerable inshore marine habitats.

Seahorses are traded dried for traditional medicines, tonic foods, and curiosities, and live for ornamental display, to an extent that raises concerns for sustainability of at least some populations. Traditional medicines (TM), particularly traditional Chinese medicine (TCM) and its derivatives, account for the largest consumption of seahorses – but capture for the live aquarium trade is the main pressure in certain regions. Seahorses (*Hippocampus* spp.) are among the many genera whose life histories might render them vulnerable to overfishing or other disruptions such as habitat damage. They are generally characterized by a sparse distribution, low mobility, small home ranges, low fecundity, lengthy parental care and mate fidelity. In addition, the male seahorse, rather than the female, becomes pregnant.

The first investigation into the international trade in syngnathids revealed a large and growing trade in seahorses, pipehorses, and pipefishes for use in TM, aquarium fishes, and curiosities (Vincent, 1996). Extensive Asian fieldwork carried out in 1993 and 1995 documented a previously unknown, but widespread and large consumption of dried and live seahorses. By 1995 at least 32 countries traded syngnathids, and the trade in Asia alone exceeded 45 tonnes of dried seahorses. In addition, hundreds of thousands of live seahorses were traded internationally, with small specimens finding a ready market. This scale of trade appeared to have depleted wild seahorse populations. A combination of official records, quantitative research, and qualitative information indicated that many seahorse catches had diminished markedly, even when fishing effort increased: estimated catch declines of between 15 and 50% over 5-year periods were common in the 1990s.

This early work raised concerns regarding the sustainability of the seahorse trade, and motivated us to keep track of how the trade in syngnathids was evolving and of any impacts on wild populations. As a follow up to the 1996 report, Project Seahorse expanded its trade surveys, primarily to concentrate on the catch and trade of seahorses from source areas. Of particular interest was the role countries outside Asia were playing in the seahorse trade, and the magnitude of such trade. Indications were that key markets were seeking new source countries for seahorses as volumes in trade from usual sources declined. In addition, many consumers in countries outside Asia use TCM and/or have their own form of traditional medicines in which dried syngnathids play a role, and the display of live seahorses in public and home aquariums is common in countries outside Asia.

This report documents surveys and trade records from a wide range of countries in Africa, North, Central, and South America, Europe, Australia, New Zealand, and the South Pacific. Our goal was to update our understanding of source countries and volumes traded, while also attempting to assess the conservation status of seahorses, and their relatives.

METHODS

We here collate reports by Project Seahorse biologists who surveyed seahorse trade in countries outside Asia. The investigations we present here were conducted between 1998 and 2001, and consist of syntheses of semi-structured interviews, published literature, local records, site visits, small group discussions, anecdotes, and observations.

The biologists obtained information about the trade in syngnathids from three main sources:

- Extensive Project Seahorse surveys of trade participants (e.g. fishers, buyers, importers/exporters, retailers) or those with knowledge of the trade (e.g. scientific researchers, NGOs).
- Data collected by government agencies (Customs, wildlife management agencies, etc.) detailing either the catch or trade of seahorses and pipefishes.
- Data collected by the Global Marine Aquarium Database (GMAD) documenting the international trade in live, marine ornamental species.

The majority of the information came from the first source: Project Seahorse surveys conducted between 1998 and 2001. Since it was impossible to survey entire nations, trade researchers attempted to identify the main seahorse landing or trade areas and focus survey effort on the areas. Trade researchers employed a “snowball” sampling methodology in which initial surveys were used to locate more trade participants for later surveying. Researchers employed a semi-structured, casual interview style to obtain information on volumes, prices, trade structure, trade routes, and changes in supply/demand. Local biologists or social workers helped the researchers interpret during visits, provided extra cultural information, and verified notes. In order to cross-validate information, similar questions were asked (i) within an interview, (ii) across interviews within a trade level, and (iii) across trade levels.

RESULTS

Species

It proved difficult to collect data at a species level because fishers and traders either do not often distinguish species or base their decisions on colourings, markings and/or size, none of which are reliable for species identification. Nonetheless, the following species were explicitly mentioned as being traded dried and/or live, imported, exported and/or used domestically: *Hippocampus abdominalis*, *H. barbouri*, *H. borboniensis*, *H. camelopardalis*, *H. comes*, *H. erectus*, *H. fuscus*, *H. histrix*, *H. ingens*, *H. kelloggi*, *H. kuda*, *H. reidi*, *H. spinosissimus*, *H. subelongatus*, and *H. zosterae*. Issues with species identification and a lack of understanding of trade mean this list is unlikely to be comprehensive.

Fisheries

Seahorses are obtained by either targeted exploitation or accidental capture in non-selective fishing gear (bycatch). Some of the world’s poorest fishers make their living targeting seahorses; fisheries for seahorses were reported in Africa (Kenya and Madagascar, as well as historically in Mozambique and Tanzania), Central America (Costa Rica and Panama, and historically in Nicaragua), North America (Mexico and the USA), South America (Argentina, Brazil, Ecuador, and Peru), and Australia. They were very rarely targeted by European fishers.

Bycatch from commercial trawlers (especially shrimp) appears to be the largest source of seahorses in international trade – but other fishing gear also played a role, including cast nets, seine nets and purse seines. Such incidental capture leads to seahorse death or displacement. Regions reporting some level of syngnathid bycatch specifically in trawl (and occasionally other) gear included Africa (Kenya, Mozambique, Nigeria, Tanzania), Australia – which mostly consisted of pipehorses –, New Zealand, North America (Mexico, the USA), Central America (Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama), South America (Argentina, Brazil, Ecuador, Peru), and several European countries (France, Germany, Portugal, Spain). Countries that reported bycatch using any gear other than trawl gear included Cyprus, Estonia, Ireland, Lithuania, and Turkey.

Trade

We found that seahorses and other syngnathids were traded dried and live in many countries outside Asia which we investigated (Table 1). The majority of the dried trade was destined for Asian countries for use as TCM. Dried seahorses were also used as TCM by local Asian communities, for local forms of traditional medicine – for example South African *muti*, and for curios/souvenirs.

Table 1. Countries reported to have traded seahorses, marked with an 'x'. Trade may or may not persist. Volumes differed greatly among countries; see regional chapters for details. 'Source' = exporting countries; 'Consumer' = importing countries and countries that only trade syngnathids domestically. Countries known only to re-export syngnathids without domestic use (Mali, Zimbabwe, Norway) are not included.

Region	Country	Dried trade		Live trade		In 1996 report	
		Source	Consumer	Source	Consumer		
Africa	Egypt			x			
	Gambia	x					
	Guinea	x					
	Kenya			x			
	Madagascar	x					
	Mozambique	x		x			
	Nigeria	x					
	Senegal	x					
	Seychelles	x					
	South Africa	x	x		x		
	Tanzania	x	x			x	
	Togo	x					
	America, North	Canada		x	x ³	x	x
		Mexico	x	x	x	x	
USA		x	x	x	x	x	
America, Central and the Caribbean	Barbados					x	
	Belize	x	x ¹	x		x	
	Costa Rica		x ¹	x	x	x	
	Cuba			x			
	Guatemala	x	x ¹				
	Honduras	x	x ¹				
	Nicaragua	x	x ¹		x ²		
	Panama		x		x ¹		
America, South	Argentina		x ¹		x		
	Bolivia		x				
	Brazil	x	x ¹	x		x	
	Chile		x				
	Ecuador	x	x ¹	x ²		x	
	Peru	x	x ¹				
	Surinam	x					
	Uruguay				x		
	Venezuela	x					
	Europe	Austria				x	
Belgium					x		
Denmark					x		
France					x	x	
Germany			x		x	x	
Greece			x ¹				
Hungary					x		
Ireland					x		
Italy			x		x	x	
Netherlands			x		x	x	
Norway						x	
Portugal			x ¹		x	x	
Spain		x	x		x	x	
Sweden					x		
Switzerland					x		
United Kingdom			x	x ³	x	x	
Oceania		Australia	x	x	x	x	x
	New Zealand	x	x	x	x	x	
South Pacific	Fiji			x			
	Solomon Islands			x			

¹ Primarily domestic use, rather than imports. ² Trade did not occur when information was gathered. ³ Sources likely captive-bred only.

Many of the countries we surveyed – particularly those in Africa and Latin America – were apparently newly engaged in syngnathid trade, while other areas may have been active before 1996 without being

recognised. Many of these new trading countries are in Africa (Egypt, Gambia, Guinea, Kenya, Madagascar, Mozambique, Nigeria, Senegal, Seychelles, South Africa, Togo) and Latin America (Argentina, Bolivia, Chile, Cuba, Guatemala, Honduras, Nicaragua, Peru, Surinam, Uruguay, Venezuela). However, at least some countries added to the list had actually been trading seahorses for some time before they were noted (e.g. Kenya, Mexico, and Panama, since at least the 1970s). While many of the countries traded seahorses every year, some exporting countries, in particular, engaged only intermittently in the trade, particularly for dried animals. Countries surveyed in the South Pacific largely did not engage in syngnathid trade, including American Samoa, Cook Islands, Federated States of Micronesia, French Polynesia, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Papua New Guinea, Samoa, Tokelau, Tonga, Tuvalu, and Vanuatu.

Values of traded seahorses varied according to country and trade, but in general fishers received very poor pay for seahorses they supplied, and eventual selling price ranged hugely but was orders of magnitude higher than that paid to the fisher. Seahorses seemed to provide extra cash but contributed relatively little to fishers' and traders' incomes.

Sources

Most countries surveyed were net exporters of seahorses – especially those in Africa, Central America, and South America – although many countries in these regions imported a limited volume of syngnathids for local use or re-export. African dried seahorses, the majority of which hailed from Tanzania, were most frequently destined for Asian markets, whereas the few countries that exported live seahorses sent them to Europe. Mexico was the only North American country that exported more seahorses than it imported – thousands of kilos of dried seahorses were sent to Asia and the USA, and hundreds of live seahorses were sent to the USA annually. Central American countries sent hundreds of kilos of dried seahorses annually to Asia and Mexico; indeed, the Honduran trade in seahorses was the largest encountered in Central America. Costa Rica sent a small number (tens) of live seahorses north to the USA. South American countries exported both dried and live seahorses – dried to Asia and North America, and live to Europe and the USA. Brazil was a major seahorse exporter – *Hippocampus ingens* was Brazil's sixth most important marine ornamental export. Australia mainly exported syngnathids live for the aquarium trade, with only a few dried kilos heading to Asia. New Zealand's role in exports was minimal, and syngnathid exploitation in the South Pacific appeared to be negligible with only two records of syngnathid trade during the period studied.

Consumers

Europe and North America were net consumers of seahorses and their relatives. Recorded European importers of dried seahorses included Germany (from Vietnam), Italy (from Vietnam and Philippines), the Netherlands (from the Philippines and India), Spain (from the Philippines), and the United Kingdom (from the USA and mainland China). The Netherlands and Spain appeared to be among the major European importers of dried syngnathids. Germany accounted for the highest number of declared live seahorse imports, followed by Italy, the Netherlands, Belgium and the United Kingdom. The main suppliers of live seahorses to the European Union (EU) were reported to be, in order of importance, the Philippines, Brazil, Indonesia, Sri Lanka and Singapore. The data also indicate that trade in live seahorses occurs among EU countries.

Live and dried seahorses were traded in the USA and Canada for use as aquarium fishes, curios, and in traditional Chinese medicine (TCM). The Philippines, mainland China and Mexico were the main suppliers of dried seahorses to the USA, according to US data. Recorded live seahorse imports were primarily from Australia and the Philippines. Little information was available on Canada's trade in live and dried seahorses but the available information indicated that dried seahorses have been imported from Hong Kong, the USA, and Peru, and that live seahorses have been imported from the USA, Singapore, and Indonesia.

Conservation consequences

The impacts of documented trade on seahorse populations may be considerable, especially when combined with the damage that is being inflicted on their vulnerable inshore marine habitats. It is impossible to determine exactly how many seahorses live in the wild and it is difficult to assess how

individual species are coping with the exploitation that is taking place, but a combination of Customs records, quantitative research, and qualitative information indicates that seahorse catches and/or trades have declined markedly. This reflects a loss of population rather than a drawdown of the trade. Countries with fishers and/or traders reporting evidence of seahorse population declines included Brazil, Costa Rica, Ecuador, Guatemala, Honduras, Kenya, Mexico (both coasts), Nicaragua, Panama, Peru, Tanzania, and the Ukraine. Conservation concern is probably greatest where seahorses are caught by trawlers (see **Fisheries** above), as commercial trawling most certainly negatively affects them via displacement or mortality of incidentally caught seahorses and through habitat damage.

Very few of the countries we surveyed had regulations specifically aimed at seahorses or other syngnathids. In Australia, strong legislation at both Commonwealth (national) and State levels protected syngnathids and/or required monitoring of their exploitation. All exports of syngnathids from Australia required permits under approved management plans. In Mexico, domestic seahorses were officially afforded some legal protection, as only those cultured or incidentally caught could be traded legally. A target fishery for the aquarium trade nonetheless existed. In Europe, two regulations, Council Regulation (EC) No. 338/97 and Commission Regulation (EC) No. 939/37 were implemented in June 1997 to monitor seahorse imports to European Union countries. In addition, some European countries, for example, Germany, France, Portugal, Slovenia and the Ukraine, afforded special protection to local syngnathid populations, recognizing habitat degradation (particularly pollution and coastal modification) and catch (intentional and accidental) as potential threats. Although few countries specifically protected seahorses, some populations may have benefited from marine parks or other legislation, such as spatial and/or temporal trawling regulations.

Other syngnathids

Trade in syngnathids other than seahorses – including pipefishes, pipehorses, and seadragons – mainly occurred in Australia and New Zealand and was very limited elsewhere. The most important syngnathid fisheries in Australia in terms of biomass and value were the bycatch landings of pipehorses (*Solegnathus* spp.) caught in ocean trawling operations; exports were worth up to US\$200,000 per annum. There was a small but important export trade in live syngnathids (almost exclusively two endemic species of seadragon) from South Australia, Victoria, and Western Australia. Although fewer than 500 animals per year were exported, the value of the fishery may have been as much as US\$100,000 per year. It appeared that during the period 1996-2001, New Zealand was a net exporter of syngnathids, the majority of these being the spiny pipehorse, *S. spinosissimus*.

Acknowledgements

This is a contribution from Project Seahorse. We would like to thank the many people who assisted in collecting, analyzing, and summarizing the data contained within this report. We particularly recognize the intellectual and managerial contributions of Dr Heather Koldewey, Associate Director of Project Seahorse. We are grateful for all sources of funding indicated in the individual reports. In particular, we thank Guylian Chocolates of Belgium and the John G. Shedd Aquarium for their support through our long-standing partnerships for marine conservation.

CHAPTER 1. TRADE IN SEAHORSES AND OTHER SYNGNATHIDS IN AFRICA¹

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ABSTRACT

Fourteen African countries were known to have participated in the seahorse trade by 2001, including Egypt, Gambia, Guinea, Kenya, Madagascar, Mali, Mozambique, Nigeria, Senegal, the Seychelles, South Africa, Tanzania, Togo, and Zimbabwe. Trade surveys were undertaken only in Kenya and Tanzania, which consequently are dealt with in most detail below. Correspondence with researchers in southern Africa provided reasonable information on Mozambique and South Africa. Information on other countries was largely gleaned from Customs records in the European Community, Hong Kong and the USA, and is correspondingly brief.

Given the scarcity of information in most African countries, it is difficult to judge the relative importance of African seahorse trading countries. The information obtained, however, suggests Guinea, Senegal, and Tanzania are the major players in African seahorse trade.

BACKGROUND FOR KENYA AND TANZANIA

Information sources

Information presented in this section comes largely from field interviews conducted by the author in Kenya and Tanzania in May and June 2000. Additionally, thirteen experts on fisheries and coastal resource utilisation in these countries were consulted in writing. In total, 234 respondents contributed their knowledge, comprising 90 fishers, 15 dealers and staff involved in the ornamental fish trade, 32 marine products traders, 9 traditional healers, 30 government officials, 5 academics, 27 people associated with local environmental NGOs, 4 aquarists maintaining private or public aquaria, 12 people with knowledge of the marine environment thanks to their diving or snorkelling experience, and 10 other residents (Table 1). Supplementary information was obtained from both published and unpublished reports on local fisheries and the status of local marine resources, as well as from import statistics from the European Community, Hong Kong and the USA, as indicated.

Interviews were conducted in either English or Kiswahili with the help of a Kenyan graduate student, Summit Johnstone Oketch, who acted as interpreter. To avoid encouraging seahorse trade where none existed, the author generally introduced herself to fishers and ornamental fish traders as a graduate student investigating the ecology and distribution of East African seahorses; marine products traders were told she was researching the exploitation of marine animals for purposes other than food. Other respondents were aware of the true purpose of this study. Interviews were semi-structured in that they did not rigidly follow a standard set of questions. Instead, they were adjusted depending on the respondents' backgrounds, their willingness to provide information, and time constraints. Notes were taken during the interviews and subsequently verified by the assistant.

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Seahorse species in Kenya and Tanzania

Geographic distribution

Seahorses appear to occur all along the mainland coast of Kenya and Tanzania, as well as in the Zanzibar Archipelago (Figure 1). They were generally considered rare in Kenya, with the possible exceptions of Kilifi Creek and Vanga, where they seemed to be slightly more abundant. Perhaps indicative of their scarcity is the lack of a Kiswahili name for seahorses in Kenya. In Tanzania seahorses seemed comparatively

more common. Fishers and traders gave the impression that they were relatively sparse off Dar es Salaam, Lindi, and most of Unguja; fairly common in northern Tanzania (Tanga, Kigombe, Pangani), Mtwara, and southern Pemba; abundant in Bagamoyo, the Rufiji delta, and Unguja's Menai Bay; and very abundant in most of northern Pemba, off Mkokotoni in the North of Unguja and in Mafia, particularly Mafia's western side (Figure 1).

In contrast to Kenya, roughly one third of the respondents interviewed in Tanzania (44 of 132) knew of a local term for seahorses, although this differed from village to village and even person to person. *Makosa kuumbwa*, the most commonly cited name, translates as 'mistake in creation,' apparently because of the fish's unusual shape. Others called seahorses *horsefish*, *farasi* (horse) or *farasi bahari* (seahorse), *simba* (lion), *dragon*, *upindo siwako* (love is not yours), *filipino* (which apparently has connotations of flexibility), *wadudu* or *vijidudu* (insect/little animal), *dodosi* or *dodoji*, *sosi*, and *haisotwa*.

Local species

Most respondents described seahorses as being of drab coloration in hues ranging from yellowish green to brown, blending with the environment. Some mentioned the rare occurrence of red seahorses, while others had seen black, white, tiger-striped and even blue seahorses. Reported heights (measured from the tip of the coronet to the tip of the tail; Lourie *et al.*, 1999) ranged from 'half an index finger' (3.5 cm) to 'one foot' (30.5 cm). Most, however, indicated a length of between 7-15 cm. Co-occurrence of more than one species of seahorse in an area appears common as many fishers mentioned the presence of both spiny and non-spiny seahorses in their fishing grounds. Two species co-exist in Mtwara Bay, according to researchers of *Frontier*, a non-governmental organisation (NGO) conducting base-line surveys of Tanzania's habitat's in conjunction with the University of Dar es Salaam (e.g. Martin Guard, pers. comm., 6 June 2000). Three species were caught during trawl studies in Gazi Bay, southern Kenya (Enock O. Wakwabi, Kenyan Marine Fisheries Research Institute, pers. comm., 29 May 2000).

Five species were tentatively identified by the author according to Lourie *et al.* (1999): *Hippocampus hystrix* and *H. borboniensis*, both of which are medium-sized and bear spines; *H. fuscus*, a medium-sized species which lacks spines; *H. kelloggi*, a large, smooth, robust-looking species; and *H. camelopardalis*, a small species characterised by three dorsal spots on the upper trunk. Apart from *H. kelloggi*, all these species are listed as Vulnerable by the IUCN according to criteria A2cd (Hilton-Taylor, 2000).

Respondents mentioned the presence of two further species: *H. kuda* and *H. capensis*. According to the most recent taxonomic revision, neither species occurs in East Africa (Lourie *et al.*, 1999). Both resemble *H. fuscus*, in that they are medium-sized, non-spiny seahorses with low coronet. Reports of their occurrence, therefore, were assumed to refer to the presence of *H. fuscus*.

Table 1. The number and backgrounds of respondents interviewed during surveys in Kenya and Tanzania in May and June 2000. Note: some respondents in Kenya also provided information on Tanzania and vice versa. Source: author's research.

Respondents' Backgrounds	Kenya	Tanzania	Total
Academic	2	3	5
Aquarist	3	1	4
Aquarium Fisher	4	0	4
Artisanal Fisher	12	72	84
Commercial Fisher	0	2	2
Diver/Snorkeller	10	2	12
Government Official	17	13	30
Healer	1	8	9
NGO employee	11	16	27
Trader of Aquarium Fish	13	2	15
Trader of Marine Products	7	25	32
Other	4	6	10
Total	84	150	234

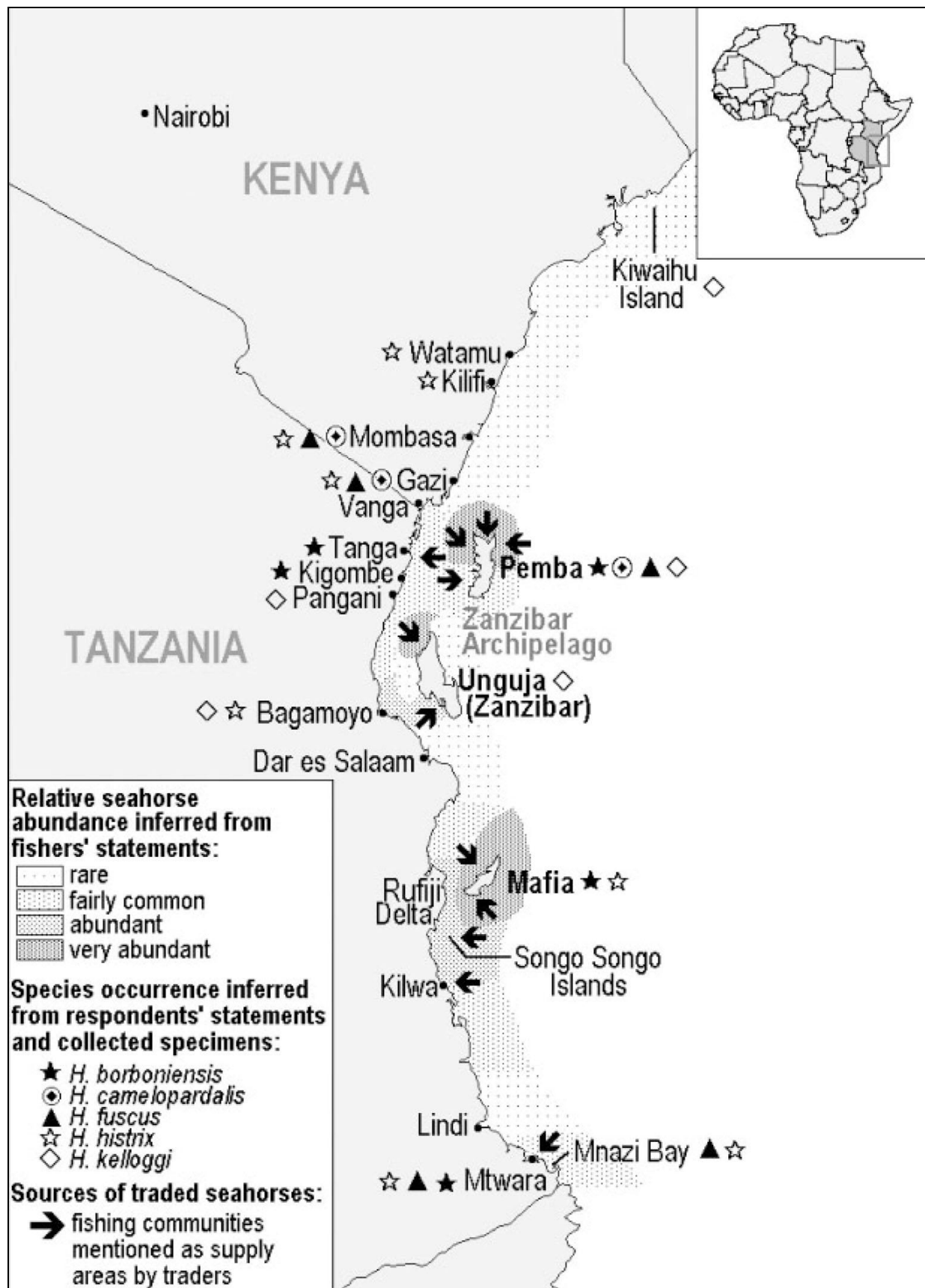


Figure 1. The distribution and relative abundance of seahorses in East Africa, with indications of sites visited, sites of record for particular species and source areas of seahorses traded in Tanzania. Source: author's research.

All five species identified by the author were exploited in Tanzania for the dried trade. It is likely that the aquarium trade present in Kenya also utilised all available species, although a former ornamental fish dealer and the curator of Mamba Village Aquarium in Mombasa only recalled encountering three species: *H. histrix*, a similarly sized smooth species they assumed to be *H. kuda*, and *H. camelopardalis*.

A major player in Tanzania's dried seahorse trade (Level 2-4) estimated that 35-40% of the seahorses he obtained bore spines. Spiny seahorses, likely to be either *H. histrix* or *H. borboniensis* were reported by fishers for Mombasa, Kenya, and all over Tanzania, for both the mainland and the Zanzibar archipelago.

H. histrix was encountered by the author in both Kenya and Tanzania. Ten live specimens observed in Kenya in private and public aquaria measured between 10-15 cm in height; they were believed, by their owners, to originate from Kilifi Creek and Nyali. Kenyan biologists had also spotted *H. histrix* in Watamu Marine Park (Richard Bennet, pers. comm., 18 May 2000) and Gazi Bay (Enock O. Wakwabi, Kenyan Marine Fisheries Research Institute, pers. comm., 29 May 2000). In Tanzania, two dried *H. histrix* specimens on sale in Dar es Salaam apparently originated from Bagamoyo. Researchers had seen the species in Chole Bay, Mafia Island Marine Park (MIMP; Jason Rubens, technical advisor to MIMP, pers. comm., 28 June 2000), Mtwara Bay and Mnazi Bay (Mallela *et al.*, 1998).

Hippocampus borboniensis, although part of the generally smooth *H. kuda* complex (Lourie *et al.* 1999), bears prominent if rounded spines on certain trunk and tail rings. This species was only encountered in Tanzania, and no respondents suggested its presence in Kenya. Dried specimens were presented to the author by Pemban fishers in Mkoani and Tumbe, and by a seahorse trader (Level 2-3) whose supplies originated from northern Pemba. *H. borboniensis* comprised roughly 20% of this trader's seahorse stock. Four specimens obtained measured 11.0-11.8 cm in height and weighed between 2.1 g and 3.1 g (dry weight). A recent volunteer with *Frontier* found *H. borboniensis* in Mtwara Bay, although identification was tentative (Davide Molon, *in litt.*, 22 July 2000). Traders (Level 2-4) in Dar es Salaam and a fisher suggested that the species also occurs off Mafia Island, Tanga and Kigombe.

Hippocampus fuscus is the suspected identity of seahorses reported from Kenya as *H. kuda* or *H. capensis*, and was seen by the author in Tanzania. In Kenya, '*H. kuda*' reportedly occurred near Nyali; '*H. capensis*' in Gazi Bay (Enock O. Wakwabi, pers. comm., 29 May 2000). The reported occurrence of *H. kuda* in Mtwara and Mnazi Bay, southern Tanzania (Mallela *et al.*, 1998), likely is a confusion with *H. fuscus* (or perhaps *H. borboniensis*, see recent findings of Davide Molon above). Dried specimens of *H. fuscus* were obtained from a trader on Pemba Island (Level 2-3) and comprised approximately 60% of his stock. Four specimens measured 9.4-12 cm in height and weighed 2.1 g to 3.3 g.

[NB: Identification both *H. borboniensis* and *H. fuscus* should be viewed as tentative. Apart from slightly enlarged spines and coronet in *H. borboniensis*, little distinguishes these two species and their taxonomy remains poorly understood (Sara A. Lourie, *in litt.*, 6 April 2001).]

H. kelloggi was encountered by the author only in Tanzania, but fishers' seahorse descriptions suggested that it may also occur in Kenya. A dried specimen was shown to the author by a fisher in Pangani, northern Tanzania. The specimen had been caught recently in nearby Ushongo, in shallow water (2m at high tide) in a rocky area with some vegetation and soft corals. Another specimen was purchased from a trader (Level 2-3) who obtained his seahorses from fishing villages in northern Pemba. Both specimens measured approximately 15 cm in height, and the Pemban one weighed 7.4 g dry. Large (>15 cm), smooth seahorses were also reported for Kiwaihu Island in northern Kenya, Bagamoyo on the Tanzanian mainland, and Mkokotoni in the north of Unguja Island.

Hippocampus camelopardalis was seen by the author only on Pemba Island, Tanzania, but respondents reported its presence in Kenya. A researcher had caught the species in Gazi Bay, and an aquarium curator suggested it also occurred near Nyali. He and a retired ornamental fish dealer described the species as 'easy to breed' over several generations, given the ability of its relatively large young to feed on brine shrimp. Dried specimens of the species were obtained from a Tanzanian trader (Level 2-3) whose supplies originated in northern Pemba. The species comprised approximately 20% of this trader's stock. The four specimens purchased measured 8.1-8.8 cm in height and weighed 0.7 g to 1.2 g (dry weight).

Ecology

Habitat

The habitat respondents most frequently associated with seahorses was *mwani* in shallow water (<10 m), described as a tall (1 m), soft, grass-like plant growing at low density and distinct from *gambari*, a short, hard and dense form of vegetation apparently not favoured by seahorses. The second most commonly named habitats were corals and rocks, or a mix of corals and vegetation. Mangroves, bare sand and floating weeds were also mentioned. Many respondents associated the occurrence of seahorses with small islands. In Kenya there was frequent mention of seahorses' preference for sediment-laden, murky waters and estuaries. As most fishing occurs in clear water (outside the rainy seasons) and on the country's reefs, frequent accounts of seahorses in muddy waters and estuaries cannot be attributed to a bias in fishing practice.

Seasonality

In Kenya, eight respondents felt that seahorse abundance varied seasonally. According to six, seahorses were more abundant when it was wet, cold and rainy—weather associated with *kusi*, the south-easterly monsoons prevalent from approximately May to September. *Kusi*, however, was also when fishers stayed closer to shore where they may be more likely to fish in seahorse habitat. Higher frequency of encounter could, therefore, be an artefact of fishing practice rather than increased seahorse abundance. One fisher in Kilifi (an estuarine area) commented that he saw seahorses more frequently during *kaskazi*, the north-easterly monsoons that bring calm and fairly warm waters from November to March. A fisher in Diani suggested that seahorses generally stayed in estuaries, but were seen in deeper waters (10 m) off Diani during September and October.

In Tanzania, opinion over seahorse seasons was divided. Some (n = 19) said there was no annual variation in abundance, but emphasised that they paid little attention to seahorses. Traders (n = 5) generally felt that there were more seahorses in the water during *kusi* and the associated rainy season between April and June, but that more seahorses were supplied to them during *kaskazi* when weather facilitated drying. Four fishers on Mafia Island agreed. However, again this may be an artefact of seasonal fishing strategies. In contrast, fishers in northern Tanzania (Tanga and Kigombe; n = 7) thought that seahorses were more abundant when waters were warm and calm from August to January, which locally corresponds with *kaskazi*. One fisher each on Pemba and Unguja supported this opinion.

Breeding Seasons and Behaviour

Breeding appeared to take place between at least May and December according to the few respondents who offered comments. A male *H. histrix* from Kilifi, Kenya was pregnant when caught in early May and soon after gave birth in captivity. The majority of dried male seahorses a Tanzanian trader (Level 2-3) had collected in late May, early June in Pemba were pregnant. The trader commented that the pouches tend to be particularly distinct in June. A Fisheries official in Tanga suggested that seahorses bred during the June and July rains and that many small seahorses were present in August. A biologist who studied seahorses in Mtwara during July-September 1999 observed pregnant males throughout this period (Davide Molon, *in litt.*, 22 July 2000). A fisher in Kigombe had observed 'twinned' seahorses he assumed to be copulating in November and December.

Anecdotal evidence also suggests that the behaviour of East African seahorses is similar to species studied in greater detail elsewhere (Lourie *et al.*, 1999). A former ornamental fish dealer commented that seahorse couples displayed early morning greetings, that their breeding cycle lasted 28 to 30 days, and that males tended to give birth at night around full moon. A number of fishers suggested that seahorses were often found in pairs rather than alone, but never in large aggregations.

Uses

Local use of seahorses was not widespread in Kenya or Tanzania. However, seahorses were occasionally sought for decorative purposes, as fishing souvenirs, by traditional healers or as aquarium pets. In Tanzania, dried seahorses were also sold as souvenirs to tourists.

Dried

In southern Kenya and along Tanzania's entire coastline fishers occasionally dried and kept seahorses to use as necklaces, key rings or house decorations. Others simply kept the specimens out of curiosity as a fishing memento. Both practices were said to be rare and limited to children and young men. A fisher near Bagamoyo had nevertheless managed to turn it into a small business by painting the seahorses and selling them to locals for up to TSh700 (US\$0.90) a piece.

No traditional healer questioned (n = 9) knew of any medicinal use for seahorses. Nor was use of seahorses reported during more extensive surveys of traditional local medicines (Marshall, 1998). Nonetheless, curio traders (Level 2-4) in Dar es Salaam noted that traditional healers from as far as Arusha and Mwanza occasionally purchased dried seahorses from them. Other marine life was certainly employed in local traditional medicines. The author was told of the use of sea weeds, octopus, turtle oil, shark heads and cowry shells. According to the National Chairman of the Tanzania Traditional Healers Association, however, the use of animals in traditional medicine was often associated with sorcery and therefore kept in secrecy. The one detailed account of a 'doctor's' use of seahorses obtained from a fisher supports this view. The fisher had observed colleagues in Fukuchani, northern Unguja, who, disappointed with their catch, had sought help from a traditional doctor. The doctor had ordered them to find a seahorse, burn it, mix its ashes with a plant concoction he provided and sprinkle the resulting liquid over their gear. This would rid the gear of any bad spells and attract fish.

Curio traders in both Kenya (mainly Mombasa) and Tanzania (mainly Dar es Salaam) offered marine products, particularly shells, to tourists. Dried seahorses were seen for sale only in Dar es Salaam, but respondents suggested that curio traders on Pemba Island and Unguja Island also sold seahorses. The four curio traders interviewed in Dar es Salaam indicated that tourists occasionally bought one or two dried seahorses for educational purposes or as souvenir. The seahorses were sold individually and were not varnished or decorated.

Live

A few seahorses found their way into private and public aquaria, but pet shops in Kenya and Tanzania did not sell marine fishes. Hobbyists generally obtained them directly from fishers or collected them from the wild.

Legislation

Neither Kenya nor Tanzania specifically protected seahorses in 2000. Kenyan seahorses potentially benefited from the country's four marine parks (closed to fishing) and six marine reserves (which prohibit certain fishing techniques; see Gaudian *et al.*, 1995). Seahorses occurred in at least two parks (Watamu and Malindi) and three reserves (Mombasa, Watamu and Kiunga). Furthermore, trawling in Kenya was illegal within five nautical miles (9.26 km) from shore and banned from December to March.

Tanzania in 2000 had one marine park at Mafia Island, where seahorses have been sighted, as well as several smaller marine conservation projects. Blast fishing and poisoning were prohibited nation-wide. So was beach seining, although Fisheries officers disagreed on whether it was banned outright or only if mesh-sizes fell below a certain size (2x2 cm). As beach seining was a major source of seahorse bycatch and uproots seagrass beds that are home to seahorses, its prohibition would certainly be beneficial. Indeed, one trader (Level 2-4) and thirteen fishers commented that the ban on beach seining and the introduction of minimum mesh sizes had caused seahorse bycatch to decline.

Seahorse trade, dried or live, was not officially recorded in either country. In Kenya, however, exporters of ornamental fishes submitted records for each export consignment to their District's Fisheries Department, which indicated species-specific export volumes. How accurate these records are is not known.

THE SEAHORSE TRADE IN KENYA

Kenya has been involved in both the dried and live seahorse trades, the former only as a re-exporter. Local seahorses were not offered legal protection in 2000. A small targeted fishery existed for the aquarium trade and seahorses were caught incidentally by artisanal fishers as well as commercial shrimp trawlers. Domestic consumption was negligible, but tentative calculations from field data suggest that, in the past, Kenya imported more than 2t of dried seahorses from Tanzania for re-export to Asia. This trade apparently ceased in 1998. A negligible export trade in Kenyan live seahorses continued in 2000, involving approximately 10 seahorses annually. Pipefishes were exported as ornamental fish in larger numbers than seahorses, but an annual estimate was not obtained.

SEAHORSES CATCHES IN KENYA

Target fisheries: for the aquarium trade

In 2000, between 50 and 100 fishers in Kenya specialised in live fish for the ornamental fish trade. They operated all along Kenya's coast, although Kilifi and Shimoni appeared to be the most popular collection sites. Most aquarium traders and fishers explained that they took seahorses opportunistically rather than targeting them. One aquarium fisher, however, said he knew of two colleagues who sought seahorses specifically, and an artisanal fisher claimed to have observed a team of ten divers who did. Possibly those divers sold seahorses they caught into the dried rather than the aquarium trade: a marine products trader in Mombasa mentioned that occasionally Japanese clients came to enquire about buying seahorses, whereupon he sent divers to look for them.

All fish for the aquarium trade were caught with nets while SCUBA diving or snorkelling. They were placed into plastic bags with seawater which were topped up with oxygen at the boat or shore for further transport. Live seahorses were said to transport well, lasting up to three days in plastic bags of water, although most were transferred to holding facilities within one day.

The artisanal fisher mentioned above reported observing divers use speared octopi as decoys to scare seahorses out of the seagrass before trapping them in bottles (a technique also used to fish lobster). This seems somewhat unlikely given that seahorses of most species generally grasp their holdfast tenaciously when threatened, as they are better at camouflage than rapid escape (Lourie *et al.*, 1999). Nonetheless, the story cannot be entirely discounted, because three fishers in Tanzania claimed that local seahorses move away from novel objects in their environment, such as nets. Furthermore, the author noted fleeing seahorses during underwater studies in South Africa (Bell *et al.*, 2003).

Bycatch: commercial and artisanal fisheries

Artisanal fishers occasionally caught seahorses in cast nets, seine nets and purse seines ranging in mesh size from 0.5 cm to 3 cm. There appeared to be a standard practice in Kenya that every fish caught but not consumed must be returned to the water without harm as quickly as possible. Even fishers using beach seines, who landed their catch ashore, specifically took unwanted fish back into the sea. This applied to seahorses, so bycatch in the artisanal fishery seemed relatively harmless to them, although the low mobility and tight social structure of seahorses means that even displacement can affect reproductive success negatively (Lourie *et al.*, 1999).

According to the recollection of one former trawl fisher, seahorses were also caught by commercial trawlers in the country. While a seven-day study of trawl bycatch did not record seahorses (Fulanda, 1999), experimental trawls in Gazi Bay yielded three seahorse species (Enock O. Wakwabi, pers. comm., 29 May 2000). Given that trawlers concentrated their efforts within two to seven nautical miles (3.7-12.96 km) from shore in waters as shallow as five fathoms (nine metres; Bernerd Fulanda, pers. comm., 17 May 2000), seahorses were probably caught. In 2000, seven trawlers operated in Kenya, in an area ranging from the Tana River mouth in the north to Malindi in the south. As the crow flies, this covers close to 100 km, approximately one quarter of Kenya's coastline. Most incidentally caught animals were reportedly dead by the time the bycatch was dumped overboard (Bernerd Fulanda, pers. comm., 17 March 2000; Fulanda, 1999).

An accurate estimate of the annual Kenyan seahorse bycatch was impeded by the absence of reliable figures on the number of fishers and gear types. Furthermore, fishers generally felt unable to give a quantitative estimate of seahorse bycatch, precisely because they caught seahorses so infrequently. A fisher in Kilifi, who came across these fish slightly more often, said he might catch three seahorses per month. Annual bycatch at a national level, therefore, is assumed to be minor.

DRIED SEAHORSE TRADE IN KENYA

Trade routes, domestic trade, exports, imports, volumes, and values

Kenya did not, apparently, export its own seahorses dried. Three of four exporters of marine products interviewed in Mombasa explained that seahorses in Kenya were too rare to support an export business. One had reached this conclusion after careful investigation of seahorse availability in response to an order from Singapore. Another admitted that, although generally there were too few seahorses to put together a shipment, he would occasionally send out divers to look for them in response to requests from Japanese clients. Only one exporter interviewed denied any knowledge of the value of seahorses in Asia, even though another source indicated that his company received seahorses from Pemba, Tanzania, until at least 1998.

Nevertheless, Kenya had until the late 1990s engaged in the dried seahorse trade, importing and re-exporting Tanzanian seahorses. Kenya's involvement in this trade dates back to at least 1985 when a Tanzanian exporter (trade level 2-4) decided to deliver his seahorses to a business partner from Hong Kong in Nairobi rather than in Dar es Salaam, because of Tanzania's unfavourable foreign exchange policies at the time. In 2000, this exporter annually shipped approximately 120 kg of dried seahorses to Hong Kong, but had sent them directly from Tanzania since currency controls were relaxed in 1986.

Kenya's involvement in the dried seahorse trade in the 1990s focused around Mombasa. With an international airport and as the country's major port, Mombasa is an ideal base for marine products traders who supply Asian markets with sea cucumbers, shark fins and shells. According to statements by Fisheries officials and marine products traders themselves, there were between six and ten such traders in Mombasa in 2000.

Several of these traders have been implicated in the seahorse trade: residents of Pemba Island, Tanzania, named three Mombasa traders who—between 1995 and 1998—were supplied with seahorses from at least three Pemban villages. Fishers (Level 1), who sorted the seahorses from their bycatch, took them to Mombasa personally or passed them on to buyers (Level 2 and 3) trading with Mombasa. One such level 3 buyer interviewed in Tanzania, *Middleman A*, stated that the exporter he supplied in Mombasa, an ethnic Chinese, initially received seahorses from 15 Pembans. The number of suppliers then apparently dropped gradually until seahorse trade ceased after 1.5 years. The respondent himself only sold seahorses for six weeks as seahorse supplies soon dwindled to such extent that he judged shipments no longer economically viable. His first two shipments, two weeks apart, were three sacks (each 60-90 kg) of dried seahorses. His third and last shipment, two weeks later, was 30 kg. This comes to a total of between 390 kg (30 kg + 2 x 3 sacks x 60 kg) and 570 kg (30 kg + 2 x 3 sacks x 90 kg) in six weeks. Each kilo sold for KSh40 (then US\$0.73) in Mombasa.

The trade volume estimates of *Middleman A* are put into question by the following facts: dried seahorses obtained by the author in Pemba had a mean weight of 2.4 g (range: 0.7 g-7.4 g, 16 specimens). It would, hence, require 12,500 seahorses to make 30 kg. While it may be possible to pack this many seahorses into one very large sack, no sack seen in East Africa would hold the number of dried seahorses required to make 90 kg.

Nevertheless, accumulating 30 kg of dried seahorses per fortnight may be possible. According to a Tanzanian fisher, a single fishing village on Mafia Island in Tanzania harvested similar amounts (13,000 seahorses) each fortnight with little effort (see *The seahorse trade in Tanzania*). Judging from fishers' statements, seahorse abundance in Mafia is similar to that in northern Pemba (Figure 1).

Making the assumption, therefore, that each Pemban fishing community was able to harvest approximately 30 kg of dried seahorses per fortnight, it is possible to arrive at an estimate of the amount of seahorses traded between Pemba and Mombasa annually in the mid-1990s. We know that:

- at least three Pemban villages supplied Mombasa with dried seahorses; and
- at least three Mombasa-based marine products exporters received dried seahorses from Pemba, probably from several fishers and middlemen each.

Between them, the three Mombasa-based marine products traders, therefore, may have received 2,340 kg (3 villages x 26 fortnights x 30 kg/fortnight) of dried seahorses each year; more if more than three Pemban villages were involved. At an average weight of 2.4 g per seahorse, this amounts to almost one million (975,000) dried Pemban seahorses imported to and re-exported from Kenya annually in the mid 1990s.

Import of seahorses from Pemba to Mombasa apparently ceased in 1998, reportedly because of dwindling supplies and/or lack of convenient transport. A ferry that used to run weekly between southern Pemba and Mombasa suspended operations in 1998 but was about to restart its service in June 2000. Re-establishment of a regular, affordable link might revive the cross-border seahorse trade, if indeed lack of easy transport was the principal reason for its demise in 1998.

LIVE SEAHORSE TRADE IN KENYA

Trade routes, domestic trade, exports, volumes, and values

The ornamental fish trade in Kenya dates back to the 1960s. In 2000, five exporting companies were operating, but there had been more in the past. Most were owned by residents of European origin and located near Mombasa, close to the only international airport along Kenya's coast. Exports were destined for Europe, the USA and Japan. Each company received the bulk of its fish from a contracted team of divers and snorkellers who were supplied with transport and equipment and paid per fish.

Aquarium fishers only rarely caught seahorses, because they concentrated on reefs, while seahorses were found in the seagrass beds of murky creeks. Exporters discouraged their contracted fishers from bringing seahorses, because seahorses were delicate fish and uneconomical for shipment as they required a lot of space and suffer high mortality (20%). Moreover, two exporters claimed that other countries were able to export comparatively larger volumes of seahorses, because they had more seahorses and these were, in some cases, "caught with poison." Consequently, the price Kenyan seahorses fetched when sent abroad was too low to adequately compensate fishers for such an infrequent catch. One exporter, who paid his fishers KSh100 to KSh150 (US\$1.40 to US\$2.13) per seahorse, said the maximum a seahorse earned him abroad was US\$3.00. In other companies, fishers received between KSh100 and KSh500 (US\$1.40 and US\$ 7.10) per seahorse, and between KSh25 (US\$0.36) and KSh500 (US\$7.10) a piece for other fish. These other fish sold abroad for as little as US\$0.50 (*Abudefduf* and *Chromis* spp.) and as much as US\$65 (*Arothron citrinellus*). Seahorses, hence, were toward the bottom of the profit range for Kenyan ornamental fish exporters.

As a result of infrequent catches, delicateness and low economic gains, seahorses were not advertised to clients and orders were uncommon. Nevertheless, two companies exported seahorses to Europe on the rare occasion that they got them. Another exporter passed all its seahorses to the company's former owner who kept them as pets. A fourth exporter had never dealt in them.

The number of seahorses that annually passed through the hands of ornamental fish traders appeared to be small. One Fisheries official vaguely remembered up to four seahorses being listed in monthly Fisheries statistics in Malindi in the mid-1980s. Detailed records of export consignments provided to the Department of Fisheries by exporters between 1968 and present could not confirm this: no seahorses were listed (Department of Fisheries Kenya, undated a). Nor did monthly landing reports in the 1980s include seahorses (Department of Fisheries Kenya, undated b). Statements by three aquarium fishers, four exporters and one of their employees suggest that fewer than ten seahorses are traded each year. Their assertions seem to be supported by European import statistics: in the years 1997 to 2000 only a single

Kenyan seahorse appeared in European import records. It was imported live to Germany for commercial purposes in 1999 (European Community, undated).

In contrast, a Tanzanian fisher who visited Shimoni in May and June of 1998 and 1999 claimed to have observed a team of ten divers collect 50 to 80 seahorses daily in bottles with seawater. Residents of Shimoni and nearby Wasini Island, however, implied that seahorses were relatively rare in the area.

OTHER SYNGNATHID SPECIES IN KENYA

Artisanal fishers occasionally supplied the Mamba Village public aquarium in Mombasa, with locally caught pipefishes and pipehorses. Several pipefish species and one species of pipehorse, perhaps of the genus *Acentronura*, were on display when the author visited. The aquarium's curator believed that at least seven pipefish occurred locally: a *Yotzia* species, *Doryramphus excisus*, *D. intestinalis*, *D. multiannulatus*, another *Doryramphus* species and two further unidentified species (Harald Weiner, pers. comm., 25 May 2000). Published records suggest that the following species occur in Kenyan waters: *Choeroichthys sculptus* (Smith & Heemstra, 1986), *Hippichthys cyanospilo* (Troch *et al.*, 1996), *Hippichthys heptagonus*, *Micrognathus andersonii*, *Microphis fluviatilis*, *Microphis brachyurus*, *Nannocampus pictus*, *Phoxocampus belcheri* (Smith & Heemstra, 1986), *Syngnathoides biaculeatus* (Troch *et al.*, 1996; Kimani *et al.* 1996), and *Trachyrhamphus bicoarctatus* (de Troch *et al.*, 1996; Kimani *et al.*, 1996; Smith & Heemstra 1986).

Pipefishes were exported as ornamental fish slightly more frequently than seahorses. A survey of traded aquarium fish in 1994 listed two pipefish: *Doryrhamphus melanopleura* and *Corythoichthys haematopterus* (Wanyoike, 1994). Descriptions of Export Consignments filed with the Mombasa Fisheries Office showed that 20 pipefish had been exported between March and May 2000; their destination was not indicated (Department of Fisheries Kenya, undated ec).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN KENYA

Generally, Kenya's marine resources were in poor health in 2000: overexploitation of many fish and invertebrate stocks was inferred from their increased scarcity and the high percentage of juveniles in landings. Pressure kept increasing because of a combination of poverty, population growth and migration towards the coast (Moffat *et al.*, 1998). The high levels of exploitation had significantly modified marine communities (McClanahan & Kaunda-Arara, 1996; Johnstone *et al.*, 1998). Despite declining daily catch per capita, however, the number of fishers remained stable (McClanahan and Mangi, 2001).

Fishing regulations on minimum mesh sizes and trawling area in Kenya could benefit seahorses, but enforcement was rare in 2000. Annual Reports of several District's Fisheries Offices lamented the lack of marine transport facilities, personnel and political will to help curb the use of undersized mesh-sizes and illegal fishing practices (Department of Fisheries Kenya, undated d,e). Trawlers, officially restricted to beyond five nautical miles (9.26 km) off shore, were known to concentrate their efforts between two and seven nautical miles (3.70-12.96 km) from shore. Even if they were caught and taken to court, fines were too small to induce compliance (Bernerd Fulanda, pers. comm., 17 May 2000).

Both small-meshed nets and trawlers are likely to land seahorses as bycatch, leading to their death or displacement. Trawlers, other destructive fishing practices and logging in coastal areas also damage habitats: beach seining, for example, leads to trampling of reefs and seagrass beds. According to a Watamu resident, mangrove logging and the concomitant loss of breeding grounds in adjacent Mida Creek in the early 1980s had apparently led to declines in the abundance of seahorses and other fish within the creek and Watamu Marine National Park. Logging, he explained, arose in response to tourism development in Watamu.

Pollution is another concern. A former ornamental fish dealer commented that in the past she and her divers had found seahorses in Port Reitz by Mombasa, but that nowadays the area was polluted and generally devoid of fish. Garbage from Mombasa's rubbish tips made its way north along the coast into Watamu Marine Park and had, according to a Watamu resident, been observed to affect marine life.

CONCLUSIONS FOR KENYA

Seahorse trade appeared not to pose a major threat to Kenyan seahorses in 2000. Exploitation of seahorses for local use and the aquarium trade seemed negligible and, apparently, no dried seahorses had been imported to or exported from Kenya since 1998. From at least 1995 to 1998, however, Kenya engaged in an import and re-export trade that may have supplied the Asian market with more than 2t of dried seahorses annually. This trade could resume should former transport links between Mombasa and Pemba, Tanzania be restored.

THE SEAHORSE TRADE IN TANZANIA

Tanzania exploited local seahorses and imported others from Mozambique, both to supply Asian markets. Tanzanian seahorses enjoyed no legal protection in 2000. A targeted fishery apparently existed in the past, but in 2000 seahorses traded were caught as bycatch in artisanal and commercial fisheries. No evidence was found for a trade in live seahorses. In contrast, annual exports of dried seahorses from Tanzania directly to Asia possibly exceeded one tonne, according to extrapolations from information gathered in the field. Between 1995 and 1998, crude calculations hint that a further 2.3t of dried seahorses may have been exported from Tanzania to Asia via Kenya each year.

Tanzania's seahorse trade dates back to at least as early as 1975. Perhaps the country's links with China explain such early entry into the trade. After Tanzania (then Tanganyika) gained independence from Britain in December 1961, it followed a socialist path. Common views on international affairs quickly led to a close friendship between the young country and China. Consequently, China became one of the most important aid providers to Tanzania (Ping, 1999). In 2000, Chinese-built housing and Chinese lettering on many of the country's trucks stood witness to this close relation, as did the presence of ethnic Chinese residents in remote locations (pers. observation).

SEAHORSE CATCHES IN TANZANIA

Countrywide, seahorses occurred in the bycatch of artisanal and commercial fishers. The primary source of seahorses traded in Tanzania appeared to be Pemba Island. Pemban fishing communities supplying the trade included Kichawini, Msuka, Kinowe, Tumbe, Sizini, Tondooni, Kifundi, Kojani Island, Wete, Mtambwe, Mkumbuu and Mkoani (Figure 1).

Traders also got supplies from Mafia, Unguja, the Songo Songo Islands and most areas on the mainland coast: Tanga Region, Kilwa and potentially other areas in Lindi District, and Mtwara District (Figure 1). Fishers based in Dar es Salaam also provided seahorses, but – according to two of their buyers and a fisher himself – were likely to catch most of these when on fishing expeditions elsewhere.

Target fisheries

The only report of targeted seahorse exploitation came from Tumbuju on the western side of Mafia Island. According to the recollection of one elderly fisher interviewed on Chole Island, Tumbuju fishers practised *kavago* fishing (a form of seining) in the early 1990s with nets of mesh sizes less than 1x1 cm. They would fish for food fish during the day and at night cast the net once in appropriate habitat specifically to catch seahorses. The seahorse fishery operated at night, explained the fisher, because seahorses were more available then. No lights were employed to attract fish. A trader from Dar es Salaam was able to buy recently deceased seahorses (still wet) from five or six groups of 15 to 20 *kavago* fishers when he visited each spring tide; it thus appears that seahorse fishing occurred only on the nights during or immediately preceding the visit. According to the elderly fisher, who had himself harvested seahorses, fishers in Tumbuju traded seahorses for only one year in the early 1990s. One fisher and one fish monger interviewed on Juani Island indicated that visits by traders to Tumbuju resumed between 1995 and 1997, but it was unclear whether fishers then bothered to target seahorses or just sorted them from their bycatch.

Bycatch: commercial and artisanal fisheries

The bulk of seahorses entering Tanzania's dried trade were sorted from artisanal fishers' bycatch; seahorses were caught mainly in seine nets and purse seines, occasionally in surround nets, and rarely in trap nets, gill nets, basket traps and cast nets.

Seine nets appeared to account for the largest bycatch of seahorses in Tanzania. Two seahorse traders (Levels 2-4) implied that the seine fishery was their major source of seahorses, although 16 others did not comment. Nine observers of the trade (mostly fishers not themselves involved in the trade) also said that seahorses were caught in seines. Only three of the 71 Tanzanian artisanal fishers interviewed were directly involved in the seahorse trade, and all were seine-fishers. The use of seine nets varied and went by many names (*juya*, *juya la kojani*, *chachacha*, *kokoro*, *kavago*), but generally involved dragging a net to shore (beach seining) or higher grounds in mid-water (mid-water seining). Mesh sizes ranged from 0.25x0.25 cm to 2.5x2.5 cm, with the smallest mesh at the net's central 'cod end'. From a conservation point of view, beach seining was particularly worrisome as unwanted fish were mostly left to die on shore. Reportedly, seahorses and other unwanted catch were usually released alive from mid-water seines, although three of the 15 seine fishers interviewed had also collected seahorses for drying with these nets.

One major seahorse exporter (Level 2-4) implied that, alongside beach seiners, sardine fishers were a major source of seahorse supplies. Sardines were generally caught with purse seines (*ringnet*, *babila* or *mtando*). These nets ranged in mesh size from 0.5x0.5 cm to 3x3 cm and were set in the shallows (5 m), near reefs, or in deep (60 m) open waters. Fish, located by swimming scouts or attracted with lights, were encircled and then trapped, as the bottom of the net was pulled closed before hauling. Most (7 of 9) purse seine fishers indicated that fish landed in bycatch were alive when returned to the water. One, however, explained that his group sorted bycatch upon return to the shore once it was dead. Occurrence of seahorses in the bycatch of purse seines apparently differed from location to location: a fisher in Mtwara explained that he would catch one or two seahorses per day when fishing near the port, but none elsewhere. As he only fished near the port two out of twelve days, he would see ten seahorses per month at best (mesh size 1x1 cm). Elsewhere, fishers caught 'one each month' (Lindi, 1.5x1.5 cm), 'fewer than two per fishing day' (Chwaka, Unguja; 2x2 cm), 'between one and seven each night' (Mkoani, Pemba; mesh size unknown), or 'half a bucket to one bucket full [=several hundred seahorses] each night' (Bagamoyo, 0.5x0.5 cm).

Surround nets caught seahorses only occasionally according to six of seven fishers interviewed who used the technique. Surround nets varied in mesh size from 2x2 cm to 4x4 cm and were cast in a circle while swimmers prevented fish from escaping. Prior to hauling, skin-divers attached a second small-meshed net (*tandio*, usually 1x1 cm) to close off the bottom. Those swimming and diving saw seahorses frequently, but reported that seahorses actively moved away, and so were rarely caught.

Trap nets (*kutega* or *kusua*, 2x2 cm to 3x3 cm), too, caught seahorses only rarely: 2-3 per month, according to two of three fishers interviewed familiar with this gear. These nets were set to trap fish in shallow waters trying to follow the outgoing tide.

Similarly few seahorses were caught in gill nets (*jarife*, 3x3 cm to 6x6 cm). Of eight *jarife*-fishers interviewed, three reported finding seahorses in their nets (clasping the net or seaweeds entangled therein). They implied, however, that seahorses were a rare catch (maximum two per month), and were generally thrown back into the water alive.

Seahorse bycatch was even less frequent in basket traps (*madema*). Only two of 71 artisanal fishers interviewed in Tanzania (of whom at least 10 used *madema* themselves) reported that seahorses were very rarely caught in these traps: perhaps once a month.

Two Fisheries officials in Tanga reported that cast nets (*vimia*, 1x1 cm) caught seahorses, but no fisher employing this gear could be interviewed.

Between 15 and 25 commercial trawling vessels operated in Tanzania in 2000. These were another source of seahorse catch but respondents disagreed on volume. One Fisheries officer who some time ago acted as an observer on a trawling vessel in the Rufiji delta spoke of 'lots of seahorses' in the trawling nets. The captain and chief engineer of one trawler, in contrast, suggested that seahorses were an infrequent catch,

which matched statements by a trader (Level 2-4) who put the number of seahorses supplied by trawl fishers at 10-15 per vessel per month. As waters trawled were rather shallow (1m-20 m) and single trawls took as little as 10-15 minutes (but up to two hours), a lot of catch was still alive when nets were hauled. Seahorses caught in trawls could potentially survive the ordeal, at least in the short term. The Fisheries officer mentioned above commented that seahorses stayed alive for up to six hours on board. Seahorses and other non-edible fish were dumped at sea, although how quickly was unclear. It seems unlikely that discarded seahorses manage to survive in the longer-term, or find suitable habitat and breeding partners where they are dumped

Finally, seahorses were occasionally harvested accidentally in seaweed farms. Seaweed farming was primarily practised in Unguja, but also in Pemba (Johnstone *et al.*, 1998). One seaweed-exporter recalled the sporadic seahorse in his shipments: approximately one per 20t-30t of seaweed.

An estimate of Tanzania's annual seahorse bycatch is difficult, given the disparity of catch levels from area to area and an absence of accurate figures on the number of fishers and gear types in the country. However, as most seahorses traded in Tanzania were caught incidentally, estimated trade volumes can shed some light on the magnitude of annual bycatch. Accordingly, national-level seahorse bycatch was estimated to exceed 42,000 seahorses annually, given that many seahorses caught never entered the trade (see ***Dried seahorse trade in Tanzania***).

Timing of seahorse catch in Tanzania

Eight of sixteen seahorse traders (Level 2-4) indicated that as a result of weather conditions favourable for drying, more seahorses were caught and traded during *kaskazi*, the north-easterly monsoon. Only one trader (Level 2-4) claimed the contrary. Generally, seahorses were sun-dried, either laid out or hanging. One former seahorse fisher explained that as alternative for the rainy season he would spread seahorses on wire mesh above charcoal embers. A local agent (Level 2) and a marine curio trader (Level 2-4) suggested the coincidence of *kaskazi* with the tourist season as another reason for increased trade during the north-easterly monsoon. While this was only speculation on the agent's part, the curio trader did sell dried seahorses to tourists along with sea shells.

Apart from this seasonal pattern, seahorse exploitation for the trade was generally intermittent in time and space. This was a function of both itinerant buyers and preservation problems. If not properly dried or stored, seahorses are prone to rot or destruction by insects. Traders at all levels faced the challenge of passing on their stock while it was still in good condition. Fishers (Level 1), therefore, were only motivated to retain seahorses if a local agent (Level 2) was buying and/or an itinerant middleman (Level 2-3) was around. Local agents, similarly, were unwilling to risk the investment until they were certain of a buyer or, as one agent pointed out, were sometimes too short of cash to do so if no buyer was expected soon.

DRIED SEAHORSE TRADE IN TANZANIA

Trade routes: dried seahorses within Tanzania

Traded seahorses passed through as many as four trade levels in Tanzania before they ended up in foreign hands (Figure 2). Fishers (Level 1) generally sold seahorses to a local agent or itinerant buyer. Local agents (Level 2) often were fishers themselves and purchased seahorses only from members of their own fishing community. Habitually, local agents had one or two regular buyers, usually itinerant middlemen (Level 2-3). These middlemen often fostered close business relations by providing agents with a baseline salary as well as cash advances to enable them to purchase seahorses from fishers. In locations where itinerant buyers did not have permanent agents, they bought from fishers directly or asked locals to act as agents for them over short time frames. Itinerant middlemen then transported seahorses from source locations to the marketing centre. There they passed their stock onto either traders who sold to foreigners within the country (Level 2-4) or exporters (Level 2-4). The latter two categories of traders occasionally, however, skipped intermediate levels and bought from fishers or local agents directly. Foreign buyers (Level 2-5) within Tanzania occasionally did the same.

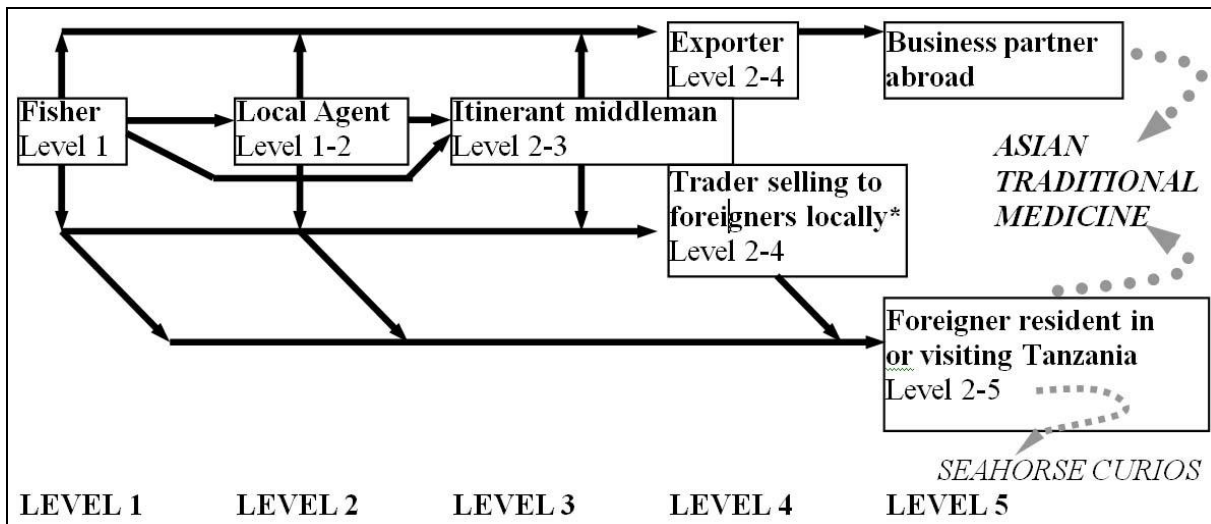


Figure 2. Agents in Tanzania's dried seahorse trade and their interactions. Source: author's research. *Includes both curio traders and traders exclusively targeting the Asian medicine market

Most commonly, dried seahorses were taken from their source to Dar es Salaam directly before leaving the country. A few possibly passed through Zanzibar Town first or were exported from there directly. A third alternative was direct export from Pemba to Mombasa, Kenya (Figure 3).

Domestic trade: dried seahorses and the curio trade in Tanzania

A few dried Tanzanian seahorses each year were purchased by souvenir-hunters. Dar es Salaam had for years housed a marine curio market where seashells, dried sea stars and dried puffer fish were offered to tourists. Precious or fragile items, including seahorses, remained tucked away until customers showed special interest. All four traders interviewed at this market indicated that tourists occasionally bought one or two dried seahorses for educational purposes or as souvenirs. Claims that seahorses were sold to tourists on Pemba (according to a Kenyan dive tour operator) and Unguja (according to a Pemban fisher) could not be substantiated, although a marine products trader dealing in seaweeds, seashells and sea cucumbers did remember being asked for seahorses by an Italian shell dealer in Zanzibar Town in the 1970s, perhaps to sell as curios in Europe.

Exports/Re-exports: seahorses from Tanzania - destinations and trade routes

The primary destination for dried seahorses from Tanzania (including those routed via Kenya) appeared to be the Asian medicine market. Two major traders (Level 2-4 and Level 3-4) had clients in Hong Kong and Taiwan. Traders at the marine curio market (Level 2-4) said that 'Chinese' were their major clients for seahorses: it was unclear whether respondents knew their clients' nationality or assumed any East-Asian-looking person to be Chinese. Another smaller trader (Level 4) sold exclusively to mainland Chinese who resided in Dar es Salaam. This trader commented that—among the Chinese he knew—only those from JiangXu province in central coastal China purchased seahorses, not those from Beijing.

According to US import statistics several hundred Tanzanian seahorses were also imported to the USA between 1996 and 2000. The vast majority of these seahorses (625 of 628), however, were imported via Hong Kong (US Fish and Wildlife Service, undated). Names of three receiving companies in the USA and three exporting companies in Hong Kong suggest that at least some of these seahorses may have been intended for use in arts and crafts

Seahorses destined for the Asian market were either exported by Tanzanian traders directly or taken abroad by foreign visitors. The latter included both professional traders, for whom seahorses and other marine products comprised the mainstay of their businesses, and amateur traders, who resided in Tanzania as doctors, engineers or aid workers and traded seahorses only on the occasion that they returned home for visits or for good.

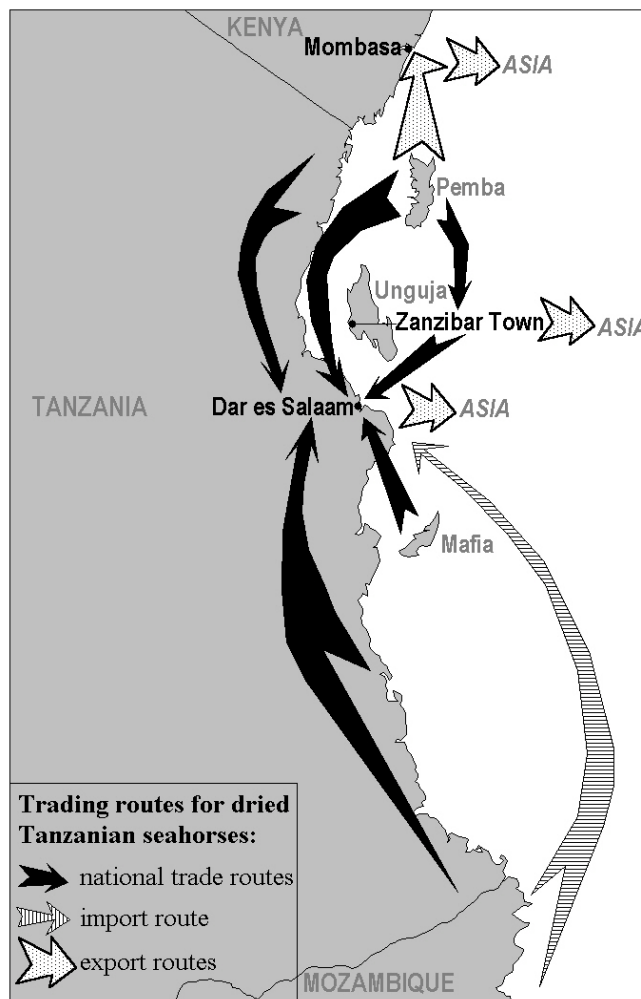


Figure 3. Alternative trade routes for dried Tanzanian seahorses. Source: author's research.

these partners specifying quantity, quality and price of products to be supplied. Payment was arranged through relatives living in Tanzania. Sea cucumbers and shark fins were generally shipped, but, like the amateur traders, these professional traders preferred to transport seahorses in their personal luggage.

Imports: dried seahorses into Tanzania

In addition to Tanzanian sources, at least one exporter (Level 2-4) based in Dar es Salaam said he obtained seahorses from Mozambique and two traders (Level 3-4 and Level 4) had explored the availability of seahorses in Mombasa, Kenya. Whether Mombasa ever supplied was unclear.

The trader importing and re-exporting Mozambican seahorses did not have permanent business partners there. Instead, he explained, he visited occasionally to buy seahorses personally from fishers (Level 1) and impromptu agents (Level 1-2) in various Mozambican locations.

Volumes: dried seahorses traded in and exported from Tanzania

Internal seahorse flows: volumes traded by local agents and middlemen

A targeted seahorse fishery on Mafia Island in the past apparently yielded tens of thousands of seahorses each month. The fisher who reported that seahorses were targeted by fishers in Tumbuju, Mafia, in the early 1990s, claimed that a trader (Level 2) from Dar es Salaam had bought 10 *tenga* (boxes, in this case approximately 30x30x60 cm) of freshly dead (still wet) seahorses when he visited each spring tide. Five or six groups of 15 to 20 *kavago* (seine) fishers each, including the respondent himself, had supplied the

The one Tanzanian exporter (Level 2-4) interviewed sent shipments to Hong Kong by courier. Another trader (Level 3-4) knew of colleagues who exported directly via the Freeport in Dubai to Japan and North America.

'Chinese' visiting or resident in Tanzania bulk-bought seahorses from local traders (or fishers) before returning home, according to three fishers in Pemba, one fisher in Tanga, and five traders (Level 2-4) in Dar es Salaam. Many of them apparently were amateur traders. Traders (Level 2-4) in Dar es Salaam believed that these East Asians generally transported the seahorses in their personal luggage on commercial flights. While traders often assumed that these clients distributed the seahorses to friends and relatives once in China, a Chinese resident interviewed by the author in Dar es Salaam explained that, once in China, he sold them to a factory. He implied that the factory used them to manufacture medicines, but knew not what type of medicines.

Although many foreign buyers apparently were amateur traders, some visited specifically to purchase seahorses and other marine products, such as sea cucumbers and shark fins, for the Asian medicine and delicacy market. According to one of their suppliers (a level 3-4 trader in Dar es Salaam), Asian entrepreneurs had established links with Tanzanian traders.

Prior to arrival, they drew up contracts with

trader. Each fishing group, he said, yielded one to two *tenga* a night and seahorses were dried by the trader. Hence seahorse fishing was presumably limited to one or two nights coinciding with the trader's appearance twice a month (this would yield 5-24 *tenga* and allow the trader to dry seahorses before they rotted). The fisher recalled that, at the time, a single seahorse sold for TSh0.20 (then worth approximately a tenth of one US cent), and a night's catch would earn each fishing group TSh300 to TSh1,000 (then US\$1.50 to US\$5.00). A fisher's average nightly share was TSh35 (US\$0.18), which according to the respondent 'was good money at the time—enough to pay a fine for kicking someone.' His information allows us to estimate the number of seahorses traded between Tumbuju and Dar es Salaam each month in the early 1990s:

- If each fisher earned TSh35 for a nightly seahorse catch, the pooled income of about 15 fishers in one group must have been TSh525.
- At TSh0.20 per seahorses, TSh525 must have been payment for 2,625 seahorses. Hence one group of *kavago* fishers apparently caught approximately 2,600 seahorses each night they targeted them.
- Since the trader was supplied by five or six fishing groups, he must have obtained at least 13,000 (5x2,600) seahorses each visit, more if six groups supplied and fished for two nights in a row (up to 31,000 seahorses per visit).
- Supposedly, the trader obtained 10 *tenga* per visit. Above calculations, therefore, put 1,300 to 3,100 seahorses in each of these boxes. Given their reported size (30x30x60 cm), this is plausible.
- Hence this particular trader may have, in the early 1990s, taken between 26,000 and 62,000 (2x13,000 or 31,000) seahorses per month to Dar es Salaam from Tumbuju alone.

In 2000, seahorses traded in Tanzania were collected from fishers' bycatch rather than targeted. Nevertheless, local agents (Level 2) and middlemen (Level 2-3) managed to amass thousands of seahorses. Two middlemen on Pemba suggested they collected more than 4,000 seahorses each year. A local agent in Tumbe, Pemba, said he accumulated 20 kg of dried seahorses over the last *kaskazi* season (north-easterly monsoons, December 1999 to March 2000). He estimated 200 dry seahorses per kilogramme but this seemed too few given that 16 dry Pemban specimens obtained by the author weighed a mean of 2.4 g (range 0.7 g-7.4 g), equal to 417 seahorses per kilo; perhaps "dried" seahorses were still fresh enough to weigh more heavily. If we accept the informant's conservative estimate, he accumulated 4,000 (20x200) seahorses in four months.

A local agent in Wete, Pemba, claimed similar amounts at 5,000 dried seahorses per *kaskazi*. However, this agent's weekly estimates—50 per week during *kaskazi*, 20 per week during the rest of the year—come to many fewer: 800 seahorses over the four *kaskazi* months, 720 over the rest of the year. Neither of these agents were necessarily the only local agents in their community.

Two middlemen estimated their yearly seahorse trade at roughly 20,000 seahorses. A Pemba-based middleman (Level 2-3) said he had shipped 1,800 to 2,000 dried seahorses each month to Dar es Salaam for the past six years. That is at least 21,600 dried seahorse annually.

A competitor (Level 2-3) based in Dar es Salaam, who obtained the bulk of his seahorses from Pemba, said he traded between 3,000 and 4,900 seahorses each month in *kaskazi*, 400-600 per month the remaining eight months. Per annum this comes to between 15,200 and 24,400 dried seahorses—volumes similar to those traded by the middleman above.

Statements from these two middlemen, a local agent (Level 2) on Pemba and a Dar es Salaam-based exporter (Level 2-4) with Pemban suppliers suggest that there were between four and six itinerant middlemen operating on Pemba Island in 2000. If all operated at similar levels, say 20,000 seahorses annually, Pemba alone may have contributed 80,000 (4x20,000) to 120,000 (6x20,000) dried seahorses to the trade each year. At an average dried weight of 2.4 g per seahorse, this constitutes 192 kg to 288 kg.

Volumes exported by professional traders

The bulk of seahorses harvested in Pemba and elsewhere must be destined for the Asian market, because both alternative uses, local consumption by traditional healers and souvenir purchases by tourists, apparently involved only limited numbers of seahorses. Traders (Level 2-4) at Dar es Salaam's marine

curio market who supplied both healers and tourists implied that these customers bought seahorses only irregularly and purchased two at a time at most.

No official records existed for seahorse exports in 2000. According to the only exporter (Level 2-4) interviewed, dried seahorses were categorised as 'fish' on custom forms. Other high value marine products, such as shark fins and sea cucumbers, were often mixed with fish offal and thus disguised as such, since 'fish offal' was the cheapest tax category for marine products (Simon Milledge, pers. comm., 27 June, 2000).

Nevertheless, information provided by informants allows us to estimate the number of dried seahorses exported from Tanzania each year. Two upper-level traders, *Export Trader A* and *Export Trader B* (both Level 2-4), were able to provide figures on seahorse exports:

Export Trader A used courier services to ship his seahorses abroad. Based in Dar es Salaam, he had been mailing approximately 10 kg of dried seahorses to Hong Kong each month since 1985, with 20-50% reportedly originating in Pemba. This translates into exports of about 120 kg or about 42,000 seahorses per annum, with 24 kg-60 kg annually coming from Pemba. A maximum of 2 kg each month, he said, were grade I seahorses (large enough that 100-200 fish make a kilo), and the remainder were grades II (200-400 seahorses/kg) through IV (600+ seahorses/kg).

Export Trader B, also based in Dar es Salaam, supplied two Asian traders (Level 5), one from Hong Kong, one from Taiwan. These traders visited Tanzania several times a year and carried home 10 kg to 20 kg of dried seahorses in their suitcases each time. Between them, reported their supplier, they fetched 70 kg to 100 kg of mixed seahorses and pipehorses annually. Specimens obtained from *Export Trader B* had a mean weight of 3.7 g, supporting the supplier's statement that there were 200-300 dried animals to the kilo. Hence between 14,000 and 30,000 dried syngnathids left the country annually via this route.

Known exports by professional traders *A* and *B*, therefore, annually amounted to between 190 kg to 220 kg, or 56,000 to 72,000 dried seahorses. Other traders were also inferred to export seahorses. Their number had to be deduced from informants' statements and Customs records:

Export trader A implied that, in 2000, his was the only large-scale export business for seahorses: three former competitors apparently died or went bankrupt, and others were discouraged by the Asian crisis in 1997. In contrast, *export trader B* spoke of four operating exporters other than himself.

A retired seaweed trader, who had considered trading seahorses (but never did so), mentioned a third active seahorse exporter in Dar es Salaam. This latter person appeared with 16 others in the 1995 Customs records for mainland Tanzania as exporting marine products (sea cucumbers, shark fins, seashells and fish offal) destined for Hong Kong, Singapore, Thailand and India (Anon., undated). Presumably others of these exporters were aware of the value of seahorses in Asia and may well have included them in their shipments.

At least one seahorse exporter in 2000 was based in the Zanzibar archipelago. A local agent (Level 2) in Mkokotoni explained that his buyer, a businessman in Stone Town who had been exporting chitons to the Middle East for the past 15 years, began requesting seahorses in late 1999. No Customs records listing marine products traders were obtained for Zanzibar.

Hence, in 2000, there were four known players in Tanzania's seahorse export: the person exporting to Hong Kong by courier (*Export Trader A*), the supplier of visiting traders from Hong Kong and Taiwan (*Export Trader B*), a further exporter based in Dar es Salaam and one based in Stone Town, Zanzibar. Assuming that the latter two trade similar volumes as the first two (100 kg annually), 400 kg of dried seahorses left Tanzania each year. *Export Trader B* suggested at least a few more seahorse exporters. Assuming that one third (5) or half (8) of the 16 other entrepreneurs listed in 1995 Customs records as marine products exporters also traded seahorses at similar levels, professional traders potentially exported as many as one tonne of dried seahorses (900 kg-1,200 kg) from Tanzania per annum.

Volumes exported by amateur traders

Asian travellers possibly increased the export of seahorses from Tanzania significantly. One Tanzanian trader (Level 3-4), an employee with a Chinese construction company in Dar es Salaam, told the author that his Chinese colleagues had enquired about seahorses eight months previously. He had, therefore, established business relations with a middleman (Level 2-3) in Dar es Salaam and ordered a cousin in his home town near Tanga to begin procuring seahorses from fishers there. As a result, he had managed to supply his Chinese colleagues with 2,000 seahorses over the eight months, with more in stock for future purchases. This very specific trade in seahorses by a novice trader may, however, not tell us much about overall trade volumes.

Most seahorses exported in the luggage of foreign amateur traders probably originated in the marine curio market in Dar es Salaam, so numbers traded here can help us estimate overall trade through this route.

The four traders interviewed at the market said that all 40 of their colleagues traded seahorses when available. One said that at any one time at least six traders had seahorses. A middleman (Level 2-3) based in Pemba who sold his seahorses at the Dar es Salaam marine curio market also spoke of six traders; perhaps an indication that six of the 40 traders at this market took the seahorse business more seriously than others.

Among the four interviewed at the market, one trader said he sold 100-200 dried seahorses per year. A colleague estimated his own seahorse sales at 5-30 each month. The other two respondents traded seahorses in much higher numbers. One explained that from December to February, he sold up to 50 seahorses each week (200 per month), the rest of the year 20-30 seahorses per week (80-120 per month). The other estimated his monthly sales at 200-300 seahorses. These numbers match an observation *Frontier* researchers made in 1998: then traders at this market had plastic bags containing approximately 300 dried seahorses (~ 2 kg) behind their stalls (Martin Guard, pers. comm., 6 June 2000).

If six traders at Dar es Salaam's marine curio market sold around 200 seahorses each month, then foreigners purchased at least 14,400 seahorses each year, plus several hundred more from the other 34 traders who dealt in seahorses occasionally. This estimate of around 15,000 seahorses per year is probably a severe underestimate. One Pemban middleman (Level 2-3) reported supplying the market with 2,000 seahorses each month, 24,000 per annum.

Traders named fishers in Dar es Salaam (and not Pemban middlemen), as their primary source, particularly citing fishers returning from fishing expeditions to the islands. One fisher in Tanga remembered that, until he left the capital in 1998, he supplied marine curio traders in Dar es Salaam with 800-1,000 dried seahorses each time his crew returned from a three-month expedition to Mafia Island.

A fisher and a fish monger on Chole Island also reported that between 1995 and 1997, marine curio traders from Dar es Salaam regularly visited Tumbuju on Mafia Island to fetch 50-100 dried seahorses each time. In fact, information provided by one of the traders (Level 2-4) at the market indicated that East Asian customers probably purchased more than 20,000 dried seahorses at the curio market each year. According to this trader, 'Chinese' living in Dar es Salaam visited regularly to buy as many seahorses as were available (another trader explained that they came by often, because they purchased fresh fish at the adjacent fish market). Reportedly, at least one regular Chinese client came by each day during the low trading season, and two each day December through February. Each visit they bought at least 50, but preferably 100 dried seahorses, said the trader.

For 12 weeks (December-February), Chinese residents weekly fetched at least 700 seahorses (50 seahorses x 2 buyers x 7 days/week) from the marine curio market; a cumulative total of 8,400 seahorses. For the other 40 weeks of the year (March-November), they fetched 350 (50x1x7) each week.; a total of 14,000 seahorses. Over the year, therefore, they obtained 22,400 dried seahorses to take home to Asia; more if they managed to purchase 100 seahorses per visit from time to time. If the average weight of dried seahorses collected by the author (2.36 g, n = 25) is representative, 22,400 seahorses approximate 53 kg.

Volume estimates for Tanzanian dried seahorse exports obtained from foreign import statistics

Two foreign sources, Customs records from the USA and Hong Kong, provide some information on Tanzanian seahorse exports. According to US records, 628 dried seahorses from Tanzania were shipped to the USA between 1996 and 2000, for a total value of US\$ 36,076 (Table 2). Only three of these seahorses, however, were shipped directly from Tanzania to the USA. All others were imported via Hong Kong. The trade involved eleven US recipients, seven companies in Hong Kong and three companies in Tanzania (Tanzanian exporters were only recorded for the three incidences of direct shipment; US Fish and Wildlife Service, undated). While the names of three receivers in the USA and three exporters in Hong Kong imply that some of these seahorses were intended for use in arts and crafts, their shipment via Hong Kong and the high price commanded by some of the shipments are suggestive of their use in TCM by Asian communities in the USA.

Tanzanian seahorses do not appear in Hong Kong's import statistics, perhaps because anything transported in personal luggage, postal packets valued at less than HK\$4,000 (US\$512) or sent as a gift is exempt from Customs declaration (Boris Kwan, *in litt.*, 28 September 2000). However, Hong Kong Customs records do show that 1.68t of dried seahorses purportedly originating in Tanzania were re-exported from Hong Kong to Mainland China in August 1999, with a total value of HK\$242,000 (US\$30 976; Census and Statistics Department Hong Kong, undated).

Total volume of dried seahorse exports from Tanzania

Estimates of dried seahorse exports from Tanzania by professional and amateur traders suggest that more than one tonne of seahorses left Tanzania each year. If the average weight (2.36 g) of the 25 specimens collected by the author is representative, this means that Tanzania yearly exported more than 42,000 seahorses. Their primary destination was Asia (Hong Kong, Mainland China, and Taiwan), with a few seahorses ultimately reaching the USA. Although Hong Kong Customs records between January 1998 and June 2001 contain only one record of Tanzanian seahorses, they seem to support above estimates, given that 1.68t of dried Tanzanian seahorses re-exported from Hong Kong to China in August 1999.

Table 2. Shipments of dried seahorses from Tanzania to the USA between 1996 and 2000, as recorded by US Customs. Yearly and overall totals were calculated from the data provided by the US Fish and Wildlife Service, as was the price per seahorse. Intended use was indicated as 'curio?' if the name of the exporting or receiving company implied that they deal in arts and crafts. Source: US Fish and Wildlife Service.

Year and shipment	Quantity (# seahorses)	Value (US \$)	US \$ per seahorse	Trade Route	Intended Use
1996					
shipment 1	50	2,872	57.44	via Hong Kong	?
shipment 2	65	4,080	62.77	via Hong Kong	curio?
shipment 3	100	7,062	70.62	via Hong Kong	curio?
Total 1996	215	14,014	65.18		
1997					
shipment 1	1	0	0.00	direct	?
shipment 2	75	2,226	29.68	via Hong Kong	?
shipment 3	11	11,814	1,074.00	via Hong Kong	curio?
shipment 4	92	5,193	56.45	via Hong Kong	curio?
shipment 5	70	700	10.00	via Hong Kong	?
shipment 6	67	1,104	16.48	via Hong Kong	?
Total 1997	316	21,037	66.57		
1998: no shipments					
1999					
shipment 1	1	50	50.00	direct	?
shipment 2	1	500	500.00	direct	?
Total 1999	2	550	275.00		
2000					
shipment 1	95	475	5.00	via Hong Kong	curio?
Total 1996-2000	628	36,076	57.45		

In light of these figures, it is surprising that exports from Pemba Island to Kenya may have totalled 2.3t annually in the mid to late 1990s (see *Dried seahorse trade in Kenya*). The estimate of volumes traded between Pemba and Mombasa should not be discarded easily, however. It assumes that three Pemban villages (Level 2-3) were able to each accumulate 30 kg of dried seahorses—approximately 12,500 seahorses—per fortnight. As described earlier, fishers in a single village on Mafia Island reportedly caught such numbers of seahorses (13,000 per fortnight) with surprising ease in the early 1990s.

Values: dried seahorses in Tanzania

Seahorse prices in Tanzania were highly variable in place and time; where trade was a recent phenomenon, prices were low (Table 3). Top-level traders (Level 4) appeared to foster ignorance about the use and destination of seahorses, perhaps in order to keep the prices low at lower trade levels (2 and 3). Most fishers and lower-level traders had no idea what dried seahorses might be used for. One middleman (Level 2-3) complained that his buyers were reluctant to provide any information despite his frequent queries.

Fishers received very poor pay for seahorses they supplied. One trader (Level 2-4) stated that local agents (Level 2) often diverted funds intended for fishers: they paid fishers less per piece than their buyer instructed them to, so as to make profit additional to the baseline salary they received. This was confirmed by a local agent (Level 2). Traders (Level 2-4) dealing with foreign buyers explained that they adjusted prices according to their assessment of the client's exigency to buy.

As for prices fetched abroad, the re-export value of Tanzanian seahorses recorded by Hong Kong Customs statistics is much lower at US\$18.44/kg than the price a Tanzanian seahorse exporter supposedly fetched in Hong Kong for his seahorses in 2000 (US\$80-300/kg). Re-export values reported to Hong Kong Customs, however, are thought to be purposefully understated, so as to evade taxes. Dried Tanzanian seahorses imported to the USA were worth anything from US\$5.00 to US\$1074.00 per piece, according to US Customs records (Table 2). How reliable value estimates are in these records is unclear.

LIVE SEAHORSE TRADE IN TANZANIA

No evidence was found for live seahorse trade in Tanzania. In 2000, no ornamental fish dealer was licensed to export marine fish from Tanzania. Live fish leaving the country originated in the East African Great Lakes (Sadock P.N. Kimaro, pers. comm., 23 June 2000). Marine life had been exported in the past, but an aquarium dealer interviewed could not think of any colleagues trading in marine fish in mid 2000. Neither did live Tanzanian seahorses appear in import statistics of the European Community, Hong Kong or the USA.

ECONOMIC IMPORTANCE OF THE SEAHORSE FISHERY IN TANZANIA

Seahorses provided extra cash but contributed relatively little to fishers' and traders' incomes. No agents involved in the seahorse trade specialised in these animals. Fishers gleaned seahorses from their bycatch when buyers were around, but rarely targeted seahorses specifically. The money they could make from seahorses was described by one fisher as 'cigarette money.' Local agents tended to be fishers themselves or fish mongers for whom seahorses were a supplementary source of income.

Traders generally accorded seahorses low importance in their portfolio because (a) they traded only small quantities and (b) vagaries in demand and supply lead to price fluctuations and stocking problems. Traders at higher levels tended to have diverse business portfolios, although most specialised in marine products, including seafood, seaweeds, shells, sea cucumbers and shark fins. One middleman interviewed noted that the seahorse trade contributes at most 10% of his total income. Another estimated that seahorses provided one quarter of his total earnings, covering the his business' transport costs (transporting seafood from Pemba to Dar es Salaam). Traders catering to foreigners at Dar es Salaam's marine curio market felt that seahorses accounted for perhaps 2-3% of their business. A major exporter guessed that seahorses earned him a tenth of what his cigarette business provided. While cigarettes were the backbone of his business, this exporter also dealt in insects, reptiles, birds, monkeys, gemstones, gall stones, mangrove products and above mentioned marine products.

Table 3. Comparison of the value of seahorses in Tanzania over place, time and trade level. Source: author's research.

Location and year of sale	Price per seahorse (unless otherwise noted) received by:							
	Fisher		Local Agent		Middleman		Exporters and traders selling to foreigners locally (Level 2-4)	
	(Level 1) TSh	US\$*	(Level 2) TSh	US\$*	(Level 2-3) TSh	US\$*	TSh	US\$*
Tanga								
2000	30	0.04	500-800	0.65-1.04				
Dar es Salaam†								
2000	300-1200	0.40-1.56			150-700	0.19-0.91	400-6,000	0.52-7.80
2000					80,000-100,000/kg	104-130/kg	Export to Hong Kong: US\$80-300/kg‡	
1998					25,000/kg	37.61		
1995					150-200	0.26-0.35		
1994					100	0.2		
1975							0.5-1	0.07-0.14
Pemba								
2000	50-150	0.06-0.19	350-400	0.45-0.52				
2000			13,000/kg					
1996/97			200/kg	0.33			Export to Kenya: KSh40/kg (US\$0.73/kg)	
1995	Children collecting seahorses off the beach for Chinese residents in Mkaoni were paid in-kind with biscuits and candy							
1994	50	0.1						
Unguja								
2000	14,000/kg	18.18/kg	17,000/kg	22.08/kg				
1994/95	7,000/kg	12.18	Fishers declined the offer.				Export to Hong Kong US\$20-30/kg	
Mafia								
early '90s	0.02	0.001						
Unspecified								
2000	80-100	0.10-1.30						

* Currency exchange rates for former years were taken from Economist Intelligence Unit (1999, 1994 and 1986). † Middlemen who sell in Dar es Salaam generally obtain seahorses cheaply elsewhere, which may explain why they sometimes get less for dried seahorses than fishers in Dar es Salaam. ‡ Grade I (100-200 seahorses/kg): US\$300; grade II (200-400 seahorses/kg): US\$130/kg; grade IV (600 seahorses/kg): US\$80-140 in low and high season respectively.

OTHER SYNGNATHID SPECIES IN TANZANIA

The author encountered two pipefish species for sale in Tanzania: *Syngnathoides biaculeatus* (Alligator pipefish) and *Hippichthys cyanospilus* (identified by Sara Lourie, *in litt.*, 13 August 2001). *H. cyanospilus* specimens were seen for sale at only one curio stall in Dar es Salaam. *S. biaculeatus*, in contrast, was frequently traded alongside seahorses by traders supplying the Asian medicinal market. Seventeen *S. biaculeatus* specimens obtained by the author ranged in length from 13.5 cm to 26 cm and weighed an average of 2 g (range 0.9 g to 6.3 g, n = 17). Two purchased *H. cyanospilus* specimens measured 13 cm in length, weighing 0.64 g on average (range 0.53-0.74; n = 2).

Tanzanian fishers were well aware that pipefishes are closely related to seahorses. *S. biaculeatus*, which have prehensile tails, were generally viewed as just another type of seahorse. Their local name in Dar es Salaam was *sea lizard*, while fishers in Mtwara referred to them as *sindano* (needle).

According to fishers, pipefish occur in the same habitats as seahorses. They have been noted in Tanga, Bagamoyo, Dar es Salaam, Mtwara, Tumbe and Mkoani on Pemba, Fumba and unspecified locations on Unguja, and the western side of Mafia Island. A trader (Level 3-4) commented that the proportions of seahorses and pipefish supplied differed with source and that seahorses were larger in areas with more Alligator pipefish. One trader (Level 2-3) stated that *S. biaculeatus* from Dar es Salaam were larger than those from Pemba. Another (Level 3-4), who donated two large specimens (5.8 g and 6.3 g), said they stemmed from Tanga or Pemba, while smaller ones were found in Mafia. Larger specimens were preferred.

A small number of *S. biaculeatus* each year were reportedly consumed locally for use in traditional medicine. According to two vendors (Level 2-4) at Dar es Salaam's marine curio market, Tanzanian traditional healers used seahorses and *S. biaculeatus* interchangeably. Larger numbers of *S. biaculeatus* have been traded alongside seahorses to Asian medicine markets since at least 1975, according to one export trader. A local agent (Level 2) in Tumbe, Pemba, said he obtained up to 2 kg of dried *S. biaculeatus* a week or 20 kg over one trading season (December to March). The mean weight of three specimens from Tumbe was 1.4 g (range 1.07-1.73 g), which suggests that there are approximately 700 individuals to a kilogram. A middleman (Level 2-3) in Dar es Salaam reportedly used to sell between 1,000 and 4,000 *S. biaculeatus* from Pemba and Dar es Salaam per month in the mid-1990s. In 2000, he explained, these pipefish were not in demand.

Export Trader A (Level 2-4), commented that the primary market for *S. biaculeatus* was Japan, but that business was 'no good' due to unreliable orders. As a result he had sold his samples to another Tanzanian, who presumably took up the trade. *Export Trader B*, in business since 1975, said he received both seahorses and *S. biaculeatus* from 40 to 50 sources spread across the country and had both in stock. He supplied visiting traders from Hong Kong and Taiwan with 70 kg to 100 kg (dry weight) of mixed pipefish and seahorses annually. The mean dry weight of specimens provided by this trader was 3.7 g (range 1.5-3.6 g for three seahorses, 5.8-6.3 g for two pipefishes, but the latter were particularly large specimens). The 70 kg to 100 kg he sold annually must hence contain between 18,900 and 27,000 dried animals. If Alligator pipefish constituted half of his consignments, he sold between 9,450 and 13,500 *S. biaculeatus* each year.

Unknown, but potentially large numbers of pipefishes were also purchased by 'Chinese' at Dar es Salaam's marine curio market. Traders (Level 2-4) at the market stated that Chinese visitors and residents were their main clients for pipefishes: they bulk bought them just as they did seahorses.

While no official records of seahorse export could be found, annual Fisheries statistics for 1989 record the export of 145 kg of *sea lizards*, worth TSh87,725 or US\$382 (US\$2.63/kg; Fisheries Division Tanzania, undated). No listings, however, occurred in subsequent years (records for previous years were not obtained). Pipefishes were generally cheaper than seahorses, reportedly because they were easier to get from fishers (Table 4). This may also reflect the relatively low value attributed to pipefishes in Asia.

The fact that pipefishes were easier for fishers to collect than seahorses suggests that pipefishes were either more abundant or that their habitat or behaviour made them more prone to capture. Desiccated specimens found under drying nets in Tumbe and Bagamoyo indicated that Tanzanian pipefishes certainly are vulnerable to incidental catch. Any concerns over bycatch and environmental degradation with respect to seahorses also apply to their relatives.

Table 4. Comparison of current values of Tanzanian pipefishes and seahorses by location and trade level. Source: author's research.

Location	Pipefish Price	Seahorse Price	Received by:
Dar es Salaam	TSh150-250 each	TSh300-1,200 each	Fishers (Level 1)
	TSh100-500 each	TSh350-700 each	Middlemen (Level 2-3)
	TSh500-700	TSh400-6,000 each	Traders catering to foreigners locally (Level 2-4)
Tumbe, Pemba	TSh30-60 each	TSh50-60 each	Fishers (Level 1)
	TSh11,000/kg	TSh13,000/kg	Local Agent (Level 2)

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN TANZANIA

As in Kenya, seahorses in Tanzania inhabited troubled waters. Although Tanzania's Fisheries Act banned blast fishing and beach seines, these destructive fishing techniques continued to degrade Tanzania's coastal environments. Dynamite fishing was rampant in the late 1990s and—although it had been curbed in certain areas—still occurred where enforcement was less vigilant (Johnstone *et al.*, 1998; Moffat *et al.*, 1998). Beach seining remained wide-spread, particularly in Lindi district and Bagamoyo (pers. obs.), even though fishers were well aware that landing juvenile fish and perturbing benthic vegetation was detrimental in the long term. In combination with population pressure, these destructive fishing techniques have led to declining resources. Human activities are said to have affected productivity in 30-40% of East African reefs (Moffat *et al.*, 1998) and declines in catch per unit effort of fin fish have been documented (Johnstone *et al.*, 1998; Semesi *et al.*, 1998), a finding echoed by several respondents. Mangrove cutting (Semesi *et al.*, 1998), coral mining for lime-stone production (pers. obs.) and pollution (Johnstone *et al.*, 1998) all contribute to coastal degradation.

Given the general status of marine resources in Tanzania, certain trends in Tanzanian seahorse exploitation are particularly worrisome.

First, demand potentially exceeded supply: four traders (Level 2-4) stated that demand was insatiable: their buyers would purchase many more seahorses were they available. In contrast, four others (Level 2-4) indicated that demand fluctuated highly, with supplies sometimes exceeding trading opportunities. Such fluctuations may be attributable to the paucity of stable business links between Tanzanian traders and customers abroad, leaving much of the trade dependent on irregular journeys by professional and amateur traders. Even where stable links existed, Tanzanian traders were likely to be suppliers of secondary importance to their overseas clients, contacted only when more traditional sources failed. This situation could change, if seahorse stocks in primary supplying areas become depleted.

Second, exploitation of seahorses may be rising, with potentially harmful effects on wild populations. Two middlemen (Level 2-3) indicated that volumes traded had increased since the mid-1990s as a result of increased fishing effort. While most fishers and traders had not noticed any change in seahorse availability over the last 10-30 years, one major trader (Level 3-4) reported a marked decline in seahorses since 1975, and a former exporter (Level 2-3) reportedly witnessed seahorse supplies plummet 85-90% in only three fortnights in 1996/97. Then, seahorse exploitation in Mtambwe, Pemba had only just begun. In the first month, yields were high at 180-270 kg per fortnight. One fortnight later the trader secured no more than 30 kg. The trader inferred that the seahorses had learned to avoid nets or migrated, but fishing may have greatly depleted the local seahorse population.

Finally, two middleman (Level 2-3) commented that the percentage of small seahorses in their supplies had increased since 1995 and large seahorses had become harder to get. They primarily traded in Pemban seahorses. Most other traders were undecided over changes in size or type. According to one trader (Level 2-4), with seahorses, 'like human beings, you have thin and fat ones; that has never changed'.

Independent of exploitation, a Fisheries officer in Tanga commented that seahorses had declined locally as a result of the El Niño event in 1997. Associated rains had apparently washed boulders and sediment into Tanga Bay that destroyed seagrass beds. While some recovery had occurred, seahorses had reportedly not yet reached their pre-El Niño abundance. However, no formal study had been undertaken; the Fisheries officer presumably reached his conclusions after discussions with fishers.

CONCLUSIONS FOR TANZANIA

All five seahorse species present in Tanzanian waters, as well as their relative, *Syngnathoides biaculeatus*, are vulnerable to exploitation. Annual exports of dried seahorses from Tanzania directly to Asia may well exceed one tonne. Until 1998, potentially more than two tonnes of dried Tanzanian seahorses also left the country via Kenya. Accounts of declines in seahorse availability and increasing scarcity of large seahorses, although few in number, could be early warning signs that, at least locally, wild populations are under pressure. Close monitoring of the trade's future development—best done in conjunction with research into local abundance and distribution of syngnathid species—is, therefore, advisable to allow for a timely response should conservation action become necessary.

THE SEAHORSE TRADE IN MOZAMBIQUE

Anecdotal evidence suggests that Mozambican seahorses are exploited both dead and alive. Given the scarcity of information, it is currently impossible, however, to judge the extent of either trade.

Information sources in Mozambique

Trade in seahorses has not been investigated in Mozambique. However, respondents interviewed during trade surveys in Tanzania provided some information. Furthermore, marine scientists working in southern Africa supplemented findings, as indicated.

Seahorses in Mozambique

Little is known about the distribution and taxonomy of Mozambican Seahorses. According to one Tanzanian trader (Level 2), they are rumoured to be larger than those in Tanzania. In the Quirimba Archipelago, northern Mozambique, they apparently occur in seagrass beds dominated by *Enhalus acoroides* (F. Gell, *in litt.* to A. Vincent, 9 January 1999). At least two species, *Hippocampus borboniensis* and *H. camelopardalis*, are believed to occur in Mozambican waters (Lourie *et al.*, 1999).

SEAHORSE CATCHES IN MOZAMBIQUE

Target fisheries and bycatch

A Tanzanian trader (Level 2-4) based in Dar es Salaam, who obtained Mozambican seahorses for re-export to Hong Kong, commented that fishing methods in Mozambique were similar to those in Tanzania. Presumably, therefore, seahorses were mainly caught as bycatch in seine nets, both beach seines and purse seines. Seahorse bycatch in the Mozambican seine fishery has been observed in Quirimba Archipelago, northern Mozambique (F. Gell, *in litt.* to A. Vincent, 9 January 1999). Seahorses seen for sale on Inhaca Island, Maputo Bay, in 1997 were also thought to have been caught as bycatch in seine nets (M. Cherry *in litt.* To A Vincent, 9 February 1999). A biologist with Mozambique's Instituto de Investigacao Pesqueira reported in 1996 that seahorses occurred in the bycatch of bottom trawls targeting scad and mackerel. She also suggested that some fishers targeted seahorses directly, catching them by hand (M. Ascensao Ribeiro Pinto, *in litt.* to A. Vincent, 14 February 1996). It was unclear from her report whether seahorses thus caught were to be traded live for use in aquaria or dried to be sold as curios or exported to Asia.

DRIED SEAHORSE TRADE IN MOZAMBIQUE

Trade routes, domestic trade, exports

In 2000, at least one Tanzanian trader (Level 2-4) based in Dar es Salaam imported dried seahorses from Mozambique, then re-exported them to Hong Kong. He had no permanent business partners in Mozambique. Instead, he occasionally visited for one or two weeks, and engaged impromptu agents in several locations. Towards the end of each stay, he collected from these agents as well as directly from fishermen however many seahorses they had managed to gather during his stay. Apparently, each fisher gathered five to ten seahorses in this time frame. The trader did not clarify how many fishers engaged in the seahorse harvest nor how much they were paid. He said he had obtained seahorses in Msimbwa, Mwibu, Uro, Matemwe, Mucojo, Kitaragu, Kiringa, Shanga, Angoche, Dakara & Nyambani.

Other Tanzanian traders possibly also purchased seahorses from northern Mozambique. In the Quirimba Archipelago seahorses from bycatch were reportedly sold to Tanzania and re-exported from there to Asia. Small (5-7 cm) seahorses in bycatch apparently sold for US\$0.50 each, locally equivalent in value to 1 kg of food fish (F. Gell, *in litt.* to A. Vincent, 9 January 1999).

The Dar es Salaam-based trader mentioned above also commented that in Mwibu, Matemwe, and Mucojo, fishers were aware of the potential economic importance of seahorses prior to his enquiries, because 'Chinese had been there.' This suggests that, in addition to trade via Tanzania, dried seahorses may also be

exported to Asia directly. A biologist investigating the seagrass fishery in Quirimba Archipelago in 1996 noted that other marine products were certainly exploited for exportation to Asia. At the time, Chinese presence in this remote part of Mozambique was strong and growing, and Chinese ships visited regularly to fetch sea cucumbers (T. Peschak, *in litt.* to A. Vincent, 4 February 1998).

Dried seahorses destined for Asia were likely to serve medical purposes. Dried Mozambican seahorses were, however, also sold as curios, at least on Inhaca Island, a marine reserve in Maputo Bay. In 1997, women there offered dried specimen of two species to tourists in front of the island's marine research station (M. Cherry, pers. comm., 10 February, 2000).

LIVE SEAHORSE TRADE IN MOZAMBIQUE

Trade routes, domestic trade, exports

Mozambican seahorses were exploited for the ornamental fish trade. An aquarium fish collector based in Durban, South Africa, was rumoured to visit Mozambique regularly to obtain live fish, including seahorses. Seahorses were apparently collected in Inhambane estuary and were found around the base of fish traps (Neil Grange, *in litt.* to E. Bell, 18 May 1999). A pet-shop owner in Cape Town, confirmed in spring 1998 that he had recently sold Mozambican seahorses (Peet Joubert, *in litt.*, 10 April 2001).

OTHER SYNGNATHID SPECIES IN MOZAMBIQUE

In Quirimba Archipelago, northern Mozambique, pipefish were found among the bycatch of seine nets and other local fishing techniques. Although they lined the beach in piles of hundreds where the fishermen sorted their catches, they were not utilised. Only children sometimes used dead pipefish as toys. Otherwise, they were left to decay (T. Peschak, *in litt.* to A. Vincent, 4 February 1998). The pipefish were tentatively identified as *Choeroichthys sculptus* and *Trachyramphus bicoarctatus* (T. Peschak, *in litt.* to A. Vincent, 28 March 1998).

THE SEAHORSE TRADE IN SOUTH AFRICA

South Africa apparently imported dried seahorses from Mozambique, Madagascar, and the Philippines and live seahorses from Mozambique and the USA. It also exported dried seahorses to Hong Kong, Mainland China, Taiwan and the USA. Domestically, seahorses (probably all imported) were sold dried as curios and live as aquarium fish.

BACKGROUND FOR SOUTH AFRICA

Information sources in South Africa

Information on seahorse trade in South Africa stems largely from correspondence with marine biologists in the country and US Customs records, as indicated. Additional information was provided by South Africa's Department of Environmental Affairs and Tourism and published literature. Findings during trade surveys in Hong Kong and Taiwan added further understanding.

Seahorses and other syngnathids in South Africa

According to Smith and Heemstra (1986), 6 seahorse and 19 pipefish species occur in South African waters (see Table 5 for pipefishes). Seahorse taxonomy has since been revised, with South African records for five seahorse species: *Hippocampus borboniensis*, *H. fuscus* and *H. histrix* have apparently been sighted in Durban, *H. camelopardalis* is known from False Bay, and *H. capensis*, a South African endemic, occurs in Knysna and surrounding estuaries (Lourie *et al.*, 1999). *H. capensis* is listed as Endangered by the IUCN, because of its limited distribution and mass-mortality in occasional floods; the other four species are listed as Vulnerable (Hilton-Taylor, 2000). *H. capensis* is also listed in South Africa's Red Data Book, as is the

estuarine pipefish, *Syngnathus watermeyerii*. Both are considered threatened by water abstraction, habitat alteration and collection (Thea Carroll, South African Department of Environmental Affairs and Tourism, *in litt.* to A. Vincent, 14 June 2001).

Legislation

Following the South African Marine Living Resources Act of 1998, no syngnathid was to be caught, disturbed or killed, except with a ministerial permit or exemption (Thea Carroll, South African Department of Environmental Affairs and Tourism, *in litt.* to A. Vincent, 14 June 2001). Furthermore, until recently, two of the estuaries in which *H. capensis* is known to exist, the Knysna and Swartvlei, fell under the protection of South Africa's National Parks Board (Whitfield, 1995).

Table 5. Pipefish species in South African waters, according to Smith and Heemstra (1986)

Genus	Species	Distribution in South Africa
<i>Cosmocampus</i>	<i>banneri</i>	Sodwana Bay, KwaZulu-Natal, northwards
<i>Doryrhamphus</i>	<i>bicarinatus</i>	Sodwana Bay, KwaZulu-Natal, northwards
	<i>dactyliophorus</i>	Aliwal Shoal, KwaZulu-Natal
	<i>excisus excisus</i>	Xora River, Eastern Cape, northwards
	<i>multiannulatus</i>	Sodwana Bay, KwaZulu-Natal, northwards
<i>Halicampus</i>	<i>dunckeri</i>	Sodwana Bay, KwaZulu-Natal, northwards
	<i>mataafe</i>	Sodwana Bay, KwaZulu-Natal, northwards
<i>Hippichthys</i>	<i>heptagonus</i>	Durban, KwaZulu-Natal, northwards
	<i>spicifer</i>	Xora River, Eastern Cape, northwards
<i>Micrognathus</i>	<i>andersonii</i>	Knysna, Western Cape, northwards
<i>Microphis</i>	<i>brachyurus</i>	Durban, KwaZulu-Natal, northwards
	<i>fluvialis</i>	Coffee Bay, Eastern Cape, northwards
<i>Nannocampus</i>	<i>elegans</i>	Great Fish Point, Eastern Cape, northwards
	<i>pictus</i>	Sodwana Bay, KwaZulu-Natal, northwards
<i>Phoxocampus</i>	<i>belcheri</i>	Bizana coast, Eastern Cape, northwards
<i>Syngnathoides</i>	<i>biaculeatus</i>	Knysna, Western Cape, northwards
<i>Syngnathus</i>	<i>acus</i>	Möwe Bay on the West Coast to northern KwaZulu-Natal
	<i>watermeyerii</i>	estuaries of Kariega, Kasouga and Bushman rivers, Eastern Cape
<i>Trachyrhamphus</i>	<i>bicoarctus</i>	Durban, KwaZulu-Natal, northwards

DRIED SEAHORSE TRADE IN SOUTH AFRICA

Trade routes, domestic trade, exports, imports

Within South Africa, dried seahorses have been sold as curios in at least Cape Town and Knysna. Two stalls at an open air market in Cape Town were seen to offer dried seahorses as recently as June 2001; one sold them incorporated into gel candles, the other displayed approximately 12-20 individual seahorses, 3-4 inches (7.62-10.16 cm) in height, amongst seashells and shark jaws. One vendor indicated the seahorses were from Madagascar (Inga Fredland, *in litt.*, 25 September 2001 and *in litt.* to Project Seahorse, 25 June 2001). Dried seahorses incorporated into shell scenes for sale near Cape Town's Waterfront in February 2000 were of unknown origin, but apparently imported (pers. obs.). A souvenir shop in Knysna sold dried seahorses imported from the Philippines until 1999, but stopped after requests from local conservation authorities (Peet Joubert, *in litt.*, 24 May 2001).

Furthermore, dried seahorses may be used in South African traditional medicine (*muti*). A survey of animals used in southern African medicine did not encounter seahorses (Simelane & Kerley, 1998), but a 'sack full' of dried seahorses was reportedly seized on an illegal *muti* market in Mpumalanga Province in 2001 (Peet Joubert, *in litt.* to Amanda Vincent, 23 September 2001).

Trade surveys in Hong Kong and Taiwan and US Customs records suggest that South Africa also exports dried seahorses. Three seahorse wholesalers in Hong Kong and one seahorse importer in Taiwan named South Africa among their sources (Boris Kwan, *in litt.*, 1 February 2001). US Customs recorded six shipments of dried South African seahorses imported to the USA between 1996 and 2000 (Table 6). Shipments occurred in 1997 and 1998. In total 3 kg and 400 individual seahorses were imported for a total value of US\$8,075, with the unit price varying considerably from shipment to shipment. Notably, the two largest shipments were routed via Hong Kong and Mainland China (US Fish and Wildlife Service, undated).

Table 6. Seahorse trade between the USA and South Africa, according to US Customs records. Quantity refers to individual seahorses and unit price equals price per seahorse, except where otherwise indicated. Source: US Fish and Wildlife Service.

Year and shipment	Quantity	Live or Dried	Value (US\$)	Unit Price (US\$)	Trade Route
Exports from South Africa to the USA					
1997					
shipment 1	6	dried	995.00	165.83	direct
shipment 2	362	dried	3,031.00	8.37	via Hong Kong
shipment 3	1	dried	742.00	742.00	direct
Total 1997	369	dried	4,768.00	12.92	
1998					
shipment 1	1	dried	0.00	0.00	direct
shipment 2	30	dried	855.00	28.50	direct
shipment 3	3 kg	dried	2,452.00	817.33/kg	via Mainland China
Total 1998	3 kg + 31	dried	3,307.00	27.58/piece	
Total 1997-98	3 kg + 400	dried	8,075.00	14.06/piece	
Imports from the USA to South Africa					
1997					
shipment 1	30	live	255.00	8.50	direct
1998					
shipment 1	110	live	916.00	8.33	direct
Total 1997-98	140	live	1,171.00	8.36	

LIVE SEAHORSE TRADE IN SOUTH AFRICA

Trade routes, domestic trade, imports

Pet shops in Cape Town occasionally sold seahorses (Inga Fredland, *in litt.* to Project Seahorse, 25 June 2001; Peet Joubert, *in litt.*, 10 April 2001). Some of these possibly originated in Mozambique. A fish collector based in Durban was rumoured to obtain seahorses and other live fish from Inhambane Estuary, Mozambique (Neil Grange, *in litt.* to E. Bell, 18 May 1999). A pet shop owner in Cape Town confirmed in spring 1998 that he had recently sold Mozambican seahorses (Peet Joubert, *in litt.*, 10 April and 25 May, 2001).

South Africa has also imported live seahorses from the USA. US Customs indicate that a total of 140 live *H. zosterae* specimen were shipped to South Africa between 1996 and 2000, for a total value of US\$1,171 (Table 6). Those shipped in 1998 had apparently been bred in captivity (US Fish and Wildlife Service, undated).

Sources

Aquaculture and captive breeding

A limited number of *H. capensis* specimens have, over the years, been made available to South African researchers. Attempts at culturing the species for research purposes have proven successful (J. Lockyear, *in litt.*, 1 October 2000). The brood stock of one researcher was given into the care of a commercial aquaculture venture when research was completed. The ultimate fate of this brood stock, numbering several thousand adults and juveniles, was as yet undecided in early 2001 (Jacki Lockyear, *in litt.* to A. Vincent, 3 February 2001).

THE SEAHORSE TRADE IN OTHER AFRICAN COUNTRIES

Anecdotal evidence suggests that at least the following ten countries have also participated in the seahorse trade: Egypt, Gambia, Guinea, Madagascar, Mali, Nigeria, Senegal, the Seychelles, Togo and Zimbabwe (Figure 4).

At least eleven seahorse species are found in African waters (Figure 4). Its Mediterranean and Atlantic coasts harbour three species, of which *Hippocampus algericus* occurs furthest south, with a distribution reaching from Senegal to Angola, and a potential record in Algeria. *H. guttulatus* is found in European waters of the Eastern Atlantic and Mediterranean, but also has records for Morocco and Senegal. *H. hippocampus* has a similar overall distribution, but in addition has been found in Algeria, Guinea and the Canary Islands (Lourie *et al.*, 1998). Two species supposedly occur in the Red Sea: *H. jayakari* and a dwarf species, *H. lichtenstienii* (Lourie *et al.*, 1998). Of these species, *H. hippocampus* and *H. jayakari* are listed as Vulnerable by IUCN, as is *H. guttulatus* under its synonym *H. longirostris* (Hilton-Taylor, 2000).

Six species are thought to occur along Africa's Indian Ocean coast: *H. borboniensis*, *H. camelopardalis* and *H. histrix* all have southerly distributions ranging from South Africa north to Tanzania and Kenya. *H. borboniensis* and *H. histrix* also reach the offshore Islands of Madagascar, Mauritius and Reunion. *H. fuscus* is said to occur in these islands as well, was seen by the author in Tanzania and has records also for Djibouti and Saudi Arabia. *H. kelloggi* is known from Tanzania and the Red Sea (Lourie *et al.*, 1998). *H. capensis*, is endemic to a few estuaries in South Africa (Lourie *et al.*, 1998) and appears on the IUCN Red List as Endangered. *H. borboniensis*, *H. camelopardalis*, *H. fuscus* and *H. histrix* are listed as Vulnerable (Hilton-Taylor, 2000).

Egypt: Egypt appears to deal in seahorses destined for the aquarium trade: both Germany and the Netherlands reported shipments of live, wild caught seahorses from Egypt in 1999, designated for commercial use. The Netherlands received one shipment of 100 animals, Germany accepted two shipments containing a total of 210 seahorses (European Community, undated). A single dried specimen imported from Egypt to the USA via Canada in 1999 appears to have been for research purposes (US Fish and Wildlife Service, undated).

Gambia: Hong Kong Customs Records show that Hong Kong received 66 kg of dried seahorses from Gambia in 1999, valued at HK\$53,000 (US\$6784). The seahorses arrived in Hong Kong in consignments shipped from Senegal, but were reported to originate in the Gambia, indicating that trade routes are indirect (Table 7; Census and Statistics Department Hong Kong, undated).

Guinea: Between January 1998 and June 2001, Hong Kong imported 347 kg of dried seahorses from Guinea, worth HK\$270,000 (US\$34,560: Census and Statistics Department Hong Kong, undated), setting the reported value of dried Guinean seahorses in Hong Kong at almost US\$100 per kilo (Table 7).

Madagascar: A seahorse fishery has been observed on the south-west coast of Madagascar on reefs off Tulear. 'Vezos' fishers there apparently targeted seahorses (D. Cretenet, *in litt.* to A. Vincent, 17 August 1999). It is unclear what purpose these seahorses were destined to serve. Some were possibly exported dried to South Africa: a vendor selling dried seahorses in Cape Town in June 2001 claimed the seahorses originated in Madagascar (Inga Fredland, *in litt.* to Project Seahorse, 25 June 2001).

Mali: In 1994, Belgian Custom officials seized an illegal shipment of carved ivory and crocodile skins en route from Mali to China. The shipment also contained several dozen seahorses (E. Fleming, *in litt.* to A. Vincent, 28 January 1997). As Mali is landlocked, these seahorses must have originated elsewhere, possibly neighbouring countries, such as Guinea or Senegal.

Nigeria: An enterprise in Lagos, capital of Nigeria, reported in 1996 that they were selling dried seahorses to Hong Kong for medicinal purposes. The business began in 1993 and constituted the main income for the entrepreneur. The seahorses originated from the West African coast. According to the entrepreneur, they were caught as trawl bycatch mainly on moon-less nights during the rainy season. The supply was steady, but culturing attempts were planned. The enterprise received approximately 2 kg of seahorses each month, which would total 24 kg over one year. The price per kilo, presumably the selling price, reportedly was US\$450 for small seahorses, US\$1,150 for large ones. The entrepreneur commented that Africa had

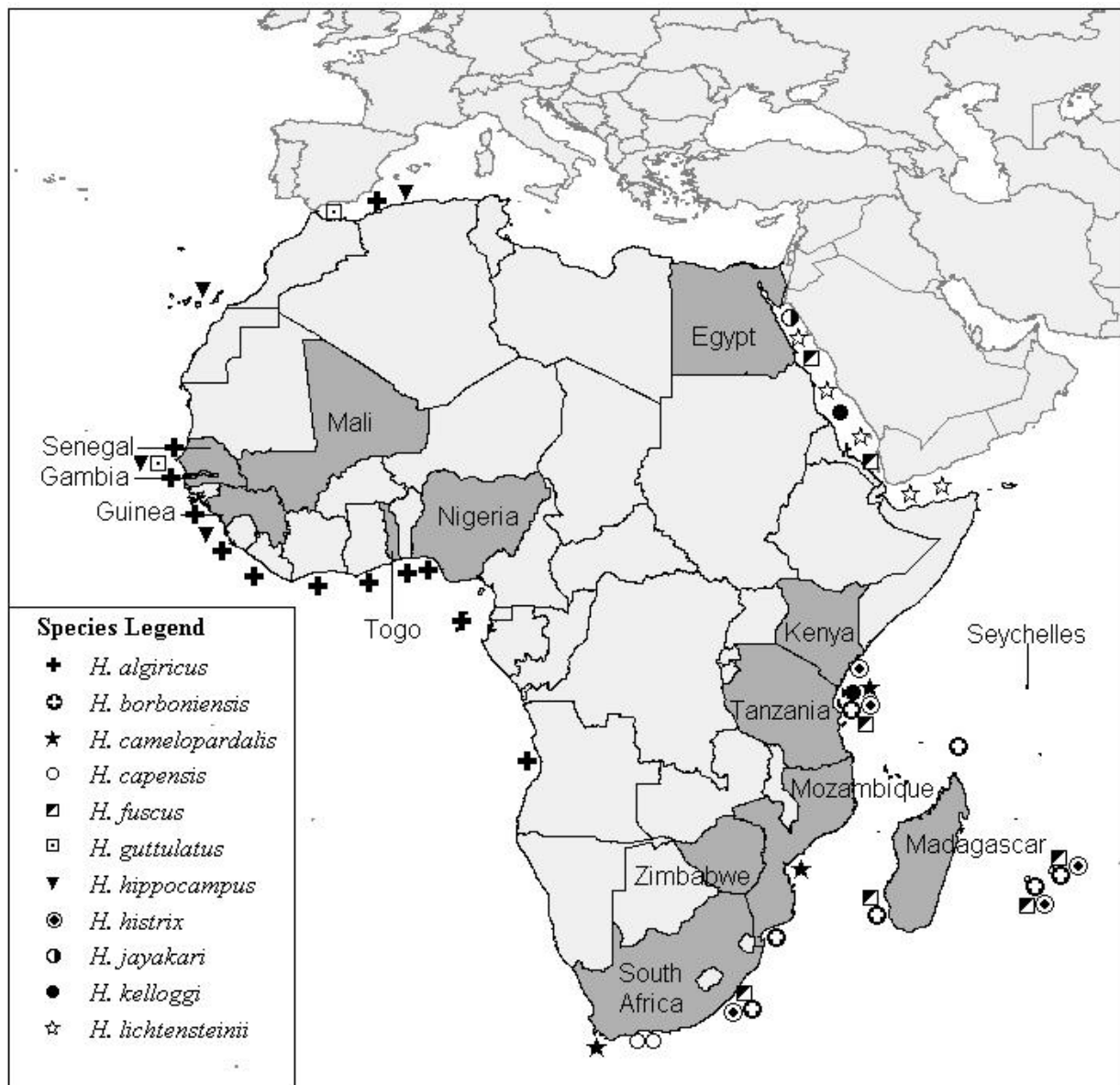


Figure 4. African countries known to be involved in the seahorse trade (named and shaded), with indications of the distribution of seahorse species in African waters, following Lourie *et al.*, 1999. Source: for species distributions Lourie *et al.* (1999) and author's pers. obs. in Kenya and Tanzania; for trading countries author's research (see individual country sections for more detail on sources).

entered the seahorse trade, because the "Asia-Pacific region is now saturated." More evidence for Nigeria's involvement in the seahorse trade comes from Belgian Customs. A 60 kg cardboard box filled with seahorses was seized at Brussels' airport on its way from Nigeria to China in 1996. The seahorses were 10-15 cm in size (E. Fleming, in litt. to A. Vincent, 28 January 1997).

Senegal: Between January 1998 and June 2001, Hong Kong imported 1,189 kg of dried seahorses from Senegal worth HK\$963,000 (US\$123,264). The custom records suggest that some of the seahorses received from Senegal in 1999 originated in Gambia, implying that Senegal imports and re-exports seahorses from there (Table 7; Census and Statistics Department Hong Kong, undated).

Seychelles: According to a seahorse exporter (trade level 2-4) in Tanzania, seahorses in the Seychelles are large. The exporter's client in Hong Kong had told him that he obtained supplies from there and that it took only 100-150 dried seahorses from the Seychelles to constitute a kilogram. Hong Kong Custom Records do not include the Seychelles as a source of seahorse imports. These records may, however, be

incomplete, as anything transported in personal luggage, postal packets valued at less than HK\$4,000 or sent as a gift is exempt from Customs declaration (B. Kwan, *in litt.*, 28 September 2000).

Togo: Hong Kong Custom records show that Hong Kong received 97 kg of dried seahorses from Togo between January 1998 and June 2001, worth HK\$82,000 (Census and Statistics Department Hong Kong, undated). That amounts to a reported value of US\$10 496 or US\$108.21 per kilogram (Table 7).

Zimbabwe: According to US Customs Statistics, Zimbabwe exported a total of six dried seahorses to the USA between 1996 and 2000 for a total value of US\$238. Three shipments occurred, one each in 1996, 1997 and 1998, involving different exporters and recipients each time (US Fish and Wildlife Service, undated). As Zimbabwe is landlocked, these seahorses must have originated elsewhere.

CONCLUSIONS FOR THE SEAHORSE TRADE IN AFRICA

Fourteen African countries were known to have participated in the seahorse trade by 2001, including Egypt in the North, Gambia, Guinea, Mali, Nigeria, Senegal and Togo in the West; Mozambique, South Africa and Zimbabwe in the South; and Kenya, Madagascar, the Seychelles and Tanzania in the East. The majority appeared to be supplying the Asian medicinal trade with dried seahorses, but at least four countries (Egypt, Kenya, Mozambique and South Africa) also dealt in live seahorses destined for the aquarium trade, and in three countries (Mozambique, South Africa, and Tanzania) dried seahorses were sold as souvenirs. While some countries, like Tanzania, have been involved in the trade for a number of years, others, such as Nigeria, appear to have entered more recently—perhaps an indication that Asia's traditional sources can no longer satisfy the demand. As information is scarce for most countries, the importance of African seahorses in both the dried and live trade is difficult to judge, as are the consequences of exploitation for Africa's seahorse populations. More information, both on the trade and ecology of African seahorses, is therefore urgently needed.

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Table 7. Hong Kong Import showing the quantity and value of imports by country and year. Where records by country of origin differed from records by country of consignment, country of consignment data is given in brackets. Note that Gambian seahorses imported to Hong Kong in 1999 were shipped through Senegal. Source: Census and Statistics Department Hong Kong.

Year	Value	Gambia	Guinea	Senegal	Togo
1998	Quantity (kg)	0	146	94	0
	HK\$	0	108,000	76,000	0
	US\$*	0	13,824	9,728	0
1999	Quantity (kg)	66	158	270	19
	HK\$	53,000 (0)	128,000	201,000 (254,000)	17,000
	US\$*	6,784 (0)	16,384	25,728 (32,512)	2,176
2000	Quantity (kg)	0	30	605	3
	HK\$	0	25,000	520,000	3,000
	US\$*	0	32,000	66,560	384
2001 (Jan-June)	Quantity (kg)	0	13	154	75
	HK\$	0	9,000	113,000	62,000
	US\$*	0	1,152	14,464	7,936
Total	Quantity (kg)	66	347	1,123 (1,189)	97
	HK\$	53,000 (0)	270,000	910,000 (963,000)	82,000
	US\$*	6,784 (0)	34,560	116,480 (123,264)	10,496
	US\$ per kg	102.79 (0)	99.6	103.72 (103.67)	108.21

* The exchange rate used to convert from HK\$ to US\$ was 7.8125

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CHAPTER 2. SEAHORSE TRADE IN THE USA AND CANADA¹

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ABSTRACT

Live and dried seahorses were traded in the USA and Canada for use as aquarium fishes, curios and in traditional Chinese medicine (TCM). *Hippocampus zosterae*, *Hippocampus erectus* and *Syngnathus pelagicus* were targeted in Florida, with landings monitored and regulations in place. Non-selective exploitation, however, was not monitored in any states and could be a potential threat for seahorses. In addition to exploitation, habitat degradation, owing to coastal development and pollution, is another concern.

According to the United States Fish and Wildlife Service (USFWS) statistics from 1996-2000, the volume of dried seahorses imported by the US was relatively high compared to the volume exported. These data also suggest that relatively few live seahorses were traded in United States during this period. Little information was available on Canada's imports and exports of live and dried seahorses but the available information suggest that Canada imported dried seahorses from Hong Kong, Peru and the United States. Live seahorses were also imported to Canada from countries such as Singapore, Indonesia and USA. Canada's information on live seahorse exports suggested that they were mainly exchanges among public aquariums or scientific institutes.

BACKGROUND FOR THE USA AND CANADA

Information sources in the USA and Canada

Most of the information in this section comes from figures recorded by the Department of the Interior (USFWS) of the United States. Seahorse import and export data were requested from the Office of Law Enforcement under the Freedom of Information Act. Enquiries were also sent to different government organizations in order to gather information about trade, exploitation and regulations in different states. Correspondence with independent parties was used as an additional source of anecdotal information. Information on *Use of seahorses in the USA* comes from an International Fund for Animal Welfare (IFAW) report (IFAW, 2000) on the availability of seahorses in the USA for use in traditional medicines, and from research on Internet.

Seahorse shipments are recorded under numerous description codes in the USFWS database. Shipments of live seahorses are recorded as live (LIV) and dried seahorses are recorded under various headings, including bodies (BOD), shells (SHE), skeletons (SKE), trophies (TRO), medicine (MED) and meat (MEA). The description codes for dried seahorses were combined in order to have only two categories: dried and live.

Commercial shipments were distinguished from non-commercial shipments, such as those between scientific institutions and aquariums, by referring to recorded names of importers and exporters. Non-commercial shipments were not included in total trade volumes and values.

In order to estimate the number of seahorses traded in the USA, a conservative estimate of 300 dried seahorses per kilogram was used to convert to number of individuals. This estimate was considered conservative because in the Philippines, dried seahorses for curios often number 800-1,000 per kilogram,

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while dried seahorses for traditional medicine usually number 250-300 and exceptionally 80-100 if it only includes large species, such as *H. kelloggi*.

Seahorses in United States and Canada

Local species

Four species of seahorse occur in North America. They mainly inhabit shallow water and are often associated with seagrass beds. All four species are listed by the World Conservation Union (IUCN) as Vulnerable (VU A2cd; Hilton-Taylor, 2000).

Hippocampus ingens is restricted to the eastern Pacific Ocean and is distributed from San Diego, California, to Peru, including the Gulf of California and the Galapagos Islands (Miller & Lea, 1972; Fritzsche, 1980). *Hippocampus ingens* has been seen in Chilean waters but not before the El Niño event of 1982-1983 (Groves & Lavenberg, 1997). Very little research has been carried out on *H. ingens* populations in the wild. One of the largest seahorse species (25-30 cm), *H. ingens* is exploited for use in TCM and as curios and aquarium fishes in Europe and North America.

Hippocampus reidi ranges from Cape Hatteras on the Atlantic coast of North America, throughout the Caribbean to Rio de Janeiro, Brazil (Dawson and Vari, 1982). Adults measure 10-18 cm (Lourie *et al.*, 1999). The species' bright colours make the species very appealing within the aquarium trade.

Hippocampus erectus occurs on the Atlantic coast of North America, from Canada (southern tip of Nova Scotia) throughout the Caribbean to as far south as Argentina (Hardy, 1978). Adult height usually varies between 5 and 18 cm. Few studies have focused on the biology of *H. erectus* in the wild (Matlock, 1992; Teixeira & Musick, 2001). This species has commonly been landed as bycatch in Florida (Baum *et al.*, in review), was also very popular in the aquarium trade and has sometimes been sold for curios (Vincent, 1996).

Hippocampus zosterae ranges along on the coast of the Gulf of Mexico, from the Florida Keys to the Gulf of Campeche, and through the Bahamas and Bermuda (Vari, 1982). Adult heights range from 2 to 4 cm. Biological information on this species comes from field and laboratory observations (Strawn, 1953; Tipton & Bell, 1988; Masonjones & Lewis, 1996; Masonjones, 1997; Masonjones & Lewis, 2000). *Hippocampus zosterae* has not been reported for use as TCM, likely because of its small size, but is a popular aquarium fish species (Vincent, 1996; Wood, 2001).

Species traded/imported

The USFWS uses 64 seahorse species names and associated codes to record seahorses traded in the USA (Table 1). According to the latest taxonomic revisions in Lourie *et al.* (1999), there are approximately 32 seahorse species worldwide; species names used by the USFWS therefore contain numerous synonyms and erroneous names. From 1995-2000, the US trade statistics reported 24 species of seahorses traded in the United States (see highlighted species in Table 1).

As taxonomy of seahorses is rather complex, the species information reported in the USFWS trade statistics may be unreliable in many cases. As an example, *H. zosterae*, a species found only in North America, has occasionally been reported as being imported from the Philippines to the USA. Similarly, *H. hippocampus*, a European species, has been recorded as originating from Mexico, the Philippines and the Solomon Islands. Because of the numerous possibilities for error that could lead to incorrect conclusions, the species information in the US trade statistics is not analysed here.

Table 1. Seahorse species names and codes used by the USFWS (Grey-highlighted species names were recorded as being traded during 1995-2000). * According to Lourie *et al.* (1999) Source: US Fish and Wildlife Service.

Species name in the database	Species code	Status*	Synonym*
<i>Hippocampus abdominalis</i>	HIAB	valid	-
<i>Hippocampus aimei</i>	HAIM	not valid	<i>H. barbouri</i> <i>H. spinosissimus</i>
<i>Hippocampus angustus</i>	HANG	valid	-
<i>Hippocampus arnei</i>	HIAR	not valid	In part synonym of <i>H. barbouri</i> and <i>H. spinosissimus</i>
<i>Hippocampus aterrimus</i>	HATE	not valid	<i>H. kuda</i>
<i>Hippocampus barbouri</i>	HIBA	valid	-
<i>Hippocampus bargibanti</i>	HBAR	valid	-
<i>Hippocampus bicuspis</i>	HBIC	not valid	<i>H. guttulatus</i>
<i>Hippocampus borboniensis</i>	HIBO	valid	-
<i>Hippocampus brachyrhynchus</i>	HBRA	not valid	<i>H. fuscus</i>
<i>Hippocampus breviceps</i>	HBRE	valid	-
<i>Hippocampus camelopardalis</i>	HCAM	valid	-
<i>Hippocampus capensis</i>	HCAP	valid	-
<i>Hippocampus chinensis</i>	HICH	not valid	<i>H. kuda</i>
<i>Hippocampus comes</i>	HICO	valid	-
<i>Hippocampus coronatus</i>	HIPC	valid	-
<i>Hippocampus dahli</i>	HIDA	not valid	<i>H. trimaculatus</i>
<i>Hippocampus erectus</i>	HIER	valid	-
<i>Hippocampus erinaceus</i>	HERI	Not valid	<i>H. angustus</i>
<i>Hippocampus fasciatus</i>	HFAS		?
<i>Hippocampus fisheri</i>	HIFI	valid	-
<i>Hippocampus foliatus</i>	HIFO	not valid	?
<i>Hippocampus fuscus</i>	HIFU	valid	-
<i>Hippocampus hilonis</i>	HHIL	not valid	<i>H. kuda</i>
<i>Hippocampus hippocampus</i>	HPHP	valid	-
<i>Hippocampus histrix</i>	HHIS	valid	-
<i>Hippocampus horai</i>	HIHO	not valid	<i>H. kuda</i>
<i>Hippocampus ingens</i>	HIIN	valid	-
<i>Hippocampus japonicus</i>	HIJA	not valid	<i>H. mohnikei</i>
<i>Hippocampus jayakari</i>	HJAY	valid	-
<i>Hippocampus kampylotrachelos</i>	HIKA	not valid	<i>H. trimaculatus</i>
<i>Hippocampus kaupii</i>	HKAU	not valid	<i>H. algiricus</i>
<i>Hippocampus kelloggi</i>	HIKE	valid	-
<i>Hippocampus kuda</i>	HIKU	valid	-
<i>Hippocampus lenis</i>	HILE	not valid	<i>H. trimaculatus</i>
<i>Hippocampus lichtenteinii</i>	HILI	valid	-
<i>Hippocampus manadensis</i>	HIPM	not valid	<i>H. trimaculatus</i>
<i>Hippocampus mannulus</i>	HMNN	not valid	<i>H. trimaculatus</i>
<i>Hippocampus melanospilos</i>	HMEL	not valid	<i>H. kuda</i>
<i>Hippocampus mohnikei</i>	HMOH	valid	-
<i>Hippocampus moluccensis</i>	HMOL	not valid	<i>H. kuda</i>
<i>Hippocampus natalensis</i>	HINA	not valid	<i>H. fuscus</i>
<i>Hippocampus novaehedborum</i>	HINO	not valid	<i>H. kuda</i>
<i>Hippocampus obscurus</i>	HIOB	not valid	-
<i>Hippocampus planifrons</i>	HIPL	not valid	<i>H. trimaculatus</i>

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Table 1. Seahorse species names and codes used by the USFWS (Grey-highlighted species names were recorded as being traded during 1995-2000). * According to Lourie *et al.* (1999) Source: US Fish and Wildlife Service.

Species name in the database	Species code	Status*	Synonym*
<i>Hippocampus polyteania</i>	HIPO	not valid	<i>H. kuda</i>
<i>Hippocampus punctulatus</i>	HIPU	not valid	<i>H. algiricus</i>
<i>Hippocampus raji</i>	HRAJ	not valid	<i>H. kuda</i>
<i>Hippocampus ramulosus</i>	HRAM		-
<i>Hippocampus reidi</i>	HIRE	valid	-
<i>Hippocampus rhynchomacer</i>	HIRH	not valid	<i>H. kuda</i>
<i>Hippocampus sexmaculatus</i>	HISE	not valid	<i>H. trimaculatus</i>
<i>Hippocampus sindonis</i>	HISI	valid	-
<i>Hippocampus spinosissimus</i>	HSPI	valid	-
<i>Hippocampus subcoronatus</i>	HISU	not valid	<i>H. camelopardalis</i>
<i>Hippocampus suezensis</i>	HSUE	not valid	<i>H. kelloggi</i>
<i>Hippocampus taeniops</i>	HITA	not valid	<i>H. kuda</i>
<i>Hippocampus taeniopterus</i>	HTAE	not valid	<i>H. kuda</i>
<i>Hippocampus takakurae</i>	HTAK	not valid	<i>H. trimaculatus</i>
<i>Hippocampus trimaculatus</i>	HITR	valid	-
<i>Hippocampus valentyni</i>	HIVA	not valid	<i>H. kuda</i>
<i>Hippocampus whitei</i>	HIWH	valid	-
<i>Hippocampus zebra</i>	HIZE	valid	-
<i>Hippocampus zosterae</i>	HIZO	valid	-

Uses

Dried

Seahorses in Traditional Chinese Medicine in United States

Dried seahorses were known to be sold as an ingredient for traditional Chinese medicine (TCM) in North America. From August to November 1999, IFAW surveyed herbal stores in the commercial districts of Chinatown in Boston, Los Angeles, New York, Oakland, San Francisco and Washington, DC in order to monitor the availability of dried seahorses and patent medicines reportedly containing seahorses. The survey results showed that 90 of the 101 shops visited carried dried seahorse or seahorse products, with prices per individual varying according to size, from US\$1.00 to 5.00 (Table 2).

Table 2. Availability of dried seahorse and patent products in herbal/medicine stores in the USA (August-November, 1999). Source: adapted from IFAW (2000).

Region	# Total of shops visited	Number of shops selling seahorse product	Number of shops selling dried seahorse and patent	Number of shops selling only patent	Number of shops selling only dried seahorse	Price ranges (per individual) for dried seahorses
Boston, MA	4	4	4	0	0	\$2.00
Los Angeles, CA	18	16	10	0	4	\$2.00-3.00
New York City, NY	46	41	17	9	13	\$1.50-4.00
Oakland, CA	8	7	3	0	4	\$2.00-2.50
San Francisco, CA	23	21	3	4	14	\$1.00-5.00
Washington, DC	2	1	1	0	0	\$1.25-2.25
Totals	101	90	38	13	35	---

IFAW (2000) collected specimens during surveys ($n=206$) and identified 11 species of seahorses sold in TCM shops in the USA. According to their results, the four predominant species were *H. ingens* ($n=32$), *H. trimaculatus* ($n=58$), *H. spinosissimus* ($n=42$), and *H. kelloggi* ($n=21$; Figure 1).

The IFAW report states that the internet has increased the accessibility of wildlife and wildlife products and therefore the availability of dried seahorses and patent medicines containing seahorse derivatives had increased recently.

Seahorses have been listed as an ingredient in at least eight general tonics commonly available in North America (Fratkin, 1986) and reportedly used in the preparation of pills intended to treat different organic disorders (Vincent, 1996). The recent IFAW (2000) report identified 11 different patent herbal formulas in the US that claimed to contain seahorse parts or derivatives.

Dried seahorses were also sold in TCM shops in Canada. No surveys were carried out but seahorses have been noted for sale in Chinatown in Montreal, Toronto and Vancouver (pers. obs.; A. Perry *in litt.*, 2 September 2001).

Seahorses as curios in United States

No extensive surveys were carried out to assess the availability of seahorses for curios in the USA but anecdotal information from independent correspondents indicated that seahorse were sold in curio and shell shops in many parts of North America. Seahorse curios were reportedly sold for prices generally ranging from US\$0.25 to 29.99. One account described seahorses, supposedly from Africa, being sold for US\$200.00 a piece, either individually as jewellery or in decorative shell arrangements. *Hippocampus barbouri* was purchased by the author for CAN\$2.50 in Percé, Québec, Canada, in a small seaside curio shop. This seahorse was purchased from an importer in Nova Scotia, Canada, and was labelled as *H. erectus*. Clear plastic yo-yos containing dried *H. barbouri* were also manufactured and sold in the USA (Figure 2). Seahorse curios were sold on the internet. Table 3 shows prices for dried seahorses sold as curios on seven North American websites in 2001. Prices per dried seahorse varied according to size and ranged from US\$0.49 to 4.95.

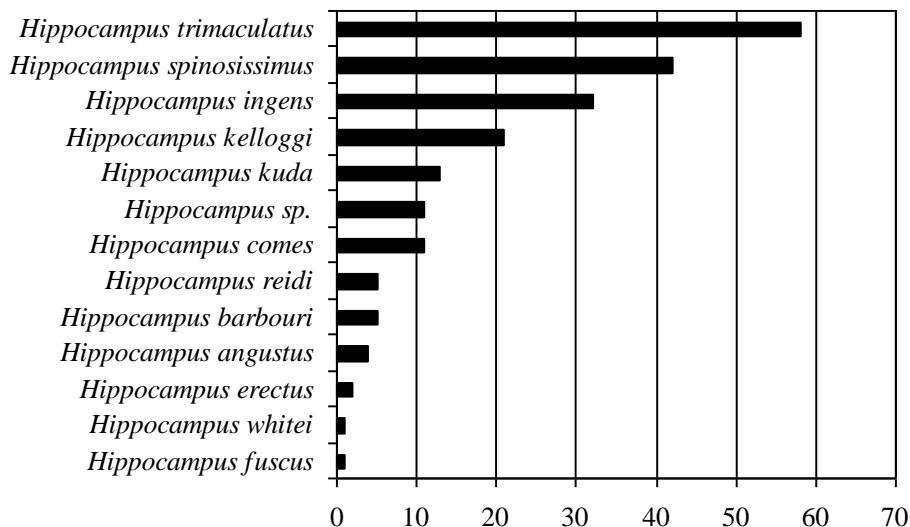


Figure 1. Number of specimens ($n=206$) identified by species in TCM shops in the USA (August-November, 1999). Source: Adapted from IFAW (2000).

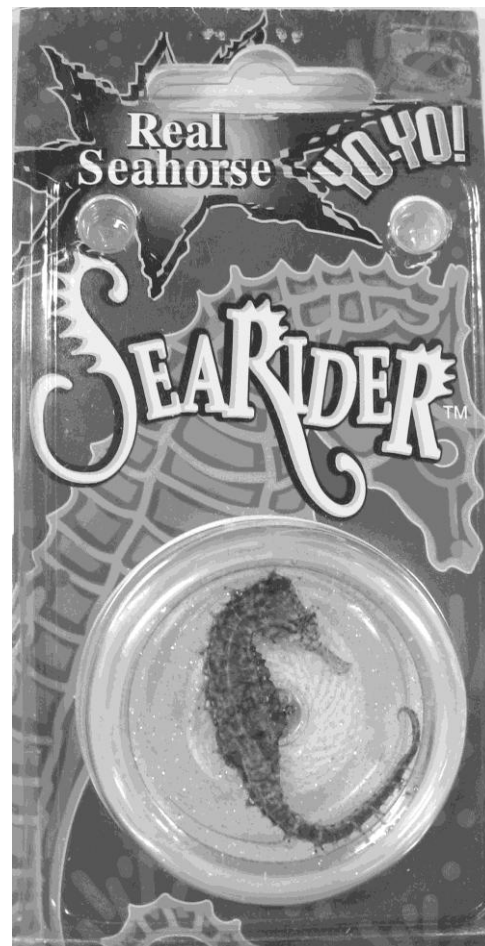


Figure 2. *Hippocampus barbouri* yo-yo manufactured and sold in the USA.

Table 3. Dried seahorses for sale as curios on the Internet in January 2001. Only North American websites are showed in the table. Source: Internet.

Website	Species	Size	Price (US\$)
Site 1	<i>Hippocampus barbouri</i>	2-3" (5-8 cm)	\$1.49 each, \$14.99/dozen, \$75/hundred
	<i>Hippocampus barbouri</i>	3-4" (8-10 cm)	\$2.49/each, \$24.99/dozen, \$125/hundred
Site 2	<i>Hippocampus</i> spp. (Colombian)	4" (10 cm)	\$2.98/each
	<i>Hippocampus</i> spp.	2-3" (5-8 cm)	\$1.29/each
	<i>Hippocampus</i> spp. (pygmy)	0.5-1" (1-3 cm)	\$0.49/each
Site 3	<i>Hippocampus</i> spp. (pygmy)	0.5-1" (1-2.5 cm)	\$0.50/each
	<i>Hippocampus</i> spp.	1-2" (2.5-5 cm)	\$0.6/each
Site 4	<i>Hippocampus</i> spp. (pygmy)	0.5-0.75" (1-2 cm)	\$25/hundred
	<i>Hippocampus</i> spp.	2-2.5" (5-6.5 cm)	\$1.50/each, \$4.00/three
Site 5	<i>Hippocampus</i> spp.	0.5-0.75" (1-2 cm)	not available
Site 6	<i>Hippocampus</i> spp. (pygmy)	1.8-2.5" (4.6-6.5 cm)	\$0.49/each
Site 7	<i>Hippocampus</i> spp.	1-2" (2.5-5 cm)	\$1.50/each

Live

Live seahorses as aquarium fishes in United States

Keeping ornamental fishes is a popular hobby in North America. The global import value of ornamental fishes (freshwater and marine) for USA in 1998 was estimated to be around US\$45.1 million (Milon *et al.*, 1999 in Wood, 2001).

The unusual biology and body shape of seahorses makes them popular aquarium pets. According to correspondence with independent parties, prices for live seahorses in pet shops in the USA from 1996-2000 varied between US\$3.00 and US\$100.00 each, according to size, colour and species. Live seahorses were also advertised for sale on the Internet. Prices on the Internet were similar to those in pet shops (Table 4).

Table 4. Live seahorses for sale on the Internet in North America in January 2001.

Website	Species*	Price (\$US)
Site 1	<i>Hippocampus zosterae</i> (dwarf)	\$15.95/pair, 41.95/six, 199.95/dozen
Site 2	<i>Hippocampus</i> spp. (pygmy)	\$19/pair
Site 3	<i>Hippocampus</i> spp.	\$29.99/each
Site 4	<i>Hippocampus</i> spp. (yellow)	\$14.99/each
	<i>Hippocampus</i> spp. (black)	\$16.99/each
Site 5	<i>Hippocampus zosterae</i> (dwarf)	\$12.95/single pregnant, \$10.95/pair, \$31.95/dozen
	<i>Hippocampus zosterae</i> (dwarf, black)	\$10.95/each
	<i>Hippocampus zosterae</i> (dwarf, yellow)	\$10.95/each
	<i>Hippocampus zosterae</i> (dwarf, green)	\$13.95/each
	<i>Hippocampus zosterae</i> (dwarf, yellow & black)	\$15.95/each
Site 6	<i>Hippocampus zosterae</i> (Brazilian)	\$45.00/each
Site 7**	<i>Hippocampus zosterae</i> (Florida)	\$24.00/each
	<i>Hippocampus zosterae</i> (black, brown, yellow)	\$7.00/each (small)
		\$9.00/each (medium)
		\$11.00/each (large)
	<i>Hippocampus reidi</i> (Brazilian, black)	\$48.00/each

*The common names and the colours are given in parentheses **Source: IFAW (2000)

Legislation

National legislation in United States

Wildlife trade in the USA falls under regulation 50 CFR Part 14. This regulation sets uniform procedures for import, export and transportation of wildlife. A declaration (Form 3-177) of import or export of fish and wildlife must be filed when seahorses (live or dead) are imported and exported in the country. If the purpose of the trade is commercial, the importer or exporter requires a valid import/export licence. In the case of imports, this form is theoretically filed when requesting wildlife clearance. For exports, the form needs to be filed in advance of actual departure to allow reasonable time for inspection. There are also restrictions regarding Customs ports through which wildlife is imported or exported; in general, no person may import or export seahorses at any place other than designated ports of entry (a list of the different ports of entry may be found in 50 CFR Part 14.12).

State legislation in United States

According to state government agencies, the only state with catch regulations affecting syngnathids was Florida. Seahorses and pipefishes were listed under Title 68 (Rules of the Fish and Wildlife Conservation Commission) of the Florida Administrative Codes and specifically in chapter 68B-42 (Marine Life). The Marine Life chapter (68B-42) was previously under the Rules of the Marine Fisheries Commission (Title 46 of the Florida Administrative Codes) and has been effective since January 1991. The main purpose of this chapter was to protect and conserve Florida's tropical marine-life resources and assure the continuing health and abundance of these species(68B-42.001).

Seahorses and pipefishes were defined in Title 68 (68B-42.001) as 'any species of the family Syngnathidae and they are designated as restricted species (Section 370.01(20)). A bag limit for recreational harvest, prohibited individuals from harvesting, possessing or landing more than 20 individuals per day of tropical ornamental marine life species, in any combination (68B-42.005). 'Live landing' and 'live well' requirements (68-42.0035) for each person harvesting any tropical ornamental marine life species required any of the species in the rule chapter to be landed alive.

Seahorses were considered a 'restricted' species, and therefore harvest for commercial purposes required a valid saltwater products licence with both a marine life fishery endorsement and a restricted species endorsement issued by the Fish and Wildlife Conservation Commission. There were no commercial limits on seahorses but the number of commercial harvesters was limited, owing to a moratorium placed on the necessary endorsement needed to harvest marine life species in commercial quantities (L. Rubenstein, *in litt.*, 14 April 1999).

National legislation in Canada

Seahorses were not listed under CITES and no specific regulations or documentation existed for the trade of seahorses in Canada.

SEAHORSE CATCHES IN THE USA AND CANADA

USA

Marine-life landings (including syngnathids) have been recorded in Florida since 1990 (Table 5). Landing records for 1990 were incomplete, as reporting for marine life (mostly aquarium species) was not mandatory until March of that year (M. D. B. Norris, *in litt.*, 26 May 1999). Most of the syngnathids recorded were collected for the aquarium trade and some were intended for the curio trade (M. D. B. Norris, *in litt.*, 26 May 1999).

To the author's knowledge, no commercial landings of syngnathids have been recorded in any states other than Florida.

Impacts of incidental catches of *H. erectus* in the live-bait shrimp trawl fishery have been studied in Florida. Baum & Vincent (2005) suggested that this fishery had the potential to disrupt seahorse populations through direct mortality and indirectly through social disruption, such as changes in sex ratios, and damage to habitat. However, Baum & Vincent (2005) concluded that the precise impacts of trawling on *H. erectus* remained uncertain because no abundance or catch estimates were available for this species.

Seahorses were not known to be targeted in Louisiana and were seldom noticed in bycatch associated with the trawl shrimp fishery. No scientific investigations were being conducted by the Louisiana Department of Wildlife & Fisheries or by local university researchers (R. Paussina, *in litt.* 22 February 2001).

Non-selective exploitation of seahorses also occurred in the shrimp trawl fishery in Alabama but has not been monitored. The Alabama Department of Conservation and Natural Resources (Marine Resources Division) Fisheries Assessment and Monitoring Program (FAMP) has collected fishery-independent data from 16-foot otter trawls since around 1980. Monthly sampling from 1980 to 1998 and quarterly sampling from 1998 to 2000 has shown that the number of seahorses landed varied from zero to 20 per year, indicating that seahorse catches have been of minor importance in the FAMP.

The Gulf Coast Research Laboratory (GCRL) in Mississippi has a similar FAMP programme in which seahorse catches have also been of minor importance. For example, 57 *H. erectus* were recorded from 1987 to 2000 and four *H. zosteræ* from 1988 to 1997. Most areas where seahorses occur in Mississippi, such as seagrass beds, have been closed to shrimp

Table 5. Syngnathids landed and declared in Florida, 1990-1998 (Dwarf seahorse, Giant seahorse and pipefish are respectively *H. zosteræ*, *H. erectus* and *Syngnathus pelagicus*). Source: Department of Environmental Protection, Florida Marine Research Institute (Division of Marine Resources).

Year	Species	Number	Trips ^a	Value ^b	Value (US \$/inds.)
1991	Dwarf seahorse	7,226	84	5,348	1,35
	Giant seahorse	6,850	375	10,208	0,67
	Other seahorse	-	-	-	-
	Pipefish	2,093	116	649	3,22
	Total	16,169	575	16,205	
1992	Dwarf seahorse	76,706	141	3,836	20,00
	Giant seahorse	7,250	448	10943	0,66
	Other seahorse	-	-	-	-
	Pipefish	1,788	162	822	2,18
	Total	85,744	751	15,601	
1993	Dwarf seahorse	66,440	118	4,652	14,28
	Giant seahorse	-	-	-	-
	Other seahorse	-	-	-	-
	Pipefish	1,670	210	2,088	0,80
	Total	68,110	328	6740	
1994	Dwarf seahorse	98,779	117	86,926	1,14
	Giant seahorse	2,231	122	9906	0,22
	Other seahorse	9,938	302	912	10,90
	Pipefish	1,419	233	1,135	1,25
	Total	112,367	774	98,879	
1995	Dwarf seahorse	22,662	61	23,074	0,98
	Giant seahorse	598	95	1,578	0,38
	Other seahorse	81	7	284	0,28
	Pipefish	733	39	1,827	0,40
	Total	24,074	202	26,763	
1996	Dwarf seahorse	17,805	53	22,875	0,78
	Giant seahorse	1,120	101	2,293	0,49
	Other seahorse	112	4	282	0,40
	Pipefish	1,400	43	3,730	0,38
	Total	20,437	201	29,180	
1997	Dwarf seahorse	87,916	57	27,462	3,20
	Giant seahorse	1,986	159	4,124	0,48
	Other seahorse	147	12	306	0,48
	Pipefish	2,309	46	6,468	0,36
	Total	92,358	274	38,360	
1998	Dwarf seahorse	15,564	79	10,260	1,51
	Giant seahorse	1,180	123	3,130	0,38
	Other seahorse	233	13	274	0,85
	Pipefish	1,019	76	1,149	0,89
	Total	17,996	291	14,813	
1999	Dwarf seahorse	61,538	81	19,299	3,19
	Giant seahorse	2,743	170	3018	0,91
	Other seahorse	141	39	295	0,48
	Pipefish	3,171	105	5,554	0,57
	Total	67,593	395	28,166	
2000	Dwarf seahorse	15,121	88	26,207	0,58
	Giant seahorse	496	90	1408	0,35
	Other seahorse	309	42	682	0,45
	Pipefish	1,763	94	4,384	0,40
	Total	17,689	314	32,681	

^aNumber of trips landing a specific species: more than one species can be encountered in one trip. ^bDockside value in US\$ (price paid by the dealer to the collector).

trawling and therefore seahorse bycatch was not considered a problem in this region (J. Warren, *in litt.*, 28 February 2001). A more significant problem was the disappearance of substantial portions of seagrass habitat in Mississippi (M. Buchanan, *in litt.*, 5 March 2001).

Canada

Little information was available for targeted fisheries or bycatch of syngnathids in Canada.

DRIED SEAHORSE TRADE IN THE USA AND CANADA

Exports

USA

USFWS statistics indicated that the volume of dried seahorses exported by the USA was considerably lower than the volume imported (Table 6 and 7). According to the data from 1996-2000, only 98 dried seahorses were exported from the USA to various countries (UK, Canada, Australia and Vietnam).

Information from outside the USA indicated that the USFWS data may contain important gaps. In 1999, Hong Kong Custom Records reported 3,218 kg of dried seahorses imported from the USA for a total declared value of HK\$232,000 (US\$29,820). The same source also showed 200 kg of dried seahorses imported from the USA, of which 60 kg reportedly originated from the USA. The other 140 kg had previously been imported into USA from Mexico. The shipment had a total declared value of HK\$200,000 (US\$25,706). These shipments did not appear in the USFWS figures. In addition, 1998 European Community import data of non-CITES Annex D species showed that the UK imported 300 dried seahorses from the USA. This shipment did not appear in the USFWS data.

Imports

USA

According to the United States Department of the Interior (Fish and Wildlife Service) a minimum of 396 119 dried seahorses and 755 kg of dried seahorses were imported into the USA from 1996 to 2000, with a total declared value of US\$371,291 (Tables 7 and 8). Roughly converting all volumes into numbers of seahorses based on an approximate 300 seahorses per kilogram (see **Information sources in the USA and Canada**), yielded an estimate of at least 622,619 dried seahorses imported during those 5 years. Based on this estimate, the Philippines, China and Mexico supplied approximately 60%, 30% and 7%, respectively, of the total volume imported from 1996 to 2000 (Figure 3). The balance was divided among New Zealand, Taiwan, South Africa, Tanzania, Brazil, Thailand, Zimbabwe and Korea.

Although our estimates show that 60% of recorded dried seahorse imports from 1996-2000 reportedly originated from the Philippines, the Philippines accounted only for 15% of the total declared value while China accounted for 70%. One possible explanation for this difference in declared value is that dried seahorses imported from China may have been targeted for the higher value traditional medicinal market, while those from the Philippines may be imported for sale as cheaper curios. Another possible explanation could be that our estimated conversion factor of 300 seahorses per kilogram was too conservative. As most of the shipments from China were declared in kilograms, as opposed to those from the Philippines (Table 7), an underestimate in the number of seahorses per kilogram may, in turn, have led to underestimated volumes of dried seahorses imported from China.

Table 6. Dried seahorses reportedly exported by the USA. Source: US Fish and Wildlife Service.

Years	Destination	Quantity (#)	Declared value (US\$)	Source
1997	United Kingdom (origin: unknown)	2	300	wild
1998	Canada (origin: Thailand)	36	54	unknown
1999	Australia (origin: Mexico)	50	100	wild
2000	Vietnam (origin: unknown)	10	0	wild

Table 7. Dried seahorses imported by the United States (1996-2000). Exporting countries are mentioned where different than country of origin. Source: US Fish and Wildlife Service.

Years	Country of origin	Quantity (No.)	Quantity (kg)	Declared value (US\$)	Source
1996	Philippines	36,802	-	4,470	wild
	Philippines	-	25 kg	4,100	wild
	China	502	-	3,192	wild
	China (via Hong Kong)	-	11 kg	2,988	wild
	China	-	4 kg	16	wild
	Tanzania (via Hong Kong)	215	-	14,014	wild
	Korea	28	-	0	wild
	Zimbabwe	4	-	100	wild
	Unknown (via Mexico)	1	-	0	wild
Total 1996		37,552	40 kg	28,880	-
1997	Philippines	242,423	-	35,482	wild
	New Zealand	7,200	-	1,308	wild
	Taiwan	1,615	-	921	wild
	South Africa	369	-	4,768	unknown
	Tanzania (via Hong Kong)	315	-	21,037	wild
	China (via Hong Kong)	-	189 kg	51,126	wild
	Unknown (via Taiwan)	12	-	15	wild
	Mexico	9	-	48	wild
	Mexico	-	35 kg	120	wild
	Unknown (via Canada)	3	-	0	wild
	Zimbabwe	1	-	0	wild
	Tanzania	1	-	0	wild
	Total 1997		251,948	224 kg	114,825
1998	Philippines	32,400	-	4,176	wild
	Philippines	5,343	-	1,473	unknown
	Philippines	-	6 kg	960	wild
	Mexico	449	-	476	wild
	Mexico	-	38 kg	151	wild
	South Africa	31	-	855	wild
	South Africa (via China)	-	3 kg	2,452	wild
	China (via Hong Kong)	-	146 kg	80,520	wild
	ZR? Unknown (via Hong Kong)	115	-	1,770	wild
	Tanzania	1	-	50	wild
	Zimbabwe	1	-	138	wild
	Total 1998		38,340	193 kg	93,021
1999	Philippines	19,256	-	1,359	wild
	Philippines	4,300	-	3,760	unknown
	Philippines	-	2 kg	24	wild
	China (via Hong Kong)	15500	-	117,500	wild
	China	-	190 kg	1,710	wild
	China (via Hong Kong)	-	31 kg	1,625	wild
	Mexico	6	-	20	wild
	Mexico	-	36 kg	75	wild
	Tanzania	1	-	500	wild
	Unknown (via Thailand)	16	-	32	wild
Total 1999		39,079	259 kg	126,605	-

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Table 7. Dried seahorses imported by the United States (1996-2000). Exporting countries are mentioned where different than country of origin. Source: US Fish and Wildlife Service.

Years	Country of origin	Quantity (No.)	Quantity (kg)	Declared value (US\$)	Source
2000	Philippines*	23,530	-	3,029	unknown
	Philippines	5,015	-	150	wild
	Brazil	305	-	816	wild
	Thailand	200	-	20	wild
	Tanzania (via Hong Kong)	95	-	475	wild
	China	-	1 kg	2,110	wild
	China (via Hong kong)	-	7 kg	1,325	wild
	Mexico	-	31 kg	30	wild
	Mexico	1	-	5	wild
Total 2000		29,146	39 kg	7,960	-

*10,000 dried seahorses (declared value \$US 800) were classified as 'live' in the database but given the volume and the importing company, these were likely dried seahorses.

All ports of entry for dried seahorses imports for 1996-2000 are shown in Figure 3. Baltimore appeared to have been the main port of entry for dried seahorses, primarily because of one shipment of 219,800 dried seahorses imported from the Philippines in 1997. Newark, Miami, San Diego and Los Angeles were important ports of entry for dried seahorses, in lower volumes than Baltimore but on a more regular basis.

Many shipments had a null declared value. Some were exchanges of dried seahorse specimens between scientific institutions or museums (Table 8). However, some shipments with null or very low declared values were definitely imported for commercial purposes, suggesting that in some cases shipment values could be underreported. This seems to be the case, for example, for dried seahorses imported from Mexico which represented 7% of the total estimated traded volume but less than 1% of the total declared value (Table 7).

Canada

Hong Kong Customs records show 3 kg of dried seahorses exported to Canada in 1998 and 12 kg in 2000, with respective declared values of HK\$12,000 (US\$1,542) and HK\$16,000 (US\$2,056). Both shipments were originally from Mainland China and were exported to Canada via Hong Kong.

The 1998 USFWS statistics reported 36 dried seahorses exported from the US to Canada, with a declared value of US\$54.00. The seahorses were reportedly originally from Thailand (Table 6).

Trade Statistics from Peru indicate that at least 25 kg of dried seahorses were exported from Peru to Montreal between 1998 and April 2000, for a total value of US\$1,921. Dried seahorses from Peru were also reportedly exported to Calgary.

Table 8. Dried seahorses imported by the United States (1996-2000) that were not for commercial purposes - exchanges between scientific institutions. Exporting country is mentioned if different than country of origin. Source: US Fish and Wildlife Service.

Years	Country of origin	Quantity (#)	Declared value (US\$)	Source
1998	Bermuda (via United Kingdom)	1	0	Wild
	Brazil (via United Kingdom)	1	0	Wild
	USA (via United Kingdom)	1	0	Wild
	Total 1998	3	0	-
1999	Australia (via Canada)	9	0	Unknown
	Egypt (via Canada)	2	0	Unknown
	Haiti (via Canada)	1	0	Unknown
	Japan (via Canada)	20	0	Unknown
	Philippines (via Canada)	1	0	Unknown
	Romania (via Canada)	17	0	Unknown
	Surinam (via Canada)	1	0	Unknown
	Total 1999	51	0	-

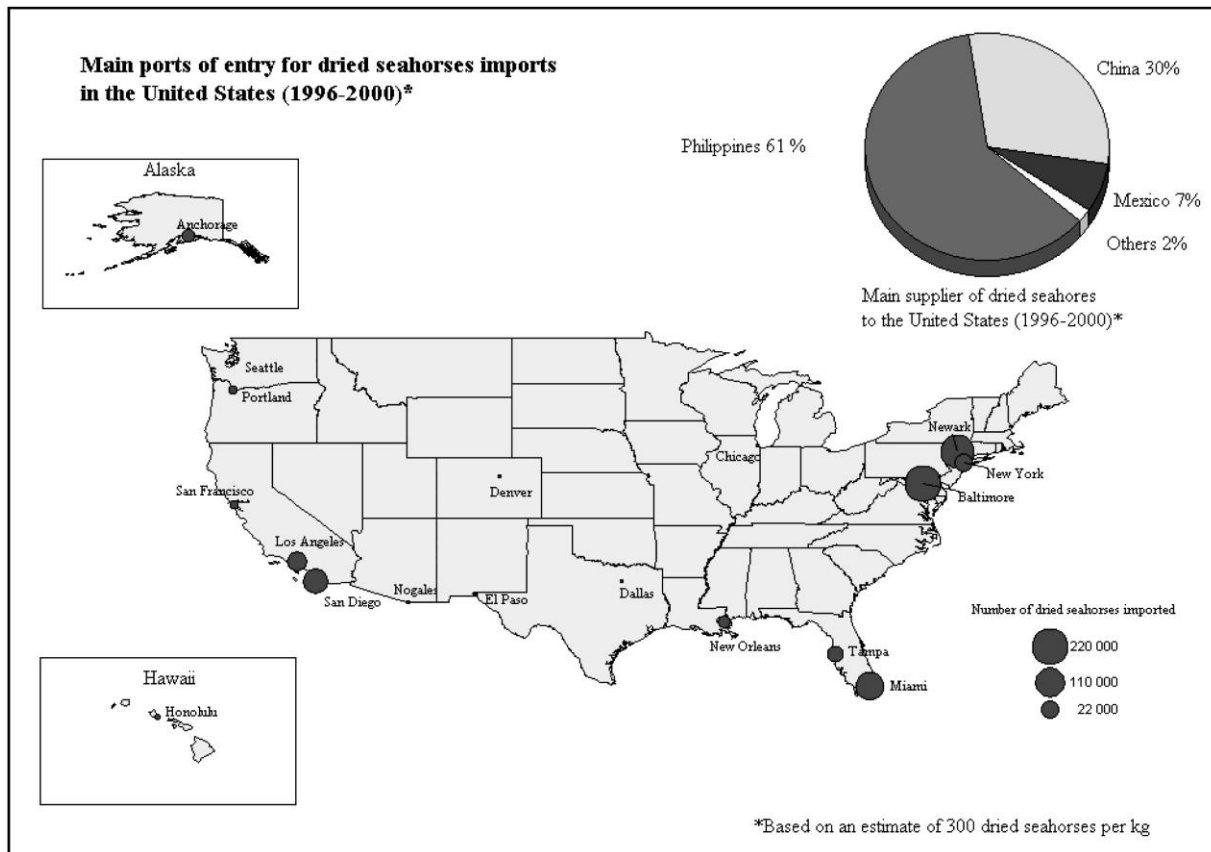


Figure 3. Dried seahorses imported by the USA (1996-2000). Source: United States Fish and Wildlife Services, Office of Law Enforcement.

LIVE SEAHORSE TRADE IN THE USA AND CANADA

Exports

USA

USFWS statistics indicate that the United States exported live seahorses to Canada, Hungary, Israel, Japan, Mexico, South Africa, Taiwan and the UK (Tables 9 and 10). Many of these export shipments contained seahorses originally from other countries, such as Brazil.

Volumes of *H. zosteræ* and *H. erectus* landed in Florida were relatively high (Table 5) but the proportions of these sold within the USA and exported outside the country remain unclear. Wood (2001) reported that the USA, particularly Florida, was the third main supplier of marine ornamental fishes for the European Union. Woeltjes (1995) included *H. zosteræ* in an

Table 9. Live seahorses reportedly exported by the USA (1996-2000). If Origin is other than USA: *Origin is from various counties; + Origin is Brazil. Source: US Fish and Wildlife Service.

Years	Destination	Quantity (#)	Declared value (\$US)	Source
1996	Mexico*	38	111	wild
	Canada	36	108	wild
	Mexico*	6	10	captive-bred
Total 1996		80	229	-
1997	Israel	143	1430	unknown
	Canada	100	500	unknown
	South Africa	30	255	unknown
Total 1997		273	2185	-
1998	South Africa	110	916	captive-bred
	Canada	2	12	captive-bred
1998	Taiwan*	20	430	wild
	Total 1998		132	1358
1999	Canada	86	0	captive-bred
	Taiwan+	80	1450	wild
	Hungary+	12	185	wild
	Japan*	7	175	wild
Total 1999		185	1810	-

annotated list of ornamental fish species traded in the Netherlands during 1992-1994. Wood (2001) also reported that *H. zosterae* occupied the second rank of the top ten fishes exported from Florida. This may suggest gaps in declaration of live seahorses exported from the United States as the declared numbers of exported seahorse are considerably lower.

Table 10. Live seahorses reportedly exported by the USA (1996-2000) that were not for commercial purposes - exchanges among aquaria. Source: US Fish and Wildlife Service.

Years	Destination	Quantity (#)	Declared value (\$US)	Source
1998	Canada	28	280	captive-bred
1999	United Kingdom	83	0	wild
	United Kingdom	75	0	captive-bred
Total 1999		158	0	-

Information from European Community import data for non-CITES Annex D species shows that the USA exported live seahorse to Austria, Belgium, Germany, Italy and Portugal in 1998 and 1999. Even though these shipments were not of a significant quantity, they should have appeared on the USFWS data.

Canada

Little information was available regarding Canadian exports of live seahorses but given that only *H. erectus* occurs in Canadian waters, exports would be expected to be minor, if any occurred. USFWS data showed that the United States imported live seahorses from Canada (Tables 11 and 12). Most of these were captive-bred, and were exchanged among aquaria (Tables 11 and 12). One shipment in 1997 reportedly comprised wild-caught seahorses but these were most likely exported to Canada by another country.

Imports

USA

According to USFWS data, over 4000 live seahorses were imported by the USA, for a total declared value of over US\$ 33,000 (Table 11 and 12). Based on USFWS records, Australia was the primary supplier of live seahorses to the USA. 54% of live seahorse shipments from 1996-2000 were from Australia (Figure 4). Some recent developments in seahorse aquaculture in Australia may explain, in part, why Australian seahorse imports account for such a significant percentage of recorded live seahorses imports in USA. This could also be an explanation for increases in the numbers of live seahorses imported in 2000 (Table 11). Live seahorses imported from Australia had a higher declared value compared to those from other countries.

The Philippines accounted for 35% of the live seahorses imported by the United States from 1996 to 2000 (Figure 4). The remaining percentage was divided among Brazil, Vietnam, Indonesia, the

Table 11. Live seahorses imported by the USA (1996-2000). Source: US Fish and Wildlife Service.

Years	Country of origin	Quantity (#)	Declared value (\$US)	Source
1996	Philippines	141	279	wild
	Solomon Islands	27	94	wild
Total 1996		168	373	-
1997	Philippines	98	62	wild
	Australia (via Canada)	30	1,255	captive-bred
	Canada	10	476	wild
	Australia	4	100	wild
	Costa Rica	1	5	wild
Total 1997		143	1,898	-
1998	Brazil	55	44	wild
	Australia	42	7,940	wild
	Philippines	4	7	wild
Total 1998		101	7,991	-
1999	Brazil	105	141	wild
	Australia	3	125	wild
	Philippines	3	6	wild
	Australia	2	64	captive-bred
Total 1999		113	336	-
2000	Philippines	1,276	1,942	wild
	Australia	1,198	11,774	wild
	Australia	1,030	5,450	captive bred
	Brazil	150	135	wild
	Vietnam	100	800	wild
	Indonesia (via Japan)	46	0	wild
	Australia (via Japan)	31	2,812	captive-bred
	Japan	5	0	captive-bred
Total 2000		3,836	22,913	-
Total 1996-2000		4,361	33,511	

Solomon Islands, Canada, Japan and Costa Rica. The main ports of entry for live seahorses in the USA are also shown on Figure 4. New York, Miami and Los Angeles appeared to be the main ports of entry for live seahorses from 1996 to 2000.

Canada

The USFWS export data show that the USA exported live seahorses to Canada. From 1996 to 2000, 252 live seahorses with a declared value of US\$900 were recorded as being exported from the USA to Canada. At least 45% of these were from captive-bred, 40% were from an unknown source and 15% were reportedly from the wild (Table 9). Of the 252 live seahorses imported, 28 were exchanges among aquariums (Table 10). There is also evidence from interviews with Singaporean and Indonesian aquarium exporters that Canada imports live seahorses from both these regions. One Singaporean exporter mentioned Montreal specifically as the furthest destination to which he shipped fishes.

Sources

Aquaculture and captive breeding

The only functional seahorse aquaculture venture known in the USA was based in Hawaii. This operation was breeding seahorses for commercial purposes. Their seahorses may be purchased by mail order or through the Internet. The proportions of these seahorses which were sold within the USA and exported were unclear.

Table 12. Live seahorses imported by the United States (1996-2000) that were not for commercial purposes - exchanges among aquaria. Source: US Fish and Wildlife Service.

Years	Country of origin	Quantity (#)	Declared value (\$US)	Source
1999	United Kingdom	95	0	captive-bred
2000	Canada	40	40	captive-bred
	Japan	30	15	captive-bred
	Japan	30	15	wild
	United Kingdom	20	31	captive-bred
Total 2000		120	101	-

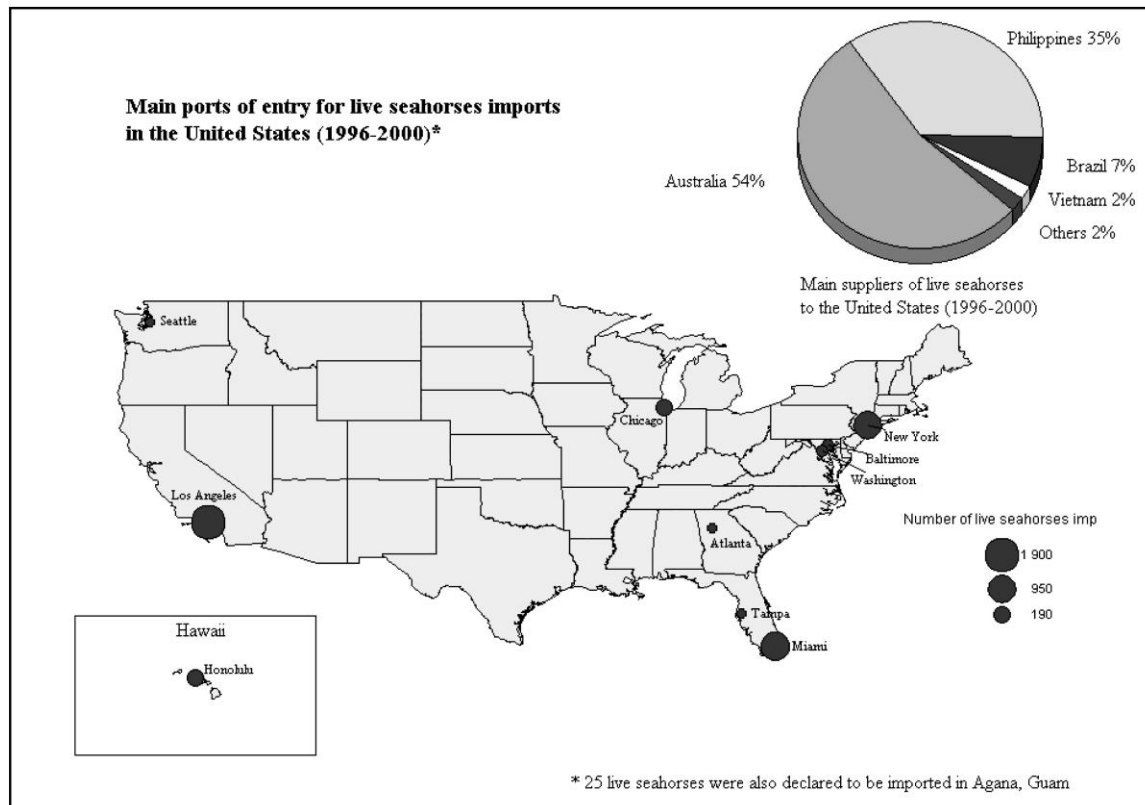


Figure 4. Live seahorses imported by the United States (1996-2000). Source: United States Fish and Wildlife Services, Office of Law Enforcement.

OTHER SYNGNATHID SPECIES IN THE USA AND CANADA

Local species of pipefishes

At least 30 species of pipefish, from seven genera, occur in American and Canadian waters (Table 13). Pipefishes usually occur in shallow coastal areas with eelgrass beds, which they use as nursery and feeding grounds as well as for shelter from predators (Teixeira & Musick, 1995). The development of coastal zones, pollution and destructive fishing gear have major impacts on eelgrass beds and may therefore pose a threat to pipefish populations. None of the pipefish species occurring in USA and Canada were listed on the IUCN Red List (Hilton-Taylor, 2000). Three species (*Cosmocampus balli*, *Doryrhamphus baldwini*, and *Halicampus edmondsoni*) are endemic to Hawaii (Dawson, 1985) and one species (*S. affinis*) has been reported as possibly extinct owing to habitat loss (Roberts *et al.*, 1998).

Table 13. Pipefishes occurring in United States and Canada. Source: Froese & Pauly (2000). Note that pipefish species occurring in Guam and Puerto Rico are not included.

Species	Common name	Pacific coast	Atlantic coast	Gulf of Mexico	Hawaii
<i>Anarchopterus criniger</i>	Fringed pipefish		√ (USA)	√	
<i>Anarchopterus tectus</i>	Insular pipefish		√(USA)	√	
<i>Bryx dunckeri</i>	Pugnose pipefish		√ (USA)		
<i>Bryx randalli</i>	Ocellated pipefish		√		
<i>Cosmocampus albirostris</i>	Whitenose pipefish		√ (USA)	√	
<i>Cosmocampus arctus</i>	Snubnose pipefish	√			
<i>Cosmocampus balli</i>	Ball's Pipefish				√ (endemic)
<i>Cosmocampus brachycephalus</i>	Crested pipefish		√	√	
<i>Cosmocampus elucens</i>	Shortfin pipefish		√	√	
<i>Cosmocampus hildebrandi</i>	Dwarf pipefish		√	√	
<i>Cosmocampus profundus</i>	Deepwater pipefish		√ (USA)		
<i>Doryrhamphus baldwini</i>	Redstripe pipefish				√ (endemic)
<i>Doryrhamphus excisus</i>	Bluestripe pipefish	√			
<i>Festucalex erythraeus</i>	Red pipefish				√
<i>Halicampus edmondsoni</i>	Edmonson's pipefish				√ (endemic)
<i>Micrognathus crinitus</i>	Banded pipefish		√ (USA)	√	
<i>Micrognathus ensenadae</i>	Harlequin pipefish		√ (USA)	√	
<i>Microphis brachyurus</i>	Opossum pipefish		√ (possibly)	√ (possibly)	
<i>Syngnathus affinis</i>	Texas pipefish		√ (possibly extinct)		
<i>Syngnathus auliscus</i>	Barred pipefish	√			
<i>Syngnathus californiensis</i>	Kelp pipefish	√			
<i>Syngnathus euchrous</i>	Chocolate pipefish	√			
<i>Syngnathus exilis</i>	Barcheek pipefish	√			
<i>Syngnathus floridae</i>	Dusky pipefish		√ (USA)	√	
<i>Syngnathus fuscus</i>	Northern pipefish		√ (USA & Canada)	√	
<i>Syngnathus leptorhynchus</i>	Bay pipefish	√ (USA & Canada)			
<i>Syngnathus louisianae</i>	Chain pipefish		√ (USA)	√	
<i>Syngnathus pelagicus</i>	Sargassum pipefish		√ (USA)	√	
<i>Syngnathus scovelli</i>	Gulf pipefish		√ (USA)	√	
<i>Syngnathus springeri</i>	Bull pipefish		√ (USA)	√	

Pipefish exploitation

According to responses from government agencies, only *S. pelagicus* has been targeted in the USA (Table 5). Pipefishes have occasionally been noticed in bycatch associated with the Louisiana shrimp fishery (R. Paussina, *in litt.*, 22 February 2001) and Alabama but bycatch landings were not monitored. Where states have a Fisheries Assessment and Monitoring Program (See **Legislation**), pipefishes have not appeared to be an important component of the catch. As an example, a total of only 1,162 *S. louisianae* and 256 *S. scovelli* were recorded in Mississippi from 1986 to 2000.

Trade in pipefishes

Little information was available on the pipefish trade in the USA and Canada. The USFWS did not have specific codes to record syngnathids, other than seahorses, and therefore no official statistics were available for the United States. Hong Kong Customs Records revealed that 10 kg of dried pipefishes, originally from China, were exported to Canada in May 2001. The shipment had a declared value of HK\$22,000 (US\$2,828).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN THE USA AND CANADA

Hippocampus reidi, *H. zosterae*, *A. criniger*, *M. brachyurus* and *S. affinis* have been identified as marine fish stock at risk in the United States owing to habitat degradation (Musick *et al.*, 2000). Seagrasses are declining globally as a result of disturbances in coastal and estuarine environments (Short & Wyllie-Echeverria, 1996) and documentation of seagrass habitat loss has become a major focus for a number of Federal programmes in the USA (e.g. Klemas *et al.*, 1993 in Short & Burdick, 1996). Disturbances such as pollution, coastal modification and outbreaks of disease affect seagrass beds (Short & Burdick, 1996) and indirectly may affect populations of syngnathids and other marine organisms.

Exploitation of *H. zosterae*, *H. erectus* and *S. pelagicus* in Florida has been closely monitored but stock assessments should be carried out in order to evaluate the sustainability of relevant fisheries and to establish management guidelines. Trawling may be disruptive to seahorse populations although the impact remains uncertain (Baum & Vincent, 2005). Further research and monitoring is needed to evaluate the impact of incidental catch on small fishes, such as syngnathids (Baum & Vincent, 2005).

CONCLUSIONS

The USFWS trade statistics have provided new information to help understand the seahorse trade in the USA. At least 622,619 dried seahorses were estimated to be imported by the United States between 1996 and 2000. The data suggest that the Philippines, Mainland China and Mexico were the main suppliers of dried seahorses, with 61%, 30% and 7% of the total dried import, respectively, from 1996 to 2000. The proportion of dried seahorses imported by the USA to supply domestic TCM and curio markets remains unclear. Recorded live seahorse imports between 1996 and 2000 were primarily from Australia (54%) and the Philippines (35%), with the remaining percentage divided among Brazil, Vietnam, Indonesia, the Solomon Islands, Canada, Japan and Costa Rica. USFWS seahorse export records showed only 98 dried seahorses and 856 live seahorses were exported from the USA during 1996-2000, but information sources from outside North America suggested that the export statistics may contain important gaps in declarations. As a first step toward better monitoring, the USFWS should update the species codes used for monitoring trade in order to reflect recent taxonomic revisions.

Information on the seahorse trade in Canada was scarce. Therefore, import and export volumes could not be estimated. The little information available indicates that dried seahorses have been imported from Hong Kong, USA and Peru, and that live seahorses have been imported from the USA, Singapore and Indonesia.

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CHAPTER 3. SEAHORSE TRADE IN MEXICO¹

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ABSTRACT

Mexico traded both dried and live seahorses. Domestic seahorses were afforded some legal protection, as only those cultured or incidentally caught could be traded legally. A target fishery for the aquarium trade nonetheless existed. Most seahorses traded dried, however, were caught incidentally in the country's shrimp trawl fisheries.

Dried seahorses were both traded domestically as curios and exported, most likely for use in TCM, to Japan, Hong Kong, Mainland China and the USA. Domestic consumption for curios was estimated to total 6,600 to 8,100 seahorses annually (20-24 kg). Exports of dried seahorses in Mexico apparently began in response to demand from the international market. Dried seahorse exports to Japan from the Pacific coast between 1985 and 1995 may have totaled 2,500 kg per annum. In addition, from 1990 onwards shark fin traders on the Caribbean coast exported unknown numbers of seahorses to Japan. Official records indicate that by the late-1990s, Mexico was also exporting 23-140 kg dried seahorses to Hong Kong and the United States each year. Mexico also exported over 7,600 kg of dried seahorses in 2000 to Mainland China.

Live seahorses traded as aquarium fish were caught illegally on the Pacific coast or captive-bred in two aquaculture ventures. Most were traded domestically, but several hundred were exported each year to the USA. Several thousand live seahorses were also imported from the Philippines, Indonesia, Hawaii, Fiji, and Brazil per annum. In total, an estimated 8,200 – 14,600 seahorses were consumed annually by Mexico's aquarium trade.

Dried and live pipefish were also traded in Mexico. Dried pipefish were traded domestically on Mexico's Caribbean coast, and may also have been exported from there. Both locally caught freshwater pipefish and imported saltwater pipefish were traded domestically as ornamental fishes.

BACKGROUND FOR MEXICO

Information sources in Mexico

Information for this section stems from research in Mexico conducted in January and February 2000. The author conducted over 250 interviews with people involved in or with knowledge of the seahorse trade (Table 1). Interviews were conducted in Spanish through an assistant, who translated and verified notes. Interviews with some aquarium fish shops in Mexico City and Guadalajara were conducted by phone by the author's assistant. The author was introduced to Government officials, academics and NGOs as a biologist researching the seahorse trade, and in most other cases as a graduate student researching seahorse biology.

Most respondents were co-operative, and notes could be taken during interviews with Government officials, researchers, aquarists, fishers and divers. However, many dried and live traders (particularly in

¹ Cite as: Baum, J.K. and A.C.J. Vincent. 2011. Seahorse trade in Europe. p. 57-77. *In*: Vincent, A.C.J., Giles, B.G., Czembor, C.A. and Foster, S.J. (eds.). Trade in seahorses and other syngnathids in countries outside Asia (1998-2001). Fisheries Centre Research Reports 19(1). Fisheries Centre, University of British Columbia [ISSN 1198-6727].

Table 1. Number of respondents interviewed in Mexico, by profession and location.

Background of Respondents	Location of interview				Sample Size
	Caribbean Coast	Guadalajara	Mexico City	Pacific Coast	
Artisanal fisher	-	-	-	13	13
Artisanal diver	-	-	-	12	12
Commercial fisher	34	-	-	24	59
Fishery inspector/ management	1	-	-	3	4
Dried marine products trader	15	-	1	34	50
Ornamental fish trader	-	13	55	11	79
Seahorse culturist	1	-	-	3	4
Academic (biologist/researcher)	-	-	1	9	10
Government official	2	-	4	4	11
NGO	-	-	-	4	4
Dive shop employee/owner	-	-	-	4	4
Other	-	-	-	7	6
Total	53	13	61	128	255

Mexico City's aquarium markets) were reluctant to disclose information about their business. In such cases, notes were made immediately following the interview.

Research was conducted inland in Mexico City and Guadalajara; in Tampico, Veracruz, Alvarado, Ciudad del Carmen, Lerma, Campeche and Cancun on the Caribbean coast, and, on the Pacific coast, in La Paz and Loreto (both in Baja California), Guaymas, Mazatlán, Puerto Vallarta, Acapulco, Puerto Escondido, Huatulco and Salina Cruz (all indicated on Figure 1). Findings are supplemented by Mexico Government fisheries statistics, Mainland China, Hong Kong and United States Customs data, and other sources as cited.

Seahorses in Mexico

Geographic distribution

Caribbean Coast

Three seahorse species occur along Mexico's Caribbean coast: *Hippocampus erectus*, a medium-sized deep-bodied species, usually marked with horizontal lines; *H. reidi*, the long-snout seahorse, a slender medium-sized species; and *H. zosterae*, a dwarf species (approx. 25mm in height). Both larger species were exploited in the Mexican dried and live trades, and traders did not distinguish between them. The author did not, however, encounter *H. zosterae* in the trade. Due to its small size, it is unlikely that this species is traded. Each of these three species is listed as Vulnerable (A2cd) by the IUCN (IUCN 2002). No biological studies of any of these species have been undertaken in Mexico.

The author obtained 41 specimens of *H. erectus* that weighed from 0.57-12.02 g (mean=2.28±1.99) and ranged in height from 5.0 to 15.1 cm. Three specimens of *H. reidi* weighed 3.34 g on average (±1.85s.d.) and ranged in height from 4.7 to 14.3 cm. Thirty fishers on this coast reported seahorse heights ranging from 5.0 to 20.0 cm (mean=10.2 cm). Four experienced fishers and vendors commented that the average size of seahorses had declined over time (between 7 and ~40 years), but eight others did not believe that there had been a change. The average weight of *H. erectus* and *H. ingens* (2.35 g) was used to convert seahorse catch estimates for the Caribbean coast to weights. Based on these specimens, there are about 425 seahorses per kilogram. Fishers most commonly caught black and brown seahorses, but some fishers also reported finding yellow, red, white and orange seahorses, and very occasionally, green or pink ones.

Along the Caribbean coast, fishers reported that they caught the most seahorses in Quintana Roo state, near Contoy, Isla Mujeres and Isla Cozumel, and in Yucatán state, near Celestún and Progreso. Fishers also commonly found seahorses in the Sonda de Campeche; several specifically mentioned Cayos Arcas and Triángulus as the best areas within this region. All of these areas are near coral reefs, with the exception of Celestún, which is located within a national park bordered by mangroves. Indeed, of the

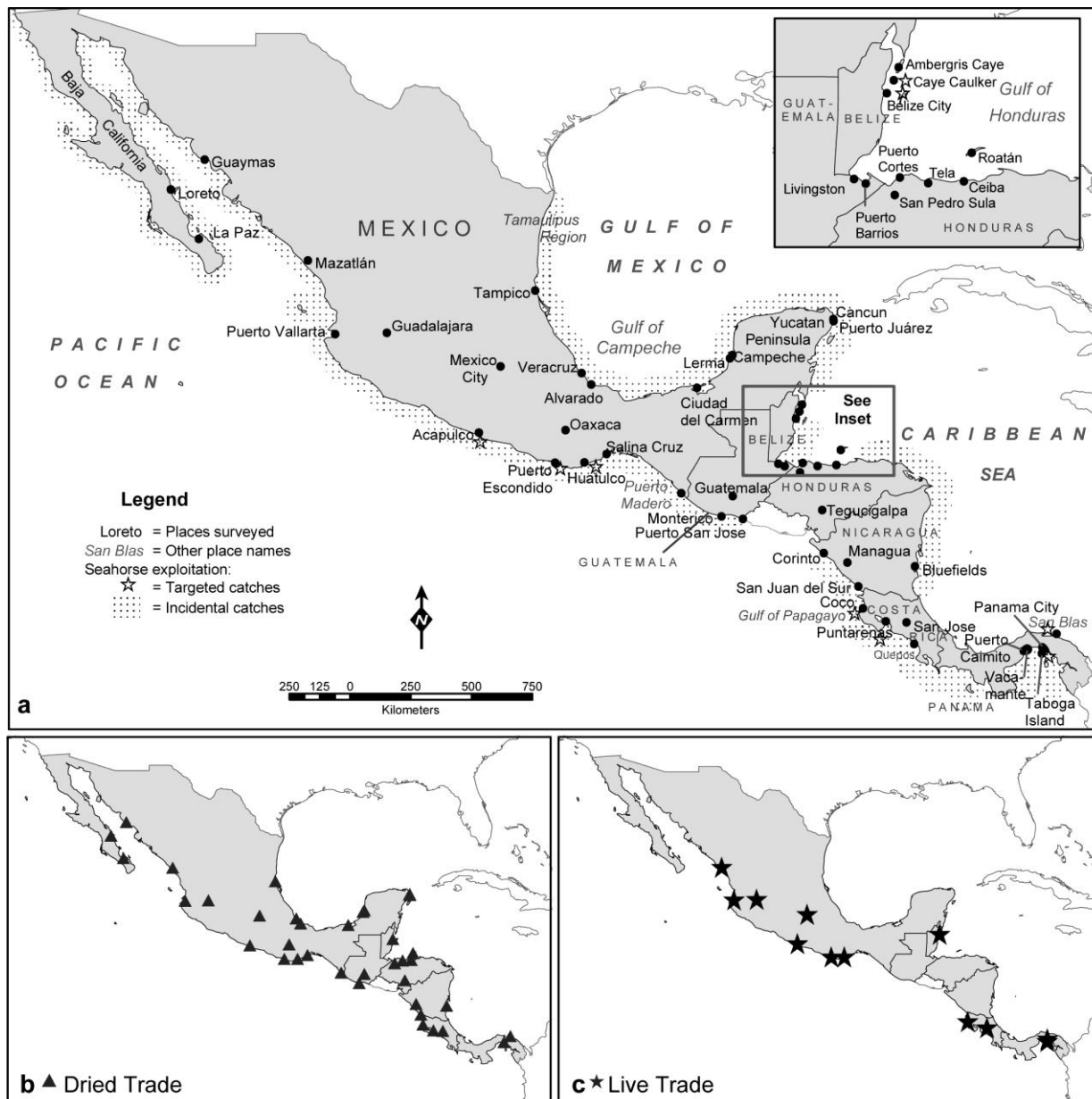


Figure 1. Maps of Mexico [and Central America] showing (a) surveyed locations, and known locations where targeted and incidental seahorse catches occurred, (b) known locations where dried seahorses were traded, and (c) known locations where live seahorses were traded.

thirty-one fishers who responded to habitat questions, most associated seahorse catches with rocks (n=20) or coral reef (n=14). A few, however, cautioned that they avoided fishing in these areas for fear of ripping their gear. Some fishers also caught seahorses in seagrasses (n=4) or algae (n=1). Reported depths for catching seahorses ranged from 8 to 80m (n=26). Seahorse catches were reportedly very low in Tampico and Veracruz, perhaps because waters are very deep there, compared to the shallow continental platform in the Sonda de Campeche, or because of the lack of appropriate habitat.

Twenty-three fishers on the Caribbean coast commented on temporal variation in seahorse catch, but there was no agreement among them as to timing. A few fishers mentioned that area was a more important determinant of catch. Twelve fishers also mentioned catching pregnant seahorses, but could not pinpoint breeding seasons.

Pacific Coast

Hippocampus ingens is the sole species found in the eastern Pacific, with a range extending from California to Peru. In Mexico, this species occurs along the entire length of the coast. One of the world's largest seahorse species, *H. ingens* is listed as Vulnerable (A2cd) by the IUCN (IUCN, 2002).

Thirty specimens of *H. ingens* weighed between 0.96 and 8.57 g (mean=4.18±2.45s.d.) and ranged in height from 8.6 to 18.7 cm. Reported seahorse heights ranged between 5.0 and 30.0 cm (mean 11.5 cm, n=29). Seven experienced fishers reported a decline in seahorse size over time, but as many others did not think there had been a change. The mean weight of specimens was used to convert estimates of *H. ingens* numbers to weights. Based on it, there are about 239 seahorses per kilogram. Fishers most frequently caught brown seahorses, but black and yellow seahorses were also common. Some fishers had also caught red, orange, grey, and white seahorses. Divers reportedly either found seahorses alone or in pairs.

Fishers who trawled the entire length of the Pacific coast cited the southern states of Oaxaca and Chiapas as the best region for catching seahorses. Within that region, Salina Cruz, Barra San Francisco and Puerto Arista were mentioned as the best areas. Divers and biologists reported that seahorses were very rare within the Gulf of California. Seahorse abundance near Puerto Vallarta, had apparently declined since the early-1990s.

Fishers (n=26) caught most seahorses in areas with algae, rocks, and/or coral. Some fishers also found seahorses in seagrasses (n=6) and sponges (n=5). A few fishers in Mazatlán reportedly caught seahorses in sandy, muddy bottoms. Fishers caught seahorses between 1 and 55m, but most fishers found seahorses between 20 and 35 m depth. Most fishers (n=29) reported seasonal variation in seahorse catches. Nine fishers also commented on the breeding season for seahorses, but there was little agreement among their responses.

Species traded/imported

Seahorses were imported from the Philippines for the curio trade, and from the Philippines, Fiji, Hawaii, Indonesia and Brazil for the aquarium trade. In the aquarium trade, at least *H. barbouri* (found in the Philippines and Malaysia) and *H. reidi* (from Brazil) were traded. Live seahorse traders did not distinguish seahorses by species, but rather by size, colour, and the presence of spines. Large brightly coloured seahorses (yellow or red) were most valued.

Uses

Dried

Seahorses in TCM in Mexico

Seahorses were not used for TCM in Mexico, although a few fishers were aware that seahorses were being exported to Asia for medicinal use. One fisher mentioned that others had put seahorses in bottles of cognac and consumed this as an aphrodisiac after being told by Chinese people about this practice.

Seahorses in folk medicine in Mexico

Evidence of the medicinal use of seahorses was found only on the Caribbean coast of Mexico, where several shrimp fishers noted that seahorses were sometimes retained to treat asthma, particularly in children. Most fishers familiar with this practice said that they gave the seahorses away, although some apparently also sold seahorses for this purpose. As in some Asian treatments for asthma, the seahorses were roasted and ground before being consumed. In general, the medicinal use of seahorses in Mexico was very limited, as few people knew of or believed in it.

Seahorses as curios in Mexico

Seahorses were sold as curios to national and foreign tourists along both coasts of Mexico. Dried seahorses were usually sold either unfinished or varnished, but the author also found seahorses for sale that had been made into key-chains, pens, "dragons" with wings and eyes attached, or in shell displays. Some fishers also retained seahorses as curios for personal use or gifts. Several of these fishers cited low value as the reason for not selling seahorses. In addition to key-chains and dragons, these fishers sometimes

fashioned small seahorses into earrings or necklaces. Four people commented that Mexicans thought seahorses were good luck, but in general very few people attached special beliefs or importance to seahorses.

Live

Seahorses as aquarium fishes in Mexico

Seahorses were popular as ornamental fish domestically. In Mexico City and Guadalajara, most aquarium retailers that sold marine fishes, sold seahorses. Large, brightly coloured seahorses (red or yellow) were preferred. Experienced live aquarium fish traders said husbandry knowledge about seahorses was limited, and many reported difficulties in obtaining live *Artemia salina* to feed seahorses. Indeed, many hobby shops that did not sell seahorses or did not have them in stock remarked that they tried to avoid seahorses because they were difficult to maintain.

Legislation

No formal records about the trade in live or dried seahorses could be obtained by the author. It is not known how, or if, seahorse imports and exports are recorded in Mexico's Customs data.

The commercialization of cultured and incidentally-caught seahorses was legal in Mexico. Permits issued through SAHAGAR (Sría de Agricultura y Ganadería), the Secretariat of Agriculture and Livestock, also allowed imports of seahorses. However, both the intentional capture of wild seahorses and their trade was illegal. Fisheries officials cited the uniqueness of seahorses and population declines as reasons for the prohibition, adding that, in the absence of scientific knowledge about these species, the Mexican Government was being cautious. Many marine products traders throughout the country believed that seahorses were endangered, and that the sale of dried seahorses was therefore illegal. No research, however, had been done on seahorses in Mexico, and the status of local populations was unknown.

The capture of ornamental fishes was prohibited in Mexico from the mid-1990s until 1999. In 2000, only two new licences (Permiso de Pesca de Fomento) had been issued for the collection of ornamental fishes, and seahorses were not included in the list of permitted species. The new licenses required collectors to pay for the monitoring of the fish populations they collect from. There appeared to be little control of the trade in aquarium fishes, which did include seahorses. A few aquariums noted that, in order to sell seahorses, they required receipts that listed the seahorses' origin. Some aquariums obtained this documentation by importing a few seahorses and then purchasing others on the black market. One diver admitted that since their catch was not inspected, prohibiting the capture of seahorses had had no effect. Indeed, a few fisheries officials admitted that there was little enforcement of laws within the aquarium trade.

Most seahorses traded were landed as bycatch in Mexico's shrimp trawl fisheries. The Pacific coast fleet was closed from March or April until September, and the Caribbean fleet was closed from May until the end of July. It was mandatory for trawl gear to be equipped with turtle excluder devices (TEDs), and trawling was prohibited in bays. Bycatch was not recorded in a systematic manner in the shrimp fishery. When target catches were low, however, the total bycatch quantity or the bycatch of commercial species that were been retained for sale was sometimes noted in official catch records. According to a Fisheries official, monitoring and enforcing regulations in these fisheries was hindered by limited resources and by the size of the fleets and fishing grounds.

There were several protected marine areas along both coasts of Mexico, including two Biosphere Reserves. Although the level of enforcement was unknown, these reserves should provide some level of protection for seahorses.

SEAHORSE CATCHES IN MEXICO

Target fisheries

No target fishery for seahorses was located on the Caribbean coast, although two respondents elsewhere mentioned that in the past there had been a few divers in Veracruz and Cancun.

Both divers in Mexico who held licenses in 2000 for the collection of ornamental fishes (not including seahorses) were located on the Pacific coast, in La Paz and Loreto, Baja California respectively. They denied catching seahorses. Other respondents suggested that artisanal fishing co-operatives in these two areas might occasionally target ornamental fishes, including seahorses, but no direct evidence of this was found.

H. ingens, however, was targeted on the Pacific coast as part of the black market in aquarium fishes, in Acapulco, and perhaps also in Puerto Vallarta, Manzanillo, Ixtapa, Huatulco and Puerto Escondido. Co-operatives of hookah divers in Acapulco primarily targeted seafood (oysters etc.), but caught ornamental fishes, including seahorses, to earn extra income (illegally, as they did not have permits). According to divers and aquarium traders, in 2000 there were likely 10-15 divers selling seahorses in the area. An experienced diver said the number of divers had increased from three when he began in the mid-1980s. Divers supplied aquarium fishes to Mexico City's two wholesale aquarium markets, and this trade-route was well-established.

Two of three divers in Acapulco reported that catches increased in the rainy summer season (May-October). An experienced diver, who usually covered an 80m² area during 4-5 hours of diving a day, reported that in the "best time" (June-July) he could catch 10 seahorses/hour and usually sold about 30/month. In contrast, during the dry season he could hardly find seahorses. A young diver explained that during the rainy season seahorses were near the water surface. He caught 80-120 seahorses/month (max. 320) in the rainy season, compared to only 16-80/month at other times. A diver, who did not target seahorses, said he still came across 2-3 per week by chance. If even half of the divers in this area opportunistically caught seahorses, collectively they could have caught at least 1,380 to 1,932 seahorses per annum [5-7 divers x (6 months x 30 seahorses/month + 6 months x 16/month)]. If all divers were involved, the catch could have been much higher [between at least 2,760 and 4,140 seahorses based on 10-15 divers x (6 months x 30 seahorses/month + 6 months x 16/month)].

In Mazatlán, an aquarium employee had heard of a group of divers who apparently collected 200 seahorses locally in one trip in 1999 for a prospective seahorse culturist. He commented that fishers knew where to find seahorses. The aquarium's manager agreed and said that divers had found out people were interested in seahorses, and were overfishing them.

Bycatch

Commercial Fisheries

All dried seahorses entering the international seahorse trade were caught as a bycatch of Mexico's commercial shrimp trawl fisheries.

The five principal shrimp trawl ports in the Gulf of Mexico and Caribbean coast were surveyed. The fleet comprised 658 boats (x 70% presumed operational at any one time = 461), each equipped with four nets 12-15 m in length, with mesh of 2.5-5 cm. Shrimp fishers targeted brown (*Peneaus aztecus*), pink (*P. duorarum*), and white shrimp (*P. setiferus*). Although some boats fished within their home state, others fished along the entire Mexican coast. During 20 to 30 day trips, trawling either took place day and night, or at night only. Boats usually did 4-hour trawls, but tows could last up to 6 hours depending on the bottom substrate. Some seahorses were still alive when nets were hauled. Although six fishers reported that they returned live seahorses, most seahorses caught in this fishery were retained and dried.

Almost half of the shrimp fishers interviewed in the Gulf of Mexico and Caribbean (n=15) reported that seahorses were a very rare incidental catch in this fishery. According to eight fishers, boats in Tamaulipas (TM) and Veracruz (VZ) States typically caught only a few seahorses per monthly trip (mean=5.6). Sixteen

fishers estimated catches of about 10 seahorses per month, and occasionally up to fifty or sixty in Campeche State (CM; mean=15.9). Fishers reported the highest catches in the Caribbean (CR): 25 seahorses per trip on average, and a few hundred per trip in the best areas (mean=64.5, n=13). Accounting for regional differences, this fleet may have from 53,000-60 000 seahorses per annum² (125-140 kg; Table 2).

The Pacific fleet had over 1,300 boats and the three major ports surveyed (Mazatlán, Guaymas and Salina Cruz) represented over 90% of the fleet. Boats fished along Mexico's entire Pacific coast and in the Gulf of Baja California. Most boats were equipped with two nets of 25-32 m length, with mesh sizes of 5.0-6.5 cm in the main net and 3.2 – 4.5 cm in the cod end. During trips of 15-30 days, fishers primarily targeted brown (*Penaeus californiensis*), blue (*P. stylirostris*) and white shrimp (*P. vannamei*). Tows of one to four hours were made continuously, day and night. Fishers said that most seahorses were alive when brought onboard, but almost all were retained for personal use as curiosities or for sale (n=20 fishers).

Catch estimates for the Pacific coast were provided by twenty-two shrimp fishers, one fishing port guard, and one biologist working aboard a research vessel. Seven fishers on the Pacific coast reported that seahorse catches were infrequent, and three fishers said that seahorses could no longer be found in the areas in which they fished. According to four fishers in Guaymas and Mazatlán, however, catches were still high at the beginning of the shrimp season, when three-hour trawls could yield between 20 and 40 seahorses. Outside of this time, typical trawls caught only a couple of seahorses. Monthly catch estimates varied considerably, from 0 to 375, with mean 45 ± 14 s.e. (n=17). Collectively, this large fleet may have caught 199,423 – 379,547 seahorses (834 -1,587 kg) per season [1,313 boats (919 operational) x 7 month fishing season x 31-59 seahorses/month/boat; 4.18 g per seahorse]

Seahorse bycatch was not generally recorded, but a catch record from the Pacific coast in 1999 indicated that ~60 kg of seahorses were caught by one boat (within one season) and sold, likely by the boat's owner reported (SEMARNAT, 1999). If correct, this record indicates substantially greater seahorse catches than fishers.

Artisanal Fisheries

Artisanal fisheries generally appeared to catch few seahorses and very few of these entered Mexico's seahorse trade. Indeed, ten artisanal fishers explained that they did not catch seahorses at all, either due to their gear type or fishing area. Most artisanal fishers who did catch seahorses returned them, but some fishers occasionally dried and kept them as curiosities. Only two fishers mentioned that they very rarely were able to sell a few dried seahorses. Consequently, surveying effort concentrated on Mexico's trawl fisheries, and this section offers only a brief overview of artisanal fisheries.

Table 2. Commercial shrimp trawl fleet size and annual seahorse bycatch estimates. Based on the mean weight of dried specimens obtained by the author, there were 425 seahorses/kilogram on the Caribbean coast and 239 seahorses/kilogram on the Pacific coast. Sources: * SEMARNAT, 2001a, 2001b; + Author's research.

Coast	Source	Operating Fleet Size*	Annual bycatch estimates ⁺		
			Per boat (kg)	Per total fleet (# seahorses)	Per total fleet (kg)
Caribbean	fishers	461	0.27-0.30 kg	53,230-59,528	125-140
Pacific	fishers	919	0.91-1.73 kg	199,423-349,547	834-1,587
	Government catch record		One boat: 60 kg		
Total		1,971		355,000-620,000	1,355-2,449

² TM & VZ: 312 boats (218 boats operational) x 9- 10 trips/annum x 5.6 seahorses/trip = 10987-12208; CM: 311 boats (218 boats) x 8-9 trips x 15.9 = 27,730-31 195; CR: 35 boats (24.5 boats operational) x 9-10trips/annum x 64.5 seahorses/trip = 14,512.5 – 16,125; Total = 53,230-59,528 seahorses @ 2.35 g per seahorse

According to three beach seine (chinchorro) fishers, this gear very rarely caught seahorses. One trader had purchased live seahorses from seven artisanal beach seine fishers in Acapulco in the mid-nineties. The author interviewed one fisher in 2000 who sold live seahorses to local buyers and buyers from Mexico City. Mesh size of beach seine nets was 5.7–6.4 cm.

Gill nets (agallera) very occasionally caught seahorses as bycatch (n=2). One fisher thought it possible to catch one to three seahorses in 24 hours at certain times, but stated that, in general, he did not catch many. Gill nets were set in depths of approximately 10-12m. Mesh sizes varied from 3.8 –11.4 cm depending on the size of the target fish.

Many artisanal fishers commented that the mesh they used was too large to catch seahorses. It is possible, however, that seahorses were taken as a bycatch of many other artisanal fishers using small-meshed nets, such as oyster and sardine fishers. One oyster fisher said he might catch 1-2 seahorses/month.

DRIED SEAHORSE TRADE IN MEXICO

Domestic trade

The domestic curio trade in seahorses was widespread on both coasts, likely because almost every coastal town supported at least some tourism.

Caribbean Coast

Seahorses were sold as curios in Tampico, Veracruz, and Cancun, but not in Ciudad del Carmen or Campeche. The author located only twelve curio traders on this coast, but more traders may operate in the Cancun area. Most seahorses in the curio trade were caught by the Caribbean shrimp fleet and sold locally by Level 2 buyers. However, two of the well-established buyers in this trade obtained their seahorses from the Pacific shrimp fleet. Nine curio traders on the Caribbean coast had only begun selling seahorses in the past few years, but three buyers in Veracruz had sold seahorses for several decades.

Trade was heavily dependent on tourist seasons: curio traders (Level 2) reported that they generally sold a few seahorses per month, with substantial increases during holiday periods, including carnival (March); Easter (Semana Santa); in the summer and during December. Ten curio traders provided volume estimates that ranged from 12 to 800 seahorses per annum. Based on their estimates, the curio trade on this coast likely consumes a few thousand seahorses each year (1,400-2,300, or about 3-5 kg).

Pacific Coast

Most seahorses that entered the curio trade on the Pacific coast were also caught by shrimp fishers. Fishers who stopped at more than one port along the coast, could choose the best location to sell their seahorses. For instance, one fisher commented that it was easier to sell seahorses in Guaymas, than in Mazatlán. In Baja California, some seahorses were also caught by hand by artisanal fishers, and in Acapulco divers supplied some of the seahorses in the curio trade.

Twenty-seven curio traders were located along the Pacific coast. Most stores had started selling seahorses within the last decade (1990s), but in each of Mazatlán, Puerto Vallarta and Acapulco, one store had sold seahorses for over ten years. And in Guaymas a store that specialized in shell craft had sold seahorses for fifty years. Curio traders sold seahorses to both Mexican and international tourists, and many reported that Mexican tourists were the more common buyers. Again, trade was closely linked to the tourist seasons described for the Caribbean. Seahorse supply was limited in Puerto Vallarta, where several people knew the capture of seahorses to be illegal.

Estimated annual seahorse sales from twenty-three of the traders ranged from 5-1000. Combining their estimates and that of one supplier who sold 3,300 seahorses annually to other traders, yields a total estimate of 5,200- 5,800 dried seahorses to tourists per annum (17-19 kg). Although the major tourist areas were surveyed, seahorses may also be traded in other areas along the coast (respondents suggested Manzanillo and Playa Azul). This figure should therefore be taken as a minimum.

Exports

Caribbean coast

On the Caribbean coast, seahorses were exported to Japan from Lerma and Campeche by shark fin traders. A retired fisher in Lerma explained that, since about 1990, he had gathered seahorses from shrimp fishers. His buyers came to the port to purchase both seahorses and sharks fins (caught in the local shark fishery). A vendor in a fish market (Level 2) in Lerma also sold seahorses to shark fin buyers. He reported that middlemen (Level 3) came from Champoton, Campeche twice a week to make purchases on behalf of one exporter (Level 4). The vendor obtained seahorses from shrimp fishers, upon request from the middlemen, who would buy all available. The exporter reportedly traded primarily in shark products, but occasionally purchased seahorses “when there was demand”. According to the fish vendor, this exporter purchased shark fins from all over Mexico for export to Miami, Los Angeles (both in U.S.A.) and Japan. He believed the exporter to be one of the principal buyers, but said there were “various (other) buyers”. Two other sources confirmed that shark fin traders purchased seahorses. Volume estimates for this trade were not possible.

It is possible that there were also other exporters on this coast. Fishers in Ciudad del Carmen, Lerma and Cancun reported that a few buyers (either from Mexico City, Veracruz, or the Caribbean) came to their port to buy seahorses from all local boats—whether for export is uncertain. Three fishers in Cancun mention specific people they believed to be exporters: (i) a local German buyer had been purchasing seahorses locally since 1996. She apparently bought all the seahorses fishers had each time, but the volume and destination of these fishes was unknown; (ii) a “medium-size” exporter from Puebla apparently bought seahorses from Campeche and Isla Mujeres from about 1986-92; (iii) an exporter from Ciudad del Carmen bought both seahorses and pipefish at the same time, in the same locations as the second exporter.

Pacific coast

Many exported seahorses were likely sourced from shrimp fishers in Sonora and Sinaloa states on the Pacific coast, since over eighty percent of the fleet was located in these two states, and fishers and traders there were familiar with seahorse exporters. According to fishers and fisheries officials, seahorses were exported to Los Angeles en route to Asia, or sent directly to Asia. The trade in Guaymas, Sonora and Mazatlán, Sinaloa involved at least 5 exporters in 2000, and possibly an additional five to six in 1999:

- According to fisheries officials, an NGO and some fishers, one local fish buyer controlled the seahorse trade in Guaymas, Sonora. This buyer’s employees likely operated as intermediate seahorse buyers, although they denied any involvement in the seahorse trade.
- A well established curio trader (Level 2) in Guaymas knew of three other dried seahorse exporters operating from Guaymas who sent seahorses to the US and then onwards to Asia to be made into capsules for medicines. These exporters included a Chinese man who bought at least 500 seahorses from the curio trader annually, and a Korean man who bought “1000s of seahorses and exports them”. Another Chinese buyer in Alamos, Sonora, who bought several hundred seahorses per year from the curio trader, may also have exported them.
- A curio trader (Level 2) in Mazatlán had apparently sold up to 2,000 dried seahorses per annum from 1998-2000 to a Chinese exporter. These seahorses were exported to Asia for TCM.
- Another level 2 curio buyer in Guaymas reported that in 1999 five or six exporters came to buy seahorses for direct export to Asia.

As none of these exporters was interviewed directly, the magnitude of their businesses remains unknown.

While only two shrimp fishers further south on the Pacific coast knew of seahorse exports to either the U.S. or Mainland China, nine reported past seahorse exports from Salina Cruz, Oaxaca and Pto. Madero, Chiapas to Japan. The earliest accounts from fishers were from the late seventies and early eighties, but most fishers said that this trade had occurred sometime between 1985 and 1995. Japan may have either produced patent medicines from these seahorses (use of dried seahorses as raw medicinal ingredient is low) or re-exported them, potentially to Mainland China. As Japan does not record Customs data on seahorses, however, this could not be confirmed. Since exports from these areas were not ongoing at the time of the survey and there were no official export records concerning this trade, it was difficult to accurately determine the magnitude of this former trade.

According to shrimp fishers, Japanese companies (Level 3) monopolized the dried seahorse trade during this time period, buying all available seahorses from “all boats”, through five to fifteen Mexican intermediates (Level 2). One fisher said buyers came to the port daily, while another commented that buyers controlled the trade by giving payment in advance. Fishers reported that at the time of the trade, seahorse catches had been much higher, estimates varied between 180 and 3,000 per 15-day trips. Based on the mean catch estimate, if these exporters had accessed seahorse bycatch from even half of the Oaxaca licensed boats, they could have exported about 600,000 seahorses per annum (2,500 kg; 50 boats x 7 month fishing season x 1,700 seahorses/month/boat).

Almost all fishers involved in the trade (n=7) said that the Japanese buyers, who had been interested only in purchasing large quantities of seahorses, had left in response to declining catches. The two fishers who still knew of buyers said there were fewer of them in 2000.

Imports

A shrimp captain on the Pacific coast of Guatemala reported exports of seahorses to Mexico in 1992 for use as aphrodisiacs. Based on the captain’s estimates, this buyer may have exported 3.5 to 5.8 kg dried seahorses that year. The exporter paid US\$0.19-US\$0.29 (at 1992 exchange rate). It seems likely that the seahorses were re-exported to Asian end users, since seahorses were not used as aphrodisiacs in Mexico.

One shell craft trader in Acapulco imported seahorses from the Philippines for the curio trade and estimated his annual sales at about 110 seahorses per annum.

Volumes

Customs data from Mainland China, Hong Kong, and the United States for the 1990s indicate that dried seahorse exports from Mexico varied greatly, from 35 to 7,661 kg per annum (Table 3). In 1990, Mainland China listed Mexico as their fourth largest seahorse supplier (by volume), and Mexican seahorses as the third most valuable (at US\$137/kg). Mexico is not cited in later records from Mainland China (1993-99), but seahorses from Mexico have been re-exported from Hong Kong to Mainland China. In 2000, Hong Kong Customs recorded Mexico’s largest seahorse export: 7,630 kg of dried seahorses declared at a value of US\$129,487, almost all of which was re-exported to Mainland China. Although Mexico was one of Hong Kong’s largest seahorse suppliers in 2000, Hong Kong recorded no seahorse imports from Mexico in either 1998 or 2001. Between 1996 and 2000, Mexico also exported about 35 kg of seahorses to the United States each year. Seahorses exported to the USA had substantially lower values than those exported to Asia.

It is difficult to get a complete picture of Mexico’s seahorse exports, without Mexico Customs data or estimates from seahorse exporters, and because other Customs records may be incomplete (Table 3). Certainly, Mexico is capable of exporting 100s to 1,000s of kg of dried seahorse per year, supplied from the bycatch of its shrimp trawl fisheries. The official exports are within estimates of annual seahorse bycatch, with the exception of the 2000 report by Hong Kong of 7,630 kg. This figure is plausible if, as the one official catch record suggested, fishers underestimated seahorse bycatch: each boat would have had to catch 3.86 kg per annum. Considering, however, that buyers don’t access the entire fleet (e.g. only sixty per cent of shrimp fishers interviewed on the Caribbean coast (n=16) were aware of seahorse commercialization), boats would have had to catch even more seahorses to supply this quantity to Hong Kong. Alternatively, seahorses may have stockpiled from previous years, or some of them could have been imported from somewhere else first (see ***Dried seahorse trade in Mexico: Imports***).

Values

Values in Mexican pesos were converted to U.S. dollars using the mean rate of exchange during the time of the interviews (US\$1=Ps9.46; available at <http://www.oanda.com/convert/fxhistory>).

Table 3. Dried seahorses exported from Mexico to Mainland China, Hong Kong or U.S according to the respective countries' Customs data. Note: Hong Kong has recorded dried and live seahorses and pipefishes as separate line items since 1 Jan 1998. Sources: Mainland China Custom Data; Hong Kong Custom Data; United States Custom Data.

Year	Destination	Quantity (No.)	Quantity (kg.)	Total declared value	Declared value/kg
1990	Mainland China	-	131	US\$18 000	US\$137.4
1996	United States (country of origin unknown –sent via Mexico)	1	-	US\$0	US\$0
1997	United States	9	-	US\$48	-
	United States	-	35	US\$120	US\$3.43
1998	United States	449	-	US\$476	-
	United States	-	38	US\$151	US\$3.97
	Hong Kong	-	-	-	-
1999	United States	6	-	US\$20	-
	United States	-	36	US\$75	US\$2.08
	Australia (via United States)	50	-	US\$100	-
	Hong Kong	-	140	HK\$139,000 (US\$17,913.66)	US\$127.95
2000	United States	-	31	US\$30	US\$0.97
	United States	1	-	US\$5	-
	Hong Kong	-	23	HK\$20,000 (US\$2 566.64)	US\$111.59
	Hong Kong (re-exported to Mainland China)	-	7,607	HK\$989,000 (US\$126 920.16)	US\$16.68
2001	Hong Kong	-	-	-	-

In 2000, fishers on the Caribbean coast sold dried seahorses for Ps1-5 each (US\$0.11-0.53); others bartered them for goods. Curio traders sold seahorses to tourists for Ps10-70 each (US\$1.06-7.40).

On the Pacific coast, fishers who sold seahorses individually were paid Ps1-5 (US\$0.11-0.53). However, one fisher in Mazatlán and one in Salina Cruz said they were paid Ps10 per seahorse (US\$1.06). One fisher explained that price varied by region: he was paid Ps5 per seahorse in Mazatlán, but only Ps3 in Guaymas. A curio trader in Puerto Vallarta, who obtained seahorses through a Level 2 buyer instead of a fisher, paid her supplier Ps15-20 per seahorse (US\$1.58-2.11). Curio traders sold dried seahorses for Ps9-69 (US\$0.95-7.29); seahorse pens and key-chains for Ps9-47 (US\$0.95-5); and framed artwork for Ps85-115 (US\$8.98-12.15). One store that carried dried seahorses from the Philippines sold them for Ps55 each (US\$5.81). Two curio traders reported that the selling price of seahorses had risen from Ps3-5 ten years prior (Table 4).

An exporter in Guaymas, apparently paid fishers Ps350/kg dried seahorse (US\$36.98/kg.). A Level 2 buyer in Mazatlán sold seahorses to a Chinese exporter for Ps5 each (US\$0.53). In Salina Cruz, Japanese exporters (or their middlemen) had paid fishers Ps0.50-5 per seahorse (then US\$0.18-1.18). According to fishers there, exporting seahorses had been a profitable business.

Table 4. Value of seahorses in dried trade by coast. Source: Author's research.

Coast	Amount paid to fishers	Amount exporter paid buyer	Cost of seahorses in domestic curio trade	Cost of imported seahorses in domestic curio trade
Caribbean	Ps1-5 each (US\$0.11-0.53)	?	Ps10-70 (US\$1.06-7.40)	-
Pacific	Ps1-5 each (US\$0.11-0.53), Ps350/kg (US\$36.98/kg)	e.g. Ps5 each (US\$0.53)	Ps9-115 (US\$0.95-12.15)	e.g. Ps55 each (US\$5.81)

LIVE SEAHORSE TRADE IN MEXICO

The aquarium trade in Mexico developed in the late-1980s. Commercial aquarium fisheries were prohibited during the mid-1990s, but by 2000 two collection permits had been issued. Two experienced aquarium traders believed the trade had peaked in the early nineties before the devaluation of the Mexican peso in 1994. Most seahorses were caught illegally on the Pacific coast. By 2000, Mexico had the most developed domestic aquarium trade in Latin America, next to Brazil, in terms of volume and husbandry techniques (pers. obs.; Wood 2001).

Mexico's aquarium trade primarily operated through two wholesale aquarium markets in Mexico City. At Market 1, some wholesalers sold fish cheaply, directly from plastic bags to avoid having to acclimate them. A well-established wholesaler (A) there said that customers were concerned with price rather than quality of the product. Ornamental fishes at Market 2 had a high turnover rate, since as one hobby shop owner noted, wholesalers there sold their fish quickly before they died. Aquarium traders usually kept seahorses alone in tanks because seahorses could not compete for food or defend themselves against other fishes. Generally no holdfasts were provided in the tanks, and seahorses were sometimes observed clinging to the air pumps.

A wholesaler trading in domestic seahorses said his seahorses suffered high mortality. He maintained seahorses at his shop for a maximum of two months, and said that during shipments from the source area seahorses were kept in plastic bags for 48 hours. According to three wholesalers who imported seahorses mortality was generally low. Seahorses were said to be in transit from Los Angeles (USA) for 6-12 hours, and they maintained them for a maximum of one week at their shops. Differences in prices paid by wholesalers for seahorses imported through Los Angeles (USA) may have partially reflected acclimation time there prior to shipment. Hobby shops reportedly maintained seahorses for up to two months. Mortality due to disease was infrequent, but several traders reported that seahorses sometimes quit eating and subsequently died.

Trade routes and domestic trade

Trade routes in live seahorses were complex. Seahorses were available from many different sources and the number of trade routes they passed through en route to retail hobby shops was variable. Domestic seahorses were either cultured in Mazatlán or illegally wild-caught on the Pacific coast (mainly in Acapulco). Wholesalers also imported seahorses from Asia (often via the United States), or Brazil. Wholesalers at the aquarium markets obtained seahorses from one to several of these sources, and their seahorses were distributed throughout Mexico. Traders often operated on several levels. For example, some retailers bypassed wholesalers; wholesalers sometimes bypassed middlemen, buying domestic seahorses direct from the source or selling them directly to aquarists; and some wholesalers also supplied seahorses to other wholesalers.

Ten seahorse wholesalers were located in Mexico City, half of whom had seahorses in stock (Table 5). In general, wholesalers were guarded with their answers and would not reveal their contacts in the business. Two wholesalers (A & B) at Market 1 were believed to be the main distributors in Mexico. Wholesaler A obtained seahorses from two aquarists in Mexico, and imported seahorses from at least Brazil and the Indo Pacific. Wholesaler B imported seahorses from at least Indonesia. The two other seahorse wholesalers at market 1 also each believed himself to be the most important marine fish distributor (including seahorses) in Mexico.

Seahorse wholesalers were also located in other cities (Table 5). In Guadalajara, there were four wholesalers (K-N), two of whom were primarily retailers, who occasionally distributed to other hobby shops in the area. Three wholesalers for marine fishes were reported from Monterrey, although nothing is known about their trade.

In total, fifty-four retail aquarium shops were located in Mexico that sold seahorses. There are several large cities in Mexico that were not surveyed in which live seahorse trade may occur, thus this number should be interpreted as a minimum. Of the 100 aquarium retailers listed in Mexico City's 1999 Yellow Pages, 42 sold marine fishes, of which thirty-six sold seahorses. Twenty-six retailers sold imported

Table 5. Trade routes for live seahorses in Mexico. Wholesalers are coded by letter from A-M. Source: Author's research.

Location	Trader	Source of Supply	Year began trading	Destination
Market 1, Mexico City	A	Indopacific; Brazil; Cultured in Mexico	1992	Marine fishes to: 100 wholesalers, 1000 hobby shops in Mexico Marine fishes to wholesalers in 25 states; hobby shops in Mexico City public; some hobby shops wholesalers in each state; public
	B	Hawaii and Asia	1992-1994?	
	C	Acapulco	~1983	
	D	Hawaii, Jakarta, (Indonesia), Philippines	1993	
Market 2, Mexico City	E	Unknown	?	public, hobby shops (?)
	F	wild-caught in Mexico	?	hobby shops
	G	Fiji; Acapulco	1990	hobby shops-Mexico City, other states
	H	Philippines (through L.A.); Cultured (through A?)	1992	hobby shops, public
Hobby Shop, Mexico City	I	wild-caught in Mexico	1999	15 hobby shops in at least Salina Cruz, Acapulco, Ciudad Victoria, Cancun
Market 1, Mexico City	J	Imported & Cultured (through Wholesaler A); Acapulco	1994	25-30 hobby shops
Hobby Shop, Guadalajara	K	Imported & Cultured (through Wholesaler A)	~1992	4-6 hobby shops in Guadalajara
	L	through Wholesaler B	~1986	7 local hobby shops, 2 in Tapitalan
	M	Unknown, through L.A.	?	hobby shops in Guadalajara
	N	through Wholesaler A	?	hobby shops in Guadalajara

seahorses, three sold domestic, three sold both imported and domestic and four were unknown. Only nine of these retailers had seahorses in stock during the 2000 survey.

In Guadalajara, thirteen out of thirty aquariums listed in the 2000 Guadalajara Yellow Pages sold marine fishes. Each of these sold seahorses, but only three said they normally had them in stock. During the 2000 survey, only trader L had seahorses in stock. Ten hobby shops sold imported seahorses (from Hawaii, Indonesia, Australia or Asia), one sold domestic seahorses, and three were unknown. On the Pacific coast, three hobby shops in Acapulco and two in Puerto Vallarta were found that sold seahorses.

Exports

The export of wild-caught seahorses is illegal, since their capture is prohibited. However, one wholesaler in Mexico City admitted that he exported wild-caught seahorses to the U.S. He said his business was small and estimated that he only sold 1,000 seahorses annually (including domestic sales). He commented that supply fell short of demand, and projected that if he could obtain 400 seahorses/month he could easily export them all. A second wholesaler believed seahorses were being exported from La Paz and Ensenada (Baja California) to the U.S and another trader had exported *H. ingens* to an aquarium in the U.S. Other traders denied that seahorses were exported from Mexico.

Exports of seahorses from Puerto Vallarta to Los Angeles (USA) occurred from the late-1980s to early-1990s. Volumes traded in this business are unknown. The exporter explained that when the government prohibited the ornamental fish trade in the mid-1990s legitimate businesses such as his had been shutdown.

Technically, exports of cultured seahorses were permitted. However, in 2000 there was no method to distinguish cultured from wild-caught seahorses. Wholesaler A reportedly had a permit for such exports, and said companies in Belgium, the UK, and the U.S. were interested in purchasing cultured seahorses from him, although they would cost more than wild-caught seahorses. He predicted that in order to maintain his business that he would have to start exporting.

Imports

Seven wholesalers in Mexico City's aquarium markets and one wholesaler in Guadalajara imported seahorses for distribution. Seahorses were imported from Fiji, Hawaii, and the Indo Pacific (Philippines, Indonesia) through Los Angeles, U.S., and by one of the wholesalers directly from Brazil. Some of these seahorses may have been first exported through Singapore. Imported live seahorses were common primarily because the trade in wild-caught seahorses was prohibited. Wholesalers also reported that by importing it was possible to obtain more types and colours of seahorses, and that, depending on the source country, imported seahorses were cheaper than domestic ones. The cost of shipment from Los Angeles to Mexico City was also cheaper than from Mazatlán to Mexico City. Most wholesalers declared these seahorses as being of U.S. origin so that they could purchase them duty free (due to NAFTA).

Using wholesalers' individual estimates yields a total import estimate of 4,400 to 7,100 seahorses per annum in the late-1990s and 2000 (Table 6). However, no official records of the live trade were obtained in Mexico. International Customs data indicate only that in 1996, 36 wild and 6 captive-bred live seahorses were exported from unknown source countries through the U.S. to Mexico at declared values of US\$111 and US\$10 respectively (United States Customs data). The seahorses accounted for over half of recorded U.S. exports that year. Mexico neither appeared in later U.S. export records (1997-2000), nor in Europe's records for 1997-1999. These records should be considered as incomplete, however, as wholesalers in Mexico City reportedly imported live seahorses throughout the late-1990s, and the companies in Los Angeles through which wholesalers reported imports were not listed in U.S. records.

Wholesalers who commented said that they could not obtain seahorses year-round. Six traders interviewed in January who did not have seahorses said they had not had any for two to six months.

Volumes

In total, the author estimates that between 8,200 – 14,600 live seahorses were traded domestically in 2000. Seahorses in the live trade were either wild-caught in Mexico (2,100–5,000), captive-bred in Mexico (1,700–2,500) or imported (4,400-7,100). Some additional trade may occur outside of the areas surveyed.

Values

In general live seahorse traders were reluctant to disclose their buying prices for seahorses. Prices approximately doubled at each subsequent trade level.

Divers sold wild-caught seahorses to Level 2 traders for Ps20-50 each (US\$2.11-5.28). One such trader in Acapulco then sold seahorses to wholesalers in Mexico City for Ps80-90 (US\$8.45-9.51), one of whom sold the seahorses for Ps80-140 (US\$8.45-14.79). Seahorse prices in hobby shops ranged from Ps120-400 for regular or small specimens (mean Ps223 (US\$23.56), and Ps220-600 for large and/or red seahorses (mean Ps390 (US\$41.20; Table 7).

Cultured seahorses (*H. ingens*) were sold by one aquarist to Wholesaler A in Mexico City according to size: 5-6 cm seahorses for Ps18 (US\$1.90), 6-8 cm seahorses for Ps22 (US\$2.32), 8 cm-11 cm seahorses for Ps25 (US\$2.64). The aquarist mistakenly believed that cultivated seahorses were more expensive than wild-caught seahorses because of the expense of the operation.

Table 6. Volume estimates of primary wholesalers for imported seahorses. Source: Author's research.

Trader	Source Country	Annual volume estimate
A	Indopacific Brazil	~ 1300 2000-2500/yr between 1995-1997; 1000 in 1998
B	Hawaii; Asia	40-60/week x 39 weeks= 1560-2340
D	Hawaii, Jakarta, Philippines	312-364
E	?	16-36
G	Fiji	2
H	Philippines	80/month ¹ x estimated 1-6 months =80-480
M	Unknown	?
Retailer	direct from Brazil	96
Grand Total:		4366-7118

¹ depending on the breeding season

Table 7. Value of live seahorses traded in Mexico, by source and trade level. Source: Author's research.

Seahorse Source	Amount Level 2 buyer paid diver	Amount paid by wholesaler	Amount paid by hobby shop	Selling price in domestic trade
Domestic – Wild-caught	Ps25-50 (US\$2.64-5.28)	Ps80-90 (US\$8.45-9.51)	Ps80-140 (US\$8.45-14.79)	Ps223 (US\$23.56); Ps390 (US\$41.20) for large and/or red
Domestic – Captive-bred	-	Ps18-25 (US\$1.90-2.64)	Ps60-250 (US\$6.34-26.41)	?
Imported	-	US\$0.75-7	Ps120-150 (US\$12.68-15.85)	Ps255 (US\$26.94)

A second aquarist reportedly sold seahorses to Wholesaler A for Ps5/cm seahorse at a minimum size of 6 cm. Wholesaler A reported that the range of prices for cultured seahorses was US\$1-5, and that he sold them for double the buying price. A wholesaler who purchased cultured seahorses from Wholesaler A paid between Ps35-100/seahorse (US\$3.70-10.56). In turn, he sold them for Ps60-250 each according to size (US\$6.34-26.41; Table 7).

Imported seahorses, in particular those from the IndoPacific/Philippines, were said to be cheaper than domestic seahorses. Black seahorses (~20 cm) imported through Los Angeles from the IndoPacific cost Wholesaler A US\$3.45 each, while those from Sri Lanka cost only US\$0.75-1.00 each. Wholesaler A imported *H. reidi* from Brazil according to size and colour: small for US\$1.60, medium marbled for US\$3-3.50, medium bright for US\$7. Again, he sold seahorses for double the buying price. Other wholesalers in Mexico City sold imported seahorses to hobby shops for Ps120-150 (US\$12.68-15.85). In turn, hobby shops (n=15) sold live seahorses to the public for between Ps 100-600 (mean = Ps255 (US\$26.94; Table 7).

One trader commented that the cost of maintaining marine aquariums limited the number of people in Mexico who had them. Angelfish (*Pomacanthus annularis*) were priced similarly to seahorses at Ps250 (US\$26.41), while surgeonfish (Acanthuridae) were much more expensive, at Ps1,900 (US\$200.73).

Sources

Wild caught

Because the live trade in wild caught seahorses in Mexico was illegal, many of the respondents involved in it would not provide volume or value estimates, or name their contacts. To estimate the total trade, wholesalers' estimated total sales were cross-validated with those of suppliers and with estimated total catches of divers.

Wild seahorses (*H. ingens*) illegally sold for the live trade market in Mexico City were primarily from Acapulco. Based on the following estimates, it appears that a few thousand seahorses have been supplied from Acapulco to Mexico City per annum since at least 1992. A former Level 2 buyer who sold seahorses from 1992-97, believed that in 1992 he had been one of only two suppliers in Acapulco, and the main supplier of domestic seahorses to Mexico City. This buyer had purchased all available seahorses from 12 divers and 7 beach seine fishers. He reported that in addition to supplying seahorses to 13 wholesalers at the aquarium markets in Mexico City, he had also shipped seahorses to hobby shops in Monterrey, Leon, Guadalajara, Saltillo and Ensenada. This buyer estimated that his peak sales were in 1992 when he sold 1,600-2,000 seahorses and that sales declined to 780-1,100 seahorses per annum in 1996, as the trade developed and wholesalers from Mexico City began to buy directly from divers in Acapulco.

Five wholesalers (C, F, G, I, J) traded wild-caught seahorses in 2000, three of whom obtained seahorses directly from divers. Wholesaler G, who obtained seahorses directly from divers in Acapulco said he often purchased 20-30 seahorses per week, but that annual sales were highly variable, totalling between 80 and 1,000. Four other wholesalers (C, F, I and J) estimated annual sales of 192 - 256, 600 - 1,000, 36, and 200 - 240 seahorses, respectively, for a total of 1,000 and 2,500 seahorses per annum.

In 2000, respondents named seven Level 2 buyers who supplied seahorses from Acapulco in addition to the wholesalers who obtained seahorses directly from divers. The author interviewed three of these buyers³. Divers in Acapulco reported that these buyers always purchased all their available seahorses. The first buyer owned an aquarium retail shop in Acapulco, and supplied seahorses to wholesalers at both aquarium markets in Mexico City, and also occasionally directly to aquarium shops in Mexico City. She had sold seahorses for 15 years, and obtained them from about ten divers. She bought 15-20 seahorses per week (20-30 during rainy season of May-October) and sold all of them each week (500-1,040 seahorse per annum⁴). She reportedly never turned seahorses away. The second buyer, a diver in Acapulco, supplied up to ten seahorses per week⁵ from himself and 3-5 other divers to 5-6 hobby shops and one wholesaler in Mexico City. The third buyer generally bought 5-20 seahorses per week, and at times purchased as many as 25 seahorses a week⁶. Together these three buyers may have traded 1,000-2,430 seahorses per annum to wholesalers in Mexico City (perhaps including wholesalers beyond the known five). Thus, the total estimate of seahorse supply from Acapulco (three wholesalers buying directly plus three intermediate buyers) is 1,900-4,700⁷, still within the possible estimated range of the divers' total catch. Volumes traded by the other four buyers are unknown, as is the destination of their seahorses.

Seahorses were also supplied to the live trade from Puerto Escondido. According to a shark fisher, live seahorse trade began there in 1990, with buyers purchasing for aquariums in Mexico City. He recalled specifically that from 1994-99 a buyer from Mexico City had purchased live seahorses from three or four local shark fishers. The buyer would request a specific amount of seahorses from the fishers in advance of his monthly visits, and may have purchased 240 – 300 seahorses per annum. In 2000, one wholesaler in Mexico City listed Puerto Escondido as one of sources for seahorses.

The total number of wild-caught seahorses sold by wholesalers in Mexico City was estimated at 1000-2500. However, this seems to be an underestimate because estimated seahorse supply from Acapulco is higher (1,900-4,700), even without estimates from four of the suppliers there. An additional 200-300 seahorses reportedly supplied from Puerto Escondido to Mexico City per annum. An experienced wholesaler suggested that the number of wild-caught seahorses traded were double that of cultured seahorses (3600-5800). Summing the totals from Acapulco and Puerto Escondido brings the estimated number of wild-caught seahorses traded in Mexico to a more likely figure of 2,100-5,000.

Aquaculture and captive breeding

Two captive breeding programs for seahorses began on the Pacific coast in Mazatlán in 1996. The director at the Mazatlán aquarium explained that their marine fish breeding project was intended to provide fishes for the aquarium exhibit, replacing the need for wild-caught fishes. In practice, they sold most of their seahorses for the live trade. At the University of Sinoloa, Mazatlán, the aquaculture program included seahorses and several other fish species. The biologist culturing seahorses aimed to commercialize them. Both systems were low-technology: seahorses were maintained in outdoor enclosures. Those at the aquarium were protected by a mesh covering overhead.

The aquaculture programs collected adult *H. ingens* from the wild for breeding, as neither had closed the life cycle in seahorses. The aquarium collected 40-50 seahorses for this each year; the university program collected ten. Both managers reported that their main problems were in raising juveniles to maturity (particularly feeding juveniles), and in funding their aquaculture projects. The aquarium director reported problems with algal blooms during the summer and with bacteria and bubble problems in the seahorses.

In addition to selling seahorses in the aquarium trade, both projects released seahorses back to the wild. The aquarium had released between 800-1,000 seahorses per year since 1996, while the biologist at the university said he released 50% of his production as a conservation effort (likely fewer than at the aquarium). He found that he was able to catch seahorses more easily, and attributed this to the restocking. The aquarium also maintained a few seahorses in their exhibit.

³ Based on comments from wholesalers and suppliers the author assumes that suppliers did not trade seahorses for between 2-4 months per year.

⁴ 15-20 seahorses/week x 9-17 weeks + (20-30 seahorses/week x 26weeks) = 655-1120 seahorses per annum

⁵ 2-10 seahorses/week x 35-43 weeks = 70-430 seahorses per annum

⁶ 5-20 seahorses/week x 35-39 weeks + 25 seahorses/week x 4 weeks = 275-880

⁷ 80-1000 + 600-1000 + 200-240 + 1000-2430 = 1880-4670 seahorses total

Two other companies in Mazatlán had begun culturing seahorses in 2000. The first, a local shrimp aquaculture company, wanted to expand into marine ornamental fish culturing, beginning with seahorses. The second, a local aquarium fish supply company already cultured other marine ornamentals.

Almost all captive bred seahorses (*H. ingens*) in Mexico were traded through Wholesaler A in Mexico City, who had purchased them primarily from one of two different aquarists in Mazatlán. He reportedly pre-ordered seahorses and sometimes paid in advance for *the Artemia salina* production for them. Between 1997 and 2000, the first aquarist sent 1,600-2,400 seahorses per annum to Wholesaler A. The aquarist commented that while it would have been possible for him to send 400 seahorses/week to Wholesaler A, the market was saturated. He sent 5-6 cm long seahorses every few months between November and May only, to avoid losing seahorses to a parasite that strikes during hot summer months. Wholesaler A reported that seahorses from this aquarist suffered very low mortality. This aquarist had apparently also sent seahorses to traders in Monterrey and Guadalajara in the past. A collector for an aquarium in Puerto Vallarta also made trips to Mazatlán to buy these seahorses. He apparently brought 100s of small seahorses (~5 cm), since most of them would die.

A second aquarist believed he had sold Wholesaler A 2,000-3,000 seahorses per annum between 1996 and 2000. However, the wholesaler reported that he lost most of these seahorses to a parasite. In total, between 1,700-2,500 captive bred seahorses⁸ may have been per annum. Although only three hobby shops reported selling cultured domestic seahorses, many did not know the source of their seahorses.

OTHER SYNGNATHID SPECIES IN MEXICO

Pipefish in Mexico

Ten pipefish species are found on in the Gulf of Mexico and Caribbean Coast of Mexico, and another six species on the Pacific Coast of Mexico (Froese and Pauly 2001). On the Caribbean coast, in Puerto Juarez, Cancun, three dried specimens of *Syngnathus springeri* Herald 1942 were obtained. Catch estimates from shrimp fishers there varied, from 15-20 up to 300 per 20-30 day trip, and pipefishes were dead when caught. Fishers found pipefishes with seahorses, in seagrass, sandy or rocky areas.

Trade in dried pipefish in Mexico

Mexico's trade in dried pipefish was quite limited. The only evidence for it was on the Caribbean coast in Cancun where three fishers had sold pipefishes for 2-7 years to two or three Level 2 buyers who came biweekly. The pipefishes were sold as curios in local markets. One fisher commented that buyers also went to Tampico and Veracruz, but in those cities there was no mention of this.

Level 2 buyers paid fishers between Ps1-3 per pipefish (US\$0.11-0.32), and fishers said they sold for the same price as average-size seahorses. A few fishers, who said they were offered less than this amount, simply kept pipefishes as curios for themselves, and sometimes varnished them. One store was found in Cancun that sold pipefish artwork, priced between Ps170-220 (US\$17.96-23.24).

It is possible that small quantities of dried pipefishes were also exported. One fisher mentioned a local German buyer who had purchased both seahorses and pipefishes for five years. While the destination of these fishes was unknown, she reportedly always bought all available pipefishes that fishers had. Another fisher described a buyer from Ciudad del Carmen, who bought both seahorses and pipefishes in Campeche, and Isla Mujeres. The fisher assumed the man had exported the fish, since he bought them in large quantities. The buyer had stopped coming six or seven years earlier for unknown reasons. Hong Kong import records of dried pipefish for 1998-2000 do not list Mexico.

⁸ Assuming ~100 of the second aquarists seahorses may have lived, yields a total of 1600-2400 +100 =1700-2500 seahorses

Trade in live pipefish in Mexico

Domestic freshwater pipefish

Three wholesalers at aquarium markets in Mexico City said they traded freshwater pipefishes, caught in either Veracruz or Acapulco. One of these wholesalers reportedly sold about 500 pipefish per week, but said his sales varied greatly: between 5-1,000 pipefish per week. He only obtained pipefish during the rainy season (July – September). He commented that he sold more pipefishes than seahorses, as the former were cheaper. In contrast, the second wholesaler only sold pipefish occasionally, and said that there was little demand for them. An aquarium wholesaler in Acapulco explained that pipefishes were much less commercialized than seahorses. One of the main aquarium distributors in Mexico City concurred that pipefish were not very popular aquarium fishes, but that their trade did increase during the rainy season. Wholesalers sold pipefishes for Ps3-5 each (US\$0.32-0.53), while the one hobby shop found selling pipefish sold them for Ps15 each (US\$1.58).

Imported marine pipefish

Live marine pipefishes were also imported to these aquarium markets in Mexico City. One aquarium wholesaler sold pipefishes, imported from the Philippines, for between Ps60-80 (US\$6.34-8.45). He said he received about ten pipefishes per week and that they sold slowly. One of the main aquarium distributors commented that while there were no marine pipefishes from Mexico sold in the markets, imported marine pipefishes (zebra, flametais, herocampo) were sold there.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN MEXICO

Seahorse populations in Mexico appear to have declined primarily as a result of indirect harvesting by the shrimp trawl fishery. The pressure to retain seahorse bycatch for the curio trade and exports may have increased the effects of this fishery.

On the Caribbean coast, over 70% of shrimp fishers who commented on changes in catch rates reported that seahorse bycatch had declined (n=21/29). Only three fishers believed there had been no change, and five did not know if there had been a change. Of the fishers who reported seahorse declines, fourteen provided quantified catch estimates (Table 8). Eight of these fishers estimated that there had been considerable declines, perhaps between 75-95% (Table 9).

On the Pacific coast, 18 of the 21 shrimp fishers who commented on catch rates over time believed that substantial seahorse declines had occurred. Of these fishers, most referred to declines in Mazatlán and Salina Cruz (n=14). In comparison to monthly catch estimates for 2000, of ten to fifty (up to a few hundred) seahorses, experienced shrimp fishers recalled

Table 8. Historical seahorse bycatch estimates from shrimp fishers on the Caribbean coast of Mexico. Catch estimates were standardised to one month periods except where indicated. Source: Author's research.

Location	Time Period	Seahorse catch estimates (/month)	Seahorse catch estimates in 2000 (/month)
Tampico, Tamaulipas	1987-88	480-600	A few
Tampico, Tamaulipas	1990	During high season 150/month	Sometimes none; 30/trawl maximum in certain areas
Isla de Lobos (100 miles south of Tampico), Tamaulipas	1990	1,000s	Few; 120-1,080 ¹
Veracruz	?	1,200-1,440	180-240
Ciudad del Carmen, Campeche	1970	240	10, up to 50-60
Ciudad del Carmen, Campeche	1980-82	40-60	- ²
Ciudad del Carmen, Campeche	1985-87	25-30	- ³
Ciudad del Carmen, Campeche	1992-93	5-10	2-3
Champoton (near Campeche)	?	3,000	23-225 ⁴
Cancun	1982	1,000 maximum	25, up to 100-200
Cancun	1988	300-450 average; 600-900 maximum;	15-20 average; 100 maximum
Cancun	1990	150 maximum	30-45
Cancun	1994-95	100-200	0-45
Caribbean	1990	100-200	0-15

¹ in other locations; ² fisher hadn't caught a seahorse for 2-3 years; ³ retired fisher; ⁴ depending on season.

substantially higher seahorse bycatch in the past, and one described catching “sackfuls” of seahorses. The experienced fishers estimated that seahorse catches had declined by 95-99% (Table 9). An experienced shrimp fisher from Salina Cruz, believed the decline began in the 1970’s, when trade with Japanese exporters was initiated. Six fishers attributed the decline to the seahorse trade and overexploitation. One fisher explained that catches of most species had declined. Catch declines cannot be attributed to change in fleet size, as this has remained fairly constant since the 1970s (SEMARNAT, undated). One fisher on the Pacific coast also reported that the average size of seahorses had declined (from 15-20 cm). Most artisanal fishers could not comment, but an experienced shark fisher in Puerto Escondido (Pacific coast) reported declines in seahorses. In 1990 he caught 10-12 seahorses per night, compared to only 1-2 per night in 2000.

The decline in seahorse catch was also reflected in the trade. On the Caribbean coast, seven out of eight fishers who commented on changes in the seahorse trade over time reported that buyers they knew of had stopped coming, usually sometime between 1990-95. Usually, this was attributed to declines in seahorse abundance. The five buyers there who commented concurred that the number of fishers selling seahorse and Level 2 buyers had declined. Exports to Japan from Salina Cruz were also thought to have ceased due to declining catches. Two shrimp fishers on the Pacific coast commented that there were no longer curio traders due to the declining catches. However, there was little indication in changes of demand in the curio trade, and one curio trader commented that the increase in foreign tourists had resulted in more sales, perhaps indicating that there were other sources of seahorses even if shrimp fishers no longer caught them in significant numbers.

Demand for live seahorses in Mexico has also placed localized pressure on seahorse populations, particularly in Acapulco. In contrast to a 2000 catch estimate of 30 seahorses/month during the high season, a diver said he had regularly caught and sold 30 seahorses/week when he began in 1986. Four out of five wholesalers who obtained wild-caught seahorses from Acapulco reported that supplied had declined. Two of them attributed this to overexploitation. Seahorse declines were also reported in Puerto Vallarta by a former diver.

Habitat loss and pollution

The development of Mexico’s coasts for tourism has likely resulted in coastal habitat loss. As example, two traders in Acapulco reported that local reefs were silting up. Three respondents on the Pacific coast and four on the Caribbean coast cited pollution as a factor affecting seahorse populations. These respondents were mainly concerned with oil pollution from PEMEX, Mexico’s main oil company.

Table 9. Historical seahorse bycatch estimates from shrimp fishers on the Pacific coast of Mexico. Catch estimates were standardised to one month periods where possible. Source: Author’s research.

Location	Time Period	Seahorse catch estimates	Seahorse catch estimates in 2000
Mazatlán	1962, 1980	500-800/month	Not many now per month.
Mazatlán	1982-83	1000/month	Beginning of season: 50-70/month; otherwise 1-30/month
Mazatlán	1988	800-1000/month	Not as many now.
Mazatlán	1990-92	1500/month	10/month
Mazatlán	1992	30-50/month	10-20/month
Salina Cruz	1970-1980	1000/month	8-15/month
Salina Cruz	1975-1980	50/day = 1500/month	14-18/month
Salina Cruz	1979-1981	4000-6000/month	No longer catch seahorses.
Salina Cruz ¹	1980	200/month	Very few now.
Salina Cruz	1980	300/trawl = 1000s /month	-
(Barra San Fransisco)	1985	360/month	14-18/month
Salina Cruz			
Salina Cruz	1985	Caught 200-400 on some nights.	-
Salina Cruz	1982-1990	20-30/trawl	-
Barra de Tonalá, Chiapas	1995-1996	Caught 300 in a night once.	Don’t catch like that now. 8-15/month.

¹ Onboard observer.

Restocking wild seahorse populations

The two main seahorse aquaculture programs in Mazatlán both released seahorses, supplementing the wild populations. The prospect of captive breeding for release into the wild is often viewed as a useful method of bolstering threatened wild populations and is also a means of disposing of unwanted or surplus stock (Project Seahorse, 2001). The release of captive animals must, however, be approached carefully as it has the potential to severely damage wild syngnathid populations and marine ecosystems. The Re-introduction Specialist Group (RSG) of the World Conservation Union (IUCN) notes that formal releases are lengthy, complex and expensive processes and strongly discourages casual releases (IUCN, 2001). Three main conservation issues may arise from planned or accidental releases: (i) diseases may be transmitted from released syngnathids to wild syngnathids; (ii) released syngnathids may threaten the genetic diversity of wild populations; (iii) released syngnathids may disrupt the structure and function of marine communities. If conservation is the goal, it will always be preferable to seek to increase the viability of wild populations than to bring animals into captivity for rearing and subsequent release.

COMPARISON TO 1996 SURVEY FINDINGS

The 1996 seahorse trade review's only record for Mexico was of the 1990 Chinese Customs record of 131 kg of dried seahorses imported from Mexico (Vincent, 1996). According to the 2000 surveys, the seahorse trade in Mexico dates to the 1970s. The 2000 surveys and Customs records from Hong Kong, Mainland China, and the U.S. establish Mexico as a significant exporter of dried seahorses (100s to 1,000s of kg/annum), and a country with well-established live and curio trades in seahorses.

CONCLUSIONS

Mexico has exported dried seahorses, most likely for use in TCM, to Japan, Hong Kong, Mainland China and the United States. In 2000, over 7,600 kg of seahorses were exported to Mainland China via Hong Kong. In the late-1990s Mexico exported 23-140 kg dried seahorses to Hong Kong and the United States per annum. Between 20-24 kg of dried seahorses are also traded domestically as curios each year. Exports to Japan from the Pacific coast between 1985 and 1995 are estimated to have totaled almost 2,500 kg per annum. Most seahorses in the dried trade were caught as bycatch in shrimp trawl fisheries. Fishers on both coasts believed trawling and the pressure to retain seahorses for the trade had caused substantial seahorse declines. In particular, the effects of intense trawl pressure on the Pacific coast should be investigated.

Seahorses in the aquarium trade were imported, wild-caught domestically or captive-bred. Imported seahorses originated in the Philippines, Indonesia, Hawaii, Fiji and Brazil. Most of these were shipped via the United States, but as USA trade records are incomplete exact numbers from each source country are unknown. Licenses to collect ornamental fishes have been issued only since 2000, and seahorses were not included in these permits. Only two licenses had been issued; it is likely that very few fishers could afford to fulfill the license requirements. However, as there was little enforcement of the aquarium trade, domestic seahorses were illegally caught by divers on the Pacific coast. *H. ingens* were also captive-reared for the aquarium trade. The two main operations both relied on wild seahorses as broodstock, and released cultured seahorses to the wild for restocking. Local wild populations of seahorses may be negatively affected by these actions (see ***Live seahorse trade in Mexico: Sources, aquaculture and captive breeding***).

Both the dried and live seahorse trades in Mexico need to be monitored. The Mexican government should be encouraged to begin recording imports and exports of dried and live seahorses as separate line items. SEMARNAT, Mexico's fishery department, should also be encouraged to work with ornamental fish collectors and to issue them licenses to enable monitoring of ornamental fish trade. Laws pertaining to this trade should be enforced. Research on wild seahorse populations and the establishment of well-enforced marine reserves should also be encouraged, to alleviate overexploitation by shrimp trawlers.

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CHAPTER 4. SEAHORSE TRADE IN CENTRAL AMERICA¹

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ABSTRACT

The Central American trade in seahorses developed in the 1990s largely in response to the expanding international market; domestic demand for seahorses was very low. With the exception of the live seahorse trade in Costa Rica, there are no formal records of this trade. This research marks the first investigation into the seahorse trade in this region. Seahorses entering the dried trade in Central America were mostly caught as a bycatch of shrimp trawl fisheries. Each country except Belize traded some dried seahorses as curios, but this trade was most common in Guatemala and Honduras. In total, the domestic curio trade is estimated at between 2,800 and 4,200 dried seahorses per annum (7-11 kg). Between the mid-to-late 1990s, Honduras directly exported an estimated 100-300 kg/annum of dried seahorses to Asia. More recently, Belize supplied Asian end users with about 40 kg/annum dried seahorses from both its own waters and Honduras. Guatemala and Nicaragua have also been involved in exports. Panama imported limited numbers of dried seahorses from Hong Kong for sale as Traditional Chinese Medicine (TCM) in Chinatown in the capital city. The aquarium trade in seahorses in Central America is very limited. Small numbers of live seahorses were exported from Belize to Europe and from Costa Rica to the United Kingdom, United States, Uruguay and possibly Korea. A few live seahorses were imported via Miami, USA, to both Costa Rica and Panama, and small domestic trades also exist in these two countries. There is no known live seahorse trade in Guatemala, Honduras, or Nicaragua.

BACKGROUND FOR CENTRAL AMERICA

Information sources in Central America

Most information presented in this section comes from 180 interviews conducted by the author in Central America between March and May 2000. Interviews targeted artisanal and commercial fishers, divers, seahorse traders, fisheries biologists, journalists, people working in local environmental NGOs and government officials (Table 1). Interviews were conducted in Spanish through an assistant who introduced the author as a graduate student researching seahorses. Findings are supplemented by material from other sources, as indicated. The currency from each surveyed country was converted to U.S. dollars using the mean rate of exchange during the time of the interviews (<http://www.oanda.com/convert/fxhistory>).

Research was conducted in Belize, Costa Rica, Guatemala, Honduras, Nicaragua and Panama. Results are presented with explicit consideration of the Caribbean and Pacific coasts. In each country, the author visited the capital city, coastal ports and fishing villages. The following areas were surveyed along the Caribbean coast of Central America: Ambergris Caye and Caye Caulker, Belize; Livingston and Puerto Barrios, Guatemala; Puerto Cortes, Tela, Ceiba and Roatán Island, Honduras; Bluefields, Nicaragua. On the Pacific coast the author visited: El Coco and Puntarenas, Costa Rica; Puerto San Jose and Monterico, Guatemala; Corinto and San Juan del Sur, Nicaragua; Vacamonte, Puerto Caimito and Taboga Island, Panama. (Figure 1).

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Table 1. Number of respondents, by profession, interviewed within each country. Note: Numbers may not add up exactly, as some people were counted in two categories.

Background of Respondents	Country					
	Belize	Costa Rica	Guatemala	Honduras	Nicaragua	Panama
Artisanal fisher	3	3	7	18	10	6
Artisanal fisher (diver)	1	3	-	-	-	1
Commercial fisher	1	4	7	19	15	8
Fishery inspector/ management	1	3	2	-	-	2
Dried buyer	1	3	2	4	3	6
Live buyer	1	4	-	-	-	1
Biologist	-	-	1	-	3	1
Government	4	4	4	4	3	2
NGO	-	2	-	2	-	-
Other (dive shops, journalists etc.)	3	2	6	2	3	2
Total	13	27	29	47	36	28

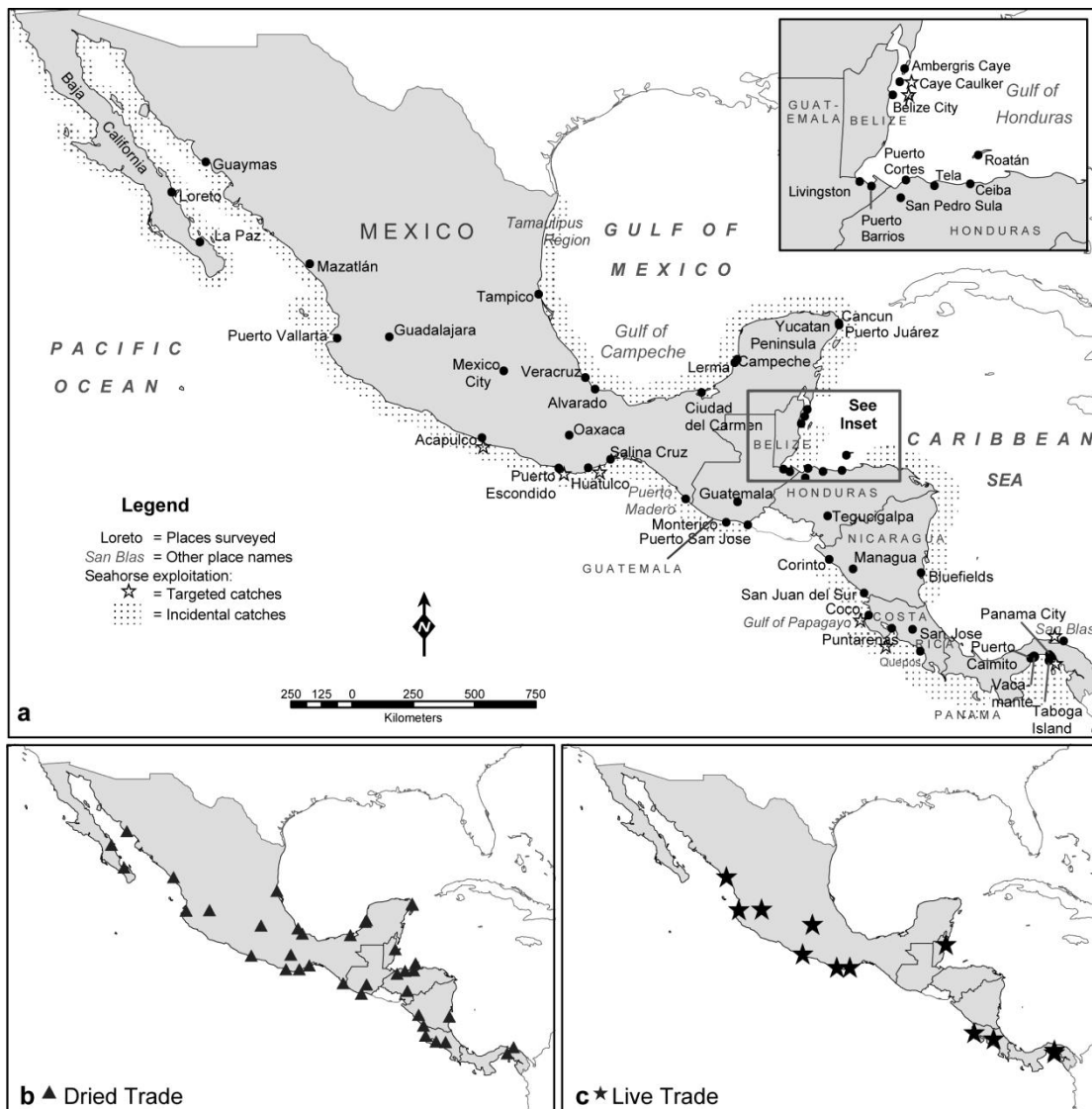


Figure 1. Maps of Central America [and Mexico] showing (a) surveyed locations, and known locations where targeted and incidental seahorse catches occurred, (b) known locations where dried seahorses were traded, and (c) known locations where live seahorses were traded.

Seahorses in Central America

Local species

Caribbean Coast

Three seahorse species are distributed within this Caribbean range. The author encountered *Hippocampus erectus*, a medium-sized deep-bodied species, usually marked with horizontal lines, and *H. reidi*, the long-snouted, slender, medium-sized species. Both species were exploited in the Central American trade and traders did not distinguish them. Although found in the Gulf of Mexico and around Caribbean islands, *H. zosterae* was not traded in Central America, likely owing to its small size (approx. 2.5 cm long). No biological studies of any of these species have been undertaken in Central America. Each of these species is listed as Vulnerable (A2cd) by IUCN (IUCN 2002).

Co-occurrence of *H. erectus* and *H. reidi* seems likely as collections of specimens given to the author by fishers usually included both species. Fishers reported catching seahorses ranging in height from 2.5 cm to 18 cm (mean=9.6 cm, n=40). Seahorses were usually described as being yellow or darker, ranging from brown through to black. Many fishers had also observed red, orange or white seahorses and a few even described seahorses of green, gray, pink or blue colour.

The author obtained 45 *H. erectus* and 14 *H. reidi* specimens from fishers and traders in Honduras and Nicaragua. The seahorses were caught in shrimp trawl fisheries, with the exception of one obtained from an artisanal fisher. Dried specimens of *H. erectus* weighed 0.81-4.86 g (mean=2.71±1.02s.d.) and ranged from 7.9 to 13.0 cm. Dried *Hippocampus reidi* specimens weighed between 0.97 and 4.72 g (mean=2.51±1.22s.d.) and ranged in height from 8.5 to 14.2 cm. The mean weight of *H. erectus* and *H. reidi* specimens (2.66 g) was used to convert estimates of seahorse numbers to weights: there are about 375 seahorses per kilogram. Fishers An aquarium dealer in Belize described the *H. reidi* he caught as being yellow, orange or black, 10.0 cm in height on average and occasionally having filaments. He had observed seahorses in pairs but believed them to be territorial since he usually found them alone.

Seahorses are found in coastal mangrove, seagrass and coral reef habitats: areas that provide them with holdfasts (Lourie *et al.*, 1999). Not surprisingly then, ten fishers trawling on sand or mud reported that they rarely caught seahorses on these 'clean' bottoms. Rather, twenty-nine fishers reported catching seahorses with seagrass, sponge, algae, or soft corals. Six fishers also associated seahorses with rocks, areas that are difficult to fish with nets and therefore generally avoided. Specific habitats and distributions are described for each country.

Fishers were divided as to whether there is seasonal variation in seahorse catch and a few emphasized that area was a more important determinant of abundance. Of the fishers who commented on seasonality, there was little agreement among answers. Some fishers in Honduras and Nicaragua believed that seasonal increases in abundance coincide with the rainy season. However, for Honduras, this is confounded by the coincident timing of the trawl season.

Respondents generally had little knowledge about timing of breeding seasons. Some fishers (n=17) believed that seasonal variation in abundance coincided with the mating season and others claimed to see pregnant males year-round. Several pregnant males were among the dried seahorses a Nicaraguan trader had collected from fishers around January.

Pacific Coast

Hippocampus ingens is the sole species found in the eastern Pacific, with a range extending throughout Central America. One of the world's larger seahorse species, *H. ingens* is listed as Vulnerable (A2cd) by IUCN (IUCN, 2002). The first biological study of *H. ingens* in Central America has been proposed in Costa Rica (R. Rojas, pers. comm., 8 May 2000).

Fishers reported very similar sizes for Pacific *H. ingens* to those for *H. reidi* and *H. erectus* on the Caribbean coast. Reported heights ranged from 2.5 to 20 cm, with an average of 9.6 cm (n=46). Thirty-one dried *H. ingens* specimens obtained by the author ranged in height from 7.7 to 13.7 cm and weighed

between 0.73 and 5.26 g (mean=2.61±1.28s.d.). As on the Caribbean coast, fishers and divers most commonly described dark (brown or black) or yellow seahorses. Several fishers had also caught red or orange seahorses, and a few described green, white, blue or spotted individuals. Divers reported that seahorses were sedentary, remaining in the same spot for months at a time. One diver knew a location with five seahorses in a 2m² area. Generally, however, seahorses were either seen alone or in pairs.

Most fishers believed that *H. ingens* abundance was variable over the year, although there was little agreement as to the exact timing. The most consistent response was that seahorse catches increased during the rainy winter season (~April-November). However, in Guatemala, Costa Rica and Panama, increased catch may have reflected the coincident onset of the rainy season and opening of the trawl fishery. A Panamanian captain explained that April was the best time of year for catching anything, likely because the stocks have not been exploited for several months at this time. A diver in Costa Rica had observed that seahorses arrived at the diving grounds in the rainy winter, when the water was warmer, and moved offshore after this season. Increased catches could well reflect ocean temperature: Pacific coastal waters are cold from January to March, when upwelling occurs, and warmer during April, May and June.

Ten fishers and divers remembered catching pregnant seahorses. Few, however, could pinpoint the timing of the breeding season and answers were inconclusive. A Guatemalan trader who visited in March had many pregnant males among the dried seahorses she had obtained from a fisher that day.

Species traded/imported

According to retailers in Panama City's Chinatown, Panama imported dried seahorses through Hong Kong. The author obtained specimens of six species. These included *H. spinosissimus* and *H. trimaculatus* (found in the Red Sea and Indian Ocean, Southeast Asia and Australia), *H. ingens* and three unidentified species. *H. barbouri* (found in the Philippines and Malaysia) and *H. guttulatus* (found in the Mediterranean and eastern Atlantic), for sale in a souvenir shop in San Jose, Costa Rica, were said to have been imported through the United States.

Aquarium dealers in Costa Rica and Panama imported live seahorses, of unknown species, from Miami. Those imported by Costa Rica were said to be between 3.5 and 10 cm in height. The Panamanian aquarium dealer imported yellow and orange seahorses approximately 10 cm in height. Seahorses imported by Costa Rica apparently came from the Philippines, the Red Sea, Hawaii and the Caribbean. One Costa Rican importer reported that the majority of his seahorses came directly from Hawaii. Seahorses were not available from his supplier year-round, and had been sent in October and November.

Uses

Dried

Seahorses in Traditional Chinese Medicine in Central America

The use of seahorses in TCM is limited in Central America. However, Chinese communities in some Central American countries used seahorses, presumably for medicinal purposes. In Belize and Honduras, seahorses were used in soup in Chinese restaurants. In Costa Rica, a seahorse handcraft vendor mentioned that members of the Chinese community from Limón bought seahorses for use as aphrodisiacs. In Panama City's Chinatown, three retailers sold whole dried seahorses they had imported from Hong Kong for TCM for treatment of goiters and sexual impotence.

Seahorses in folk medicine in Central America

Outside Chinese communities, seahorses were not widely used medicinally in Central America. However, a few respondents mentioned the use of seahorses as aphrodisiacs and to treat asthma. It is not known whether these practices were adopted from TCM, or if they arose independently in Latin American cultures. A seahorse trader in Costa Rica mentioned that locals bought seahorses to treat asthma. In Puerto San Jose, Guatemala, dried seahorses were sold for both of these purposes. One fisher in Honduras knew of groups of people along the northern coast who caught seahorses to treat asthma. Seahorses used for this purpose were taken in a drink after being ground into powder. A Level 2 buyer in Nicaragua commented that according to folklore, to treat asthma, a seahorse should be worn as a necklace and then thrown away. The asthma was said to be transferred to whoever picked up the seahorse.

Seahorses as curios in Central America

On the Caribbean coast of Honduras and Panama, dried seahorses were sold as curios to tourists for good luck. In Honduras, the curio trade centred on Roatán Island, with a smaller trade reported from Tela. In Panama, indigenous Kuna in San Blas sold natural and painted seahorses as necklaces, and in shell craft with conches, crabs and shells. No evidence was found of a seahorse curio trade in Belize or on the Caribbean coast of Guatemala or Nicaragua.

On the Pacific coast, seahorses were traded as curios in Puntarenas (Costa Rica), Puerto San Jose (Guatemala) and in Panama City. One souvenir store in San Jose, Costa Rica, sold dried seahorses. Artisanal fishers in Nicaragua had also occasionally sold seahorses to tourists. A Nicaraguan biologist had reported that in El Salvador, too, dried seahorses were sold as souvenirs.

Artisanal and commercial fishermen in all countries, except Belize, occasionally retained seahorses either for themselves or as gifts. Fishers sometimes painted dried seahorses with varnish or nail polish and shaped them into a desired form. The seahorses were made into necklaces, earrings and key chains or hung in homes and cars as amulets. A handcraft vendor in Costa Rica added coloured plastic gems to the eyes of his varnished seahorses and hooks, to string them as necklaces. Another artisan there made seahorse 'dragons' by adding fish fins and plastic silver, and embedding them into plastic globes. Respondents in Costa Rica and Nicaragua sometimes added gold to seahorse necklaces. In Nicaragua, seahorses were also sometimes decorated with horns or scorpion parts, and restaurants in Managua apparently used seahorses as ornaments. Seahorse 'dragons' may also be made by pasting shells to their body or by applying flyfish fins as wings.

While not widespread, special beliefs about seahorses were reported by some fishers in Central America. A vendor in Costa Rica mentioned that seahorses were love amulets. Several fishers there believed that seahorses were good luck charms and dried seahorses might be hung on boats or in homes for this purpose. A Honduran fisher commented that men ground up seahorses and drank them to attract women. Experienced fishers in Panama also reported that seahorses were kept for good luck. In contrast, three respondents from Costa Rica and Panama reported that seahorses were used for witchcraft or were bad luck for fishers.

Live

Seahorses as aquarium fishes in Central America

The few hobby shops that dealt in marine fishes in San Jose, Costa Rica and Panama City, Panama sold limited numbers of domestic and imported seahorses. Some exhibition aquariums in San Jose apparently also kept seahorses. Seahorses were said to be popular in the 'mini-reef' aquariums kept by Panama's elite. The author found no evidence of seahorses being sold live as aquarium fishes within Belize, Honduras, Guatemala or Nicaragua.

Seahorses in tourism in Central America

Seahorses may have in situ commercial value because of their appeal to tourists. Dive masters in El Coco, Costa Rica, mentioned taking divers to see seahorse couples. Apparently, dive masters working at a resort on Roatán Island, Honduras, also had sites where they showed seahorses to tourists.

Legislation

No protective measures specific to seahorses had been enacted in Central America. However, seahorses were included under some legislation, such as regulations pertaining to fisheries in which they were caught as bycatch. Little government data were available for the Central American seahorse trade. Where import or export permits for seahorses were required, traders usually lacked them. Thus, trade was not accurately recorded. Customs records grouped live seahorses together with other ornamental fish, and dried seahorses into a generic category (i.e. 'other products of fish or crustacean'), further obscuring figures for the seahorse trade. Details specific to each country are included in their respective sections.

THE SEAHORSE TRADE IN BELIZE

The earliest report of a seahorse trade in Belize is from 1993. In 2000, Belize may have exported almost 40 kg of dried seahorses to Asian end users, caught in the Belizean and Honduran shrimp trawl fisheries. One aquarium dealer also exported about ten live seahorses to Europe in 2000.

Seahorses in Belize

H. erectus and *H. reidi* were found in seagrass and mangroves along coastal Belize. Artisanal fishers and divers observed seahorses at St. George's Caye, Caye Caulker, Victoria Channel and Punta Gorda.

Legislation in Belize

Belize allowed exports of non-food marine fishes, including seahorses. However, no seahorse exports had been recorded. Permits were required to export live aquarium fishes, including seahorses; in 2000 one of the two licensed aquarium dealers traded seahorses. Seahorses were caught in the shrimp trawl fishery which operated for 8 months annually, from mid-August until mid-April. Fishing grounds were limited to a 5 x 20-30 mile area (8.1 x 32.2-48.3 km) outside of Belize's coastal reef habitat.

SEAHORSE CATCHES IN BELIZE

Seahorses were caught by the three shrimp trawlers operating in southern Belize, from Dangria to Plascencia. One captain estimated that his boat caught 30lb (13.6 kg) of seahorses per annum. This matched his monthly estimates of up to 5lb (2.3 kg) for the beginning of the fishing season, considering the volume caught was said to decrease over the season. However, his nightly catch estimates of 3-20 seahorses yielded a total of about 3 kg of seahorses per annum. In total, based on this fisher's estimates, the three shrimp trawlers in Belize might have caught 9-90 kg of seahorses per annum (Table 2). Seahorses for the aquarium trade were caught directly by an aquarium dealer around St. George's Caye and by lobster divers who supplied him from around the Cayes along the northern coast.

Table 2. Commercial shrimp trawl fleet size (# boats) and annual seahorse bycatch (kg) estimates by country.

Country	Caribbean shrimp trawl fleet			Pacific coast shrimp trawl fleet		
	Fleet Size	Annual bycatch estimates ¹		Fleet Size	Annual bycatch estimates ¹	
		Per boat	Per total fleet		Per boat	Per total fleet
Belize	3 ²	3-14	9-90	-	-	-
Costa Rica	-	-	-	73 ³	?	?
Guatemala	-	-	-	67 ⁴	0.7-2.2	46-147
Honduras	130 ⁵	4.1-7	537-901	-	-	-
Nicaragua	5 ⁶	8.8	492	31 ⁶	0.6-3.4	18-107
Panama	-	-	-	232 ⁷	0.1-0.3	32 - 77
Total			962 – 994			96 – 333

Source: ¹ Author's research; ² Myvett, G., Fisheries Dept., Belize pers. comm. March 2000; ³ INCOPECA, pers. comm. March 2000;

⁴ UNIPESCA; ⁵ DIGEPESCA; ⁶ MADEPESCA; ⁷ AMP 2000

DRIED SEAHORSE TRADE IN BELIZE

Domestic trade, exports, volumes, values

According to fisheries managers and fishers, trade in dried seahorses operated through Chinese restaurants in Belize City. The trade was first recorded in 1993 by a UK-based environmental consultant who reported 'limited commercial collections [of seahorses in Belize] for dispatch to Chinese end users' (D. Phillips, *in litt.* to A. Vincent 20.9.93). Seahorse trade was confirmed by the author in only one of six Chinese restaurants visited in 2000. Other respondents believed, however, that several Chinese restaurants sold seahorses, and the shrimp captain interviewed stated that each of the six restaurants attempted to purchase 5-10lb (2.3-4.5 kg) of seahorses from fishers after each month-long fishing trip.

One restaurant owner (Level 2-4) in Chinatown confirmed purchasing seahorses from local fishers and the much larger shrimp trawl fishery in Honduras for export to Hong Kong and Miami. The restaurant owner stated she had sent 2lb (0.9 kg) of seahorses in the previous week to the buyer in Miami, reportedly for use in restaurants. If representative of average weekly exports, she would have exported 3.6 kg per month, a value that matches the shrimp captain's estimate of buyers' demand. Assuming consistent supply during the months that fishers in Belize or Honduras were operating (10.5 months), her exports would total 38 kg per annum (Table 3), which could be supplied by the Belizean fleet alone. The restaurant advertised that they purchased seahorses for BZ\$75/lb (US\$82.67/kg; Table 4).

Table 3. Annual live and dried seahorse trade estimates by country, with Domestic being seahorses traded within-country. Source: Author's research.

Country	Live Trade Estimates/ Annum (# indivs)		Dried Trade Estimates Per Annum		
	Exports	Imports	Domestic (# indivs)	Exports (kg)	Imports
Belize	10	-	-	38	-
Costa Rica	300-400	? ¹	80-135	-	24 indivis
Guatemala	-	-	1,200- 1,600	4-6 (in 1992)	-
Honduras	-	-	1,100- 2,100	12-38 ² 100-300 (mid-90s)	-
Nicaragua	? (mid-90s)	-	280	? (late 1970- 2000)	-
Panama	-	<10	Unknown (~100)	-	18-27 kg
Total	310-410	~10			

¹ thought to be small; ² Exports of potentially several hundred from Honduras went to Belize, and were re-exported.

LIVE SEAHORSE TRADE IN BELIZE

Trade routes, exports, values

One aquarium dealer (Level 1-2) in Belize traded seahorses. He had collected and exported ornamental fishes, including seahorses, since 1980. Seahorses were not an important part of his business (they were not included on his sales list of fishes), with exports of only about ten per annum (Table 3). His aquarium fishes were sent to Germany, Switzerland, Denmark and Austria but these exports did not appear in Europe Custom Data (undated) for seahorses in 1997-99. A diver on Caye Caulker sold seahorses (likely to this dealer) for BZ\$7-10 (US\$3.5-5) each (Table 5). In 1995, an aquarium dealer in the UK reported imports of live seahorses from Belize (R. Sankey, *in litt.* to A. Vincent 30 October 1995).

Table 4. Value of dried seahorses traded in Central America. Source: Author's research.

Country	Cost of seahorses in domestic trade	Value of exported seahorses – amount paid to fishers	Value of exported seahorses – amount paid by exporter	Value of imported seahorses
Belize	-	US\$82.67/kg	?	-
Costa Rica	¢600-1,000 each = US\$2.00-3.34	-	-	-
Guatemala	Q2.5-15 each = US\$0.32-1.93	Q396.8-595.2/kg = US\$77.05- 115.58	?	-
Honduras	US\$1-5 each	US\$3.76-30.08/kg	US\$55.11/kg	-
Nicaragua	C10-60 each = US\$0.81-4.85	US\$0.23-0.50	?	-
Panama	US\$2.50-5each	-	-	US\$2.75-4.50 each; US\$15 each

Table 5. Value of live seahorses traded in Central America (in US\$). Source: Author's research.

Country	Amount paid to divers/seahorse	Amount paid by exporter/seahorse	Amount paid by importer/seahorse	Selling price per seahorse in domestic trade
Belize	3.5-5	?	-	-
Costa Rica	0.67-6.68	US\$5.27	6-12	16.45-49.34
Nicaragua	5.98 in 1996	?	-	-
Panama	10-15	-	14	30-40

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN BELIZE

Although populations of seahorses in Belize have not been assessed, there appears to be little cause for concern. Tourism within Belize has provided the government and citizens with strong motivation to protect their natural resources. The aquarium dealer reported that there had been no change in density of seahorses over time, with the caveat that seahorses were generally difficult to see because of their camouflage. Bycatch of seahorses was limited to the very small shrimp trawl fishery that in 2000 was threatened with closure owing to declining catches and the expansion of shrimp farming in Belize. Seahorses would benefit from the enlarged no-trawl area this would provide but may suffer from impacts of shrimp aquaculture upon their habitat.

THE SEAHORSE TRADE IN COSTA RICA

Between 1996-2000 at least, Costa Rica exported and imported small quantities of live seahorses for the aquarium trade, mainly through the United States. Official data suggest catches of 20-156 live *H. ingens* per annum but export estimates range from 300-400 seahorses per annum. There were no exports of dried seahorses from Costa Rica. A very small domestic curio trade existed on the Pacific coast of Costa Rica.

Seahorses in Costa Rica

Along the Caribbean coasts of Costa Rica and Panama, the continental platform drops off sharply, unlike the coasts of Honduras and Nicaragua. Nonetheless, shallow coral reefs on the Caribbean coast of Costa Rica were thought to provide good habitat for seahorses (R. Rojas pers. comm., 8 May 2000).

On the Pacific coast, divers in Guanacaste province had observed *H. ingens* in Bahia Culebra, Isla Catalina, Bahia Huevos, Cabo Huelas, Tamarindo, Cabez Mon and at Argentina. Further south in Costa Rica seahorses have been observed in brackish water near an estuary in Quepos and in mangroves and seagrass beds at Isla Chita (R. Rojas pers. comm., 8 May 2000). According to fishers, Herradura, Guayabo and Isla del Caño were also areas with seahorses. Seahorses were associated mainly with coral reefs, followed by algae, seagrasses and rocks. Generally seahorses were caught between depths of 6 and 20m, with a maximum reported depth of 100m.

Legislation

Seahorses were included under the Ministry of Agriculture's (MAG) decree 19,450, which regulated the extraction of coral reef fishes. In each of eight fishing zones in the country, up to 20 permits could be issued for collection. Each month, divers were allowed to collect 50 specimens of each listed species, for a monthly maximum of 1,000 specimens per zone. Regional Fisheries offices inspected the catches weekly, including seahorses, and permits could be revoked if divers were found to exceed the catch limit.

Permits were required for import or export of ornamental fishes. The Costa Rican Institute of Fish and Aquaculture (INCOPECA) recorded catches and exports of live seahorses. Some confusion has arisen from the fact that the exports of invertebrates was illegal in Costa Rica and many divers and Fisheries officials believed seahorses were invertebrates.

The shrimp fishery, which landed seahorses as bycatch, was regulated by spatial closures in the Gulf of Nicoya. Trawling was banned completely in the innermost part of the Gulf, and was closed inshore from Puerto Toros and Puerto Cuchito for 5 months from May 15th to October 15th. The artisanal gill net fishery was closed 15 May – 15 July and, as of 2000, no new permits for this fishery were being issued.

SEAHORSE CATCHES IN COSTA RICA

Target fisheries

Between 40 and 60 divers in Costa Rica targeted live fish, including seahorses, for the ornamental trade. This fishery was primarily based in Guanacaste province (Pacific coast), with a few divers also located further south in the Gulf of Nicoya and Quepos. Divers worked for specific live fish traders, who sometimes supplied them with equipment (including boats) to ensure their continued loyalty. Seahorses were maintained in plastic bottles in the water until buyers arrived. Many seahorses were said to die en route to San Jose, perhaps from starvation (V. Loaiza Naranjo pers. comm., 12 May 2000).

Divers did not primarily target seahorses, but nor would they bypass them, since as one trader reported “a seahorse in the hands of a diver is money.” By all accounts their monthly catches were well below the regulated levels (50 per month). Official government records reported very small total annual catches, between 20 and 156 seahorses (Table 6). Actual catches are likely higher, as a fishery inspector reported that divers each caught 2-3 seahorses per month, and three divers estimated catches at 4-5 seahorses per week during the peak season of April to November (16-20/month), after initially downplaying seahorse catches to the author. The latter estimates would equate to over 100 seahorses per diver per annum (based on 16 per month x 8 months).

The most established, and reputedly the largest ornamental fish exporter maintained that seahorse abundance was low. He reportedly only received one or two seahorses per month in total from the 40 divers he claimed to employ on the Pacific coast. However, a diver estimated that this exporter could obtain 20-30 seahorses per month in total from all divers in his area, and had seen 25-30 seahorses during a visit to the exporter’s warehouse in the low season. This monthly estimate, which is lower than the divers catch estimates, would still result in 240-360 live seahorses being traded by this exporter per annum.

Bycatch

Costa Rica’s commercial fisheries were concentrated almost exclusively on the Pacific coast. Eight artisanal fishers, divers, and buyers reported that seahorses were mainly or only caught in shrimp trawls. Centered in Puntarenas, the shrimp fleet comprised 61 shallow-water trawlers, which trawled up to 40m depth using two nets with meshes of 2-5 cm. Boats fished along the coast of Costa Rica, but fishing effort concentrated in the Gulf of Nicoya. Twelve deep-water trawlers were not thought by fisheries officials or the head of an artisanal fishers’ co-operative to catch seahorses. Three fishers reported catches of about 100 seahorses during trips of 2-4 weeks but also noted that catch varied with area and season. A fourth shrimp fisher indicated that seahorse catches were quite rare. Fishers reported that most seahorses were caught alive and were returned to the water. As seahorses had almost no economic value in Costa Rica, there was little incentive for fishers to select them from among the bycatch. Changes in local seahorse abundance are thus unknown, as fishers paid them little attention. An experienced shrimp fisher, however, described substantial declines in shrimp catch and fish bycatch in trawl nets over the past 25 years.

Gill net fishers on the Pacific coast may each have caught only a handful of seahorses annually, because of the large mesh sizes used (8-10 cm). Beach seine fishers might also catch seahorses, albeit very rarely. It is not likely that these seahorses are traded.

Table 6. Live seahorse catch records. Source: INCOPECA, Costa Rica.

Year	Quantity
1996	156
1997	38
1998	20
1999	20

DRIED SEAHORSE TRADE IN COSTA RICA

Domestic trade, volumes, values

Unlike in other Central American countries, the author found no evidence of dried seahorse exports from Costa Rica. It is unclear if this reflects low abundance of seahorses along Costa Rica's Pacific coast, where the fishery was located, incomplete surveying, or lack of established trade routes.

A very limited trade in dried seahorses (80-135 per annum total) for curios existed on the Pacific coast, in Puntarenas, San Jose, and perhaps Quepos, but trade on the Caribbean coast was unknown (R. Rojas, pers. comm., 18 May 2000; Table 3). The author located only one San Jose souvenir store selling seahorses, within a tourist district. Seahorses imported from the United States sold infrequently to foreign tourists (about 24 per annum based on 2/month) for ₡700 each (US\$2.34). Some handcraft vendors in the area believed seahorse trade to be illegal; others directed the author to the tourist town of Puntarenas.

In Puntarenas, marine products, including seahorses, were sold as curios. The seahorse trade is thought to be very small, considering that imports of about 50 seahorses by a Nicaraguan supplier in 1995 had apparently flooded the market. A local curio trader, who had sold seahorses since 1995 sold one or two seahorses per week and maintained that it was not a profitable business (52-104 per annum). He obtained seahorses from shrimp fishers for ₡200-300 (US\$0.67-1.00) and sold them unvarnished for ₡600 (US\$2.00) or decorated for ₡1,000 (US\$3.34). This trader was not familiar with any buyers interested in large quantities of seahorses. Although he estimated that there might be up to 25 local handcraft vendors selling seahorses, the author found evidence of only one other buyer, an artisan who had sold a few seahorse 'dragons' set in plastic globes for ₡600-1,000 (US\$50.10; Table 4).

LIVE SEAHORSE TRADE IN COSTA RICA

Domestic trade

The domestic market for live seahorses was quite small. Only two out of twenty- three aquarium shops in San Jose sold marine fishes, including seahorses, during the 2000 surveys. The two shops (Level 2) both sold domestic seahorses and seahorses imported through the U.S. Seahorses were imported mainly because of increased choice of colours and sizes. The first aquarium retailer did not have seahorses in stock when visited and said he only rarely obtained them on order from customers. A third Level 2 buyer had owned a hobby shop in San Jose until 2000, where he had also sold domestic and imported seahorses. Trade estimates for these three buyers are unknown, but thought to be small. Both the first and third buyer attributed the lack of trade to poor husbandry knowledge among customers and the fragility of seahorses. Between 1995-98, a fourth Level 2 buyer had purchased ornamental fishes, including 10 seahorses, for use in display aquariums. A fishery inspector mentioned an additional hobby shop that sold seahorses and divers mentioned three other aquarium fish buyers to the author. However, these reports could not be confirmed, and the divers did not know whether these buyers traded seahorses domestically or in the export market.

Exports

Costa Rica has exported small numbers of seahorses to at least Europe, the United States and Uruguay. In 1995, a few seahorses were exported from Costa Rica to the UK but more Latin American seahorses reportedly went to North America than Europe, probably because of lower transport costs (R. Sankey, *in litt.* to AV 30 October 1995). U.S. Customs data report imports of one *H. ingens* (value US\$5) in 1997, while European Customs data showed imports of 26 seahorses to Italy from Costa Rica in 1999. Official Costa Rican Customs records show only limited live seahorse exports, 11 seahorses (valued at US\$58) from one of four listed ornamental fish exporters between December 1999 and 2000 (INCOPECA, 2000).

Trade by the largest exporter in Costa Rica, estimated to receive 240-360 seahorses per year from divers for export to the US and Uruguay, did not show up in Customs data. Combining recorded exports (11 in three months during the low season extrapolated to 44 per year) with the largest exporter's estimated trade results in total estimated exports of 300-400 seahorses per year from Costa Rica.

Values

Prices for live seahorses varied substantially by trade level and destination. Divers maintained that seahorses sold so cheaply that they were hardly worth catching. However, according to a species list supplied by an exporter, divers were paid slightly above the average price per ornamental fish for seahorses (¢191; US\$0.64). Divers stated that buyers for the domestic market paid them substantially more for seahorses (¢1,000-2,000 each; US\$3.34-6.68) than did exporters (¢200-300; US\$0.67-1.00). An aquarium retailer imported seahorses from the United States for US\$6-12 each (Table 5). Aquarium retailers sold seahorses in the domestic trade for ¢5,000-15,000 each (US\$16.70-50.01). Exported seahorses were valued at about US\$5 each.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN COSTA RICA

Seahorse populations in Costa Rica may be threatened by exploitation and habitat degradation. All commercial and recreational divers interviewed reported that seahorse abundance had declined in the Gulf of Papagayo (Guanacaste province). Respondents other than commercial divers attributed the decline to the extraction by commercial divers. The extent to which shrimp trawling has contributed to the decline, or affected seahorse populations elsewhere in Costa Rica, is unknown. Fishers were clear that the quantity of shrimp caught had declined; a coincident decline in bycatch species, such as seahorses, is likely. Contamination from sewage, mercury and oil also appeared to be a significant problem in the Gulf of Nicoya, the location of Costa Rica's most concentrated fishing pressure.

Although demand for seahorses appears relatively low, were it to increase, legislation to protect seahorses is poor. The aquarium trade in Guanacaste was reportedly largely unregulated: fish were illegally extracted and catch limits were violated (Naranjo, 2000). In 2000, a proposed bill, which would establish severe penalties for illegal extraction, was awaiting debate. Similar violations of legislation were evident in fisheries in which seahorses were caught as bycatch. Artisanal and commercial fishers in Puntarenas admitted that, given the lack of enforcement, they fished throughout the closures.

An aquarium dealer interested in seahorse conservation would like to restock depleted areas in Guanacaste province with seahorses imported from the US. Releases could be detrimental to wild seahorse populations (IUCN, 2001; Project Seahorse, 2001).

THE SEAHORSE TRADE IN GUATEMALA

Guatemala had a very limited domestic trade in dried seahorses for medicines and curios, located on the Pacific coast. Apparently exports of between 4-6 kg dried seahorses to Mexico occurred through one buyer in 1992.

Seahorses in Guatemala

Guatemala's small Caribbean coast supports mangroves, seagrasses and rocky areas, which were designated as marine protected areas. It seems likely that *H. erectus* and *H. reidi* inhabit these areas. In contrast, Guatemala's Pacific coast appears to provide little habitat for *H. ingens*, as there is a strong coastal current and the continental shelf is very narrow. Fishers on the Pacific coast reported that they found seahorses among rocks, which seahorses might use as a form of shelter.

Legislation

No records exist for dried or live seahorse exports from Guatemala. Exported fisheries products were only categorized as shrimp, lobster or fish. Collection and export permits for live fishes required records of each species traded but no one held a licence to trade live seahorses in 2000. Marine reserves that allowed only artisanal fishing had been created on both coasts in Guatemala but it is unknown if seahorses occur within them, or whether they are enforced. The shrimp trawl fishery, which landed seahorses as bycatch, was closed annually from 1 April until 15 May.

SEAHORSE CATCHES IN GUATEMALA

Bycatch

Most seahorses caught in Guatemala, and all those entering the trade, were sorted from the bycatch of commercial shrimp trawlers on the Pacific coast. A bycatch report from research conducted on the Pacific coast listed *H. ingens* as a species caught in this fishery (Salaverría & Barrientos, 1998). Puerto Quetzal was the primary port for the 67 shrimp boats that fished along the entirety of the coast. Boats trawled two 18m nets of 2.5-3.18 cm mesh. According to five fishers, each boat caught between four and 15 seahorses per 2-week trip (8-30/month), except during the rainy season, when catches could increase to 50-150 seahorses per trip (100-300/month). Based on 2 months per annum of seasonal increases, the Guatemalan shrimp fleet may have caught 17,700–56,300 seahorses per annum² (46-147 kg; Table 2). Seahorses apparently were alive when nets were hauled but often died while the fish were being sorted. Fishers threw live seahorses back and sometimes retained dead ones.

On the Caribbean coast, four fishers reported that seahorses were only an occasional bycatch (one to three per month per boat) of a small-scale shrimp fishery (n=40 boats), likely because fishing occurred in muddy bottoms without vegetation. In total, this fleet may have caught 480-1,440 seahorses each year. Seahorses might still be alive when caught; fishers kept most of these as curiosities. Mesh size was 2.5-3.8 cm.

Three gill net (trasmallo) fishers on the Pacific coast said that catching seahorses was very rare (zero to one per month per boat) but that occasionally they had caught several in a night. Most fishers maintained that seahorses were caught alive and returned to the water. Reported mesh size was 3.8 cm, despite the minimum legal size of 6 cm.

DRIED SEAHORSE TRADE IN GUATEMALA

Domestic trade, exports, volumes, values

A shrimp captain on the Pacific coast reported exports of seahorses to Mexico in 1992 for use as aphrodisiacs. At that time, an exporter (Level 2) visited weekly from Mexico for one fishing season (May-March) and bought 30-50 seahorses/week. Based on the length of the fishing season and the average weight of specimens, this buyer may have exported 3.5-5.8 kg that year (46 weeks x 30-50 seahorses/week x 2.52 g/seahorse; Table 3). The exporter paid Q1-1.50 per seahorse (US\$0.19-0.29 at 1992 exchange rate; Table 4). It seems likely that the seahorses were re-exported to Asian end users, as seahorses were not used as aphrodisiacs in Mexico.

Although domestic trade in seahorses was small (likely 1,200-1,600 seahorses per annum), one fisher commented that when catches of target fishes were low, fishers could at least sell seahorses. Domestic sales of dried seahorses, used as curios and folk medicine, were limited to two small Level 2 vendors in Puerto San Jose. The first vendor had sold seahorses for 13 years. His reported purchases convert to an estimate of 1,000-1,350 seahorses per annum, although he claimed to sell over 3,000 seahorses per annum. A second vendor who had sold seahorses for only 2 years estimated sales of 200-250 seahorses per annum (Table 3). These traders reportedly bought seahorses from fishers for Q0.5 each (US\$0.06), although fishers said they were paid Q1-2each (US\$0.13-0.26). The second vendor priced seahorses according to their use and supply at Q2.5-15each (US\$0.32-1.93). Seahorses were sold to the author for Q2.5-4 each (US\$0.32-0.51; Table 4).

² 1 67 boats x (8 months x 8-30 seahorses) + (2 months x 100-300 seahorses) = 17688-56280 seahorses x 2.61 g/seahorse = 46.1-146.9 kg

LIVE SEAHORSE TRADE IN GUATEMALA

No live trade in seahorses was found in Guatemala in 2000. Both marine ornamental dealers interviewed incorrectly said it was illegal to obtain live seahorses from Guatemalan waters, but given demand they could import seahorses through the US, at a selling cost of Q80-150 (US\$10.27-19.26).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN GUATEMALA

Demand for seahorses in Guatemala was very low. Seahorses should benefit from marine protected areas on both coasts of Guatemala, although their level of enforcement was unknown. Trawling, however, may pose a threat to *H. ingens* populations. Both trawl fishers and inspectors (n =5/7) stated that seahorse catch had declined. Two experienced fishers recalled past catches of 100-150 seahorses per trip, and up to 700 in one area, respectively, in comparison to average catch estimates of four to 15 seahorses per trip in 2000. It was not clear when the decline began.

THE SEAHORSE TRADE IN HONDURAS

The Honduran trade in seahorses was the largest encountered in Central America. For 2 years, in the mid-to-late 1990s, Honduras directly exported substantial numbers of dried seahorses (an estimated 100-300 kg/annum) to Asia. In 2000, seahorses destined for Asia were traded via Belize. There was also a small domestic trade in dried seahorses for curios.

Seahorses in Honduras

Commercial fishers trawling on the Caribbean Coast found *H. erectus* and *H. reidi* 24-48 km from shore, in depths of 24-45m. Seahorse distribution along this coast appeared to be patchy. Trawl fishers considered the following areas to be abundant in seahorses: the island Bocas Key, areas north-east of La Mosquitia, such as Cabo Falso, Cayo Gora and Cayo Caratasca (each close to reefs), and Banco Gracias a Dios at the Nicaraguan border. One resident of Roatán Island had also observed seahorses there. A Honduran trawl fisher with experience of fishing in Belize, Columbia and the Pacific coast of Nicaragua believed seahorses to be most abundant in Honduras. The areas where artisanal fishers caught seahorses (Tornabe, Punta Sal, and Cayos Cochinos) were all described as having reef and/or seagrass bottoms.

Legislation

There were no official records of the Honduran seahorse trade. The export of dried seahorses from Honduras required a permit from the Ministry of Fisheries. Although applications had been made for these permits, none had ever been issued. Indeed, traders reported that permits were difficult to obtain. In 1995, an unauthorized Ministry issued a permit to export seahorses and the shipment was seized at San Pedro Sula airport. It is presumably as a result of this seizure that fishers and traders alike mistakenly believed that seahorse trade had been prohibited by the government. There were no records for live seahorse exports, although records existed for other ornamental fishes.

Artisanal fisheries operated year-round, while the commercial trawl fishery was closed annually from 1 February to 30 June. Trawling was prohibited within 3 miles (4.8 km) offshore. Protected areas, in which nets were prohibited, also existed along the Caribbean coast.

SEAHORSE CATCHES IN HONDURAS

Bycatch

Commercial trawl fisheries

Almost all seahorses that entered Honduras' dried trade were landed as bycatch from the shrimp trawl fishery based in two ports on Roatán Island, Caribbean coast. One hundred and thirty boats equipped with

four 13.7-15.2m nets of 2.5-6.3 cm mesh fished out to 100 miles (160.9 km) from Mosquitia, off north-eastern Honduras. A few boats also fished along the northern coast off Tela. Generally, two 6-hour trawls were done each night. *Hippocampus erectus* and a pipefish species (*Syngnathus* sp.) were listed as species caught in a bycatch report from this trawl fishery (Morales, 1998).

Bycatch of seahorses was highly dependent on fishing area and twelve fishers said seahorses were not caught in all areas. Most fishers (n = 16) estimated typical nightly catches of five to fifty seahorses for areas where seahorses were found, although two fishers reported catches of over 100 seahorses. Monthly seahorse catch estimates from eleven fishers ranged from 0.1-3.4 kg dry weight per boat (mean=0.99 kg). One fisher, who retained seahorses to sell to a foreign buyer, showed the author 220 dried seahorses (0.59 kg), which he had caught in a month-long trip. He judged this amount to be average. Based on these monthly estimates (0.59-1 kg/month), the total fleet may have caught 540-900 kg per annum³ (Table 2).

Artisanal fisheries

Few seahorses caught by artisanal fishers on the Caribbean coast of Honduras entered the dried trade. Only gill net (trasmallo) fishers occasionally caught seahorses. Absence of seahorses could reflect the inshore sandy-bottomed area in which fishers operate or may simply have been an artifact of fishing gear.

While four gill net fishers caught seahorses only very rarely (once every few months or years), four others reported catching up to 20 seahorses per month. Reasons for the discrepancy between catch estimates were not clear. Only one fisher said he sold seahorses. All other respondents returned most seahorses to the water, perhaps keeping a few to give away. Mesh size ranged between 6.4 and 7.6 cm.

Beach seine (chinchorro) nets were set on sandy or muddy bottoms without vegetation; which may explain why fishers (n=4) stated that they never caught seahorses when using this gear. One fisher who made periodic trips to Cayos Cochinos caught seahorses accidentally when seining on the seagrass bottom there. The seahorses were returned to the water alive.

DRIED SEAHORSE TRADE IN HONDURAS

Domestic trade

Seahorses were sold to tourists on Roatán Island, a popular dive resort area. Most of the trade occurred in Coxen Hole where cruise ships arriving three times a week were met by curio traders (Level 2) selling handicrafts, shells and seahorses. Some fishers sold directly to the tourists, while others sold to the curio traders. Four such traders were named to the author. According to a fisher, one of these curio traders had bought 100 seahorses on his last visit to the shrimp port in French Harbour, Roatán. A second curio trader based in West Island, Roatán, bought bags of seahorses once or twice per fishing season from five or six shrimp fishers for sale to tourists. He estimated that he purchased 1,000-2,000 seahorses annually. A minimum estimate for the domestic trade is 1,100-2,100 seahorses per annum, as volume estimates for their other two traders are unknown (Table 3).

The sale of seahorses in mainland Honduras appeared quite limited. Anecdotal evidence suggested that seahorses were obtained from the few shrimp boats that came to fish in Tela and were sold to individuals and in one hotel. Artisanal fishers along the coast may have also occasionally sold seahorses to tourists.

Exports

Historical Exports

Honduras' involvement in the international seahorse trade began in the mid-1990s, when several foreign exporters took advantage of the quantities of seahorses caught as bycatch in Roatán's trawl fishery. Seahorses were sent through San Pedro Sula or Tegucigalpa en route to either Mainland China or Japan.

³ 130 boats x 0.59-0.99 kg/month x 7 months = 537-901 kg/annum.

This trade continued for only a few fishing seasons and was thought to have ended by 1998. Almost all shrimp fishers were familiar with this trade and many recalled that Level 2 buyers (known as 'coyotes') came directly to the ports to buy from all shrimp boats. Some fishers referred to between two and five Japanese, Korean or Chinese buyers, while others were familiar with Honduran middlemen who supplied Asian exporters. Exporters in Hong Kong apparently rejected seahorses with broken brood pouches. Since none of the exporters could themselves be interviewed, and fishers and buyers had little knowledge regarding the details of trade above their own levels, the trade volumes, frequency of shipments and total number of exporters are somewhat uncertain. At a minimum, there were probably four groups of exporters (A-D) in one year who traded between 100-300 kg of seahorses and two exporters the following year who traded 50-300 kg (Table 3). Estimates stem from the following accounts:

- Buyer A (Level 2-3) supplied seahorses destined for Hong Kong to an exporter (Exporter A) in Tegucigalpa, over a 2-year period (likely 1995 and 1996). A few fishers referred to this buyer, one of whom believed him to be the biggest buyer. This buyer also believed himself to be the biggest local buyer on Roatán, because Japanese exporters had come to him for advice upon arrival. This local buyer recalled buying 1-2lb (0.5-1 kg) of seahorses from each of five to six fishers after a fishing trip. Although he preferred to buy directly from fishers, level 2 buyers also sometimes supplied him. He estimated that over the 2 years his total shipments were about 30lb (14 kg) and 60lb (27 kg) per annum, respectively.
- According to Buyer A, a group of Japanese exporters (Export Group B) was also present in 1995 or 1996. They purchased directly from fishers (at one point meeting the boats at sea) and were thought to have exported the seahorses for the medicinal market. Export Group B only came to Roatán once, because they were interested in buying larger quantities of seahorses than were available.
- Buyer A also knew a Japanese exporter (Exporter C) who operated through a buyer in Ceiba. Although the scale of his business is unknown, Buyer A thought he had left owing to inadequate seahorse quantities.
- In 1995, a Chinese man was arrested at the San Pedro Sula airport for attempting to export seahorses (Exporter D). At the time, he had 7,196 seahorses (26 kg) and 39 pipehorses (species unknown; 230 g) in his possession.
- One local Level 2 buyer, with whom many shrimp fishers were familiar, sold seahorses in 1997 or 1998 to middlemen who purchased large quantities for Chinese and Japanese buyers. He supplied two to three Level 3 buyers (presumably middlemen for the above exporters) with seahorses on a monthly basis. He recalled that one Chinese buyer purchased 1-3lb (0.5-1.4 kg) from him per month; sales to his other buyers are unknown. The buyers had not returned in 1999. If supplied by a few Level 2 buyers such as this one, each middleman (Level 3) could have bought between 6 and 38 kg of seahorses per annum (2-4 Level 2 buyers x 1-3lb/month x 7 month fishing season).

Based on export estimates for Buyer A (14 kg total in year 1 and 27 kg total in year 2) and Exporter D (26 kg in one shipment) and the fact that Exporters B and C were only interested in large quantities of seahorses, it seems reasonable to assume that each exporting group traded an average of around 25 kg per annum. Hence, a minimum estimate of dried seahorse exports for one year in the mid-1990s is 100 kg/annum and 50 kg/annum in the following year after the departure of two exporters (B and C).

The number of seahorses entering the trade depended on the amount of seahorses caught by the trawling fleet and the access of buyers to this catch. Considering this, if exporters had accessed the seahorse catch of even a third of the fleet (n=43 boats), the number of seahorses traded would have been substantially higher. Based on a monthly catch estimate (0.59-0.99 kg/month x 7 months), 176-298 kg of dried seahorses may have been exported from Honduras per annum.

Seahorse exports to Asia appear to have ceased because of their perceived illegality. A second contributing factor, however, may have been that quantities of seahorses were lower or diminished below some baseline quantity necessary to interest Asian buyers in this market.

Exports in 2000

There appeared to be no direct seahorse trade to Asia in 1998-2000. However, Honduras did export dried seahorses to Belize in at least 1999 and 2000: (i) An artisanal fisher in La Ceiba has sold 1lb (0.5 kg) of

seahorses to a Belizean buyer once in 1999 through an intermediary buyer. (ii) Two fishers on Roatán Island were also familiar with a Belizean buyer. One of these fishers had supplied seahorses for 2 years to a Level 2-3 buyer from Belize who apparently visited the area semi-annually. On the previous visit, he had supplied 8lb (3.6 kg) of seahorses to the Belizean buyer, and he currently had a bag of 220 seahorses (0.6 kg) that he was saving for him. Exports to Belize may have started as early as 1993, the year exports from Belize were first recorded (see *The seahorse trade in Belize*).

Once in Belize these seahorses were likely re-exported to Asia through exporters based in Chinese restaurants in Belize City. One Belizean exporter, who exported seahorses to Miami and Hong Kong, reported obtaining seahorses from trawl fishers in the Honduran fleet. Moreover, a few Honduran fishers were aware of the involvement of Chinese restaurants in Belize City in the seahorse trade. Based on catch estimates for the shrimp trawl fishery, it is possible that even if only these three fishers supplied the Belizean buyer, he could have traded 12-21 kg of seahorses annually. The Honduran fleet could have easily supplied the annual estimate of 38 kg of seahorse for the Belizean exporter (see *Dried seahorse trade in Belize*).

Fishers mentioned three other exporters who traded seahorses in the late-1990s (from Cuba, Italy and an unknown country), but details of their trades are unknown.

In summary, the only official record of the Honduran seahorse trade is of the attempted export of 26 kg of seahorses and 230 g of pipehorses by a Chinese man in 1995. However, trade surveys indicate that Honduras exported between 100 and 300 kg dried seahorses per annum to Asia through Chinese and Japanese exporters between about 1995 and 1998. Honduras also exported several (and potentially hundreds of) kilograms of dried seahorses to Belize in 1999 and 2000, and possibly as early as 1993. Some of these seahorses were re-exported to Hong Kong and Miami; others were likely also re-exported to Asia.

Values

One shrimp fisher estimated that crew could earn 20% of their income from seahorses and shells, and that this made it worthwhile for almost all of them to collect and dry seahorses. Fishers were reportedly paid between L25-L220/lb (US\$3.76-33.07/kg) and L2-L20 (US\$0.14-1.36) per individual seahorse. Marine product traders (Level 2 buyers) sold seahorses to tourists for US\$1-5 each. They reported that seahorses sold more slowly and for less money than did shells and coral. One such trader believed that seahorses comprised about 10% of his business.

Reported prices for dried seahorses varied greatly between respondents and depending on whether the seahorses were sold individually or by weight. It is clear, however, that substantial mark-ups occurred at each level, making the trade a profitable one for buyers. For example, seahorses purchased for L100/lb (US\$15.04/kg) by the Level 2-3 buyer in Roatán were sold to his buyers in the capital for US\$25/lb (US\$55.11/kg). He believed that during the period he traded with Asian buyers, seahorses had made up a quarter of his business (Table 4)

LIVE SEAHORSE TRADE IN HONDURAS

No information was collected on the live seahorse trade in Honduras, and it is presumed not to exist.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN HONDURAS

Trawling may pose a threat to seahorse populations on the Caribbean coast of Honduras. Seventy per cent of fishers who commented (n=9/13) believed that there has been a decline in the abundance of seahorses. However, most fishers were unable to quantify this decline as they only began paying close attention to abundance with the inception of the seahorse trade in the mid-1990s. Fishers blamed the intense trawl pressure of the shrimp fishery for the decline in seahorses and marine life in general.

Artisanal fishers along the north-western coast reported that the few commercial shrimp boats that fished in that area neglected the 3-mile offshore limit. Considering the remoteness of the main trawling grounds (Mosquitia, on the Caribbean Coast) enforcement of the offshore limit there, too, seems unlikely.

THE SEAHORSE TRADE IN NICARAGUA

Nicaragua has been sporadically involved in the seahorse trade, likely since the late-1970s. Seahorses obtained from Caribbean trawl fisheries have been exported through several different buyers to at least Costa Rica, Japan, Panama and the United States. It seems likely, however, that no exporter obtained seahorses from the fishery over long time periods.

Seahorses in Nicaragua

On the Caribbean coast, fishers in Bluefields caught *H. erectus* and *H. reidi* offshore from the port between El Bluff and Corn Island, from Puerto Cabeza to Puerto Isabel, around the Pearl Keys and as far south as Monkey Point. In these areas, seahorses were caught between 6 and 20 miles (9.7-32.2 km) offshore together with sponges, seagrass or occasionally algae. A few fishers had also found seahorses in rocky areas close to shore. Seahorses were found between depths of 9 and 44m but appeared to be concentrated in depths of 21 to 30m. A Nicaraguan fisher with experience on both coasts felt that there was a greater abundance of seahorses on the Caribbean coast.

Fishers on the Pacific coast variously reported Coral Edge, Limón, Puerto Sandino, Masachapa and San Juan del Sur as good areas for catching seahorses. Seahorses were primarily associated with seagrasses, as well as rocks, algae and coral. Fishers mainly reported catching seahorses 3-5 miles (4.8-8.0 km) offshore in depths of 18-73m.

Legislation affecting seahorses in Nicaragua

There were no government records of seahorse trade in Nicaragua. Theoretically at least, a permit is required to export live and dried seahorses but none had ever been issued. Trawl fisheries, which landed seahorses as bycatch, operated year-round with no closed season. Several fishers on the Caribbean coast mentioned that there had been a 3-month closed season prior to 2000. Trawling was prohibited within 3 miles (4.8 km) of shore. *Hippocampus ingens* had been observed at La Flor, a protected area on the Pacific coast (E. van den Berghe, pers. comm., 27 April 2000).

SEAHORSE CATCHES IN NICARAGUA

Bycatch of seahorses Nicaragua

Commercial trawl fisheries

Seahorses were caught incidentally in the commercial shrimp trawl fisheries that operate on both the Caribbean and Pacific coasts of Nicaragua. A bycatch study of the Caribbean coast trawl fishery lists *H. erectus* as a species caught, but not *H. reidi* or *H. zosterae* (Sánchez, 1998).

The Caribbean shrimp trawl fleet of 56 boats operated primarily from Bluefields, with boats fishing along the length of the coast. Most boats were equipped with two nets, although a few operated with four. Reported mesh size was 2.5-3.8 cm. Fishers were unable to estimate average seahorse catches owing to high variability associated with fishing areas (n=8). Almost all fishers said that in good areas they could catch a few hundred seahorses per night (n=6). Based on catch estimates and the assumption, based on a fisher's comment, that boats only trawled in 'good' seahorse areas a few days per trip, each boat may have caught 300 seahorses per month-long trip. On an annual basis, the fleet may have caught 492 kg of seahorses⁴ (Table 2). The majority of seahorses was said to come up alive but they probably died onboard while the shrimp were culled. Although some fishers occasionally retained a few seahorses as curiosities, they were generally returned to the water.

⁴ 56 boats x 11 months x 300 seahorses/month x 2.66 g/seahorse = 491.6 kg

The smaller Pacific fleet of 31 trawlers fished between the Gulf of Fonseca and San Juan del Sur. Boats operating out of Corinto had four nets each, while those in San Juan del Sur had two. A fisher with experience on both coasts commented that in comparison with the Caribbean, there were hardly any seahorses on the Pacific coast. He attributed this difference to less suitable bottom substrate on the Pacific coast. Certainly, catch estimates were much lower on the Pacific coast: four fishers reported that 'good' sets caught between two and 15 seahorses, although one fisher had caught 30 seahorses in a set in 2000. Two monthly catch estimates ranged between 20 and 120 seahorses⁵ (Table 2). Seahorses caught alive were returned, while dead ones were occasionally retained.

Artisanal fisheries

Seahorse volumes caught in Nicaragua's artisanal fisheries are unknown. On the Caribbean coast, the small trawl boats that operated around Bluefields each September may have caught a few seahorses. A biologist and former fisher reported that fishers using cast nets did not catch seahorses (R. Chan, pers. comm., 30 April 2000). One gill net fisher in Bluefields claimed to catch seahorses consistently year-round.

Along the Pacific coast of Nicaragua, seahorses were so rare in the gill net fishery that fishers could not provide average landings estimates. When caught, seahorses were alive and may have been kept as curiosities.

DRIED SEAHORSE TRADE IN NICARAGUA

Domestic trade

Retail sales of seahorses within Nicaragua were very limited (Table 3). The author did not locate seahorses for sale in Managua or anywhere along the Pacific coast. Three vendors at Huembes, the largest handcraft market in Managua, had sold seahorses in the past but none since 1999. Respondents suggested seahorses might be sold at the handcraft markets in Masaya and Leon. Seahorses had infrequently been traded in San Juan del Sur (Pacific coast) for C15-60 each (US\$1.21-4.85).

In 2000, there were two seahorse buyers in Bluefields (Caribbean coast). One Level 2 buyer had been fishing and selling seahorses since 1990. He sold seahorses individually to tourists and in larger quantities to buyers from the Pacific coast who came during vacation periods. His wife showed the author a bag of approximately 150 seahorses and said that the buyers typically purchased quantities of that size. Beyond that, however, she was unable to estimate sales volumes.

The second Level 2 buyer began selling dried varnished seahorses in 1997-1998 in his jewellery shop. He obtained seahorses from a few shrimp fishers, year-round, although supplies were irregular. This buyer estimated that he bought bags of about 500 seahorses two to three times per year, or 1,000-2,000 seahorses annually, and claimed to pay only C20-30 per bag (US\$1.62-2.43). He also commented that he did not buy larger quantities of seahorses sometimes offered by fishers, since he could not sell them. He sold seahorses to tourists for C10 each (US\$0.81), regardless of size or colour. Customers bought only a few seahorses at a time; no one bought in large quantities. In a regular week, he might sell one or two seahorses and this was said to increase to 20-30 during the vacation week of Semana Santa (in March). Based on these sales estimates and the low purchase price, it appears likely that, contrary to his claims, this buyer sold closer to 130 seahorses per annum.

Exports

A Fisheries official in Managua knew of seahorse exports in 1997 but no written records for these exports could be obtained. According to shrimp trawl fishers in Bluefields (Caribbean coast), exports of dried seahorses from Nicaragua had reportedly occurred in the 1990s through several traders. Although some

⁵ 31 boats x 11 months x 20-120 seahorses x 2.61 g/seahorse = 17.8-106.8 kg

trawl fishers in Bluefields had never heard of a trade, others knew of specific buyers. Since knowledge of buyers was quite variable among shrimp fishers, it appears that no traders bought seahorses over long time periods or from many fishers:

- One trawl fisher reported that around 1997 three buyers from a Japanese company came to the port to buy seahorses. These buyers made announcements over a loudspeaker, and apparently purchased seahorses from all the fishers for US\$0.50 each, or US\$0.25 if supplies were plentiful. These buyers bought seahorses 'by the sack' but only came in one season. The final use and destination of these seahorses was unknown and the fisher knew of no other buyers.
- A second trawl fisher said that buyers purchased ten to 20 seahorses at a time, never more. He remembered that in 1995 a Brazilian buyer had requested 50lb (22.7 kg) of seahorses but fishers told him they couldn't catch this many.
- A third fisher knew an American couple that came once in the 1990s and bought a 'mountain of seahorses'.
- The second Level 2 buyer in Bluefields mentioned that an American had come around 1998 enquiring whether it was possible to sell seahorses in 'large quantities'. To this, the buyer replied no.
- An experienced trawl fisher remembered a Managuan buyer who had not come since before 1990. This Level 2 buyer used to come to Bluefields every 6 months for 2-3 years to buy fish, including seahorses. On each trip, he purchased 40 dozen seahorses (960 seahorses per annum) for C8 per dozen (US\$1.87).

One vendor at Huembes market, Managua, reported that her husband had exported seahorses to Costa Rica and Panama. His business lasted over 10 years, and was likely in the late 1970s and early 1980s. Once imported, the seahorses were made into keychains and sold to tourists. Her husband obtained the seahorses directly from shrimp fishers in Puerto Cabeza and Bluefields, on the Caribbean coast. Although she did not know the quantity he exported, she believed he sent a large sack monthly.

A fisher in San Juan del Sur recalled that, during a 3-month period in 1996, a Costa Rican bought seahorses through a contact from Puerto Sandino (Level 2 buyer). The contact bought 30 seahorses every 2 weeks from shrimp fishers in San Juan del Sur (180 seahorses total). Total volumes of seahorses exported from Nicaragua are unknown.

LIVE SEAHORSE TRADE IN NICARAGUA

In 2000, no aquarium retailers in Nicaragua sold seahorses. Two shops that sold live seahorses from the Pacific coast in the past had stopped because of maintenance difficulties and low demand. One of these Level 2 buyers had bought seahorses from shrimp boats for C50 each (US\$5.98) in 1996.

According to a Fisheries official, an American company that caught ornamental fishes for export to Miami in the mid-1990s, targeted seahorses at one point. Since they lacked the necessary licence to catch seahorses, no records for volumes or values of these exports were available.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN NICARAGUA

Population declines

As in other Central American countries, trawling may pose a serious threat to seahorse populations. Heavy trawl pressure owing to the lack of a closed fishing season and the increase in foreign boats has resulted in overexploitation of the shrimp fishery. Six experienced shrimp trawl fishers on the Caribbean coast believed there had been substantial declines in seahorse catches (n=6/8 fishers), and a few pinpointed the decline as having begun 10 years ago.

Habitat loss

Much of Nicaragua's coastal mangrove habitat has been destroyed for shrimp farms. Dynamite fishing, although technically illegal, is known to occur in the mangroves around Corinto (Pacific coast).

Legislation

Further potential threats to Nicaragua's seahorses were the lack of fisheries legislation and enforcement of existing legislation. A Fisheries official remarked that trawl fishing definitely occurred within the 3-mile limit. Regulations appeared virtually non-existent on the Caribbean coast, which is physically isolated from the rest of Nicaragua.

THE SEAHORSE TRADE IN PANAMA

Panama imported 18-27 kg of dried seahorses from Hong Kong for sale as TCM in Chinatown per annum. Unknown quantities of seahorses caught on the Caribbean coast were also reportedly sold as curios. A handful of live seahorses were imported from the United States for use in private reef tanks.

Seahorses in Panama

On the Caribbean coast divers in the San Blas territory find seahorses in algae. Seahorses have been observed during commercial dives on the Caribbean coast of Panama in seagrass beds (*Thalassia* sp.) and among mangrove roots.

Along the Pacific coast of Panama, fishers have encountered seahorses in Puerto Armuelles, Punta Gorda, Garachine, Mensabe, Punta Patiño, Los Farullonas and the islands of Chana, Contadora, Taboga and Uraba. Fishers associated seahorses mainly with corals (n=4), although areas with rocks, algae and sponges were also mentioned. Seahorses may also be found in the mangroves of the two gulfs, areas in which it is illegal to fish (see **Legislation**). Seahorses were caught by trawl fishers between 1 and 8 miles (1.6-12.8 km) from the coast.

Uses

Dried

Within the Chinatown in Panama City, three retailers were found selling whole dried seahorses imported from Hong Kong. One retailer sold seahorses to Panamanian and ethnic Chinese customers for good luck and for medicines. Retailers at a TCM medical clinic and a TCM pharmacy said doctors prescribed recipes that included seahorses and '9-10 other herbs, roots and medicines' to treat sexual impotence and goitres. Seahorses were ground, mixed with other ingredients and taken with liquor, tea or mixed with food. The pharmacist considered seahorses to be a very expensive medicine and noted that demand for them was low because they were only used for the two purposes above. He maintained that seahorses were only bought for medicinal purposes by ethnic Chinese people, because Panamanians were not familiar with their uses. The medical clinic also had pre-packaged medicines containing seahorses for sale. These included Man Nan Oral Liquid, a 'special oral liquid for health-keeping' (seahorse content: 10%) and Tzepao Sanpian pills for sexual dysfunction (seahorse content: 1%).

Legislation

There were no official records of seahorse trade in Panama. The capture and export of ornamental fishes is illegal. Seahorses were landed as bycatch in the commercial shrimp trawl fishery, which is closed annually between 1 February and 11 April. Commercial boats were also prohibited from fishing in several coastal areas, including mangroves in the Gulf of Chiriqui and Gulf of Panama (AMP, 2000).

SEAHORSE CATCHES IN PANAMA

Target fisheries

Divers caught small quantities of seahorses. The indigenous Kuna people of San Blas (Caribbean coast) combine diving for food with the collection of conches, seastars and sponges for sale to tourists. They began to target seahorses in 1998. A diver in Portobello (Caribbean coast), and another on Taboga Island (Pacific coast) targeted ornamental fishes, including seahorses, for the live trade. The divers were equipped with simple snorkelling gear and caught seahorses using a small hand dip net.

Bycatch

Seahorses were among the incidental catch of Panama's large shrimp fishery. Based in Vacamonte, boats trawled in the Gulf of Chiriqui, Gulf of Panama and in Darien State. The size of the fleet had decreased from 300 boats in the early 1980s to 232 in 2000 (AMP, 2000). Most boats operated two nets of 5 cm mesh, although a few boats used four nets. Seahorses were usually alive when caught but many died onboard during shrimp culling. As fishers paid them little attention, most seahorses were returned to the water. For this reason, many fishers had difficulty estimating how many seahorses were caught. Generally they believed that they caught few seahorses (zero to four) per 20-day trip. A few noted that in peak areas and/or seasons they may catch two to ten seahorses in some trawls, totalling ten to 20 seahorses per trip. Based on the average weight of specimens and 2.5 months of high season (from fisher's comments), this fleet may catch between 32 and 77 kg dried seahorses per annum in total⁶ (Table 2).

Gill nets and cast nets (ataraya) were used all along the Pacific coast. Five artisanal fishers in Caimito reported they very rarely caught seahorses; none knew of, or had been involved in, any trade in seahorses.

DRIED SEAHORSE TRADE IN PANAMA

Domestic trade

Seahorses caught in commercial fisheries along the Pacific coast were sold as curios sporadically and in very limited quantities. None of the fishers interviewed knew of any seahorse buyers. However, one captain mentioned that some fishers occasionally sold seahorses. One former curio trader (Level 2) in Taboga had sold seahorses but stopped in 1998 because she had lost contact with her supplier. She said she normally sold 50 seahorses in a 6-month period, mainly to foreigners. One Panamanian remembered that seahorses were also sold in the Gulf of Chiriqui, although more so in the past. Since 1998, Kuna had sold seahorses to foreign tourists in San Blas and at one stall in a Panama City handcraft market.

Imports

Three retailers in Panama's Chinatown may import between 18-27 kg dried seahorses (4,540 to 6,900 seahorses) from Hong Kong per annum (Table 3). Seahorses were available year-round. One TCM retailer had sold seahorses since 1970, another since 1986; neither believed demand had changed over time. Overall, demand for seahorses was said to be low; the proffered explanation was their limited medical use. Low demand was also cited by one pharmacist as the reason TCM retailers did not obtain seahorses caught in local Panamanian fisheries. The trade estimate stems from the following accounts:

- One retailer imported 20-30 dried seahorses once or twice per annum (40-60 annually). She had sold out of seahorses the previous month and had not yet received a new shipment. She also imported unknown quantities of pre-packaged medicines containing seahorses from China.
- A second retailer reportedly bought 4.5 kg of seahorses every 3 months, which he estimated to be 1,000 seahorses. Based on this estimate and the mean weight of nine specimens this buyer may trade 4,600 seahorses (18 kg) per annum (4.5 kg x 4/3.90 g/seahorse).

⁶ Low season: 232 boats x 11 trips x 1-4 seahorses/trip x 2.66 g/seahorse = 6.8-27.2 kg; High season: 232 boats x 4 trips x 10-20 seahorses/trip x 2.66 g/seahorse = 24.7-49.4 kg). Total = 31.5-76.7 kg

- A third retailer commented that people only bought three or four seahorses at a time because they were a very expensive medicine. He indicated that a jar with approximately 250 seahorses would last for 6 months (500 annually). However, this trader also said he bought seahorses in small quantities, which he estimated to be 5lb (2.2 kg), three or four times annually. Accordingly, he might trade 6.6-8.8 kg (1,690-2,250 seahorses) annually.

Values

One fisher claimed, to the author, to have sold seahorses for US\$5-10 each. However, a Level 2 buyer in Taboga reported paying fishers US\$1 per seahorse, and sold them for US\$2.50 each. A curio trader sold seahorses in San Blas for US\$3-4 and for US\$5 in the market in Panama City. He also claimed to sell seahorses made into necklaces for US\$12 and for US\$50 when painted and made into decorations with conches, shells and crabs. Seahorses sold for more than his other items, because they were more difficult to obtain.

Imported dried seahorses for TCM sold for US\$2.75-4.50, roughly the same as domestic seahorses. One retailer sold the largest seahorses for US\$15. Two of the retailers considered seahorses to be a very expensive ingredient and cited this as a reason for buying or selling low quantities. None of the retailers would disclose how much they had paid for their seahorses.

LIVE SEAHORSE TRADE IN PANAMA

Volumes

An aquarium trader (Level 2) at an aquarium shop in Panama City claimed to be the only retailer and importer of tropical fishes in Panama. His business began in 1991 and had been supplied by the same two divers since then. The aquarium trader also imported small quantities of seahorses from Miami. According to this trader, demand for seahorses in Panama was quite low, and between his two sources he was able to obtain seahorses year-round. He knew of only six privately owned reef tanks in Panama City with seahorses. He estimated that he bought and sold about 14 seahorses in 1999: eight local and six imported (Table 3).

Values

The aquarium retailer/importer in Panama City paid his suppliers in Panama US\$10 for tan and black seahorses and US\$15 for orange and yellow seahorses. Imported seahorses from the United States cost US\$14 after the Panamanian duty tax was added. In his shop, seahorses sold for US\$30-40 depending on the size and colour (Table 5).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN PANAMA

Population declines

A biologist in the Fisheries Department (Autoridad Marítima de Panama) believed that many seahorses had been caught in trawl nets in the 1970s and 1980s but that since 1985-1990 the amount of seahorses per unit effort had declined along with shrimp. Six fishers and divers also commented that they had caught more seahorses in the past. One believed that as recently as 5-8 years ago they had caught double the quantity of seahorses.

Localized fishing pressure in San Blas had apparently caused a substantial decline in seahorse abundance since the Kuna began targeting them in 1998. While it used to be easy to find seahorses, very close to the shore in algae, fishers in 2000 had to go further from the shore to locate them.

Habitat destruction

Seahorses inhabit areas near either end of the Panama Canal. Oil spills in the Panama Canal contaminate the marine environment. Coral reefs near the canal were also affected by increased sedimentation and lowered salinity from freshwater outpour.

OTHER SYNGNATHID SPECIES IN CENTRAL AMERICA

A Guatemalan biologist reported that four species of pipefish were known to occur in Guatemalan waters: *Pseudophallus mindi*, *Microphis brachyurus lineatus* in freshwater and estuarine habitats on the Caribbean coast, *Syngnathus scovelli* in marine habitats on the Caribbean coast and *Pseudophallus starksi* in freshwater habitats on the Pacific coast (Dr. H. Kihn, pers. comm., March 2000). None of these species is known to be traded.

The first report of a trade in other syngnathids in Central America is from 1993, when a TCM importer in Hong Kong reported that an increasing number of 'poor quality' pipefish were coming from Latin America, and specifically Belize (A. Vincent, pers. obs. and A. Lau, *in litt.* to AV 18 March 1994). The Gulf pipefish (*Syngnathus scovelli*), while used in Asia as a replacement for *Solegnathus* species (pipehorse), more closely resembles the cheap *Syngathoides biaculeatus*. TCM merchants in China have also reported obtaining 'seadragons' (pipehorses) from Latin America (Vincent, 1996).

The only pipefish trade reported within Latin America was from Honduras, where, in 1995 and 1996, pipefishes, with seahorses, were traded in small quantities to Asia. Pipehorses were a rare bycatch of the trawl fishery in Roatán: a Level 2-3 buyer there, who supplied an exporter with seahorses and pipefishes destined for Hong Kong, estimated that only three or four 'dragons' (pipehorses) might be found among 10lb (4.5 kg) of seahorses. He reported that the 'dragons', which were about 6 inches long (15.2 cm), were in greater demand and had a higher value than seahorses. The Chinese man arrested for attempting to export syngnathids had 39 pipehorses (~125 g) in his possession, less than 1% of his total shipment.

COMPARISON TO 1996 SURVEY FINDINGS

The only known seahorse trade in Central America cited in the 1996 seahorse trade review was of exports of dried seahorses from Belize and live seahorses from Costa Rica (Vincent, 1996). All Central American countries surveyed in 2000 were involved in the seahorse trade.

CONCLUSIONS

Both dried and live seahorses are exported from Central America. Dried seahorses originating from Belize and Honduras are exported through Belize to Hong Kong and Miami (40 kg/annum). In the 1990s, dried seahorses were exported from Guatemala, Honduras, and Nicaragua. Large scale exports (100-300 kg/annum) from Honduras by Asian exporters in the mid-1990s did not result in a permanent trade. Live seahorse exports by Belize and Costa Rica are estimated at 300-400 seahorses per year in total.

The domestic seahorse trade in Central America is small. Dried seahorses were mainly traded as curios in Guatemala and Honduras, although small numbers were also traded in Costa Rica, Nicaragua, and Panama. Panama also imported between 18-27 kg of dried seahorses from Hong Kong for use in TCM. Both Costa Rica and Panama imported a few live seahorses through the United States for the aquarium trade.

Dried seahorses entering the trade were primarily caught in shrimp trawl fisheries: as much as 1,000 kg per year on the Caribbean coast and between 100-300 kg per year on the Pacific coast (Table 2). Commercial trawling will almost certainly negatively affect seahorse populations, through displacement or mortality of incidentally caught seahorses and through habitat damage (Watling & Norse, 1998). Information gathered during the 2000 survey suggests that populations on the Caribbean coast of Honduras and Nicaragua and on the Pacific coast of Guatemala, Nicaragua, Costa Rica and Panama, have declined as a result of trawl fisheries.

Lack of enforcement of fishery legislation was a general problem in Central America that may also threaten seahorse populations. An additional problem is the lack of monitoring of seahorse populations and the seahorse trade in Central America. Governments in Central America should be encouraged to begin recording imports and exports of dried and live seahorses as separate items in their Customs data. Research on wild seahorse populations and the establishment of well-enforced marine reserves should also be encouraged.

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CHAPTER 5. SEAHORSE TRADE IN SOUTH AMERICA¹

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ABSTRACT

Large quantities of dried seahorses have been exported from several South American countries in recent years. *Hippocampus erectus* and/or *H. reidi* were exported from Brazil to Hong Kong (240 kg in 2001) and from Surinam to Taiwan (203 kg in 2000); *H. ingens* was exported from Ecuador to Taiwan, Mainland China, Hong Kong and the US (120-385 kg per annum between 1994 and 1997) and from Peru to at least Hong Kong and Canada (81-536 kg per annum between 1998 and 2000). Venezuela may also have exported seahorses to Hong Kong. Several thousand dried *H. ingens* were also likely imported to Chile from Peru.

In South America, live seahorses were traded predominantly by Brazil. Brazil is one of the world's leading exporters of ornamental fishes and was among the 15 most important global traders between 1995 and 1997 (FAO, 1999). In a recent review of the global trade in marine ornamental fishes, Wood (2001) considered the Brazilian fishery for marine ornamental as large, involving 23-25 wholesalers. *Hippocampus erectus* is Brazil's sixth most important marine ornamental export (Monteiro-Neto *et al.*, 2000). Live seahorses were exported from Brazil to 20 countries in the Americas, Asia and Europe; according to Brazilian Custom's data the United States is the main market for these fishes. Live seahorses were also traded domestically in both Argentina and Brazil.

Domestically, small curio trades in dried seahorses are known from Argentina, Bolivia, Ecuador and Peru. Dried seahorses were also traded for TCM in Peru. The presence of a seahorse trade in other South American countries is unknown.

BACKGROUND FOR SOUTH AMERICA

Information sources in South America

Information presented here results mainly from research in Ecuador and Peru in May and June 2000, and in Brazil in December 2000, and February and April 2001. In Brazil, Ecuador and Peru, the authors surveyed the capital city, coastal ports and fishing villages and conducted 227 interviews with people involved in the seahorse trade (Table 1). Findings are supplemented by additional cited sources, including Hong Kong, Mainland China and Taiwan Customs data. The results are presented alphabetically for countries on the Atlantic coast, followed by the Pacific coast.

In Brazil, surveys were conducted along the north-east coast and in Santa Catarina state, South Brazil. Supplementary information was obtained through visits to scientific collections, loan of specimens and through underwater surveys carried out by the author, colleagues and local divers. Additionally, Collection permits issued by the Brazilian environmental agency, IBAMA, were examined from the states of Ceará, Paraíba, Pernambuco, São Paulo and Bahia.

In Ecuador, research was conducted in Quito, Manta, Puerto López, Salanga and Guayaquil. Export data were provided by the Department of Fishery Studies of the Directorate General of Fisheries, the Guayaquil

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based company, Empresa de Manifiestos, and by the Central Bank (Figure 1). In Peru, surveys were conducted from north to south, including Puerto Pizarro, La Cruz, Zorritos, Canchas, Sechura, Parachique, Chiclayo, Pimentel, Lima, Pucusana, Pisco, San Andrés, Chaco and Paracas (Figure 1). Biologist and seahorse researcher Marina Quine-Fernandez provided additional interview data in Peru.

Other South American countries have not been surveyed. Information for Argentina stems from correspondence with biologists and residents there.

Data for Surinam is from Taiwan Customs records. Anecdotal evidence for Venezuela, Bolivia and Chile came from respondents in other countries.

Seahorses in South America

Geographic distribution

Atlantic Coast

Two medium-sized seahorse species are found on the Atlantic coast of South America. *Hippocampus reidi* is found throughout South America, south to Rio Grande do Sul, southern Brazil. *Hippocampus erectus* ranges throughout South America to its southern limit in Argentina. *Hippocampus reidi* is a slender long-snouted seahorse, while *H. erectus* is usually deeper-bodied and has a proportionally shorter snout. Skin filaments seem to be much more characteristic of *H. erectus* than *H. reidi*. Both species exhibit morphological variation and distinct colour patterns which deserve further investigation from a taxonomic viewpoint. Records of other species of seahorse in Brazil, such as *Hippocampus kuda*, result from misidentifications. Both *H. erectus* and *H. reidi* are exploited for the dried and live trade in Brazil although traders did not discriminate one species from the other. The limited biological data available in 2001 was obtained under laboratory conditions (Silveira, 2000a;b;c). In 2001, Argentinean biologists were about to research the basic biology of *H. erectus* in the wild. *Hippocampus reidi* remained unstudied in the wild. Both of these species are listed as Vulnerable (A2cd) by IUCN (IUCN, 2002).

The following information on seahorse appearance, seasonal variations in abundance and breeding seasons was mostly gathered in Brazil but is believed to reflect patterns along South America's entire Atlantic coast. Specimens seen in the wild in the NE of Brazil were mostly orange, red or brown, often with saddle marks or tiny black dots. Black, brown, red, yellow, orange and marbled colours have been described by fishers and observed at aquarium shops and exporters' warehouses. Three fishers and one trader of seahorses in Santa Catarina State, Brazil, suggested that the specimens found there were mostly black or dull coloured. A few fishers also mentioned blue or green seahorses.

Three respondents in Brazil mentioned that seahorses could be caught throughout the year but most fishers (n=23) interviewed in NE Brazil felt that seahorses exhibited signs of seasonality, associating their catches with the seasons. Five traders of dried specimens in NE Brazil mentioned that the supply of seahorses was reduced in the winter months (June to August). Most fishers claimed that, during rainy months (June to August), seahorses were mostly caught in the sea, while in summer they were mostly caught in estuaries. Diminished seahorse catches in estuaries when it is rainy may be caused in part by reduced visibility. Visibility, however, is only important in the live seahorse fishery. Most seahorses sold dried were caught in beach seines.

Table 1. Number of respondents, by profession, interviewed within each country. Note that totals do not necessarily reflect the sum of columns, as some respondents were counted in two categories.

Background of respondents	Country		
	Brazil	Ecuador	Peru
Artisanal fisher	32	7	13
Commercial fisher	-	20	4
Fish company management	-	2	-
Diver	4	1	9
Marine products trader	51	2	19
Ornamental fish trader	16	-	1
Academic (biologist/researcher)	10	-	1
Government official	8	9	8
NGO	2	2	2
Local resident	15	-	-
Total	138	43	55

Seahorses bred throughout the year, according to most respondents in Brazil. Observations in NE Brazil, and specimens from South Brazil suggest that seahorses breed at least from July to May. Most fishers had captured pregnant seahorses and some had seen young being born. Fishers generally believed that it was the female seahorse that became pregnant; few were aware that it is the male that carries the young.

Anecdotal evidence, aquarium observations (Silveira, 2000a), and limited underwater observations suggest that behaviour of these species is similar to species studied in greater detail elsewhere (Lourie *et al.*, 1999). In Brazil, seahorses in the wild were seen either solitary or in pairs and had been observed to undertake greeting rituals (T. Dias & I. Rosa, unpubl. data). Experiments carried out in aquaria in Brazil (Silveira, 2000a) indicated that the incubation period of *H. reidi* lasts 21-25 days and that 200-1,000 juveniles are produced. Three males were seen giving birth in the wild in Brazil and their behaviour conformed to that described for other species (Lourie *et al.*, 1999).

Pacific Coast

The only species in the eastern Pacific, *H. ingens*, extends all the way from California to southern Peru. *Hippocampus ingens* is exploited for the curio and aquarium trades and in TCM, where it is valued because of its large size and smooth texture. This species is listed as Vulnerable (A2cd) by IUCN (IUCN, 2002) owing to the perceived threat of shrimp trawling in Ecuador (J. Gomezjurado cited in Lourie *et al.*, 1999). The first field study of *H. ingens* has recently been proposed in Peru (M. Quine-

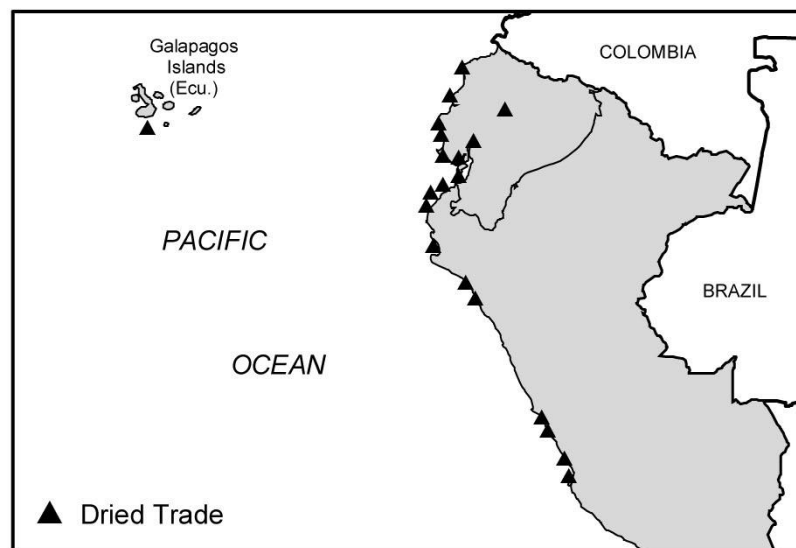


Figure 1. Maps of Ecuador and Peru showing (a) surveyed locations, and known locations where targeted seahorse catches occurred, and (b) known locations where dried seahorses were traded.

Fernandez, pers. comm., June 2000).

Thirty-five *H. ingens* specimens were obtained in Ecuador and Peru. They weighed between 1.23 g and 7.59 g (mean=3.77±1.31) and ranged in height from 11.6 to 18.3 cm. Over eighty fishers reported seahorse heights ranging from 2.5 cm to 30.5 cm (mean=138 mm). Most fishers had observed seahorses of either yellow or more neutral colours ranging through shades of brown, to grey and black. Other fishers had caught green, orange, red or white seahorses. A few fishers also described pink, blue, purple and silver seahorses and black ones with white dots. One diver in Ecuador claimed to have seen seahorses in small groups of two to four, while divers in Peru observed seahorses either alone or in pairs.

Although four fishers reported that seahorses were so scarce that there was no season for them, the majority of fishers in Ecuador and Peru (n=19) who commented believed that seahorse abundance varied seasonally. In Ecuador, however, region was viewed as a more important determinant of seahorse catch. In contrast, almost all fishers in Peru believed that seahorses are most abundant from January to March, when the cold Humboldt current is temporarily pushed back by warmer central-Pacific currents moving south from Ecuador.

Only a few fishers commented on catching pregnant seahorses and none could pinpoint when the breeding season occurs. In Peru, Laguna Grande is commonly believed to be a breeding ground for fishes, including seahorses.

Uses

Dried

Seahorses in TCM in South America

Nothing is known about use of seahorses by ethnic Chinese populations in South America outside of Peru. *Hippocampus ingens*, obtained from fishers in northern Peru, was seen for sale in Lima's Chinatown. Seahorses were generally sold by the pound (a few pounds at a time) for use as a tonic food in soups. Retailers were unfamiliar with the concept of purchasing seahorses individually and one retailer explained that soup with only one seahorse in it would have no flavour. An article entitled 'Seahorses of Strength', posted in one shop, explained that seahorses are used for asthma, kidney pain and 'most famously' as aphrodisiacs, or for 'masculine fatigue'. The seahorses were said to only produce their effect if whole and without any tears. The article described two seahorse preparations: one marinated with ginseng roots, the other a tonic soup prepared with pork.

Seahorses in folk medicine in South America

Medicinal uses of seahorses were reported for Brazil, Ecuador and Peru. Medicinal uses in other South American countries are unknown.

The use of seahorses for folk medicine is widespread in Brazil. All fishers interviewed in NE Brazil and in Santa Catarina state knew about the use of seahorses to treat asthma and bronchitis ('cansaço' and 'puxado'), and most said that they kept some at home just in case the remedy was needed. The medication was prepared by grinding seahorses and mixing the powder with water, soup or juice. According to most dried seahorse traders interviewed, the remedy was a charm ('simpatia') and the patients receiving it could not know what they were drinking or the effect would cease. Additionally, some healers mentioned that a female patient should prepare the concoction with a male seahorse and vice versa.

Commercialization of prepared seahorse medicines in Brazil appeared to be limited, as it was only found in one market. One trader visited in NE Brazil sold a powdered mixture of seahorses and other ingredients to treat asthma. The vast majority of interviewed healers, however, were not in favour of ready-to-use seahorse remedies because they were afraid they could not guarantee the quality or even the composition of the product.

In Ecuador and Peru, reported medicinal use of seahorses was limited outside Lima's Chinese community. Two fishers in Manta, Ecuador commented that some Ecuadorians came to the port to obtain seahorses for asthma treatment. Seahorses used for this purpose were ground and taken with juice.

Seahorses as curios in South America

On the Atlantic coast, seahorses were occasionally found for sale as curios in coastal towns in Argentina (F. Navarro & N. Britos, *in litt.*, 2 April 2000) and in Brazil. Seahorse curios in Brazil mainly comprised varnished specimens made into key-chains or mounted on seashells as decorative items. More rarely, varnished or painted seahorses were sold in a composite basket of marine products, including starfish and shells. Some fishers in Brazil also kept seahorses in their homes as decoration. Apart from these two countries, the domestic curio trade on the Atlantic coast remains unknown.

On the Pacific coast, the domestic curio trade remains unknown outside of Ecuador and Peru, where very small quantities of dried seahorses were seen for sale as curios. Within Ecuador, one vendor sold seahorses at a handcraft market in Quito and other respondents suggested that dried seahorses may also have been sold in Atacamas and Salinas. Furthermore, artisanal fishers in Salanga said tourists very occasionally requested seahorses. Along the coast of Peru, seahorses were found for sale in Puerto Pizarro, Cancas, Sechura, Chiclayo, Pimentel, Pisco and Chaco. One retailer in Lima's Chinatown commented that some people bought individual seahorses as decorations. Seahorses were also sold as decorations in the witchcraft section at the Chiclayo market. A curio trade apparently also existed in Bolivia.

In many areas on the Pacific coast, fishers commonly retained seahorses for personal souvenirs or gifts, rather than selling them. Such seahorses are sometimes varnished or painted and might be made into key-chains or necklaces. Occasionally people also added decorations such as crystals or plastic 'gemstones' to the eyes. A few fishers in Ecuador and Peru emphasized that the practice of keeping seahorses for curios had been more popular in the past, perhaps because seahorses were formerly easier to catch.

Seahorses as charms in South America

Seahorses were also sold as amulets at umbanda (African-origin religion) stores in Brazil to protect against 'evil eye', to bring good luck or to put a spell on someone. Furthermore, some fishers in Brazil kept seahorse in their houses for decoration or to bring good luck. Seahorses did not appear to have any special meaning in either Ecuador or Peru. Fishers in Ecuador emphasized that seahorses were only decorations. Three respondents, however, mentioned that people believed seahorses brought good luck.

Live

Seahorses as aquarium fishes in South America

On the Atlantic coast, live seahorses were sold for aquariums in Buenos Aires, Argentina (R. González, *in litt.*, 18 Jan 2001) and throughout Brazil. In Brazil, wild seahorses were heavily commercialized in the country and there were reports and personal observations of them being sold in some aquarium/pet shops in the States of São Paulo, Bahia, Paraná, Santa Catarina and Alagoas. The height of 60 examined specimens in NE Brazil ranged from 7.0 - 16.0 cm, but smaller specimens (5.0 cm) were seen for sale in Bahia (Cláudio Sampaio, pers. comm.). Most fishers and dealers of live seahorses interviewed in Brazil suggested that orange, red and yellow specimens were becoming rare. Four aquarium shop owners commented that seahorses were not popular aquarium fishes in Brazil because they were expensive and difficult to keep. Some stores that generally only sold freshwater fish supplied seahorses upon demand. One aquarium shop owner in Santa Catarina State mentioned that she did not sell seahorses because they were an endangered species. On the Pacific coast, only one aquarium retailer was located in Ecuador who had sold seahorses in the past. There was no marine ornamental fish trade in Peru.

Tables 2 and 3 summarize the values of dried and live seahorses, respectively, traded in South America by level within each country.

THE SEAHORSE TRADE ON THE ATLANTIC COAST: ARGENTINA

A small curio trade of domestic and imported seahorses occurred in some coastal towns. Small numbers of domestic and imported live seahorses were also sold for aquariums, mainly in Buenos Aires.

Table 2. Value of dried seahorses traded in South America. Source: Authors' research.

Country	Cost per seahorse in curio trade	Amount paid to fishers (/indiv.)	Value of exported seahorses	
			Amount paid to fishers (/kg)	Amount paid to Level 2/3 buyer
Argentina	US\$3.80	-	-	-
Brazil	US\$ 0.45- 4	-	-	-
Ecuador	US\$1-5	1,500-12,000 sucres (US\$0.06-0.48)	120,000-1 million sucres/lb (US\$10.58-88.18/kg)	10,000 sucres (US\$0.40) ea; US\$88.18/kg
Peru	US\$0.29-10.06	S0.5-1 (US\$0.14-0.28)	S30-70/kg (US\$8.62-20.17/kg)	S160/kg (US\$45.98/kg-US\$248/kg ¹)
Surinam	-	?	?	?
Venezuela	-	?	?	?

¹ for largest *H. ingens*.

Seahorses in Argentina

Hippocampus erectus is the only seahorse species found in Argentina. The southernmost populations of this species in the south-west Atlantic are found near San Antonio Oeste. These populations may be isolated from the rest of the *H. erectus* range, as is also the case for other fish species in this area (L. Orensanz, *in litt.* to A. Vincent 14 Nov 2000).

In 1996, during underwater studies on another species in Argentina, researchers observed seahorses in substantial numbers, distributed in the same areas as octopuses, and the main distribution areas were identified (R. Gonzalez, A. Gosztonyi & M. Narvarte, unpubl. data). A collaborative study in 2001 aimed to obtain basic information about the biology (reproduction and growth), population structure, spatial distribution and abundance of this species (R. González, *in litt.* to A. Vincent 18 Jan 2001).

SEAHORSE CATCHES IN ARGENTINA

San Antonio Oeste was reportedly the only location in Argentina where seahorses were directly targeted. Seahorses were caught by a few part-time divers who sold them live for aquariums or dried as souvenirs (L. Orensanz, *in litt.* to A. Vincent 14 Nov 2000). Seahorses at this location had reportedly been exploited in a semi-intensive way in past years mainly for aquarium purposes. Further information on the commercial activity of seahorse fishers in San Antonio was being collected in 2001 (R. González, *in litt.* to A. Vincent 18 Jan 2001).

Hippocampus erectus was also thought to be among the bycatch of shrimp trawls in Mar del Plata (L. Magnasco, *in litt.* to A. Vincent 23 May 1999).

DRIED SEAHORSE TRADE IN ARGENTINA

A small curio trade for seahorses has been reported from some coastal towns in Argentina. Dried seahorses were found for sale in Santa Teresita, Provincia de Buenos Aires, in 1999. Each shop (the total number of shops was not reported) apparently stocked 50 dried seahorses, selling at US\$3.80 each (F. Navarro and N. Britos, *in litt.* to A. Vincent 2 April 2000). The seahorses had supposedly been imported from the Philippines. Demand for dried seahorses from the San Antonio seahorse fishery was apparently limited (R. González, *in litt.* to A. Vincent 18 Jan 2001).

Table 3. Value of live seahorses traded in South America (in \$US). Source: Authors' research.

Country	Amount paid to divers	Cost of imported seahorses paid by dealer	Selling price per seahorse in domestic trade	Value of exported seahorses- amount paid to exporters
Argentina	?	?	60-80	-
Brazil	0.45 – 3.50	-	-	?
Peru	?	-	5.75-7.18	-

LIVE SEAHORSE TRADE IN ARGENTINA

Small numbers of live seahorses were sold as ornamental fish in Argentina. The main market was in Buenos Aires but public and private aquariums were also located in Mar del Plata and San Clemente (R. González, *in litt.* to A. Vincent 18 Jan 2001). One respondent reported that the San Antonio supply had been discontinued in the 1990s and that most seahorses offered were *H. reidi* from Brazil (Magnasco, *in litt.* to A. Vincent 23 May 1999). Another source suggested that seahorses were not currently very popular in Argentina owing to their cost and local lack of husbandry knowledge. However, a rise in demand was anticipated because the aquarium industry was increasing in Argentina and neighbouring countries (R. González, *in litt.* to A. Vincent 18 Jan 2001). Live seahorses cost US\$60-80 each in aquarium retail shops (F. Navarro & N. Britos *in litt.* to A. Vincent 2 April 2000).

THE SEAHORSE TRADE ON THE ATLANTIC COAST: BRAZIL

Exports of dried seahorses have not been recorded in Brazil but Hong Kong Customs data indicate that Brazil exported 240 kg of dried seahorses to Hong Kong in 2001. Brazil is one of the world's leading exporters of ornamental fishes (FAO, 1999; Wood, 2001), and is the main exporter of live seahorses in Latin America. *H. erectus* is Brazil's sixth most important marine ornamental export (Monteiro-Neto *et al.*, 2000). In 2000, Brazil exported live seahorses to, at minimum, Belgium, Denmark, France, Germany, Holland, Italy, Portugal, Spain, Switzerland, United Kingdom, Canada, United States, Mexico, Chile, Argentina, Philippines, Taiwan, Macau, Hong Kong, Mainland China, Singapore and Japan. Seahorses were caught in most coastal States and the majority of the traded specimens were captured in Espírito Santo, Bahia, Pernambuco, Ceará and Alagoas. Recently seahorse captures had also begun in the State of Piauí. Live and dried seahorses were also heavily traded within the country, however, no official statistics of the trade exist. Both the live and dried seahorse trade were unregulated in Brazil.

Seahorses in Brazil

In Brazil, seahorses are known to occur in the following States: Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Rio de Janeiro, Espírito Santo, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul. In São Paulo and Rio de Janeiro they were considered a threatened species; population status has not been evaluated in the other States.

The habitat that respondents most frequently associated with seahorses was shallow calm water near mangrove vegetation (mainly *Rhizophora mangle* but also *Avicenia* sp.), followed by rocky pools and floating weeds. One university researcher had found young seahorses in floating algae in NE Brazil. Seahorses have been observed to use the following holdfasts: roots of mangrove vegetation, *Carijoa* sp., sponges and *Ascidia nigra* (T. Dias & I. Rosa, unpubl.data). One fisher reported that seahorses lived in association with a particular type of algae. In contrast, another experienced fisher/trader stated that he had caught between 10,000 and 20,000 seahorses, none associated with algae.

Seahorses are also known to occur in deep areas: nine seahorses (six in October, two in November and one in December) have been found in the stomachs of the oceanic dolphin, *Coryphaena hippurus*, captured off the SE and S Brazilian coast (Zavala-Camin, 1986). In NE Brazil one seahorse was found in the stomach of a *C. hippurus* captured in January 1999, 60 miles off the Ilhéus coast (Cláudio Sampaio, pers. comm., July 2001). Seahorses have also been captured in research trawls (depth 30 m) in NE Brazil (A. Vera, pers. comm., February 2001).

Legislation

Brazil had no official national list of threatened marine fish species in 2001 but both Rio de Janeiro and São Paulo States officially listed seahorses as threatened. They were, however, traded in both States. Federal Brazilian environmental legislation did not specifically protect seahorses or any other marine aquarium fish. However, Section I (Crimes against the Fauna) of the 'Lei da Vida' (Law no. 9.605 of February, 12/1998 and Decree no. 3.179 of October, 21/1999) contained statements that could be invoked to protect seahorses as a component of wildlife. Section I stated that unauthorized captures, sales or exhibition of specimens or parts of them, their eggs or larvae, impediment of their procreation, or alterations of the purposes of the license were considered as crimes. Application of this section would be

particularly relevant to the dried seahorse trade, which was generally based on unauthorized captures. Additionally, Item I of Article 34 stated that it was illegal to fish for species that should be protected; this could be directly applied to the States of Rio de Janeiro and São Paulo, where seahorses were officially listed as endangered.

In 2001, the Brazilian Institute of the Environment and Natural Resources (IBAMA: Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) had no list of marine fishes that could be captured (such a list exists for freshwater fishes). Hence, captures were authorized by IBAMA regardless of the species. A list of authorized marine fishes would facilitate control of the live seahorse trade because, for example, it could be updated to accommodate population declines in a State or area. An unpublished list of threatened marine fish species prepared in 2000 by the Brazilian Society of Ichthyology listed both *H. erectus* and *H. reidi*.

The dried trade was unregulated and no official statistics were available in Brazil. Apparently most specimens were commercialized within Brazil but exports have occurred, at least to Hong Kong.

Permits were required to trade live seahorses but quotas were not well enforced. In 2000, live seahorse traders had to register at the Ministry of Agriculture and then request an authorization from IBAMA to capture a given number of seahorses. Traders did not have to indicate collection sites or final destination of the specimens. Generally, in 2000, each company authorized to catch seahorses for the aquarium trade was allowed to catch a maximum of 10,000 seahorses per year (5,000 each *H. reidi* and *H. erectus*). However, owing to misidentification, permission to capture 5,000 *H. kuda* was also frequently given, thus inflating the quota. Colour morphs were listed as species on a few permits, thus artificially increasing the quota. Additionally, one marine fish dealer reported that because the contents of the live-fish shipments were not checked, when the maximum quota for seahorses was reached they were sold as another species.

To export live seahorses, traders had to obtain an additional licence that indicated the number of exported seahorses. However, the numbers of both captured and exported seahorses provided by traders were not checked by officials at any point and figures provided by different sources differed markedly from one another. Live seahorses were exported under the general commercial category 'ornamental fishes' (code 0301.10.00 of 'Nomenclatura Comum do Mercosul') which also included freshwater species. Thus pertinent Governmental offices had no export statistics for the live trade.

Fisheries regulations were not well enforced in Brazil. Brazilian law prohibits blast fishing and ichthyotoxics but both practices were known to occur in NE Brazil. One fisher explained that in the past he used ammonia and insecticide to aid in the collection of fishes for the aquarium trade and that in 2000 he used commercial anaesthetic. Beach seines with stretched mesh sizes below 30mm (Raul Borba, pers. comm., June 2001) were prohibited by law, however enforcement was virtually non-existent. Furthermore, fishing was allowed in most existing protected areas. In fact, seahorses were captured for commercial purposes within the boundaries of at least two Marine protected areas in NE Brazil (APA Mamanguape, Paraíba State and APA do Litoral Norte, Bahia State).

Concern regarding the marine aquarium trade, however, was growing. In November 2000, IBAMA promoted a workshop specifically to analyse the marine fish trade and to gather information to support the first statutory regulations of the trade. Additionally, when interviewed some traders of live specimens showed disposition to collaborate with monitoring initiatives.

SEAHORSE CATCHES IN BRAZIL

Seahorses were caught for the aquarium trade along most of the Brazilian coast. Fisheries directed at live seahorses occur at least in the following states: Pernambuco (one company licensed in 2000), Bahia (two companies licensed in 2000), Ceará (eight companies licensed in 2000), Alagoas (one company licensed in 2000) and Espírito Santo (about 21 companies licensed in 2000). These fisheries were mostly conducted by self-taught divers, who generally also practiced subsistence fishing, or by former artisanal fishers. Exporters bought fishers' catches from several locations and even from different states, either directly or through intermediate buyers. In 2000, each company was authorized to capture a total of 10,000 seahorses (5,000 of *H. erectus* and 5,000 of *H. reidi*) per year. However, one collection permit examined

by the author had four color morphs listed as separate species, potentially resulting in the collection of 20,000 seahorse specimens.

Seahorses were also incidentally caught in beach seines and were targeted or incidentally caught in cast-nets. Beach seining was an important source of seahorses for the dried trade; shrimp trawler fishery was the main source of dried seahorses at Santa Catarina State, South Brazil, but there are no estimates of bycatch numbers. Fishers from small coastal towns where the seahorse trade was not established explained that they released captured individuals or sometimes took them home and dried them for use as medicinal remedies, decoration or gifts. Where seahorse fishing had been commercialized, however, the vast majority of seahorses caught in nets were sold into the domestic dried trade.

DRIED SEAHORSE TRADE IN BRAZIL

Domestic trade, exports, volumes, and values

Hong Kong Customs records for 2001 indicate that 240 kg of dried seahorses were imported from Brazil in March of that year (Hong Kong Customs Data, 2001). Two fishers from Paraíba State mentioned in 2000 that they had been asked to sell dried seahorses to fishers working on Taiwanese vessels operating in Cabedelo municipality. One dealer from Santa Catarina State mentioned that a member of the crew of a Japanese fishing vessel had 15,000 dried seahorses to be sold in China. It is likely that dried seahorses were being exported from Brazil, unreported. Many dried specimens were sold domestically, mainly for medicinal purposes. However, the frequency with which seahorses were exported, and volume estimates, are unknown. Seahorses were largely (but not exclusively) collected in the north-east and in the State of Espírito Santo, SE Brazil, and traded from one state to another, throughout the coast and in various inland municipalities. Commercialization was made either directly from the fisher to the distributor or through intermediate buyers. Suppliers from Bahia state distributed seahorses to the coastal states of Sergipe, Alagoas, Pernambuco, Paraíba, São Paulo and Santa Catarina, and to some inland municipalities. Traders in Rio Grande do Norte State may have also supplied dried specimens to the Alagoas market for medicinal and religious purposes. One trader at an *umbanda* store mentioned that she imported seahorses from the Red Sea and India through a retailer in São Paulo State.

Only occasionally were specimens displayed to consumers; they were generally kept hidden in cans. Most traders interviewed ($n=38$) expressed their concern about being caught by environment officials because they perceived their activity as illegal. Five traders believed that the trade was illegal because seahorses are under threat of extinction. Two traders reported that IBAMA officials had seized their stock of dried seahorses because 'selling seahorses was illegal'. Numbers of seahorses traded are difficult to estimate at this point. The number of traders in the seven markets visited in NE ranged from one to 30 and each had a standing stock of 30-150 seahorses. Five respondents mentioned they usually bought 100 seahorses at a time but they could not say how long on average it took to sell the specimens. One informant mentioned she could sell 12 seahorses per day, another said he once sold 30/day. Traders usually sold other dried animal products, such as sloth's claw and starfish, along with seahorses.

Retailing prices varied with the size of individuals, their origin and degree of preservation, and ranged ($n=730$) from 1.00-6.50 Reais (approximately equivalent to US\$0.45-3.00). One trader said that when there was a shortage of seahorses, prices reached US\$5.00-7.50. Retailers buy dried seahorses from fishers, usually for less than US\$0.50. Specimens were unbleached and sometimes had small sections of the body missing owing to mouse bites or insects. Seahorses imported to Hong Kong had a declared value of HK\$84,000 (US\$10,769.36), equivalent to 44.87/kg.

LIVE SEAHORSE TRADE IN BRAZIL

Exports, volumes, values

Brazil is one of the leading exporters of ornamental fishes and was among the 15 most important global traders between 1995 and 1997 (FAO, 1999). *Hippocampus erectus* is Brazil's sixth most important marine ornamental export (Monteiro-Neto *et al.*, 2000).

Although all marine aquarium fishes exported from Brazil are lumped into a single commercial category ('ornamental fishes'), upon request Brazilian Customs sorted out seahorses from other ornamental fishes exported and provided official numbers of the trade. In 1999, according to Brazilian Customs data, 1,050 seahorses were exported to eight countries. However, that year in a monitoring programme carried out by one IBAMA office, a single wholesaler from NE Brazil declared to IBAMA that he exported 3,215 seahorses, more than the supposed total for all of Brazil. Furthermore, 1999 European Imports data showed Brazil as the source for 5,080 seahorses and in the same year, the United States imported 608 Brazilian seahorses. At a minimum then, Brazil exported 5,688 live seahorses in 1999. The discrepancies in numbers of exported seahorses clearly indicate the need to monitor the trade and to integrate the various levels of data collection. In 2000, according to information provided by Brazil's Customs, 11,519 seahorses were exported to 19 countries; in 2001 (between January and April) 5,561 were exported to 13 countries, the United States being the largest importer (2,611 seahorses imported). In NE Brazil seahorses were mainly exported through wholesalers located in the States of Ceará, Pernambuco and Bahia. To a lesser extent, Alagoas also exported seahorses. In SE Brazil, exporters existed at least in the State of São Paulo and Espírito Santo. Apparently the Southern States did not have a significant role in seahorse exports.

Seahorses were sold either directly from fishers to exporters or through up to three intermediate buyers. Seahorses caught by artisanal fishers were either taken immediately to the wholesaler or kept with the fisher, possibly for up to one week. Fishers, who worked on boats owned by the wholesalers, took seahorses directly from the boat to the holding facility. Three dealers mentioned that they could sell as many colourful seahorses as they could obtain. No estimates of daily sales were obtained but at one holding facility 150 seahorses were in stock to be sold when the author visited. One fisher mentioned that one intermediate level buyer from NE Brazil shipped 300 seahorses to Rio de Janeiro.

During visits to two holding facilities in NE Brazil, a large number of pregnant seahorses were found. The quality of holding facilities varied greatly, ranging from one facility with inadequate sanitary conditions and tanks with a precarious aeration system, to a few well-equipped companies who had invested in equipment, such as UV filters and skimmers. At two holding facilities visited in NE Brazil specimens were individually packed; the maximum number of seahorses shipped daily mentioned by respondents was 300.

Fishers were paid between US\$0.45 and (exceptionally) US\$3.50 for each seahorse. Prices mostly depended on colour, with red, orange and yellow specimens being most, and black ones least, valuable. One trader in NE Brazil claimed that the price of black specimens had decreased in the last 10 years whereas the price of coloured ones had markedly increased. One buyer (Level 2) in NE Brazil mentioned that seahorse prices tripled at each level. In hobby shops seahorses were sold for prices ranging from US\$7.50 (Alagoas) to 20 (Santa Catarina State). US import data from January 1996 to April 2000 show that Brazilian seahorses were imported, at a price of US\$0.80-18.00 each. On a North American Internet site, Brazilian seahorses were advertised at US\$45 each.

OTHER SYNGNATHID SPECIES IN BRAZIL

In 1993 a TCM importer in Hong Kong reported that an increasing number of 'poor quality' animals were coming from Latin America and specifically Brazil (Vincent pers. obs. and A. Lau, *in litt.*, 18 March 1993). The Latin American pipefish, while used as a replacement for *Solegnathus* species, more closely resembles the cheap *Syngnathoides biaculeatus*. TCM merchants in Mainland China have also reported obtaining 'sea dragons' (pipehorses) from Latin America (Vincent, 1996).

Within Brazil, two pipefish species are known to be commercialized in the aquarium trade: *Cosmocampus albirostris* (whitenose pipefish) and a *Syngnathus* sp. (likely *S. scovelli*, Froese & Pauly, 2001). In the dried trade pipefishes apparently were not commercialized. None of the traders interviewed in NE Brazil knew what pipefishes were and none were found for sale.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN BRAZIL

Population declines

Most fishers ($n= 25/29$) interviewed reported declines in seahorse catches since 1990. One reported that, while in 1990 he could catch 500 seahorses daily and had a choice of colours, in 2000 he caught no more than five or six per day. Another, who could catch 150 per day in 1990, had since stopped collecting seahorses because it was no longer financially attractive. Six other fishers indicated that seahorses, previously common, had disappeared locally.

Most respondents mentioned heavy fishing pressure as the cause for these declines. Additionally, two fishers from Alagoas State expressed their concern about blast-fishing and reported seeing a small number of dead seahorses floating after some of the explosions. Two fishers in NE Brazil mentioned pollution as a possible cause for the observed decline in seahorse numbers. Finally, one trader expressed his concern about the effects of trawling and disorganized tourism on reef fishes in general.

A high number of pregnant seahorses (live and dried) were found for sale. One fisher explained that in order to avoid problems with environment officials, whenever he found pregnant seahorses he squeezed the pouch to get rid of the offspring. Traders of live specimens said that newborn seahorses usually died shortly after birth; three collectors said that they occasionally released the newborn in the wild.

Lack of monitoring

A major cause of concern for seahorse conservation stems from the near total lack of monitoring of the marine aquarium trade and the poor collection-permit system. After receiving the authorization, few traders report how many seahorses were actually captured. Captures by unregistered traders occurred, at least in some NE Brazilian States, and exert an additional pressure on wild seahorse populations. This aspect is particularly relevant given the fact that since 1995 seahorses have become one of the top species in the Brazilian marine aquarium trade (Monteiro-Neto *et al.*, 2000).

The lack of control of the dried trade is also a major cause for concern; numbers of traded seahorses are unknown, despite the fact that dried seahorses are commercialized for various purposes and throughout the country.

Habitat destruction

Mangrove destruction and pollution of estuaries represent additional threats for seahorses (at least in NE Brazil). Despite being protected by law, some mangrove areas were being lost to logging and clearance for aquaculture ponds in NE Brazil. As examples, aquaculture ponds are found in Rio Jaguaribe, Pernambuco State, and Rio Mamanguape, Paraíba State.

Aquaculture brings additional threats: three fishers (from Santa Catarina) and one biologist (from NE Brazil) who cultivated oysters stated that many seahorses were found in the aquaculture ponds, using the culturing lines as holdfasts. One of the fishers, as a result, had decided to place all caught seahorses in a confined area to sell them.

CONCLUSIONS FOR BRAZIL

Brazil exported dried seahorses to Hong Kong in 2001 (240 kg), and has been a major exporter of live seahorses since at least 1999. There is a need to integrate the various steps in data collection and to closely monitor the trade at least to guarantee that reliable capture, mortality and dried and live trade estimates are obtained. In order to conserve seahorse populations in Brazil the following recommendations should be considered: trade regulations should be implemented and enforced; quotas should be reviewed to avoid overexploitation of local seahorse populations; education programmes and small-scale aquaculture initiatives should be promoted; research on taxonomy, population parameters and ecology should be stimulated; suitable sanctuaries should be delimited, where fishing is prohibited or strictly regulated.

THE SEAHORSE TRADE ON THE ATLANTIC COAST: SURINAM

DRIED SEAHORSE TRADE IN SURINAM

Exports

Taiwan Customs data indicate that Taiwan imported 203 kg of dried seahorses from Surinam in 2000. This is the only known record of the seahorse trade in Surinam and no further details of the trade are known. A biologist in Surinam found no evidence of a seahorse trade through visits to markets and interviews with Fisheries officials and aquarium retailers there (A. Moredjo *in litt.*, 2 Aug 2001).

THE SEAHORSE TRADE ON THE ATLANTIC COAST: VENEZUELA

DRIED SEAHORSE TRADE IN VENEZUELA

Exports

In 1998, a seahorse wholesaler in Hong Kong reported that Venezuela was among his South American source countries (Boris Kwan, pers. comm., 31 Dec 1998). In 2000, a salesperson working for an exporter in Peru mentioned that, in addition to Hong Kong their seahorses might also be exported to Venezuela. Details of the trade in Venezuela, however, are not known.

THE SEAHORSE TRADE ON THE PACIFIC COAST: BOLIVIA

DRIED SEAHORSE TRADE IN BOLIVIA

Imports

In land-locked Bolivia, too, seahorses have apparently been sold as curios: a curio trader in Peru knew of someone who was caught at the border trying to export 2000 seahorses to Bolivia, likely for curio trade. She herself had taken 50 seahorses to sell to tourists in La Paz, Bolivia.

THE SEAHORSE TRADE ON THE PACIFIC COAST: CHILE

DRIED SEAHORSE TRADE IN CHILE

Imports

Chile is beyond the southernmost range of seahorses (*H. ingens*), so that any seahorse trade here must rely on imports. One seahorse trader (Level 2) in Peru reported exports of dried seahorses to Chile in 1997. According to him, a diver in Pisco, Peru, collected seahorses from many divers and made bi-weekly or monthly trips to Tacna, Peru, near the Chilean border. There he sold 80-100 dried seahorses to a single Chilean importer, who placed advanced orders for the seahorses to give the diver time to collect them. The buyer in Peru speculated that these seahorses were destined for the curio trade. A fisher in Chaco (near Pisco, Peru) also knew of an exporter he believed to be from Chile, who bought seahorses in the past from many fishers in Laguna Grande during the summer of 1999 (January to April). This exporter reportedly came several times a week and could obtain between 0.5-1 kg from each boat; how frequently and from how many boats was not clear. The two accounts of trade with Chile, however, suggest that a few thousand dried seahorses may have crossed that border annually in the late 1990s.

THE SEAHORSE TRADE ON THE PACIFIC COAST: ECUADOR

Ecuador has exported dried seahorses to Asia since at least 1986, in addition to trading seahorses domestically as curios. While the capture of seahorses was unregulated in 2000, seahorse exports required permits and were recorded in three separate databases in Ecuador. Exports in the past have been destined for Taiwan, Hong Kong, Mainland China and the USA, and in the mid-1990s amounted to 120-385 kg annually. Available databases did not record any seahorse exports from 1998-2000 but respondents suggested that the trade continued. Most seahorses in the trade were caught as bycatch in Ecuador's shrimp trawl fishery, although sea cucumber divers in the Galapagos took some. Trade in live seahorses apparently did not occur.

Seahorses in Ecuador

A biologist reported that populations of seahorses were found along the Gulf of Guayaquil, close to Posorja, Manabi coast, and from La Libertad to Manglaralto zone (J. Gomezjurado *in litt.* to J. Baum, May 2000). Fishers in Ecuador associated seahorses most commonly with rocky areas (n=13) and/or algae (n=5). Some fishers also said they catch seahorses in sand (n=5) or mud (n=3) bottoms. They had caught seahorses around Manta, the Bay of Libertad, La Puntilla de Salinas, Playas and in reefs near Los Frailes. Although the northern coast was not surveyed, fishers elsewhere reported that seahorses were found in Esmeraldas, Pedernales and Suá. One fisher in Guayaquil reported that seahorses were more plentiful in the north, although still not abundant. In the Galapagos, seahorses were said to generally be restricted to the western islands, although they were occasionally seen elsewhere (Dr. R. H. Bustamante, *in litt.* to J. Baum, 4 June 2000).

Legislation

Ecuador was one of the few countries that had official seahorse trade data, although the reliability of these data is unknown. The Central Bank in Ecuador controlled exports by informing the private banks which species were permitted for export and providing them with lists of the necessary requirements. Dried seahorse exports were listed under the CUCI codes 0363904000. A code also existed for the export of live seahorses (CUCI: 0365101000) but in practice Customs data on the trade in ornamental fishes was aggregated into a general category, thus it was not possible to obtain records specific to live seahorses. Although seahorse catches were unregulated in Ecuador, permits for the export of seahorses existed. Unfortunately, nothing in Ecuadorian export law prevented the export of illegally caught species, or of species — like seahorses — for which there was no permit system for capture.

Ecuador's shrimp trawl fishery, which caught seahorses incidentally, was normally closed from December 15th to February 15th but there had been no closure in 1999. In the Galapagos, the season for the sea cucumber fishery, which may also take seahorses, lasted only 2 months, between May and July each year (Dr. R. H. Bustamante, *in litt.* to J. Baum, 4 June 2000).

No areas were protected from trawling along the mainland coast. A marine park, within which commercial fishing was prohibited, extends 40 nautical miles around the Galapagos Islands.

SEAHORSE CATCHES IN ECUADOR

Target fisheries

In 2000 and 2001, there was no known seahorse fishery in the Galapagos Islands (V. Toral, *in litt.* to J. Baum, 2 Feb 2001; Dr. R. H. Bustamante, *in litt.* to J. Baum, 4 June 2000). Despite closely monitoring fishing activity and the majority of catches, the Charles Darwin Research Station (CDRS) had no recent records of a seahorse fishery. They did, however, report informal accounts of seahorses being gathered by divers while fishing for lobsters and sea cucumbers (Dr. R. H. Bustamante, *in litt.* to J. Baum, 4 June 2000).

It is possible, however, that fishers who primarily targeted other species also took seahorses. In 2000, there were approximately 970 registered fishers operating 500 boats (up to 18m in length) fishing in the

Galapagos, and likely 200-300 divers (Dr. R. H. Bustamante, *in litt.* to J. Baum, 4 June 2000). Biologists at CDRS were to conduct a general survey in 2000 to assess this 'incidental' catch of seahorses and other rare species (Dr. R. H. Bustamante, *in litt.*, 4 June 2000).

Historically seahorses were caught in the Galapagos; a seahorse fishery was established in the mid-1990s. In 1994, sea cucumber fishers also targeted seahorses for the dried trade, particularly on the western part of Isabela (Canal Bolivar; V. Toral, *in litt.*, 2 Feb 2001). The dried trade continued in 1995, apparently in response to an Ecuadorean fisheries dispute (J. Barry, *in litt.* to A. Vincent, 6 July 1995), in which the closure of the sea cucumber fishery (because of over-harvesting) led to angry confrontations and destructive fishing within the proposed Galapagos Islands marine reserve. Clear protective status had not yet been established for marine species within the reserve (J. Barry, *in litt.*, 6 July 1995), and CDRS biologists reported that seahorses were among many species taken (J. Gomezjurado, *in litt.* to A. Vincent, 31 Oct 1995). Many were hand-collected by hookah-rig divers seeking sea cucumbers (J. Gomezjurado, *in litt.*, 31 Oct. 1995). Although the impact of this fishery was unknown, given the low density of seahorses recorded on the west side of the archipelago (one to three seahorses per 100m² in October 1995, J. Gomezjurado, unpubl. data), large areas may have been quickly depleted.

A small number of divers in northern Ecuador possibly also captured seahorses occasionally. A diver from Suá with 26 years experience in the area reported having sold seahorses throughout that time. Although he believed himself to be the only diver in Suá, he knew of another diver in Atacames. Volume estimates are not available for this fishery.

Bycatch

Commercial

Most seahorses entering the trade in Ecuador were taken as bycatch of the commercial shrimp trawl fishery. The fleet had diminished since 1988 and in 2000 consisted of approximately 200 active boats. The main ports were in Esmeraldas, Manta and Guayaquil. Fishing pressure was concentrated in the Gulf of Guayaquil, but boats fished along the entire coast. Boats trawled two 75-85 ft. (23-26 m) long nets using mesh sizes of 2.5-5 cm. Boats fished in waters up to 30m deep and fishers reported catching seahorses in depths of 6-15 fathoms (11-27 m).

At a minimum, this shrimp fleet may have caught between 30,000 and 72,000 seahorses (113-271 kg) per annum (200 boats x 10-12 month fishing season x 15-30 seahorses/month). Fishers reported typical monthly catches of only 15-30 seahorses. However, three fishers reported that in certain times and/or areas it was possible to catch between 20 and 100 seahorses in one four-hour trawl. Seahorses were generally still alive when caught. Although most fishers ($n=10$) said they returned seahorses, two fishers reported that almost all their crew kept the seahorses they caught.

In addition to the above shrimp fleet, a small trawl fishery for pomada/titi shrimp (*Protrachypene precipua*) was located in Posorja. Given the small mesh size used in this fishery (1.3 cm), it seems likely that here, too, seahorses were caught as a bycatch. No estimates of seahorse bycatch in this fishery could be made however.

Purse seiners may occasionally catch three or four seahorses per set but, generally, seahorses were caught very sporadically in this fishery. No respondents indicated that these seahorses enter the trade. Seahorses were alive when landed and were returned to the water or given away as presents. Mesh size used was 2-2.5 cm.

Artisanal

Seahorses caught in Ecuador's artisanal fisheries were occasionally given away or sold to tourists but Level 2 buyers trading seahorses in quantity did not access these fisheries. Gill-net fishers did not regularly catch seahorses, probably because of the size of mesh used (3-5 inches/7.6-12.7 cm). A beach-seine fisher commented that, even with the very small mesh used (1.3 cm), it was rare to catch a seahorse. When caught in these gears, seahorses were normally returned to the water alive.

DRIED SEAHORSE TRADE IN ECUADOR

Domestic trade

This survey located very few merchants selling dried seahorses. In Quito, one vendor (trade level 3) was found selling seahorses and other dried marine products in a handcraft market. She knew of no other seahorse traders in the capital and reportedly only sold about eight seahorses per annum herself, mainly by order, at US\$1.40 each. On the coast, one curio vendor (Level 2) in Manta had sold seahorses since 1998. He obtained seahorses from shrimp fishers but had received only nine in the previous two weeks. His seahorses were sold mainly to foreign tourists, who apparently paid US\$5 each. When interviewed, however, he sold seahorses to the author for US\$1 each. A few fishers in Guayaquil reported that they sold dried seahorses only in limited quantities in handcraft markets, because they did not catch many. A fishery official had also seen seahorse curios for sale in Bahía de Carracas, Manabi.

The curio trade in seahorses may, however, have been more pervasive in the past. In the 1990s, dried seahorses were reportedly sold as curios along the coast of Ecuador (J. Gomezjurado, *in litt.*, Sept 1999) and in souvenir shops around the three major towns of the Galapagos (J. Gomezjurado, *in litt.*, 31 Oct 1995). The curio vendor in Manta mentioned that many people had bought seahorses in 1997-1998, before the last El Niño, but that seahorses had been very rare since then.

An experienced shrimp fisher in Salanga recalled that commercialization of seahorses began around 1970. According to him, there were always a few buyers in Puerto Bolivar, Manta and Libertad at that time, who paid a few sucres per seahorse, depending on size. These buyers came to the ports from the interior of Ecuador for conches and seahorses, and sometimes visited different ports along the coast. The fisher speculated that the seahorses were used for aphrodisiacs. Fishers then kept and sold seahorses to obtain extra pocket money.

Exports

The earliest official record of Ecuador's involvement in the seahorse trade is from Taiwanese Customs records for 1986 which show imports from Ecuador of 7 kg of dried seahorses (presumably *H. ingens*) that year, constituting 0.22% (7th rank) of the recorded imports to Taiwan. The seahorses had a total declared import value of US\$1,000 (\$143/kg), second in price only to seahorses from Thailand (US\$158/kg).

Dried seahorses were also exported to Taiwan in the early nineties; they were sold to Taiwanese merchants in Galapagos (J. Gomezjurado, *in litt.*, Sept 1999). The Director of Galapagos National Park reported that around 1994 they had seized a package of approximately 100 seahorses destined for mainland Ecuador (pers. comm. to Anita Sanchez, TRAFFIC, 5 June 2000). In 1995, hookah-caught seahorses were dried on boat decks to be sold later (J. Gomezjurado, *in litt.*, 22 August 1995). At that time, dealers from Taiwan and mainland Ecuador were reportedly 'purchasing all available dried specimens' from Galapagos Island fishers (J. Gomezjurado, *in litt.*, 31 October 1995). They paid fishers up to US\$3 per seahorse in 1995 (with only 60-80 seahorses/kg versus 800-1,000 seahorses/kg in the southern Philippines; Vincent, 1996). Ecuador, however, did not appear in Taiwan trade records for 1995 or subsequent years (1996-1999) and the database provided by Empresa de Manifiestos, a Guayaquil-based company, did not list any seahorse exporters in the early 1990s (1991-1994).

Officially recorded dried seahorse exports were supplied by three different sources and were cross-referenced for accuracy. Exports ranged from 120 to 385 kg per annum for the years 1994-1997 (Table 4). Data supplied by Empresa de Manifiestos was compiled by navy agencies and is considered to be quite reliable. Their database also denoted specific exporters and their trade routes corresponding to the recorded exports. Five seahorse exporters sent the following seahorse shipments: Exporter A exported from

Table 4. Exports of dried seahorses from Ecuador. Source: Banco Central Bank, Department of Fishery Studies of the Directorate General of Fisheries, Empresa de Manifiestos; *Source unknown.

Year	Destination	Kg/ country	Value/ country (US\$)	Total kg/yr
1990	-	-	-	20.0*
1994	-	-	710	120.0
1995	Hong Kong	142.3	639.14	385.4
	USA	243.1	974.40	
1996	Hong Kong	143.6	639.60	286.3
	USA	142.7	833.40	
1997	Hong Kong	106.4	532.00	236.4
	USA	36.28	240.00	

Manta in 1995 to an unknown destination; Exporter B exported from Manta and Guayaquil to Hong Kong in 1996; Exporter C exported from Guayaquil to New York in 1995-1997; Exporter D exported from Guayaquil to New York and Miami in 1995, and from Manta and Guayaquil to Hong Kong in 1996-1997; Exporter E exported from Guayaquil to Miami in 1996.

Records for 1998 and 1999 did not show any seahorse exports from Ecuador, nor has Ecuador appeared in Hong Kong seahorse import data since monitoring began in Hong Kong in 1998, although Hong Kong Customs data is not thought to be complete. For 2000, data from Empresa de Manifiestos did not list any seahorse exporters, while data were not yet available from the Central Bank or the Department of Fisheries Studies. Seahorse exports, however, appeared to continue in 2000. In Galapagos, Asian dealers buying sea cucumbers also requested seahorses, despite their low abundance (Dr. R. H. Bustamante, *in litt.*, 4 June 2000). No records of Galapagos fishers supplying this demand, however, have been made since the mid-1990s.

Seahorses exported from mainland Ecuador were supplied by shrimp fishers at every major port: Esmeraldas, Manta, Puerto Lopez, Playas, Posarjas, Puerto Bolivar and Guayaquil. In both surveyed ports, Guayaquil and Manta, fishers either sold seahorses directly to Chinese buyers or through intermediates (Level 2), who then sold them by the pound to Chinese buyers. Intermediates in Manta believed that the Chinese buyers always purchased seahorses through buyers like themselves.

In Guayaquil, several shrimp fishers ($n=6/14$) were familiar with the seahorse trade, while two others knew only of a trade in the past. Only a few fishers commented on the history of the trade: exporters may have begun purchasing seahorses between 1985 and 1988. According to one fisher, depending on the catch, it took his boat 4-7 days to gather a pound of seahorses (1 kg/9-15days) and the fishers on his boat would then sell them to various buyers and divide the money. Fishers involved in the trade knew of Level 2-3 buyers (likely the exporters) located in the centre of Guayaquil who bought seahorses by the pound. While some fishers always went directly to these main buyers, others sold seahorses to a couple of Level 2 buyers at the Guayaquil and Posorja ports, who were intermediates for the main Guayaquil buyers. Two fishers separately described the location in Guayaquil where an Ecuadorian couple bought seahorses by the pound. Another fisher said he took seahorses to a Chinese buyer at a store in Guayaquil but would not reveal names or locations. He reported that there were four or five such shops where Chinese buyers purchased seahorses, shark fin and Argentine croaker jaws (*Umbrina canosai*). Even if only these six fishers supplied exporters in Guayaquil, 120 kg dried seahorses may have been traded per annum (6 fishers x 1lb/week x 44 weeks fishing season).

All shrimp fishers interviewed in Manta ($n=5$) knew of Chinese seahorse buyers. According to fishers, there were somewhere between five and 20 Level 2 buyers through whom this trade operated. One fisher estimated that in total his boat sold 1lb of seahorses (0.45 kg) every 2 months. He could not estimate the total number of buyers, but had personally sold seahorses to ten Chinese buyers who he said also bought shark fin and croaker (corvina) jaw. Level 2 buyers knew of the following exporters:

- One Level 2 buyer, identified by shrimp fishers, knew of a Chinese exporter who had operated out of Manta for 2 or 3 years before leaving in 1997. The exporter bought seahorses from intermediates by the individual, once they had gathered 50 to 100 seahorses. The seahorses were sent to Mainland China, apparently for soup. The Level 2 buyer also knew of other people who had bought seahorses around the same time, but wouldn't say how many. He was also aware of seahorse buyers in Guayaquil in 2000 who purchased seahorses by the pound. He denied being personally involved in the trade and would supply no further information.
- The curio vendor mentioned in the domestic trade section had sold seahorses to a Chinese exporter three times over a 1-year period: the first sale was of 130 seahorses that he had gathered from ten boats over 2-3 weeks; the next two times he sold 50 and 60 seahorses respectively. This Chinese buyer had left 6 months earlier and the buyer thought he may have been based in Guayaquil. Although he did not know how many Level 2 buyers this exporter obtained seahorses from, he thought there to be between 6-8 intermediates (Level 2 buyers) in the area who would sell seahorses to foreigners opportunistically. Other buyers had told him of Americans, Koreans and Chinese people who were exporting seahorses.

Chinese buyers may have also obtained seahorses from Esmeraldas, the main shrimp port in northern Ecuador, although it was not recorded as a trading port in export records. An experienced diver and

seahorse buyer (Level 2) who obtained most of his seahorses from shrimp fishers said he sold seahorses by the kilogram to Chinese exporters there. According to him, Chinese exporters had been established in the area since about 1980, as the owners of petrol companies and fish packing plants. The diver believed they exported fish, octopus, shark fin, sea cucumber and seahorses to Japan and Europe. He thought that there were about 70 exporters in the area and said that they came regularly to the port to buy. This account was not validated during the survey.

Official estimates from three Ecuadorian databases for dried seahorse exports in the mid-1990s range from 120 to 385 kg per annum (Table 4). These estimates appear reasonable compared to the minimum annual estimate of seahorse bycatch in the shrimp trawl fishery (113-271 kg).

Values

Fishers reported prices per individual seahorse and per pound. One fisher explained that Chinese buyers only purchased seahorses by the pound, whereas other Level 2 buyers bought seahorses individually. There was no consensus as to whether or not fishers were paid according to the size of the seahorses. In 2000, fishers reportedly received 1,500-5,000 sucres per seahorse (US\$0.06-0.20) from Level 2 buyers (middlemen or exporters), although one fisher said seahorses were worth 12,000 sucres (US\$0.48) each. Owing to fluctuations in the sucre, fishers were paid 1,000 sucres per seahorse (US\$0.10) in 1999 and 500 sucres (US\$0.13) in 1997. When purchased dried by the pound in 2000, fishers were paid between 120,000 sucres/lb and 1 million sucres/lb (US\$10.58-88.18/kg). In 1998, Level 2 buyers apparently paid 80,000 sucres/lb (US\$32.36/kg).

One Level 2 buyer said seahorses sold to Chinese exporters for US\$40/lb (US\$88.18/kg), the same price as shark fins and sea cucumbers. A second Level 2 buyer reportedly sold seahorses in early 2000 to a Chinese buyer (thought to be an exporter) for 10,000 sucres each (US\$0.40). Another Chinese exporter who purchased seahorses in the mid-1990s (until 1997), paid his Level 2 buyer 1,000 sucres (then ~US\$0.33) per seahorse.

LIVE SEAHORSE TRADE IN ECUADOR

No evidence of a live seahorse trade in Ecuador in 2000 was found. The aquarium retailers visited in Quito did not sell seahorses and only one had sold them in the past. Ecuador did export live seahorses to Florida between at least 1988 and 1991, when they were caught off the Santa Elena peninsula by divers targeting other aquarium fishes (J. Gomezjurado, *in litt.* to A. Vincent, 31 October 1995).

OTHER SYNGNATHID SPECIES IN ECUADOR

No evidence was found of a trade in other syngnathids in Ecuador. Pipefish species known from Ecuador include *Doryrhamphus excisus excisus* (bluestipe pipefish), *Bryx veleronis* (J. Gomezjurado, *in litt.* 22 Aug. 95; species names: Froese & Pauly, 2001) and *Syngnathus auliscus* (Froese & Pauly, 2001).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN ECUADOR

Ten of the thirteen shrimp fishers who commented on catches over time reported that their seahorse catch had declined in the 1990s. A few fishers ($n=3$) attributed the decline to cold waters resulting from the recent El Niño event. Fishers also cited heavy fishing pressure as the cause: four fishers said that many other species had also declined, while two others believed the trade had caused the declines. Three artisanal fishers also reported that their seahorse catches had declined.

Furthermore, the development of shrimp farms, which in 1999 accounted for a substantial proportion of Ecuador's total shrimp production, has destroyed coastal mangrove habitats in which seahorses live (J. Gomezjurado, *in litt.* to A. Vincent, Sept 99).

CONCLUSIONS FOR ECUADOR

Dried seahorses have been exported to Taiwan, Hong Kong, Mainland China and the USA. Exports for the mid-1990s, compiled in three databases in Ecuador, ranged from 120 to 385 kg annually. There are no records of dried seahorse exports since 1998 but respondents suggested that the trade continued. Most seahorses in the trade were landed incidentally in Ecuador's shrimp trawl fishery, although sea cucumber divers in the Galapagos took some. Seahorse catches had declined in the 1990s.

THE SEAHORSE TRADE ON THE PACIFIC COAST: PERU

Peru exported dried seahorses to Hong Kong and Canada at least between 1998 and 2000 (81-536 kg/annum), the years in which Customs data were available. During that time, Peru has also probably exported seahorses to Mainland China, Chile and possibly Venezuela. Several thousand seahorses were also traded domestically in 2000 for use in tonic soups in Lima's Chinatown or as curios. Seahorses were targeted by divers, mainly in the Pisco region, and were also landed as a bycatch of Peru's purse seine and shrimp trawl fisheries. There was no live trade in Peru in 2000.

Seahorses in Peru

Hippocampus ingens is found from the northern border as far south as Laguna Grande. The southern extent of this population may fluctuate with El Niño events. Fishers and divers in Peru caught seahorses mainly in areas with algal and seagrass bottoms ($n=13$). Some also mentioned finding seahorses in rocky areas ($n=5$). A biologist in the Fisheries Department believed that seahorses could be found offshore near Piura, Ica and Arequipa, and in Sechura, Parachique, Pucusana, Chala: all areas of seagrass habitat along the Peruvian coast. Red and white mangroves found in northern Peru, near the Ecuadorian border, and in the Tumbes and Piura river deltas may also serve as seahorse habitat. Indeed, a few fishers mentioned finding seahorses near Tumbes and close to the border. An artisanal fisher in this area said that he caught seahorses 5 miles (8.05 km) from shore, while a commercial trawl fisher there found seahorses at 120ft (36.58 m). The Paracas National Reserve was widely known in Peru as an area with a local seahorse population. Divers in this area caught seahorses in nearshore waters (3.7-27.4 m), with macro-algal and seagrass bottom.

Legislation

No harvest or trade regulations existed for seahorses in Peru (Dr. M. A. Espino Sanchez, Scientific Director, Instituto del Mar del Peru (IMARPE), Sector Pesqueria, *in litt.* to J. Schulz, 3 April 1998). Official records of dried seahorse exports were available for the years 1998-2000. Seahorses were exported under the codes 305599000 (Seahorse: dried, whether or not salted but not smoked), 1605909000 (Other molluscs and aquatic invertebrates, prepared or frozen), 307999090 ('Other molluscs, including powdered aquatic invertebrates'), and 307290090 ('Molluscs etc.').

Artisanal divers required licenses to fish but were not limited to certain species or by quotas. Artisanal fishers fished year-round.

Peru had two marine reserves: Paracas National Reserve located near Pisco and another near the border of Ecuador that served to protect mangrove habitats. Paracas National Reserve's status as a marine reserve was curious, however, considering that regular fishing activities were permitted in the waters. Divers captured seahorses in this reserve, thus the reserve affords them little protection.

SEAHORSE CATCHES IN PERU

Target fisheries

Divers in at least Chiclayo, Chimbote, Pucusana and the Paracas area caught seahorses opportunistically. Divers were permitted to catch any species and generally targeted invertebrates (octopus, crab, lobster,

mussels, clams, scallops, squid, conches) and some fish. Some divers seasonally switched to fishing with nets (e.g. during the winter).

According to a curio trader in Pimentel, divers based in Chiclayo and Chimbote caught seahorses for the curio trade. Divers from Chiclayo accompanied boat owners on fishing trips to Isla Lobos de Tierra and Isla Lobos de Afuera, 6-8 hours from the coast. Between 20-30 divers were also believed to fish near shore. The curio trader reported that divers retained shells and seahorses from such trips, while fish were kept by the boat owners. This trader had reportedly bought seahorses from about 40 divers since 1997. He said that during the summer (January- March), two or three divers came twice a week and brought 10-40 seahorses each. At other times, divers caught fewer seahorses.

In Pucusana, there were 30 divers. One diver reported increased catches of seahorses during the summer months but thought that, overall, seahorse catches had declined since 1999, since the last El Niño event. Catch estimates for these divers were not available.

According to the Fisheries Department there were 400 divers in Paracas in 2000, while a 2000 census by the Paracas reserve counted 2000 people fishing in the area, including boat drivers, divers and fishers. Divers fished locally within Laguna Grande (Paracas reserve) for scallops (concha abánico *Argopecten purpuratua*). Boats with two divers and several guides also left in the early morning for fishing grounds a few hours away and returned after 4-6 hours of diving. Benthic habitat in this region was described as sandy with rocks, red and brown algae (*Sargassum* spp.). Divers used compressors to fish at 6-24m depth and carried mesh bags to store their catch. Laguna Grande was considered to be the best area for seahorses and five divers said they could find one to six seahorses per day there. Divers occasionally took a few seahorses for curios but generally seahorses were only retained when there were buyers. One diver commented that seahorses were scarce because they had caught and sold them, and another said it was rare to see a seahorse. Preliminary transects in Laguna Grande in January 2000 by a biologist and local diver yielded only two seahorses (M. Quine-Fernandez, pers. comm., 2000).

Bycatch

Commercial

The major commercial fisheries in Peru are the purse-seine fisheries which primarily target anchovies and sardines but also take mackerel (jurel and caballa), striped bonito (bonito) and albacore (albacora), and the demersal trawl fishery for hake (merluza) and mackerel.

The principal ports for the 677 purse-seine boats fishing in Peru are Chimbote, Pisco, Supe, Callao and Illo (FAO, 2000). Purse-seiners targeting anchovies used nets of 45-90m with small mesh (0.3-2.5 cm) and fished from close inshore to a depth of 150m. Purse-seiners that target mackerel, bonito and albacore used slightly larger mesh sizes (1.3-2.5 cm) and operated in the summer months. According to two anchovy fishers, boats could catch between six and 15 seahorses per day. Seahorses were alive when caught and have been retained by fishers and dried in recent years. A purse-seine fisher in northern Peru estimated that his boat usually caught 100-200 seahorses per 2-week trip when targeting anchovies, and 20/day when targeting larger fishes, depending on the number of sets. He commented that fishers had been able to sell seahorses since 1995; since that time buyers had purchased all available products (lobster, shrimp, shells). Another purse-seine fisher recalled that in 1998 his boat caught 300 seahorses in one set at Isla de los Lobos. That year they caught seahorses 'by the kilogram', and each fisher retained his share and dried them to be sold at port. It is not possible to estimate total seahorse bycatch for these fisheries but it is evident that substantial quantities of seahorse are caught and retained in them.

The demersal trawl fishery for hake and mackerel consists of 70 boats (FAO, 2000). This fishery operated primarily to the north of 6°S where the continental platform is most extensive (FAO, 2000). According to fishers and to biologists at IMARPE (the Peruvian Institute of the Sea) who had conducted research on bycatch in the hake fishery, this fishery did not catch seahorses. The lack of seahorses is likely related to the gear and location of the fishery: boats fish 48-64 km from shore in 180-250m of water — probably too deep for seahorses — and are equipped with mesh of 10 cm, which is larger than the seahorses.

Artisanal

The shrimp trawl fishery operated from ports in Tumbes and Piura, the two northernmost coastal provinces in Peru. Shrimp fishers targeted white shrimp (langostino *Penaeus vannamei*) and caught seahorses incidentally. This fishery was considered to be artisanal, thus there were no estimates of the fleet size. Boats shrimp trawling were equipped with two nets of 15-25m length, with mesh of 2.5-3.8 cm. Trawls of 1-3 hours were made during short trips of one to three nights. Seahorses were caught alive and retained for sale. Indeed, the main buyer at Las Delicias said he obtained seahorses mainly from shrimp boats. Fishers estimated that they caught 2-3 seahorses per week and 6-20 per week in the warm summer months (December-March; $n=4$ fishers). One fisher explained that during the summer his boat would catch 1 kg of seahorses in five nights fishing. He recalled that in 1998 his boat had caught this many seahorses year-round but said that in 2000 they did not find nearly as many. Some fishers also caught shrimp with gill-nets (trasmallo). One such fisher commented that in 1997 or 1998 he regularly caught eight to ten seahorses per night but that in 2000 it was rare to catch them at all.

Hundreds of artisanal fishers also fished along the coast with gill nets of varying mesh sizes (2.5-20 cm). Fishers using small-mesh nets caught seahorses incidentally. Two fishers in northern Peru estimated that they caught between one and five seahorses per night but both also said that the catch was irregular. Seahorses were caught alive and were sometimes sold as curios. Curio traders there emphasized that they had to buy from many fishers, as each fisher might only catch a few seahorses each month. One fisher and one buyer commented that seahorse catch increased in the summer.

DRIED SEAHORSE TRADE IN PERU

Domestic trade

Within Lima's Chinatown, two businesses (also involved in the export of seahorses) sold dried seahorses by the kilogram for use as a tonic food in soup. The first business (Exporter A) sold seahorses to restaurants in Chinatown for this purpose. His employees said they had approximately ten regular clients, each of whom bought 0.5-2 kg seahorses at a time. From their opening in April 1999 until December of that year, they had sold 10 kg of seahorses; during the first half of 2000 they had sold 3 kg. These traders believed that seahorses could be found for sale individually at other stores in Chinatown for US\$3. The second business, owned by a TCM healer, had sold seahorses since 1993 (Exporter B). Seahorses were packaged in 100 g and 250 g packages but no sales estimates for this business were obtained. One employee said that some people bought seahorses individually as curios. A second employee who provided information about exports denied this. In 1999, the owner explained that most people actually bought seahorses for decoration rather than as medicine. When taken medicinally, he prepared the seahorses with other ingredients for the customers. (P. Majluff *in litt* to A. Vincent, 27 Jan 1999; see **Uses: Dried, Seahorses in TCM in South America**). Both of these businesses also sold other dried marine products, including shark cartilage and fins, fish, octopus and/or sea cucumbers.

The curio trade in coastal Peru arose mainly in the 1990s, although one vendor in Chiclayo market had sold seahorses for over 20 years and two traders in Cancas had been selling seahorses since the early 1980s. Level 2 curio traders usually obtained seahorses from local divers and artisanal fishers. These traders then sold the seahorses in the curio trade to local residents (including students), and Peruvian and foreign tourists. A vendor in Pimentel said seahorses were popular with Asian tourists, who believed they resembled dragons. In total, 19 curio traders (Level 2) were located selling dried seahorses as curios to tourists along the coast of Peru. These traders are described in detail below by their location (from north to south):

- Zoritos/Mancora: Four fishers here sold seahorses sporadically to national and foreign tourists; foreigners bought up to ten at a time. Fishers were also familiar with other people who sold seahorses as curios. A curio trader who sold seahorses in Puerto Pizarro and Zoritos said he obtained seahorses infrequently and sold them to tourists during the summer. He estimated his monthly sales at one dozen seahorses in summer, with a maximum of 50 sold per annum. A fisher in Mancora said different buyers had been coming about once a year for over 20 years to purchase

seahorses from shrimp crews. A Level 2 buyer in Talara, Mancora, also sold sharks jaws and dried seahorses.

- Cancas: About five out of 15 curio traders here who sold dried marine products sold dried seahorses. These traders estimated that that they sold 20-50 seahorses per annum, mainly between December and February, and in July.
- Chiclayo: Seahorses were sold in the witchcraft section (Sección Remedieras) of Chiclayo Modelo market among products used in folk medicine. However, no vendors thought seahorses were used for this purpose. At least six vendors sold seahorses, although only one had seahorses in stock. This vendor estimated that even during the high season he might only sell 2-5 seahorses per month. Indeed, the sale of seahorses appeared to be seasonal: seahorses were obtained either from fishers or Level 2 buyers who came mainly in the summer (January to April).
- Pimentel: In nearby Pimentel, a Level 2 curio vendor sold varnished seahorses and other handicrafts. During the 3-month summer tourist season the boardwalk was said to be full of vendors, all of whom sold seahorses when they had money to buy them from divers. During the summer, two or three divers came twice a week and brought 10-40 seahorses each. At other times, fishers caught fewer seahorses. The buyer in Pimentel said he bought 15-20 of these seahorses each day and that other artesans purchased the remainder. He estimated that, in summer, he sold between 30 and 100 seahorses per weekend. A local handcraft store also occasionally sold seahorses to tourists upon request.
- Pucusana: Many vendors sold seahorses here in the 1990s, particularly during the last El Niño (M. Quine-Fernandez, pers. comm., June 2000). Fishers reported that, in 1999, two potential buyers had come: the first, a Peruvian woman who wanted 100 seahorses for a curio business and the second, a European who requested dozens of seahorses, apparently for export as curios. Fishers said it is rare to find seahorses in the area and did not think these people had obtained them.
- Pisco: The most established curio trade was located in this region, in southern Peru, where trade apparently peaked in 1998, during the last El Niño. Divers in Laguna Grande had accumulated 30 to 50 seahorses at a time for sale to artisans from Pisco or Chaco in recent years. Sometimes, they also sold their seahorses to tourists directly. Divers in Chaco also supplied vendors there. All artisans said seahorse supply had declined substantially since 1998, when it was common for fishers to bring 50 seahorses at a time. Indeed, the divers sold seahorses only infrequently in 2000, because they rarely found any.
- In 2000, three vendors sold seahorses to tourists in Pisco, five vendors sold them at a handcraft market in Chaco, and others did so on Isla Ballesta. Most vendors had last purchased seahorses during the El Niño (1997-1998) and were selling seahorses stockpiled since then. By 2000 only one vendor in Pisco still bought seahorses from fishers. He had last come in March 2000, reportedly visited several times weekly in summer and purchased seahorses from four boats. One vendor who last purchased seahorses in January 1999 had ten out of 300 remaining in June 2000. All vendors ($n=8$) said they sold few seahorses and that obtaining them was difficult now.

In total, the domestic curio trade in Peru may have traded between 1,300 and 4,100 dried seahorses in 2000 (Table 5). This is likely an underestimate, considering that many coastal towns in Peru were not surveyed. One curio trader in northern Peru had heard that some seahorses were being sent to Lima 'for processing'. Except in the Pisco area, none of the curio traders had been approached or had heard of anyone interested in buying seahorses in large quantities.

Exports

Official Customs statistics from both Peru and Hong Kong indicate that dried seahorses were exported from Peru to Hong Kong between 1998 and 2000 (Table 6). Peru data listed eight exporters during this period (Table 7). The reliability of these data is unknown. Volumes recorded by the two countries do not agree and are not consistently biased one direction. Peruvian figures indicate that recorded exports to Hong Kong were greatest in 1999, when 457 kg were sent, at a total declared value of US\$32,852 (US\$71.89/kg). According to the Peruvian data, exports to Hong Kong were sent via air and sea by five exporters (A, C, D, E, F).

Peru Customs statistics also show exports of dried seahorses to Canada that were sent by air by two different exporters (G, H) to Montreal, and by a third exporter (I) to Calgary (Table 7). While small quantities were exported to Montreal in 1998 and 2000, more were exported in 1999, the majority of

which (60 kg) were sent to Calgary. No respondents mentioned seahorse exports to Canada. Although not reported, as several respondents in Peru suggested, Peru also exported seahorses to Mainland China, as China Customs records for seahorses are incomplete. PROMPEX, a Peru Government agency responsible for exports, noted increasing fishery exports to China in a 2000 report (Prompex, 2000).

The two retailers operating in the domestic trade in Lima's Chinatown were also the only two businesses located that exported seahorses to Asia (Exporters A & B). Both businesses were supplied with seahorses year-round from fishers from Tumbes and Piura provinces in northern Peru. Exporter A, who appears in Peru's trade records as the third largest exporter of dried seahorses, had a store in Chinatown that opened in 1999 and a main office elsewhere from which the exporting occurred (to Hong Kong, and also possibly to Venezuela). They obtained seahorses by the kilogram from about five fishers, who came infrequently and usually brought about 2kg at a time. Peru Customs data indicate that they exported 94 kg in 1 year. No sales estimate was obtained from the exporter; employees indicated that seahorse supply did not meet demand.

Exporter B had sold seahorses in 1993, although he did not appear in Peru's export records. Seahorses were sold to several different clients from Hong Kong and Mainland China, who took seahorses with them after visits to Peru. It seems probable that these seahorses were simply not reported. The employees interviewed were uncertain as to the total volume traded by this business: two fishers supplied them with roughly 6-9 kg each per annum, more seahorses than they could sell. Eight 0.25 kg bags (2 kg total) above the counter had apparently been bought by one buyer for export to Mainland China.

Exported seahorses were supplied by fishers in northern Peru from at least Tumbes and Piura provinces, and in the south, from the Pisco area. It appears that fishers sold seahorses to intermediate buyers who then sold to exporters (likely all in Lima). It is not clear, however, whether these intermediates supplied the exporters who were interviewed or others. Based on the following accounts, it was estimated that in 2000 exporters had access to supplies of at least 415 kg of dried seahorses (Table 8). This compares reasonably well with the export figures for Peru.

An artisanal fisher in Tumbes province knew of a group of two or three traders (Level 2) who, since 1997, had visited each January, June and September to purchase 5 kg of dried seahorses. They also bought shark fins, shark jaws and turtle shells. The fisher thought the traders were from Piura or Lima and did not know the seahorses' end destination. Given the quantity purchased, these seahorses were likely for export.

Table 5. Estimates of the domestic curio trade in seahorses in Peru for 2000
Source: Author's research.

Location (Town, Province)	Curio Traders	Estimated amount sold/trader	Total annual estimate
Zoritos, Tumbes	Level 2 trader (n=1)	max. 50/annum	50
Cancas, Tumbes	Fishers ¹	up to 10/time	~100
	Level 2 traders (n=5)	20-50/annum	200
Talara, Piura	Level 2 trader (n=1)	?	?
Chiclayo, Lambayeque	Level 2/3 traders (n=6)	2-5/month ²	36-90
Pimentel, Lambayeque	Level 2 traders (n=1)	30-100/weekend in summer	360-700
	Other Level 2 traders (n=many)	unknown, but max supply for area likely 480-2880/summer	480-2880 ³
Pucusana, Lima	various traders prior to 2000	-	-
Pisco, Ica	Level 2 traders (n=8+)	~10/annum	80-100
Grand Total			1300-4100

¹occasional sales directly to tourists; ²mainly between January-March; ³including above traders

Table 6. Dried seahorses exported from Peru to Hong Kong. Source: Peru Customs and Hong Kong Customs (Hong Kong began recording dried and live seahorse and pipefishes as separate line items from 1 Jan 1998).

Year	Peru Customs Data		Hong Kong Customs Data	
	Quantity (kg)	Value	Quantity (kg)	Value
1998	80	US\$10,329	321	HK\$260,000 (US\$33,569)
1999	457	US\$32,852	332	HK\$251,000 (US\$32,351)
2000	76	US\$8,360	96	HK\$82,000 (US\$10,524)
2001	no data obtained		4	HK\$3,000 (US\$385)

Fishers in Piura province knew of various traders from Piura and Sechura who had made frequent trips to ports (at Las Delicias) to buy seahorses in quantity since 1994 or 1995. Anchovy and shrimp fishers there tried to accumulate seahorses but sold them individually, not by weight. Some traders reportedly came specifically for seahorses, while others also purchased other marine products. One fisher estimated that buyers purchased about 12 seahorses/day during the low season and 50-100 seahorses daily in the high season (about 33-56 kg per annum). According to another fisher's catch estimates, however, each boat may have caught between 7 and 24 kg seahorses annually. Depending on how many of the 25-50 boats normally there traded seahorses, 175-1,200 kg seahorses were supplied to traders each year.

Table 7. Details of dried seahorse exports from Peru. Source: Peru Customs.

Year	Destination	Exporting Companies	Kg	Value (US\$)
1998	Hong Kong	C	80	10,329
	Canada	G	1	81
	Total		81	10,410
1999	Hong Kong	A, D, E, F	457	32,852
	Canada	H, I	79	2941
	Total		536	35,793
2000	Hong Kong	E	76	8,360
	Canada	G	5	162
	Total		81	8,522

In nearby Parachique, some fishers mentioned one of these Level 2 traders specifically, who for the past five years had sold seahorses in quantity to a buyer from Lima. This trader knew of two other traders (Level 2) in the area. He claimed to buy seahorses from about 200-300 fishers (mainly shrimp trawlers and purse-seiners) who gathered together kilograms of seahorses. He bought 30-50 kg of dried seahorses per week during the high season (December-February), and 1-2 kg/week the rest of the year (400-680 kg/annum). His supply had decreased substantially in recent years: a few years earlier, he claimed, he bought 40-50 kg per day (rather than per week) during high seasons. His client, a Level 3 buyer from Lima, visited on a monthly basis and purchased all his seahorses, presumably for export. The final destination of this trader's seahorses is unknown.

A painted sign hanging outside the home of a Level 2/3 buyer in Sechura advertised the sale of seahorses. The buyer said she had only recently started the business. She may have traded with exporters; she said only that her clients were from outside of Sechura and were not tourists. She denied selling very many seahorses but would not provide volume estimates. She also knew of other buyers in the area who purchased directly from fishers.

In southern Peru, seahorse exports may have also occurred from the Pisco region in the recent past. A fishery official believed that a Japanese business had come to Paracas in 1999 specifically to commercialize seahorses. However, he denied that the business had actually exported seahorses. Many fishers in Pisco confirmed that buyers had come in the late 1990s (perhaps around the time of El Niño). One fisher had

Table 8. Known seahorse supply presumed to be for export. Source: Author's research.

Region	Information source	Traders	Year(s)	Amount bought from fishers	Export destination
Tumbes province	artisanal fisher (n = 1)	Level 2 buyers (n = 3)	1998-2000	15 kg/annum	Unknown
Piura province	Level 2 buyer (n = 1; estimates from 2 fishers at Las Delicias)	Level 2 buyer (n = 1)	2000	400-680 kg/annum	Unknown
			1998-1999	much greater amounts than in 2000	
	Level 2 buyer (n = 1)	other Level 2 buyers in region (n = 2)	2000 (at least)	Unknown	Unknown
Pisco, Ica province		Level 2 buyer (n = 1)	1998-2000	"all available"	Japan or Mainland China
		Level 2 buyers	late -90s	Unknown	Japan or Mainland China
		Japanese exporters	1999	Unknown	Japan
Grand total for 2000				Minimum 415 kg	

seen Japanese people making enquiries at the docks but all other fishers knew only of Peruvian buyers, although some believed these to be intermediates for exporters. One Peruvian seahorse buyer apparently came consistently for 3 years to purchase all available seahorses from divers in Pisco. One fisher reported that buyers sometimes bought by the kilogram and that the seahorses were exported either to China or Japan. However, several fishers in this area did not know of any buyers who had purchased seahorses in large quantities.

Exports of dried seahorses to Chile in 1997 were also reported by one buyer. According to him, one diver in Pisco collected seahorses from many divers, and made bi-weekly or monthly trips to the Chilean border, where he sold 80-100 dried seahorses to a single buyer each time. For what purpose is unknown. A fisher in Chaco, near Pisco, also knew of an exporter he believed to be from Chile who bought seahorses from many fishers in Laguna Grande in the summer of 1999. This man reportedly came several times a week and could obtain 0.5-1 kg from each boat. How frequently and from how many boats was not clear. The two accounts of trade with Chile, however, suggest that a few thousand dried seahorses may have crossed that border annually in the past.

As only two of nine exporters were interviewed and seahorses traded by intermediates cannot be linked to specific exporters, the best estimate of Peru's seahorse exports remain the data provided by Hong Kong and Peru Customs.

Values

In the domestic trade in Peru, fishers were paid S0.5-3 (US\$0.14-0.86) per seahorse depending on the size. One fisher explained that the money earned was divided among the crew. Earnings from seahorses provided extra income for fishers.

Seahorse curios were usually sold for S1-8 (US\$0.29-2.30) each, although one handcraft store said they sold them for S35 (US\$10.06). Compared to other dried marine products, seahorses were quite cheap; shells were similarly priced, but coral cost S15-20 (US\$4.31-5.75), turtle shells S30 (US\$8.62), and shark jaw S100 (US\$28.74). In local Chinese restaurants, soup containing seahorses apparently sold for US\$10 per bowl.

In contrast, seahorses sold for export were extremely valuable, albeit only at the top trading levels. Fishers who sold seahorses in large quantities (presumably to exporters) were either paid S30-70 (US\$8.62-20.17) per kilogram or S0.5-1 (US\$0.14-0.28) per specimen. Two fishers mentioned that sales of seahorses were highest in 1998 when the fish were most plentiful. A Level 2 buyer, who sold in quantity to buyers from Lima (presumably for export), was paid S160 (US\$45.98) per kilogram. One business sold seahorses to exporters from Mainland China and Hong Kong for US\$180 per kilogram, while a second exporter sold seahorses destined for Hong Kong according to size: small and medium seahorses for US\$100/kg and \$150/kg respectively, large ones (15-20 cm *H. ingens*) for US\$248/kg. This company also exported sea cucumbers (US\$25-65/kg), shark cartilage (US\$15/kg) and fins (US\$150/kg), but seahorses were among their most valuable products. In contrast, the highest value of seahorses declared to Peruvian Customs was US\$130/kg.

LIVE SEAHORSE TRADE IN PERU

Domestic trade and values

Peru is one of the main suppliers of freshwater ornamental fishes in the world but does not trade in marine ornamentals. A small domestic trade in live seahorses occurred in the past, but apparently there was no such trade in 2000. In the past, a few live seahorses were traded locally by fishers in Pucusana and Chaco to private aquarium owners. These sold for only S3-5 (US\$1.05-1.75 in mid-1990s). In Lima, we located only two aquarium retailers that had sold seahorses. The first had obtained seahorses from fishers in northern Peru (Máncora and Punta Sal) in 1998. This was during the last El Niño event, when seahorses were said to be plentiful. The shop owner had obtained seahorses in the summer season, during which time he sold four or five per week. Since 1998, however, fishers had not brought seahorses. The second

shop obtained its seahorses from divers only on request from customers. Live seahorses in Lima sold for S20–25 (US\$5.75-7.18) each.

OTHER SYNGNATHID SPECIES IN PERU

No evidence was found of a trade in other syngnathids in Peru. *Cosmocampus arctus coccineus* (*Syngnathus independencia*) and *Leptonotus blainvillanus* are known from Tumbes, Callao, Pisco, Bahia Independencia (Dr. M. A. Espino Sanchez, Director Cientifico, Instituto del Mar del Peru (IMARPE), Sector Pesqueria, *in litt.* to J. Schulz, 3 April 1998). *Syngnathus auliscus* also occurs in Peru (Froese & Pauly, 2001).

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN PERU

Two biologists who have worked in Laguna Grande expressed concern about declines in local seahorse populations. Five divers there reported that seahorse catches had declined: in the early 1990s two divers reportedly caught 20-40 seahorses per day. As the population was reportedly highest during the last El Niño event, it is possible that this most southerly population is not permanent but instead undergoes cyclical dynamics. However, several sources noted that the nearby fish-processing plant in Paracas had caused substantial pollution in the area, which could affect seahorses. A biologist had observed many dead pipefishes in the discharge (M. Quine-Fernandez, pers. comm., June 2000).

In contrast, fisheries officials in Peru were not concerned about seahorse populations, likely because the trade was not well known. There was no consensus among fishers as to whether seahorse catches had declined. Purse-seine and shrimp trawl fishers only began trading seahorses in the mid-1990s. Some of them noted that prior to that they paid seahorses little attention; thus they were not able to estimate changes in seahorse abundance over time.

CONCLUSIONS FOR PERU

From at least 1998 to 2001, Peru exported dried seahorses to Hong Kong and Canada. Total exports, recorded in both Peru and Hong Kong Customs data, ranged between 81 and 536 kg seahorses per annum. Peru has also likely exported seahorses to Mainland China, Chile and possibly Venezuela in recent years. Dried seahorses were sold domestically, as curios along the coast and as a tonic food in soups in Lima's Chinatown. Seahorses were targeted by divers and taken as a bycatch of commercial purse seine and artisanal shrimp trawl and gill-net fisheries. The *H. ingens* population in Laguna Grande should be more thoroughly investigated.

COMPARISON TO 1996 SURVEY FINDINGS FOR SOUTH AMERICA

The 1996 seahorse trade review cited only Ecuador and Brazil as South American countries trading seahorses (Vincent, 1996). No surveys had been undertaken in South America at that point, however, a Taiwanese Customs record provided evidence that Ecuador had exported dried seahorses in 1986, and anecdotal information suggested the dried seahorse trade developed in the Galapagos Islands in 1995. Anecdotal information also suggested that Ecuador exported live seahorses between 1988 and 1991 and that the UK had imported live seahorses from Brazil, where supply was said to be abundant in certain seasons (Vincent, 1996). There was no evidence of a seahorse trade in other South American countries and very little was known about the volumes, values, or destinations of seahorses traded by Ecuador and Brazil.

The South American surveys in 2000, Customs records from Hong Kong, Mainland China, Ecuador and Peru, and further anecdotal information have provided evidence that since 1996, Bolivia, Chile, Peru, Surinam and Venezuela have all begun trading dried seahorses. It is also clear that Argentina has traded live seahorses since at least the early 1990s. The presence of a seahorse trade in other South American countries is unknown.

The 2000 South American surveys established that large quantities (several hundred kilograms) of dried seahorses had been exported from several South American countries since the 1996 review. Domestically, small curio trades in dried seahorses are known from Argentina, Bolivia, Ecuador and Peru. Dried seahorses were also traded for TCM in Peru. The 2000 survey also confirmed that in South America, live seahorses were traded predominantly by Brazil. Indeed Brazil exported live seahorses to 20 countries, and *H. erectus* is Brazil's sixth most important marine ornamental export (Monteiro-Neto *et al.* 2000).

CONCLUSIONS FOR SOUTH AMERICA

This analysis is the first documentation of the seahorse trade in South America. Seahorses were targeted by divers in Argentina, Brazil, Ecuador and Peru. They were landed as a bycatch of artisanal fisheries in Brazil and Peru, and in commercial fisheries in Ecuador and Peru. Information gathered during these surveys suggests that seahorse populations in areas of Brazil, Ecuador and Peru have declined.

Dried *H. ingens* have been exported by Ecuador and Peru and *H. erectus* and/or *H. reidi* by Brazil and Surinam. Dried seahorses were also traded domestically as curios in Argentina, Brazil, Ecuador and Peru, and for TCM in Peru. Live *H. erectus* and *H. reidi* were traded primarily by Brazil. In the past several years Brazil has supplied thousands of live seahorses to at least 19 countries.

The Brazilian Government should be encouraged to begin recording seahorses as separate line items in Customs records. In Brazil, the dried and live seahorse trades need to be more closely monitored and quotas should be reviewed in order to avoid overexploitation of local seahorse populations. The trade appears to be reasonably well monitored in Ecuador (with the exception of the past few years) and Peru, and these countries should continue to record Customs data about the seahorse trade. Trade regulations should be implemented and enforced. Research on wild seahorse populations and the establishment of well-enforced marine reserves where fishing is prohibited or strictly regulated should also be encouraged.

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CHAPTER 6. SEAHORSE TRADE IN EUROPE¹

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ABSTRACT

Syngnathids are traded in Europe primarily for use as curios and ornamental fishes. Two new regulations, Council Regulation (EC) No. 338/97 and Commission Regulation (EC) No. 939/37, were implemented in June 1997 to monitor seahorse imports to European countries. In addition, some European countries, for example, Germany, France, Portugal, Slovenia and the Ukraine, afforded special protection to local syngnathid populations, recognizing habitat degradation (particularly pollution and coastal modification) and catch (intentional and accidental) as potential threats.

BACKGROUND FOR EUROPE

Information sources in Europe

No survey was conducted in Europe. Information in this section comes from a questionnaire on seahorses, seadragons and pipefishes that was sent in 1998 to governmental organizations in different European countries in order to gather information about regional exploitation, trade and relevant legislation. Additional information was obtained from official trade figures (Unpublished import data from the European Commission), and correspondence from independent parties detailing observations of syngnathid trade, as indicated. The responses from the European Commission, Germany, Sweden and the Ukraine to a request by the Convention on International Trade in Endangered Species (CITES) for information on seahorses and other syngnathids were also used as a source of information.

Seahorses in Europe

Local species

Two seahorse species, *Hippocampus hippocampus* and *Hippocampus guttulatus*, are known to occur in European waters (Lourie *et al.*, 1999). Both species are listed as Vulnerable (VU A2cd) by the World Conservation Union (IUCN; Hilton-Taylor, 2000).

Hippocampus hippocampus ranges widely in the Mediterranean Ocean and along the Atlantic coast, from the Wadden Sea southward to Portugal. The species also occurs in the Black Sea and Azov Sea (Dawson, 1986). Similar specimens have been observed in the Canary Islands and along the coasts of Senegal and Guinea but further research is needed to determine whether they truly are the same species (Lourie *et al.*, 1999). Adult size usually varies from 7.0 to 13.0 cm. (Lourie *et al.*, 1999). Most of the available life-history information comes from only a few sources (D'Ancona, 1932; Boisseau, 1967; Wheeler, 1973; Reina-Hervas, 1989).

Hippocampus guttulatus, previously known as *H. ramulosus* (Lourie *et al.*, 1999), has a similar distribution and habitat to *H. hippocampus*. *Hippocampus guttulatus* is larger than *H. hippocampus* (adults measure 8.5-18.0 cm in length) and has a longer snout and higher number of fin rays (Lourie *et al.*, 1999). Genetic data, including the number of chromosome pairs and comparisons of cytochrome b gene

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sequences in mitochondrial DNA, support their classification as two species (Vitturi & Catalano, 1988; Casey, 1999).

Species traded/imported

Seahorse taxonomy is complex and because it can be difficult to correctly identify species the species lists in the EC import data may not be reliable. The EC used 38 species names to record seahorse imports (Table 1). According to the recent taxonomic revisions, only 25 of these species names are valid and 12 have valid synonyms. In 1997-1999, EC data record the import of 14 species to Europe (see Table 1); the reported country of origin of at least six of these species, however, lies outside their natural range.

For example, *H. reidi* and *H. erectus*, which are found in the western part of the Atlantic Ocean (Lourie *et al.*, 1999), have sometimes been recorded as originating from Indonesia. *Hippocampus hippocampus*, which is a European species (Lourie *et al.*, 1999) was recorded as being imported from the Philippines, Brazil and Costa Rica.

Uses

Dried for TCM and curios

Little information is available regarding the use of dried syngnathids for traditional Asian medicines in Europe.

Dried seahorses are sold as curios in many European nations. Anecdotal information from correspondents indicates that at least Italy, Greece, Spain and Portugal traded seahorses domestically for sale as curios.

Table 1. Seahorse species names used by the European Commission (EC). Species highlighted in grey were declared traded during 1997-1999. Status and Synonym according to Lourie *et al.* (1999). Source: European Commission (Unpublished import data).

Species names used by EC	Status	Synonym
<i>Hippocampus abdominalis</i>	valid	-
<i>Hippocampus aimei</i>	not valid	Synonym of <i>H. barbouri</i> and <i>H. spinosissimus</i>
<i>Hippocampus angustus</i>	valid	-
<i>Hippocampus bargibanti</i>	valid	-
<i>Hippocampus bicuspis</i>	not valid	<i>Hippocampus guttulatus</i>
<i>Hippocampus borbonensis</i>	spelling error	<i>Hippocampus borboniensis</i>
<i>Hippocampus brachyrhynchus</i>	not valid	<i>Hippocampus fuscus</i>
<i>Hippocampus breviceps</i>	valid	-
<i>Hippocampus camelopardalis</i>	valid	-
<i>Hippocampus capensis</i>	valid	-
<i>Hippocampus comes</i>	valid	-
<i>Hippocampus coronatus</i>	valid	-
<i>Hippocampus erectus</i>	valid	-
<i>Hippocampus erinaceus</i>	not valid	<i>Hippocampus angustus</i>
<i>Hippocampus fuscus</i>	valid	-
<i>Hippocampus hippocampus</i>	valid	-
<i>Hippocampus histrix</i>	valid	-
<i>Hippocampus horai</i>	not valid	<i>Hippocampus kuda</i>
<i>Hippocampus ingens</i>	valid	-
<i>Hippocampus japonicus</i>	not valid	<i>Hippocampus mohnikei</i>
<i>Hippocampus jayakari</i>	valid	-
<i>Hippocampus kaupii</i>	not valid	<i>Hippocampus algiricus</i>
<i>Hippocampus kelloggi</i>	valid	-
<i>Hippocampus kuda</i>	valid	-
<i>Hippocampus lichensteinii</i>	valid	-
<i>Hippocampus minotaur</i>	valid	-
<i>Hippocampus planifrons</i>	not valid	<i>Hippocampus trimaculatus</i>
<i>Hippocampus ramulosus</i>	not valid	<i>Hippocampus guttulatus</i>
<i>Hippocampus reidi</i>	valid	-
<i>Hippocampus sindonis</i>	valid	-
<i>Hippocampus spinosissimus</i>	valid	-
<i>Hippocampus takakurae</i>	not valid	<i>Hippocampus trimaculatus</i>
<i>Hippocampus taeniops</i>	not valid	<i>Hippocampus kuda</i>
<i>Hippocampus trimaculatus</i>	valid	-
<i>Hippocampus tristis</i>	not valid	<i>Hippocampus kuda</i>
<i>Hippocampus whitei</i>	valid	-
<i>Hippocampus zebra</i>	valid	-
<i>Hippocampus zosterae</i>	valid	-

For example, in Italy, a shop in Genoa displayed dried seahorses (approximately 12.0 cm or less in length) for US\$3.25 each (A. DiNatale, *in litt.*, October 1996). Small curio stalls on the streets of Rhodes, Greece, were selling dried seahorses in 1996 for GRD500 each (approximately US\$2.10; D. Karavellas, *in litt.*, August 1996). Dried seahorses were sold as souvenirs throughout central to south-western Portugal (P. Ré, *in litt.*, 18 October 1995). They were fairly common items in souvenir shops in Faro, southern Portugal. Prices in 2000 varied between PTE300 and PTE750

(approximately US\$1.37-3.43) depending on size; observed seahorses measured 5-11 cm in height. Species sold as curios in Portugal included *H. guttulatus*, *H. hippocampus* and imported *H. hystrix* (J. Curtis *in litt.*, April 2001). In Spain, seahorses landed incidentally were dried and sold as curios for between ESP5,000 and ESP12,000 per kilogram (approximately USD 34.80-83.52/kg; J.G. Torres, *in litt.*, March 1997).

Live aquarium fish

The European community represents an important market for the aquarium trade. Sadovy & Vincent (2002) reported that there were approximately 800,000 European marine fish keepers and around 80 public aquariums with least five new major aquariums under construction, and ten to 20 more in the planning stages.

In an annotated list of ornamental fishes traded in the Netherlands, Woeltjes (1995) reported four species of seahorses sold as aquarium fishes. This list included two species which were sometimes imported from Singapore (*H. kuda* and *H. 'coloured [sic]'*), and one which was imported from the western Atlantic Ocean (*H. zosterae*). Reported retail prices for *H. kuda* and *H. 'coloured [sic]'* were NLG11.50-22.50 (US\$ 7.18-14.04) and NLG12.50-25.00 (US\$7.80-15.60), respectively (Woeltjes, 1995). *Hippocampus guttulatus*, which is found in European waters, also appeared on this list (Woeltjes, 1995). It is likely that seahorses sold as aquarium fishes in other European countries included more than these four species listed (See ***Live seahorse trade in Europe***).

Legislation

European Union legislation

In June 1997, the European Union (EU) implemented two new regulations concerning international trade in wild plants and animals. Council Regulation (EC) No. 338/97 was intended to protect species of wild fauna and flora and to guarantee their conservation by regulating trade (EC, 1997a); Commission Regulation (EC) No. 939/37 provided detailed rules concerning the implementation of the Council Regulation (EC, 1997b). This legislation mainly served to enforce the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as well as adding new measures for the conservation of traded species (World Conservation Monitoring Center (WCMC), 2000). The Council Regulation contained four Annexes (A, B, C and D) under which species were named and trade regulations specified. The Annexes included species that were listed by CITES as well as non-listed species.

Seahorses were found under Annex D; this listing mandated the declaration of any 'live', 'whole dead', or 'substantially whole dead' seahorse specimens imported into the EU. Import permits were not required for seahorses but an importer had to complete an Import Notification Form and present the form at the border post of introduction before the seahorses arrived. Because only 'live' specimens and 'whole' or 'substantially whole dried' specimens had to be declared, 'powdered' seahorses used in traditional medicine were essentially unregulated.

There were no specific requirements regarding the export of either dead or live seahorses. Any EU nation could, therefore, export seahorses without restrictions or documentation.

Country-specific legislation and listing

In addition to Council Regulation (EC) No. 338/97 and Commission Regulation (EC) No. 939/37, some European countries had national legislation and/or listings to protect syngnathids.

France

Hippocampus guttulatus was added to the French Red Data book in 1987 (under *H. ramulosus*; Beaufort, 1987). Consequently, fishing for *H. guttulatus* was prohibited along the Atlantic coast south of Bordeaux (Arcachon Basin). The species was listed primarily because of its increasing rarity and its sensitivity to habitat degradation through pollution and coastal modification (Beaufort, 1987). Despite its similar biology and habitat, *H. hippocampus* did not appear in the French Red Data book. Trade regulations in France banned the import of tropical species under the name of *H. kuda* (L. Foure, *in litt.*, April 1998). These trade regulations were not fully enforced (see ***Live seahorse trade in Europe: Imports***).

Germany, Denmark and Netherlands

The 1995 Red List of the Trilateral Wadden Sea Area (Germany, Netherlands and Denmark) included some pipefish species that occur in North Sea waters. On this list, *Syngnathus acus* was categorized as Vulnerable and *Syngnathus typhle* as Endangered (status of endangerment not known; Berg *et al.*, 1996). They were listed primarily because of habitat loss (Berg *et al.*, 1996). In addition, Germany maintained a separate Red List under which *Syngnathus acus* and *Syngnathus typhle* were listed as Endangered, and *Entelurus aequoreus* was considered Potentially Endangered.

Portugal

Portugal listed both European seahorse species in its Red Data book. Their status was considered Undetermined and Rare in the Azores because of low abundance and the lack of information regarding populations. The principal reasons for listing seahorses in Portugal were their sensitivity to habitat destruction as well as fishing pressure through accidental capture in artisanal fisheries and directed catch for the curio market.

Slovenia

The Government of the Republic of Slovenia created an order to protect threatened animal species in October 1993. These regulations prohibited the hunting, preparation, trade, export, collection of eggs, or any disturbances to listed animals in their natural habitat. Protected species could not be kept in captivity. The syngnathid species protected under this law were: *H. guttulatus*, *Nerophis ophidion* and all species of the genus *Syngnathus* (T. Kosar, *in litt.*, March 1998).

Ukraine

The Ministry of the Environmental and Natural Resources of Ukraine believe that a subspecies of *H. guttulatus*, named *H. g. microstephanus*, occurred in the Ukraine's economic marine zone in the Black Sea and Sea of Azov. According to government authorities, a sharp decline in population numbers occurred because of water pollution and over-catch for souvenirs (V. Domashlinets, *in litt.*, 5 June 2001). Therefore, *H. g. microstephanus* was included in the Ukraine's Red Data Book under the category II (Vulnerable) in 1994 (V. Domashlinets, *in litt.*, 30 August 2001).

SEAHORSE CATCHES IN EUROPE

Seahorses and other syngnathids were seldom targeted by European fishers, in several countries, but were landed as bycatch. Landings, however, were apparently not recorded. European seahorse fisheries and their potential impacts were therefore difficult to quantify. Information provided on intentional and accidental seahorse catch is given below:

France

Seahorse were reportedly caught as bycatch by French fishers trawling au gangui (a local term in the vicinity of Marseille meaning 'to trawl with a fine-mesh net'), although this method is prohibited in many areas. French fishers did not appear to target seahorses (J. Harmelin, *in litt.*, 25 September 1991).

Italy

Seahorses were probably caught incidentally in Italy, given that over 1,000 *H. guttulatus* were caught by a research trawler during a survey cruise in the Gulf of Catania, eastern Sicily (A. DiNatale, *in litt.*, October 1996). Although trawling in coastal areas is illegal in Italy, except for official research purposes, seahorse bycatch may occur with other fishing gear.

Portugal and Spain

In Faro, Portugal, *H. guttulatus* and *H. hippocampus* were reportedly caught as bycatch in the Rio Formosa lagoon by fisher using gill net, trammel, push nets, beach seines and beam trawls (J. Curtis, *in litt.*, July 2001). They were also caught with a variety of traps designed for catching baitfish. Seahorses retained by local fishers were dried, varnished and then sold by street vendors (J. Curtis, *in litt.*, April 2001). Seahorses were also captured incidentally by net fishers in Spain (J. C. Torres, *in litt.*, March 1997; E. López-Jamar, *in litt.*, 1998).

Turkey and Croatia

Turkey and Croatia have been reported to catch seahorses incidentally (K. Adalani, *in litt.*, June 1998; A. Kulte, *in litt.*, February, 1998).

DRIED SEAHORSE TRADE IN EUROPE

Exports

Little is known about the export of seahorses from Europe because no specific regulations or monitoring systems applied: Hong Kong Customs statistics, however, provided some information, as below.

Norway

Records from Hong Kong trade statistics in 2000 show that Hong Kong imported 2,900 kg of dried seahorses from Norway, for a total value of HK\$174,000 (approximately US\$22,331.16). According to the same statistics, this batch of seahorses was re-exported to Mainland China. No seahorses are known to occur in Norwegian waters, and so they were likely imported to Norway from another, unknown country.

Spain

In 2000, Hong Kong trade figures also documented 1,318 kg dried seahorses imported from Spain, with a declared value of HK\$90,000 (approximately US\$11,550.60). These seahorses were also re-exported from Hong Kong to Mainland China.

Imports

Because Import Notification forms were required only for live, whole or substantially whole dead specimens, EC import data for dried seahorses underestimate actual import volumes.

Germany

According to EC data, Germany imported only 24 dried seahorses between 1997 and 1999. All were imported in 1998, eight from Switzerland and 16 from Vietnam. No information was provided on the origin of the seahorses imported from Switzerland.

Italy

Italy imported considerable numbers of dried seahorses between 1997 and 1999. EC records indicate that 5,000 dried seahorses were imported from the Philippines in 1998 and 200 from Vietnam in 1999. Surprisingly, the records reveal only 14 seahorses imported from the Philippines in 1999, which may indicate gaps in import declarations.

Netherlands

Among European countries, the Netherlands appears to be a significant importer of dried seahorses. EC data show that in 1999, 20,000 dried seahorses were imported to the Netherlands from the Philippines. Indian statistics from Customs invoices show 14 kg of seahorses exported to the Netherlands in 1986, for a total value of INR13,558 (approximately US\$287.97).

Spain

Spain, too, appears to be among Europe's major importers of dried seahorse: EC import data show that Spain imported 30 kg of dried seahorses in 1998 from the Philippines, likely for sale as curios.

United Kingdom

According to EC figures, the UK imported 300 dried seahorse bodies from the USA in 1998 as well as 200 boxes containing seahorse derivatives from Mainland China. In 1999, the data indicate that the UK received 2 kg of dried seahorses from Mainland China.

LIVE SEAHORSE TRADE IN EUROPE

Exports

No accurate data are available regarding the export of live seahorses from European countries. There is some indication that live seahorses are traded among EU countries. Trade within the EU, however, is not strictly monitored so that it is difficult to estimate the impact of this activity on local seahorse species.

Imports

Germany accounted for the highest number of declared live seahorse imports between 1997 and 1999, followed by Italy, the Netherlands, Belgium and the United Kingdom (Table 2; Figure 1). The apparent increase in imports from 1997 to 1999 is likely a result of improved data collection and monitoring following implementation of the EC Council Regulations in June 1997.

According to EC import data, the main suppliers of live seahorses to the EU are, in order of importance, the Philippines, Brazil, Indonesia, Sri Lanka and Singapore. Ninety-seven percent of the live seahorse shipment recorded from 1997 to 1999 was reportedly imported from these five nations. The remaining 3% was divided among Australia, Costa Rica, Cuba, Egypt, Hong Kong, Kenya, Malaysia, USA and the Solomon Islands. Most of the declared imports were for commercial purposes and were wild-caught in their country of origin. The data also indicate that trade in live seahorses occurs among EU countries; Portugal had apparently imported live seahorses from the UK and Italy reported receiving seahorses from Switzerland.

Ornamental fish exporters in Singapore, Indonesia, Pakistan and Thailand reported sending seahorses to Europe, particularly to Germany, Italy, Belgium and the Netherlands. Interviews with dealers in Indonesia and evidence from in-stock certificates and invoices suggested that exports to France also occurred. During a four-month period in 1999, two Indonesian companies jointly exported a minimum of 256 *H. kuda* to France, despite the fact that French law strictly prohibits the import of tropical species under the name of *H. kuda*. Ornamental fish dealers in Kenya also said they occasionally sent seahorses to Europe.

Table 2. Live seahorses imported and declared in the European Union from 1997 to 1999. 1997 is not complete because monitoring only began in June 1997. Source: European Commission (Unpublished data).

Country	1997	1998	1999	Total
Germany	2273	6,499	8,658	17,430
Italy	--	3,570	6,363	9,933
Netherlands	--	2,182	3,971	6,153
Belgium	137	457	2,099	2,693
United Kingdom	--	354	1,305	1,659
Sweden	108	404	139	651
Austria	5	245	397	647
Portugal	--	210	179	389
Denmark	--	9	364	373
Total	2523	13,930	23,475	39,928

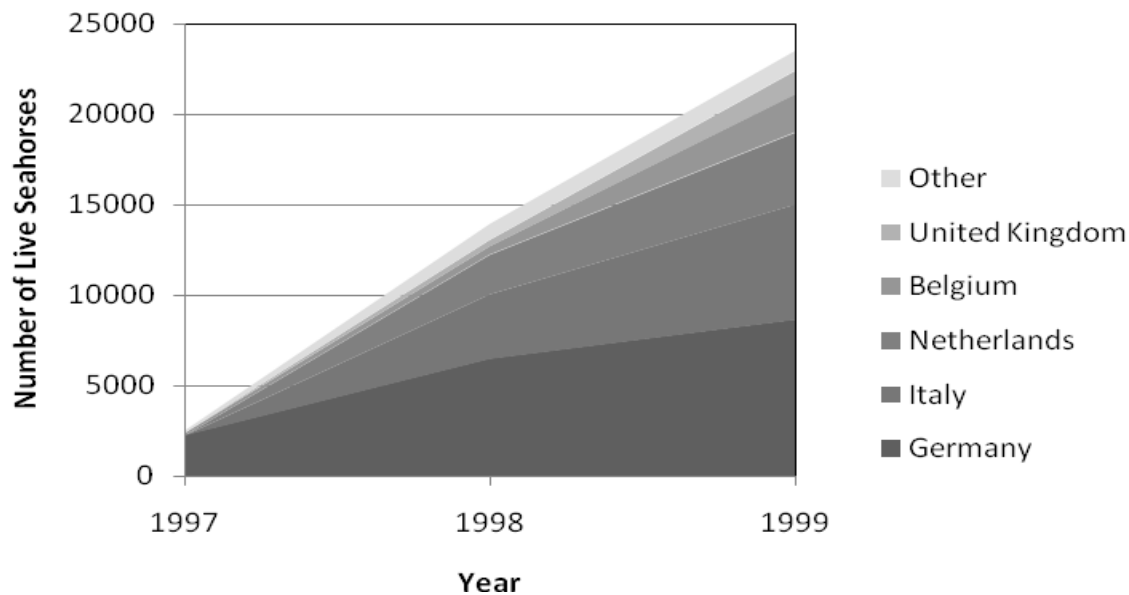


Figure 1. Main suppliers of live seahorses for 1997-1999 (n=39 928) according to European Commission import data of non-CITES annex D species.

Information from outside Europe suggests that EC import data contain gaps. For example, French seahorse imports do not appear among EC import data, although dealers in Indonesia confirmed that they export *H. kuda* to France. Australian export records for 1998/1999 show that 54 seahorses (three wild *H. breviceps* and 51 captive-bred *H. abdominalis*) were exported from Australia to the UK (Australian export data 1998/1999). However, the only recorded Australian exports reported in the EC data were three wild-caught *H. kuda* that were sent to Germany in 1999. The 1999 United States trade statistics show that the USA exported 75 captive-bred seahorses and 83 wild-caught seahorses to the UK and 12 wild-caught seahorses to Hungary. Those shipments do not appear in the EC data. Furthermore, Ireland is known to import syngnathid species for marine aquariums (D. Minchin, *in litt.*, February, 1998) but Ireland is not mentioned in the EC data.

OTHER SYNGNATHID SPECIES IN EUROPE

At least 14 pipefish species of four different genera are commonly found in European seas (Table 3). They are mainly found in coastal and estuarine waters associated with eelgrasses and algae. Some species (*Syngnathus plegon*, *Syngnathus schmidtii*) are known to be pelagic, offshore fishes. None of the European pipefish species are listed under the IUCN Red List (Hilton-Taylor, 2000), with the exception of *Syngnathus abaster*, which is listed as data deficient (DD). Some pipefishes (*Syngnathus acus*, *Syngnathus typhle*, *Entelurus aequoreus*, *Nerophis ophidion*), however, are listed under national legislation in countries such as Germany, Denmark, the Netherlands and Slovenia (see **Legislation**). These pipefish species are primarily threatened by the destruction of seagrass beds owing to coastal development and pollution (Berg *et al.*, 1996).

Of the seven species of pipefish present in the Black and Azov Seas, *Syngnathus schmidtii* and *Syngnathus variegatus* are endemic to the area. The biology of *S. schmidtii* has been studied by Gordina *et al.* (1991) but little is known of *S. variegatus*.

Uses of pipefishes

Live pipefishes were imported by European nations for aquariums. Most available information comes from trade surveys in Asia (Singapore, Indonesia and Thailand). These surveys suggested that four pipefish species were commonly exported to Europe for the aquarium market: *Doryrhamphus dactyliophorus*, *Doryrhamphus janssi*, *Corythoichthys intestinalis* and *Syngnathus biaculeatus*. Woeltjes (1995) mentioned *Dunckerocampus dactyliophorus* and *Syngnathus biaculatus* as sometimes being imported to the Netherlands from Singapore. Between 1992 and 1994, both these species were sold at a retail price of Dfl17 (Woeltjes, 1995). Local species, such as *Syngnathus acus*, *Syngnathus typhle* and *Nerophis ophidion*, are also reportedly sold as ornamental fish in the Netherlands (Woeltjes, 1995). No information is available regarding the uses of dried pipefishes in Europe.

Table 3. Pipefish species occurring in European waters. Source: Froese & Pauly (2000), Dawson (1985, 1990), Whitehead *et al.* (1986), Wheeler (1973).

Species	Geographic distribution			
	North Sea and/or Baltic Sea	North East Atlantic (European coast)	Mediterranean Ocean and/or Adriatic Sea	Black Sea and/or Azov Sea
<i>Entelurus aequoreus</i>	√	√		
<i>Minyichthys sentus</i>			√	
<i>Nerophis lumbriciformis</i>	√	√		
<i>Nerophis maculatus</i>		√	√	
<i>Nerophis ophidion</i>	√	√	√	√
<i>Syngnathus abaster</i>		√	√	√
<i>Syngnathus acus</i>	√	√	√	√
<i>Syngnathus phlegon</i>		√	√	
<i>Syngnathus rostellatus</i>	√	√		
<i>Syngnathus schmidtii</i>				√
<i>Syngnathus taenionotus</i>			√	
<i>Syngnathus tenuirostris</i>			√	√
<i>Syngnathus typhle</i>	√	√	√	√
<i>Syngnathus variegatus</i>				√

Catches of pipefishes

No pipefish species appeared to be targeted directly in Europe but some pipefishes were caught as bycatch. Pipefishes caught incidentally had low commercial value and were generally discarded. *Entelurus aequoreus* was frequently captured in gill-nets targeting Atlantic salmon in Ireland, even 50 nautical miles offshore (D. Minchin, *in litt.*, February 1998). Incidental capture of pipefishes was also reported to occur in the trawl shrimp fishery along the North Sea coast of Germany (R. Berghahn, *in litt.*, February 1998). Species such as *Nerophis ophidion* and *Syngnathus typhle* were landed as non-target species in the Baltic Sea along the Estonian and Lithuanian coasts (R. Aps, *in litt.*, March 1998; R. Repecka, *in litt.*, March 1998). *Nerophis ophidion*, *Syngnathus acus* and *Syngnathus typhle* were also reported among bycatch species in Turkey, Croatia and Cyprus (K. Adanali, *in litt.*, June 1998; M. Argyrou, *in litt.*, May 1998; A. Kutle, *in litt.*, February 1998).

There is no monitoring of pipefish bycatch, therefore the impact on pipefish populations is virtually unknown.

CAPTIVE BREEDING OF SYNGNATHIDAE IN EUROPE

In 2001, there were two projects for syngnathid aquaculture in Europe. One was based in Ireland and the company was looking to farm the native European species *H. guttulatus* and *H. hippocampus*. The project was still at an early stage but the company wanted to raise seahorses in order to sell them on the TCM market in Mainland China.

The second company undertaking syngnathid aquaculture was in the UK and was breeding one seahorse species and the pipefish *Doryrhamphus multi-annulatus* for the aquarium market.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN EUROPE

At least six countries have listed one or more syngnathid species in their national Red Data list. In all cases, the reason stated for the listing is related to habitat degradation. In some cases, exploitation (catch and bycatch) is also mentioned as a threat to syngnathid populations in Europe.

Few data are available to assess the precise impact of habitat degradation and exploitation on syngnathid populations, therefore further research is needed.

CONCLUSIONS

Council Regulation (EC) No. 338/97 and Commission Regulation (EC) No. 939/97 improved the understanding of the syngnathid trade in Europe. The monitoring of imports highlighted new countries involved in the trade and led to identification of primary suppliers of live seahorse to European countries. Unfortunately, most of the trade in dried seahorses in Europe remained unknown. The lack of information on export of *H. hippocampus* and *H. guttulatus* from Europe was also problematic, as it was impossible to quantify the trade pressure on these local species. Furthermore, regulations in 2000 did not apply to the movement of species on Annex D within the EC, which may have left certain trade routes among European countries hidden.

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CHAPTER 7. SYNGNATHID TRADE IN AUSTRALIA¹

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ABSTRACT

Australia is highly important for syngnathid biodiversity with at least 13 seahorse species, two endemic seadragons and 90 other syngnathids (pipefishes and pipehorses). Strong legislation at both Commonwealth (national) and State levels protected syngnathids and/or required monitoring of their exploitation. All exports of syngnathids from Australia required permits under approved management plans. Domestic consumption of dried syngnathids was relatively minor (<200 kg per year) all animals being imported from Asia (primarily Hong Kong) for Traditional Chinese Medicine (TCM). The domestic aquarium market was also small (estimated sales of <15,000 individuals per year) supplied from domestic sources (both wild-caught and captive-bred animals) and from overseas. Recorded exports of seahorses from Australia (mandatory since 1998) were less than 5 kg of dried animals and 3,300 live animals per year with substantial increase in the latter from 1999 to 2000 attributable to commercial aquaculture. However, recorded imports of dried seahorses from Australia into Hong Kong, Mainland China and Taiwan were in the range of 100-300 kg per year. This discrepancy was probably due to other syngnathids being misclassified as seahorses in the import statistics but these data warrant further investigation. Total value was estimated to be negligible for dried seahorses and less than US\$30,000 per annum for the live trade.

The most important syngnathid fisheries in Australia in terms of biomass and value were the bycatch of pipehorses (*Solegnathus* spp.) caught in ocean trawling operations (Queensland East Coast Trawl Fishery and South-East Trawl Fishery). Recorded exports were over 2,100 kg dry weight per annum in 1998 (with a declared import value of up to US\$165,000) but had declined to less than 250 kg in 1999 and 2000 (with an estimated value of US\$60,000-100,000). However, export data from processors and import data from Hong Kong, Mainland China and Taiwan reported significantly greater volumes of approximately 1,200 kg in 1999 and 850 kg in 2000 (worth US\$200,000 and 150,000 respectively). There were a number of possible explanations for the discrepancies between the two data sets which should be investigated. There were few data on population dynamics of these exploited *Solegnathus* needed to assess the impact of the fishery. This remains a high priority for research. There was a small but important export trade in live syngnathids (almost exclusively two endemic species of seadragon) from South Australia, Victoria and Western Australia. Although less than 500 animals per year were exported the value of the fishery may have been as much as US\$100,000 per year.

BACKGROUND FOR AUSTRALIA

Australia has the highest estimated syngnathid diversity of any country in the world, with an estimated 25-37% of the world's species (Lourie *et al.*, 1999; Kuitert, 2000; Pogonoski *et al.*, 2001). Factors which contribute to this include its huge size (8.5 million km²) and coastlines extending across 3,700 km of latitude and 4,000 km of longitude (total coastline approximately 26,000 km). Coastal waters include both the Indian and Pacific Oceans and span the Tropic of Capricorn from cool temperate in the south to warm tropical in the north. Recent work has recognized four pelagic and 17 demersal marine bioregions (CSIRO 1996). Under the United Nations Convention on the Law of the Sea Australia has rights and responsibilities for 16 million km² of sea.

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Syngnathid biology has been comparatively well studied in Australia in comparison to most other parts of the world. Distribution, abundance and species taxonomy have been documented (e.g. Dawson, 1985; Lourie *et al.*, 1999; Kuitert, 2000). Detailed data on ecology and behaviour have been collected for some species in the wild (e.g. Gronell, 1984; Steffe *et al.*, 1989; Vincent & Sadler, 1995; Kvarnemo *et al.*, 2000) and laboratory studies have been conducted on aspects of syngnathid ecology (e.g. Howard & Koehn, 1985; Flynn & Ritz, 1999). However, given the enormous size of the coastline and diversity of the syngnathid fauna, there remain large areas of ignorance.

Syngnathids have had a reasonably high profile in Australia with considerable public interest particularly for seahorses and seadragons. Marine conservation and community involvement programmes have used syngnathids as flagship species (e.g. the Dragon Search programme).

Finally, in a global context, there are five species found in the northern tropical areas of Australia that are also found in other parts of the Indo-Pacific where they may be heavily exploited in other countries (e.g. *H. kuda*, *H. spinosimus* and *H. trimaculatus*). Australia may represent a refuge for some of these species.

Information sources in Australia

Information for this section was obtained from government agencies (n=12), non-governmental organizations (n=5), commercial organisations (n=3), Australian syngnathid researchers (n=4), and interested individuals (n=2; Table 1).

Table 1. Sources of information in Australia. The following abbreviations will be used throughout the tables in this section for Australian States and Territories: ACT – Australian Capital Territory, NSW – New South Wales, NT – Northern Territory, Qld – Queensland, SA – South Australia, Tas – Tasmania, Vic – Victoria, WA – Western Australia.

Category	Location	Source
Govern't	Commonwealth	Environment Australia (EA) [www.ea.gov.au]
	Commonwealth	Australian Fisheries Management Authority (AFMA) [www.afma.gov.au]
	Commonwealth	Great Barrier Reef Marine Park Authority (GBRMPA) [www.gbrmpa.gov.au]
	Commonwealth	Agriculture, Fisheries and Forestry Australia (AFFA) [www.affa.gov.au]
	Commonwealth	Australian Quarantine & Immigration Service (AQIS) [www.aqis.gov.au]
	NSW	NSW Fisheries Dept. [www.fisheries.nsw.gov.au]
	NT	Department of Primary Industries & Fisheries (DPIF) [www.nt.gov.au/dpif]
	Qld	Queensland Fisheries Service (QFS) - Dept. Primary Industries (DPI) [www.dpi.qld.gov.au/Fishweb]
	SA	Primary Industries and Resources SA (PIRSA) [www.pirsa.gov.sa.au]
	Tas	Dept. Environment and Heritage (DEH) [www.deh.sa.gov.au]
	Vic	Dept. Primary Industries, Water and Environment (DPIWE) [www.dpiwe.tas.gov.au]
		Natural Resources and Environment (NRE) [www.nre.vic.gov.au]
		Marine and Freshwater Research Institute (MAFRI) [www.fisheries.wa.gov.au/westfish]
	NGO	Australia-wide
Australia-wide		Marine and Coastal Community Network (MCCN) [www.ozemail.com.au/~mccnet]
Australia-wide		Australian Marine Conservation Society (AMCS) [www.amcs.org.au]
Australia-wide		Dragon Search [www.dragonsearch.asn.au]
Academic	NSW	TRAFFIC Oceania [www.traffic.org/about/in_field_oceania]
	Australia-wide	WorldWide Fund for Nature (WWF) [www.wwf.org.au]
	ACT	Bob Wong (Australian National University)
	Qld	Dr. Rod Connolly (Griffith University)
Commercial	WA	Alan Kendrick (Murdoch University)
	WA	Virgina Mosk (University of Western Australia)
	ACT	Australian Seafood Industry Council (ASIC) [www.asic.org.au]
	Qld	Queensland Seafood Industry Association (QSIA)
Other	Qld	Ocean Oddities
	WA	Paul Groves & Glenn Moore, Aquarium of Western Australia
	NSW	Jonathon Clark-Jones
	SA	Steve Reynolds

The majority of export data for syngnathids were collected from 1998 onwards by Environmental Australia, the Australian CITES management agency, under Permit/Authority to Export regulations (see **Legislation**). Although there were considerable inconsistencies between supposed equivalent data supplied to different individuals, these data probably represent reliable lower estimates for syngnathid trade. Estimates for bycatch volumes of pipehorses in the Queensland East Coast Trawl Fishery were extracted from a Fisheries Research and Development Corporation study (Connolly *et al.*, 2001). Data on syngnathid imports into Hong Kong, Mainland China and Taiwan were supplied by Customs agencies of those countries.

Trade surveys were conducted in Traditional Chinese Medicine (TCM) shops in Sydney in 1999 and 2001 and in Perth in 2001. In Sydney, two shops were surveyed in 1999 (C. Woodfield pers. comm.) while six shops were surveyed in 2001 by the author and others. In Perth two TCM practitioners were surveyed in 2001 by the author. Respondents were asked about the volume and price of syngnathids, source and trade routes of animals that they sold, uses of those animals, temporal changes in demand or supply and any other information on seahorses. Approximate numbers of TCM retailers and wholesalers for the whole of Australia were determined from phone directories and Internet searches.

Surveys of aquarium retailers were conducted by the author in Adelaide (2 shops), Sydney (3 shops) and Perth (4 shops) in 2000 and 2001 in shops stocking seahorses. Aquarium collectors (3) and people conducting aquaculture (2) were also interviewed. Respondents were asked about the origin and trade routes of seahorses, volumes and prices and temporal changes in demand and supply. Phone interviews were also conducted in Sydney (12) and Perth (8) to determine the proportion of aquarium retailers stocking seahorses for calculations of domestic trade volumes. Phone directories and Internet searches were used to calculate approximate number of aquarium retailers for the whole of Australia.

Seahorses in Australia

Geographic distribution and local species

Australia has the highest diversity of seahorses of any country in the world with at least 13 species found in its territorial waters (Lourie *et al.* 1999), although it has been suggested that there may be as many as 24 species (Kuitert, 2000). Pogonoski *et al.* (2001) recognize 21 species in a report on the conservation status of fish species in Australia. Given the instability in the taxonomy it was decided to use the species of Lourie *et al.* (1999), while recognizing that the status and conservation information may have to be revised. Information on the 13 species recognized by Lourie *et al.* (1999) are given in Table 2.

Six of the Australian species in Lourie *et al.* (1999) are listed as Vulnerable in IUCN Red List, while a further three are listed as Data Deficient (Hilton-Taylor, 2000). These species were assessed in 1996 and the criteria for their listings were generally small area of occupancy and/or small population sizes. None of the species are listed on the Australian Red List (Environment Australia, 2001). Pogonoski *et al.* (2001) proposed listing 17 species of seahorse as Data Deficient on an Australia-wide basis and a further three species (*H. dahl*i, *H. sp. nov.* B & G = parts of *H. trimaculatus* and *H. spinosissimus* in Lourie *et al.* 1999) as Lower Risk (near threatened) and one species (*H. bleekeri* = part of *H. abdominalis* in Lourie *et al.* 1999) as Lower Risk (conservation dependent).

Species traded/imported

The following seahorses were sold as dried product in TCM shops in Australia:

- *H. comes*. Identified for sale in Cairns in 1999.
- *H. histrix*. Both males and females seen, approximate size 80-120 mm standard length (SL), unbleached and bleached.
- *H. histrix* complex (*H. histrix* or *H. barbouri*).
- *H. spinosissimus*. Both males and females seen, approximate size 60-120 mm SL, unbleached and bleached.

Table 2. List of Australian species of seahorse recognised by Lourie *et al.* (1999). Endemic species marked with an asterisk. Sources: Lourie *et al.*, 1999; Kuitert, 2000; Pogonoski *et al.*, 2001.

Species	Common name	IUCN Status	Habitat	Biology	Trade
<i>H. abdominalis</i>	Big-belly seahorse, pot-bellied seahorse	VU A2d	Algae, sponges, seagrasses, rocky reefs, artificial structures. 0-20+ m	Breeds Oct-Jan; brood size 300-1000+; Gestation 28 d at 17°C; found alone, pairs, groups	Live aquarium trade from Qld, SA, Tas, Vic Dried trade from Tas
<i>H. angustus*</i>	Narrow-bellied seahorse	VU A2cd	Most specimens trawled, thus habitat uncertain but known on soft coral, algal reef & mud/rocky reef. 0-60+ m	Unknown	Live aquarium trade from WA
<i>H. bargibanti</i>	Pygmy seahorse	DD	Only known from <i>Muricella gorgonians</i> 16-40+ m	Breeding Mar-Nov; found in singletons or pairs	No known trade
<i>H. breviceps*</i>	Short-snouted seahorse, short-headed seahorse	DD	Seagrass, algae (<i>Sargassum</i>), artificial structures 0-15 m	Breeding in summer; brood size 50-100; found in pairs or small groups	Live aquarium trade from Vic & Qld (??)
<i>H. fisheri</i>	Fisher's seahorse	Not listed	Unknown	Unknown	No known trade
<i>H. kelloggi</i>	Great seahorse, Kellogg's seahorse	Not listed	Soft bottom sediments 20+ m	Unknown	No known trade
<i>H. kuda</i>	Yellow seahorse, spotted seahorse, estuary seahorse	VU A2cd	Estuaries, seagrasses, mangroves, algae 0-50 m	Breeding in wet season (Indonesia); gestation 20-28 d; brood size 20-1000; may occur in pairs	No known trade in Australia
<i>H. minotaur*</i>	Bullneck seahorse	DD	Trawled from fine sand or hard substrate (only 3 specimens). 64-100 m	Unknown	No known trade
<i>H. spinosissimus</i>	Hedgehog seahorse	VU A2cd	Trawled from muddy or sandy substrate, coral reefs To 70 m	Unknown	No known trade from Australia
<i>H. subelongatus*</i>	West Australian seahorse	Not listed	Estuaries, mud substrates, edges of rocky reefs, artificial structures 0-25 m	Gestation 14-21 d; brood size 250-600; may undergo seasonal migration to deeper water	Live aquarium trade from WA
<i>H. trimaculatus</i>	Three-spot seahorse, low-crowned seahorse	VU A1cd+2cd	Algal reefs; trawled from gravel & sand 0-20 m	Breed May-Sep; brood size 400-1000	No known trade in Australia
<i>H. whitei*</i>	White's seahorse, Sydney seahorse	VU A2cde	Seagrasses, sponges, algal reefs, artificial structures 0-25 m	Breed Oct-Apr; gestation 21-22 d; brood size 100-250; generally found in monogamous pairs	Live aquarium trade from Qld
<i>H. zebra*</i>	Zebra seahorse	Not listed	Trawled from soft bottom substrates, channels in estuaries. 20-60 m	Unknown	No known trade

The following seahorses were sold in aquarium shops in Australia:

- *H. abdominalis*. Predominately captive-bred juveniles and small adults (both male and female) seen. Approximate size 50-130 mm SL
- *H. barbouri*. The majority of individuals for sale were captive-bred juveniles of approximately 20-50 mm SL, although some larger captive-bred adults were also seen.
- *H. kuda*. All animals seen were wild-caught adults up to 120 mm SL.
- *H. subelongatus*. All individuals seen were wild-caught adults of both sexes of approximately 70-150 mm SL.

The following seahorses were sold as curios in Australia:

- *H. abdominalis*. Predominately juveniles up to 70 mm SL.
- *Hippocampus* spp. Unidentified species, probably not Australian species.

Uses

Seahorses in Australia have been used in traditional medicine, as curios and as aquarium fish.

The use of seahorses in traditional medicine was mostly confined to traditional Chinese medicine (TCM). TCM practitioners or suppliers were found in all parts of Australia although the largest ethnic Chinese communities were in Sydney, Melbourne, Brisbane and Perth (Khoo & Price, 1996). Respondents (n=7) in TCM shops indicated that seahorses were used for “kidney” (a general term for whole body health), skin health, for “mens’ spirit” (aphrodisiac), as a treatment for asthma & phlegm, as a tonic and to clear toxins from blood. One shop recommended a tonic soup made with one seahorse, one pipefish and pork. In addition, they were considered a “natural” remedy which was more efficacious than synthetic drugs. Invariably seahorses were sold to ethnic Chinese and most (n=5) of the TCM pharmacists surveyed said that most of the seahorses that they sold were to fill TCM practitioners’ prescriptions. Seahorses were generally considered to be expensive items and therefore were not particularly popular. Seahorses were sold by weight (generally traditional measures such as the liang [37.5 g]) and prescriptions would normally involve one or two animals as a therapeutic dose.

Seahorses have been sold as curio items in Australia but this trade appeared to be small in volume and localized. Smooth, dried seahorses were noted for sale in rural Victoria (Kinglake) in 1999 that were reported to be from the Philippines and were being sold on a stall alongside seashells (D. Osborn, pers. comm.). Dried seahorses, identified as sourced from S.E. Asia by the trader (level 2) and dried pipehorses (identified as *Solegnathus hardwicki*) were noted for sale in Cairns, Queensland in 1999 (A. Kendrick, pers. comm.). Mortalities from a culturing operation in Tasmania were sold individually, as jewelry, glued to cards, set in plastic as key-rings, and as paperweights in 2000 and 2001 and reported for sale prior to this (A. Vincent & A. Perry, pers. comm.).

Seahorses were traded as aquarium fish throughout Australia, with confirmed reports from Adelaide, Brisbane, Hobart, Melbourne, Sydney and Perth. Some of these seahorses were local species, particularly *H. abdominalis* and *H. subelongatus*, but tropical species (*H. barbouri* and putative *H. kuda*) were also seen. A report from an aquarium trader in 2001 (level 1/2) was that *H. barbouri* and *H. kuda* were sold in Sydney, Melbourne and Brisbane during 1999 and 2000. The same trader indicated that seahorses were a popular item, but it was known that they were reasonably difficult to keep particularly in a community tank with other fish. Aquarium retailers in Perth (three traders at levels 1/2 and 2) in 2001 reported that seahorses were consistently popular items but supply of wild-caught animals was variable.

Many public aquaria in Australia had seahorse displays in 2001 including Manly Oceanarium & Darling Harbour Aquarium (both in Sydney), Melbourne Aquarium, Aquarium Western Australia (Perth), ReefHQ (Townsville, Queensland), Seahorse World (Beauty Point, Tasmania) and Underwater World (Mooloolaba, Queensland). Most of these aquaria held local species including *H. abdominalis*, *H. breviceps*, *H. kuda* and *H. subelongatus*.

Legislation

Australia has among the strongest protection for syngnathids of any country in the world. Legislative jurisdiction is divided between Federal (known as Commonwealth) and State governments; State jurisdiction extends from the coast to 3 nautical miles (5.6 km) while Commonwealth jurisdiction extends from 3 nautical miles to the edge of the Exclusive Economic Zone at 200 nautical miles (370.4 km) and in Marine National Parks (e.g Great Barrier Reef, Jervis Bay). However, co-operative agreements under the Offshore Constitutional Settlement (OCS) can be made between State and Commonwealth ceding jurisdiction from one to the other. They have been negotiated on the broad concept that localized fisheries adjacent to a State should be managed by the State but the Commonwealth should manage fisheries which occur off more than one State or involving foreign vessels. Examples of these are the Commonwealth management the Northern Prawn Trawl Fishery operating in the Northern Territory and Queensland and the Southern Shark Fishery. For some fisheries that are primarily managed by the Commonwealth (South-East Trawl Fishery, Great Australian Bight Trawl Fishery), no OCS arrangements exist and therefore the States manage the fishery within 3 nm, even though the majority of the fishery takes place outside this limit.

National

Prior to 1998 syngnathids (in common with other marine species) were listed on Schedule 4 of the Wildlife Protection Act 1982 (WPA), which allowed unlimited exports from Australia (Table 3). In 1998, syngnathids were removed from Schedule 4, requiring all export thereafter be carried out under approved management plans. The WPA was superseded by the Environment Protection and Biodiversity Conservation Act 1999 (EPBC) which came into effect on 16 July 2000. The Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection) Bill 2001 repealed the WPA and incorporated its provisions into the EPBC Act. Syngnathids are 'listed marine species' under the EPBC Act. It is an offence under the EPBC Act to take, trade, injure or kill listed marine species except under permits issued by the Minister of the Environment. Such permits for export of syngnathids are issued subject to an approved management plan which must be approved by the executive agency, Environment Australia (within the Department of Environment and Heritage). Exemptions may also be granted for exchange of specimens between scientific institutions for the purposes of research. In this case, the receiving institution must be registered with EA.

One of the requirements for export permit approval is that the exporter must keep accurate records of volumes of syngnathids exported and supply these to EA. These exports are recorded by the Australian Quarantine and Immigration Service (AQIS) under the Australian Harmonized Export Commodity Classification (AHECC) scheme. The AHECC code for dried syngnathids is 03.05.59.10 and for live syngnathids is 0301.10.20. No separate listings are provided by the Australian Bureau of Statistics for either live or dried syngnathids.

Table 3. Commonwealth (Federal) legislation affecting syngnathids in Australia. Source: Environment Australia.

Agency	Legislation	Management Plans
Environment Australia (EA)	Environment Protection and Biodiversity Conservation Act 2000 (EPBC)	EA issues Authority to Export syngnathids from captive-bred and wild-caught operations. EPBC states that approved management plans are 'disallowable instruments' meaning that animals may be traded from such operations.
Great Barrier Reef Marine Park Authority (GBRMPA)	Great Barrier Reef Marine Park Act 1975 and Great Barrier Reef Marine Park Regulations 1983 and subject to provisions of EPBC	GBRMPA participates in the development by Queensland Fisheries Management Authority (QFMA) of fishery management arrangements and formal management plans through various policy fora including Management Advisory Committees and an associated Working Group, and in the development by QFMA of a management document for syngnathids under the Wildlife Protection Act 1982.
Australian Fisheries Management Authority (AFMA)	Fisheries Management Act 1991	Draft management plan for syngnathids in SE Trawl Fishery was being negotiated between AFMA & EA in 2001. No specific management arrangements for syngnathids are in operation for other Commonwealth Fisheries managed by AFMA including Northern Prawn Trawl, Torres Strait, Christmas Island and Cocos (Keeling) Islands and Great Australian Bight Fisheries.

State/Provincial

The level of protection for syngnathids in State waters varies around Australia (Table 4). In 2001 the strongest protection for syngnathids was in Tasmania and Victoria. Most of the legislation applied to commercial operations only, while recreational catches for most species of syngnathid were permitted. However, in Tasmania and Victoria all syngnathids were listed as protected aquatic biota (or equivalent) prohibiting all capture without a permit.

SEAHORSE CATCHES IN AUSTRALIA

Target fisheries

The only target fisheries for seahorses in Australia were for the aquarium trade and broodstock for aquaculture. To this end, in 2000 at least 30 licences had been issued in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia that allowed the holders to collect seahorses. The total number of seahorses that these licences allowed collection of was not precisely known but estimated to be less than 3000. Permit conditions varied from State to State (and licence to licence) but generally placed restrictions on the location of collection, time of collection, number of animals and type of

Table 4. State and Territory legislation affecting syngnathids in Australia (see Tables 1 & 3 for abbreviations). Source: Environment Australia.

State/ Terr	Authority	Legislation	Management Plans
NSW	NSW Fisheries	Fisheries Management (General) Regulation 1995, Fisheries Management Act 1994 and Fisheries Management Amendment Act 1997.	None in effect in 2001.
NT	DPIF	Fisheries Act 1988 and Fisheries Regulations 1993	None in effect in 2001
Qld	DPI	Fisheries Act 1994	Queensland Fisheries Management Authority (QFMA) has prepared a syngnathid management document addressing the trawl bycatch and aquarium fishery for approval under the Wildlife Protection Act. Five companies export dried pipehorses (<i>Solegnathus hardwickii</i> and <i>S. dunckeri</i>) under section 44 authorities issued under the WPA.
SA	PIRSA	Fisheries Act 1982 and Fisheries (General) Regulations 1984	All syngnathids are protected from trade or commercial capture. Ministerial exemptions may be issued for capture and holding of syngnathids. In 2001 PIRSA was preparing a management plan for syngnathids in SA.
Tas	DPIWE	Living Marine Resources Management Act 1995.	Syngnathids may only be captured for commercial purposes under permits issued under provisions of WPA and EPBC Acts. In 2000 the Marine Aquarium Fishery Development Plan was being assessed under which syngnathids would be considered.
Vic	NRE	Fisheries Act 1995.	Ministerial permits required for commercial capture of syngnathids. In 2001, the Department of Natural Resources and Environment was developing a management plan for syngnathids.
WA	Fisheries WA	Fish Resources Management Act 1994 and Fish Resources Management Regulations 1995	In 1998 the WA Marine Aquarium Fish Management Plan was approved under the WPA allowing the export of syngnathids, except the leafy seadragon, for aquarium fishery purposes only. In 2000 management arrangements for the collection of syngnathids for the aquarium trade were being assessed under the controlled specimens provisions of the WPA

gear used. The distinction between the aquarium fishery and aquaculture broodstock was not clear as animals collected under an aquarium licence were sold to an aquaculture operation as broodstock. However, in general, aquaculture broodstock was collected in Queensland, South Australia and Tasmania while the majority of aquarium fishery was in Queensland and Western Australia. Although seahorses could be obtained from trawl bycatch (interview with an aquarium fisher level 1/2), it was suggested that the majority were collected by hand on SCUBA because all target fisheries required live seahorses in good condition. Seahorses from bycatch were often in poor condition with decompression problems and didn't survive.

In New South Wales, the number of permits allowing seahorses to be captured for commercial purposes was not known. A permit for collection of 50 seahorses (*H. kuda*, *H. trimaculatus* and *H. whitei* [= *H. procerus* in Kuiter 2001]) for a nascent aquaculture venture at Tweed Heads (Queensland) was issued in 2000 for collection in Moreton Bay (Queensland) by Queensland Fisheries Service (QFS). These animals were collected by hand using SCUBA. Part of the permit conditions by QFS mandate that at least the same number of animals were returned to the collection location from the culturing operation.

In 2001, there were two Ministerial exemptions in South Australia to take and hold *H. abdominalis* as aquaculture broodstock. The number of animals that could be taken was not known.

In Tasmania in 2000, five permits were in operation: (1) Possession of 10 *H. abdominalis* for educational and community awareness purposes. (2) Collection and possession of 10 *H. breviceps* for scientific research purposes. (Not all numbers collected). (3) Collection and possession of 10 *H. breviceps* for educational and community awareness purposes. (Not all numbers collected). (4) Collection and possession of 20 *H. abdominalis* & 3 *H. breviceps* for scientific research purposes (numbers taken not yet known). (5) Possession of up to 800 *H. abdominalis* as broodstock only (not to be sold), taken under previous permits.

In Victoria, permits for the collection of syngnathids (mainly *H. abdominalis*) were issued for educational facilities, research and aquaculture development (broodstock). As of 2001, approximately 6 permits were issued annually, with the number of individual animals limited to between two and five per permit.

In Western Australia, in 2001, 13 transferable licences had been issued under the Marine Aquarium Fish Management Plan with a total permitted harvest of 750 syngnathids. Catches in excess of 750 animals per year required that Fisheries Western Australian demonstrate to Environment Australia that the catch was sustainable. Licence conditions restricted the location of collection, gear type and size of boat used in the fishery. Fishers were also required to complete resource assessment forms and provide yearly reports on total catch and monthly catch per unit effort by species, location, quantity, size, reproductive state and sex of individuals.

Many interviewees from a variety of backgrounds (researchers, conservationists, aquarium collectors) reported that seahorses were taken recreationally, primarily close to urban centres. These animals were presumed to be collected for home aquaria. Seahorses were observed being collected from Sydney Harbour (J. Clark-Jones per. comm.), Townsville (level 1/2 aquarium collector) and around Perth (A. Kendrick pers. comm. and level 2 aquarium collector).

Bycatch

The Australian fishing zone is the third largest in the world and is diverse, targeting different species with a variety of gear types. In 1998 there were approximately 9,000 commercial boats (1,200 with Commonwealth licences, 7,800 with State licences), directly employing 21,000 people in catching/harvesting and 4,000 in processing (AFFA, 2001). Wild-catch fisheries were worth approximately A\$1.6 billion (US\$ 1.0 billion) in 1998/9 (ABARE, 2000) with the most valuable species being rock lobster, prawns, tuna, other finfish and abalone. The major fisheries by value and volume, together with gear type and levels of bycatch are given in Table 5.

Table 5. Major fisheries in Australia.

Fishery	Species	Manag't Agency	Data Year	Catch (tonnes)	Value (A\$millions)	Gear Types
Tasmania abalone	abalone	DPIWE				
Tasmania rock lobster	rock lobster	DPIWE				
Queensland trawl	Prawns, scallops, whiting	DPI	1998	12 357	143.3	Trawl
Queensland non-trawl	Crabs, large number of fish	DPI	1996	13 411	74.3	Nets, pots, hook-and-line
Victoria abalone	Abalone	NRE				
Victoria rock lobster	Rock lobster	NRE				
WA rock lobster	Rock lobster		1998	970		
NSW abalone	Abalone	NSW Fisheries	1998/9	320	14	Diving
NSW ocean prawn trawl	Prawns	NSW Fisheries	1998/9	1102	15.6	Otter trawls
NSW ocean trap and line	Variety of fish	NSW Fisheries	1998/9	5003	17.2	Meshing and hauling nets
NSW other	Rock lobster, estuary prawns, fish	NSW Fisheries	1998/9	2575	11.9	Traps, otter trawling, purse seines, baited lines

Some of the most valuable fisheries in Australia have had little bycatch, because of selective capture methods. These include the high value rock lobster fisheries that use lobster pots and abalone collected by divers. However, there are a number of other fisheries that have high levels of bycatch, particularly trawl fisheries for prawns and dredges for scallops. Bycatch has been a major issue in Australian fisheries and policies have been developed to address the problem in a number of fisheries.

Under the Commonwealth Fisheries Management Act 1991 fisheries managers have a duty to “ensure that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (ESD) and the exercise of the precautionary principle, in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment”. Thus, the Commonwealth Policy on Fisheries Bycatch (AFMA, 2000) was developed and Bycatch Action Plans (BAPs) developed for the major fisheries. This document outlines the obligations on fisheries managers, strategies to minimize bycatch and a checklist for producing BAPs. In 2001, BAPs were available for eight Commonwealth fisheries. Two of these (Great Australian Bight Trawl Fishery and South-East Trawl Fishery) mentioned syngnathids as a group for concern. The former stated that no interactions with syngnathids had been noted, but that they would be recorded in a pilot Integrated Scientific Monitoring Program. In the South-East Trawl Fishery, the BAP stated that a management regime was being developed by EA and AFMA for approval under the Management Plan. In this fishery the majority of syngnathids of concern were pipehorses (see *Pipefish, pipehorse, and seadragon catch in Australia* section).

Similarly, State fisheries departments had bycatch policies at various levels of development with mandatory controls (such as Turtle Excluder Devices) or voluntary codes of conduct.

Information on syngnathid bycatch from government agencies was generally qualitative and the source of data obscure in most cases. Interviews (n=5) with fisheries officers responsible for bycatch suggested that quantitative data were only collected for high-value commercial species.

An exception to this was a study from coastal New South Wales conducted by New South Wales Fisheries from 1989-1992 for prawn trawls and 1993-1997 for fish trawls using observer programmes. Catches were very low with five seahorses in total collected from over 2,100 trawls on almost 400 days in prawn trawls and only one seahorse collected in total in over 2,500 trawl shots on 1,105 days from fish trawls.

With expansion of cage-based aquaculture for Atlantic salmon in Tasmania and grow-out for southern bluefin tuna in South Australia over the period 1995-2001, there have been reports of seahorses being found on cages. In South Australia, seahorses for aquaculture broodstock (*H. abdominalis*) were collected from tuna cages (see **Live seahorse trade in Australia: Sources, Aquaculture and captive breeding**). Similarly, some *H. abdominalis* were collected from salmon cages for broodstock in Tasmania. Interviews (n=4) with salmon farm managers and commercial divers indicated that considerable numbers of *H. abdominalis* (tens-hundreds) were found on outer, predator nets that had developed fouling communities after 2-4 months immersion. No quantitative data were available and it remained unclear whether such structures were acting as aggregating devices for local seahorse populations or additional habitat structure. Furthermore, the fate of the animals (i.e. proportion abandoning the substrate) when the nets were removed and cleaned was unknown. Research on this topic is encouraged.

DRIED SEAHORSE TRADE IN AUSTRALIA

Domestic trade

The major use of dried seahorses in Australia appeared to be in TCM. Although sales of dried seahorses as curios were reported, such reports were sporadic and not widespread. Dried seahorses were noted for sale in Brisbane, Sydney and Melbourne for TCM and reported from other urban centres. Table 6 shows the distribution of TCM suppliers and wholesalers as estimated from phone directory and Internet searches, confirming Sydney and Melbourne as the two largest centres representing over 65% of listed TCM businesses. There was no evidence of use of local species of seahorse in TCM, all interviewees and respondents reporting that seahorses were imported.

Exports

Trade routes were not known for dried seahorses from Australia, primarily because there appeared to be few exporters and volumes were low. Following the legal changes to the status of syngnathids in 1998 and compulsory reporting of volumes and destinations, dried seahorses were exported to Hong Kong, Mainland China and Taiwan between 1998-2000. In 1999 nine dried seahorses were exported to the USA via Canada during exchange between registered scientific institutions (source: US Fish & Wildlife Service).

Imports

All interviewees in Sydney reported that dried seahorses were imported from overseas, primarily Hong Kong. One TCM shop bought all their seahorses from sailors who were from Hong Kong and turned up at random intervals. Another TCM shop bought from a wholesaler who imported from Hong Kong (along with other dried seafood). This shop would phone up an order to the wholesaler as and when they needed them, approximately two or three times per year. A third shop sometimes got seahorses from Hong Kong and was unclear of the origin of the seahorses they bought at other times while a further retailer had no precise idea where the seahorses were imported from but said they were from “overseas”. Bleached seahorses were noted for sale in a number of shops in Sydney and it is highly probable that these animals originated from Hong Kong (Vincent, 1996). A single record by the US Fish & Wildlife Service in 1999 recorded a

Table 6. Traditional Chinese Medicine suppliers in Australia. Source: Telstra Yellow Pages & www.citysearch.com.au.

State/ Territory	Area	# Suppliers (Phone directory)	# Suppliers (internet)
ACT	Canberra	-	3
NSW	Sydney metro	42	38
	Central coast	1	0
	Wollongong	1	0
	Other	4	-
NT	All	0	0
Qld	Brisbane	8	6
	Gold Coast	4	1
	Other	1	2
SA	Adelaide	4	2
Tas	All	1	0
Vic	Melbourne	39	36
	metro		
	Other	2	-
WA	Perth	14	1
Total	All	121	89

small shipment (50) of dried seahorses originating in Mexico, exported to the U.S.A. and re-exported to Australia.

Volumes and Values

Estimated from exports of dried seahorses

Until 1998 record-keeping for export volumes and destinations of syngnathids was not mandatory and thus information was piecemeal. Environment Australia provided data from New South Wales, Queensland and Victoria for the period Jul 1995-Jan 1997 although these data refer to syngnathids as a group (Table 7). It is extremely likely that the majority of these quoted export figures refer to pipehorses, particularly since the states (Queensland and Victoria) with high export volumes are known to have substantial pipehorse exports in subsequent years. The total volume of syngnathids exported for the 18 month period Jul 1995-Jan 1997 was 1,559 kg with a further 632 kg exported from Queensland in the remainder of 1997 (see ***Pipefishes, Pipehorse, and Seadragon catch in Australia***).

Since 1998 and the removal of syngnathids from Schedule 4 of the WPA and the introduction of mandatory export permits, all exports of seahorses were to be recorded. However, there was considerable disagreement between export figures from Australia and import figures from other countries (Table 8). Volumes of dried seahorses recorded by Environment Australia as exported from Australia in the period 1998-2000 were less than 5 kg while imports to China, Hong Kong and Taiwan over the same period were over 500 kg. The most likely explanation for this large discrepancy is that pipehorses from Australia were recorded as seahorses when they were imported into Hong Kong and Taiwan. However, it is also probable that there was some under-reporting of volumes exported from Australia. There appeared to be no evidence that volumes in Hong Kong and Taiwan were over-reported.

In addition to the data in Table 8, Hong Kong recorded 2,664 kg worth HK\$160,000 (US\$20,600) of dried seahorses being re-exported to China in July 1999 with the country of origin as Australia and China reported imports of 4,168 kg (US\$22,000) of dried pipefish and seahorses from Australia in 1994, but none in any other years from 1993-1999. These volumes were very large and again it was probable that these data referred to pipehorses rather than seahorses (i.e. confusion between different export categories). It seemed unlikely that volumes two orders of magnitude greater than those recorded by Australian authorities could be exported without some record.

Estimated from imports of dried seahorses

All TCM retailers surveyed said that dried seahorses were considered to be expensive items and that trade volumes were sporadic but generally low. TCM retailers would typically buy 0.5-1.0 kg at one time and buy these volumes every 2-6 months (n=4). No TCM retailers thought that volumes of sales had changed much in the last five years, although one thought that sales had decreased as the value of the Australian dollar had slumped in 1998-2000. Reported retail sales were consistently in the range of 0-5 animals per retailer per week although there were rare occasions on which 30-40 animals might be sold in a week.

Table 8. Recorded dried seahorse exports from Australia from 1998-2000. Source: Environment Australia and Country of Import Statistics.

Year	Species	Australian Export Statistics			Country of Import Statistics		
		State of Export	Destination	Quantity	Quantity (kg)	Value ('000s)	Value (US\$ 000s)
1998	-		Hong Kong	0	292	HK\$613	79.1
1999	<i>H. abdominalis</i>	Tasmania	Hong Kong	3 kg	132	HK\$113	14.6
	<i>H. abdominalis</i>	Tasmania	Mainland China	10 indivs.	0	-	
	<i>H. abdominalis</i>	Tasmania	Taiwan	200 indivs.	0	-	
2000	-		Hong Kong	0	100	HK\$78	10.0

Table 7. Recorded exports of dried syngnathids. Exports refer to syngnathids as a group and likely refer to pipehorses. Source: Australian Quarantine and Immigration Service.

State	Period	Volume (kg)
NSW	Jul 95-Jan 97	40
NT	Jul 95-Jan 97	None known
Qld	Jul 95-Jan 97	1250
	Jan 97-Dec 97	632
SA	Jul 95-Jan 97	None known
Tas	Jul 95-Jan 97	None known
Vic	Jul 95-Jan 97	269
WA	Jul 95-Jan 97	None known

All dried seahorses for TCM were sold by weight although prices given by interviewees were often converted to approximate prices per individual. In 1999 dried, unbleached seahorses (*H. barbouri*, *H. histrix* and *H. spinosissimus*) were sold for A\$1.50–\$2.04 (US\$0.97–1.32) each for animals weighing approximately 2–4 g. In 2001 prices had increased to approximately A\$2.00–4.00 (US\$1.04–2.08) per individual (based on the following prices: A\$80 (US\$42) per 150 g for unbleached 8–12 cm SL, A\$120 (US\$63) per 150 g for bleached 8–12 cm SL; A\$30 (US\$16) per 37.5 g for bleached 10–12 cm SL; A\$40 (US\$21) per 37 g for 8–12 cm SL unbleached). These price increases may just reflect inflation and the drop in the value of the Australian dollar against the US dollar from 1999–2001 (approximately 25%).

In 1999 50 wild-caught dried seahorses (declared value of US \$100) were exported from Mexico to the U.S.A. and then re-exported to Australia.

The following assumptions were used to calculate total retail volumes and prices of dried seahorses in Australia in 2001:

- Total number of retailers in Australia = 89–121 (Table 6)
- Proportion stocking seahorses = 50–70%
- Volume sold = 4–8 per retailer per week (=20–40 g)
- Price per animal = A\$2–4 (=A\$0.5–1.0 per g)
- Lower estimate of volume and price = 46 kg (A\$23,000 = US\$12,000)
- Upper estimate of volume and price = 176 kg (A\$176,000 = US\$92,000)

Although these estimates are fairly crude, it can be seen that the total volume and economic value of seahorses imported into Australia was fairly small, particular in comparison with other countries.

Prices for dried seahorses as curios were reported as A\$3 (US\$2) each in Victoria in 1999 (D. Osborn, pers. comm.) and A\$5 (US\$3) each in Cairns in 1999 (A. Kendrick pers. comm.), while curio items in Tasmania in 2001 ranged up to A\$10 (US\$5). No volumes were reported for any of these curio sales.

LIVE SEAHORSE TRADE IN AUSTRALIA

Trade routes

Live seahorses were traded within Australia and exported to a variety of countries around the world (Japan, Korea, Mainland China, Netherlands, South Africa, Switzerland, Taiwan U.K., U.S.A.). The aquarium collectors interviewed (n=3, all level 1 or 1/2) all normally exported directly to their overseas buyers but occasionally used consolidators sending other shipments of live fish. Seahorses were generally held by the collectors for a period of weeks before shipping – one collector (level 1/2) reported that it took 10 days–2 weeks to get wild-caught animals feeding on dried or frozen food. Another collector (level 1) historically (pre 2000) raised juveniles from wild-caught pregnant males as they were easier to train on to frozen food and had better survival when exported. All aquarium collectors exploited a variety of species and seahorses only represented a small (<10%) proportion of their total business. Seahorses for export were generally packed in cooled, insulated containers with high oxygen environments and were flown from Melbourne (Victoria), Perth (Western Australia) and Brisbane and Cairns (Queensland). Seahorses from captive breeding operations in South Australia and Tasmania were also exported by air in the same manner as above.

Trade routes for live seahorse within Australia were not known, although aquarium shops in Adelaide, Sydney, Melbourne and Perth had all stocked captive-bred *H. abdominalis* from Tasmania during 1999–2000 and shops in Perth had stocked wild-caught *H. subelongatus* and captive-bred *H. barbouri* from Western Australia in 2000–2001.

Trade routes for live seahorse into Australia were more difficult to determine. One aquarium trader (level 1/2) reported that *H. barbouri* were imported from Bali and the Philippines during 1999 but that supply then dried up and they were replaced by *H. kuda*. Following a cyclone in late 2000 there was no supply at all for six months in late 2000/early 2001 but that supply of *H. kuda* from Bali was resumed towards the middle of 2001.

Volumes

Prior to 1998 mandatory data on exports of live seahorses were not collected. One set of data was available for the period 1994-1997 for Victoria (Table 9) which showed exports of 45-105 animals per year (mean = 73). If it assumed that exports from Victoria comprised the same proportion of the total Australian wild-caught total as in the period 1998-2000 (i.e. 55-83%), then total exports from Australia were 54-190 seahorses per year from 1994-1997.

Following the introduction of mandatory export permits in 1998, quantitative data on live exports were collected by Environment Australia. These data show exports of 254 seahorses in 1998, 250 in 1999 and 3,224 in 2000, the majority of which (66-99%) were *H. abdominalis* (Table 10). The large increase in the number of animals traded in 2000 represents commercial production from aquaculture operations in South Australia and Tasmania (at least 3,076 of 3,215 animals; see **Live seahorse trade in Australia: Sources, Aquaculture and captive breeding**). Prior to 2000, it is likely that all of the animals exported were wild-caught. The numbers of wild-caught seahorses declined slightly over the period 1998-2000 with a mean catch of 217 animals (± 60 sd) per year. Unlike data on dried seahorses, there was reasonable consistency (within 20%) between export figures from Australia and import figures from the largest market, the U.S.A. (Table 11). However, there was disagreement on the source (wild-caught or captive-bred) of over 1,000 seahorses, recorded as captive-bred by Australia and wild-caught by the U.S.A. It is probable that the Australian record was correct in this instance.

Volumes of seahorses traded within Australia were more difficult to estimate due to the lack and diffuse nature of detailed records. There are a large number of aquarium shops in Australia (360-570 from phone

Table 9. Exports of live seahorses from Victoria during period 1994-1997.

Year	Wild	Cultured	Total Exported
1994	31	42	73
1995		45	45
1996	14	91	105
1997	6	59	67

Table 10. Recorded live seahorse exports from Australia from 1 Jul 1998. Note that there may be taxonomic confusion between *H. angustus* and *H. subelongatus*. Source: Environment Australia.

Year	State	Destination	Species			
			<i>H. abdominalis</i>	<i>H. angustus</i>	<i>H. breviceps</i>	<i>H. whitei</i>
1998	Vic	Japan	60		32	
	Vic	Mainland China	4			
	Vic	U.K.	51		3	
	Vic	U.S.A.	54		6	
	WA	Japan		44		
		Total	169	44	41	0
1999	Qld	Japan	65			
	Vic	Japan	61	14	17	
	Vic	U.S.A.	40		25	
	Vic	Not specified	5			
	WA	Japan		11		
	WA	Switzerland	12			
	Total	183	25	42	0	
2000	Qld	Korea	25			
	Qld	U.S.A.	15		5	4
	SA	Japan	10			
	SA	South Africa	8			
	SA	U.K.	50			
	SA	U.S.A.	150			
	Tas	Mainland China	6			
	Tas	Netherlands	180			
	Tas	U.K.	40			
	Tas	U.S.A.	2632			
	Vic	Japan	10			
	Vic	Taiwan	9			
	Vic	U.K.	55			
	Vic	U.S.A.	25			
	Total	3215	0	5	4	

directories and the internet, Table 12) with the largest numbers in the urban centres of Adelaide, Brisbane, Melbourne, Perth and Sydney. However, not all of these shops stocked marine fish and of those that did, not all stocked seahorses. Marine aquarium shops represented approximately 20% of the total and phone surveys of these in Perth and Sydney (n=20) suggested that approximately 50% of these shops stocked seahorses. Thus the estimated number of shops in Australia stocking seahorses in 2001

was 36-57. Interviews with aquarium traders (n=5, levels 1/2 and 2) suggested that seahorses were popular items when they were stocked. One aquarium shop in Perth reported selling 3-4 pairs of *H. barbouri* per week over the first six months of 2001 while another shop said trade was variable from 2-10 individuals per week. A number of aquarium shops in Adelaide, Perth and Sydney had stocked captive-bred *H. abdominalis* but these had suffered high mortality both in the shop and after sale. As supply of seahorses was reported to be variable it was assumed that each shop would only sell seahorses for six months a year which gave estimates of 1,850-14,750 live seahorses per year. It would appear that the domestic market was at least as large as the export market, perhaps an order of magnitude larger.

Values

Declared export values were not known from Australian data but were known from the U.S.A. data which represented almost 90% of the Australian export market. These data varied from declared values of US\$189 in 1999 to US\$20,036 in 2000 (Table 11). In 1998, 42 animals were declared at US\$189 each and similarly, in 2000, 31 animals were declared at US\$91 which were much higher than any other consignment (mean costs per animal of approximately \$40 for wild-caught specimens). This suggested that these were unusual specimens or there may have been confusion with other, more valuable syngnathid species. From 2000 data, it appeared that cultured *H. abdominalis* fetched considerable lower prices (US\$5-10 per animal) than wild-caught animals in previous years.

Assuming similar average prices in other countries around the world to those in the U.S.A., the total live seahorse market from Australia was approximately US\$10,000 in 1998, US\$9,500 in 1999 and US\$28,600 in 2000. An interview with an aquarium trader (level 1/2) suggested that seahorses could be sold for wholesale prices of up to US\$30 per animal to the U.S.A. for small volumes.

Within Australia, seahorses were reasonably expensive aquarium fish. In 2001 in Adelaide 80-100 mm SL *H. abdominalis* were being offered for sale at A\$25 (US\$13) each or A\$40 (US\$21) per pair, while in Perth *H. barbouri* juveniles (30-40 mm SL) were sold for A\$22-25

Table 11. Imports of live seahorses to U.S.A. from Australia from 1996-2000. Source: US Department of Fish & Wildlife.

Year	Country of re-export	Quantity	Declared value (US\$)	Value per ind. (US\$)	Source
1997	Canada	30	1255	42	Captive-bred
	none	4	100	25	Wild
Total 1997		34	1355	40	
1998	none	42	7940	189	Wild
Total 1998		42	7940	189	
1999	none	3	125	42	Wild
	none	2	64	32	Captive-bred
Total 1999		5	189	38	
2000	none	1198	11774	10	Wild
	none	1030	5450	5	Captive-bred
	Japan	31	2812	91	Captive-bred
Total 2000		2259	20036	9	

Table 12. Number of aquarium shops in Australia according to the phone directory and the internet. Source: Telstra Yellow Pages and www.citysearch.com.au.

State/Territory	Area	No. of shops (phone)	No. of shops (internet)
ACT	Canberra	15	10
NSW	Sydney metro	98	81
	Central coast	13	4
	Wollongong	10	7
	Other	41	-
	All	5	0
Qld	Brisbane	78	51
	Gold Coast	20	15
	Other	37	21
SA	Adelaide	51	38
Tas	All	16	9
Vic	Melbourne metro	103	83
	Other	23	-
WA	Perth	53	43
	Other	13	-
Total	All	576	362

(US\$11-13) each or A\$40 (US\$21) per pair and adult *H. subelongatus* (70-100 mm SL) were sold for A\$25-40 (US\$13-21) each. In Sydney, in 2000, juvenile *H. abdominalis* (<50 mm SL) were sold for A\$15 (US\$9) while adults (>70 mm SL) were sold for A\$20-25 (US\$12-15) each. Using the estimates of volumes in the previous section the estimated value of retail sales for the domestic trade in live seahorses was A\$28,000-250,000 (US\$14,500-130,000).

Sources

Aquaculture and captive breeding

Seahorse aquaculture developed substantially in Australia over the period 1996-2001. Prior to 1996, captive breeding was reported as under development in Queensland (Vincent, 1996) but there were no operations producing large numbers (>1,000 animals per year). Following increased awareness of a market for seahorses, a number of start-up aquaculture ventures were proposed throughout Australia (Macpherson, 1997; Project Seahorse, *in litt.*). In 2001, there were three known operations culturing seahorses commercially, with two further operations in developmental stages.

The first and largest of these ventures started culturing *H. abdominalis* in Tasmania in 1997 and proposed to produce 1 million animals per year (Caples, 1997) rising to 12 million by 1999 (Seahorse Aquaculture, 1997), primarily for the TCM market (Forteat, 1997). However, such expectations were not realized and, in 2001, cultured animals were exported only for the aquarium trade and were in the order of 3,000 animals per year (Table 10). Domestic sales appeared to be larger, but the total volume of animals sold was estimated to be less than 20,000 per year (see **Live seahorse trade in Australia: Volumes**). Broodstock for this operation were collected in Tasmania under permits from DPIWE with an initial collection of 1,500 animals allowed. Concerns were raised by the Tasmanian Conservation Trust (TCT) over identification of wild-caught and captive-bred animals resulting in a study of otolith structure by the Central Ageing Facility, Queenscliff, Victoria (Green *et al.*, 2000). Although captive-bred and wild-caught populations could be distinguished by otolith structure, there was considerable overlap between populations (Green *et al.*, 2000). In 2001, TCT and EA were engaged in an Administrative Appeals Tribunal arbitration process to resolve this issue. Late in 2001, this company stopped culturing seahorses and was sold for general aquaculture purposes.

A second operation culturing *H. abdominalis* started in South Australia in 1999, sourcing broodstock from tuna cages under a permit from PIRSA to collect 60 animals. This operation was targeted primarily at the aquarium market and was a subsidiary business, rather than a stand-alone operation. The company received Authority to Export from EA in 2000 and exported approximately 200 live animals for the aquarium trade, primarily to the U.K. and U.S.A. (Table 10). This operation also supplied live animals to the domestic aquarium market but the volumes were not known. The third known commercial operation was in Western Australia. In 2001, this operation was culturing *H. barbouri* for the Australian domestic aquarium market. Broodstock for this operation was sourced from S.E. Asia through the aquarium trade. It appeared that these animals were primarily sold locally in Western Australia.

Two other aquaculture operations were in development in 2001; one in Queensland, examining culture of *H. whitei*/*H. procerus*, again for the aquarium trade and the other in Western Australia focusing on *H. subelongatus*. Permits for the former allowed collection of up to 50 individuals (in total) from three species, issued by Queensland Department of Primary Industries as broodstock.

Concerns have been expressed about the conservation value of seahorse aquaculture in Australia. All of the operations described above were commercial ventures that were initiated to generate profit for owners or investors. Undoubtedly, these operations have the potential to produce large numbers of seahorses. However, to be of conservation benefit, there have to be consequent reductions in the catches of wild animals which has yet to be demonstrated. Australia has not been a large supplier of seahorses to the TCM or aquarium trade and the major species in culture (*H. abdominalis*) has not been traded (Vincent, 1996). Whether seahorse culturing reduces the exploitation of wild populations will partly depend on its effects on subsistence fishing communities in source countries. Seahorse fishers are commonly so poor that they cannot stop catching seahorses unless they earn money in other ways. One outcome of aquaculture in countries that do not traditionally exploit seahorses might be reduced prices in source countries. This would either (a) force fishers to catch more in order to meet their basic needs (if effort can be increased) or (b) move them from one diminished resource to another. Both of these scenarios exacerbate conservation

problems. Aquaculture is likely to be of greatest conservation value where it facilitates seahorse fishers becoming seahorse farmers, thereby directly reducing pressure on wild populations.

Given the commercial nature of Australian operations, there is strong pressure to seek the creation of new markets, either trading species that have not been utilized previously and/or seeking new uses for these animals. Furthermore, once trade has commenced, natural populations have a value which may encourage exploitation of wild animals, particularly if they cannot be distinguished from captive-bred animals.

Aquaculture operations have the potential to disrupt natural populations of seahorses, either through direct removal of broodstock or through discharge of effluent and/or disease.

It is possible to address these concerns and responsible aquaculture ventures should ensure that (1) the international impact on subsistence fishers (and thus wild seahorses) has been addressed (2) international conventions such as the Convention on Biological Diversity are respected (3) the culturing operation will not promote new trade - or increase existing trade - in wild seahorses.

ECONOMIC IMPORTANCE OF THE SEAHORSE FISHERY IN AUSTRALIA

The seahorse fishery was probably of limited economic importance throughout Australia. The wild-caught export fishery for both dried and live seahorses was probably less than A\$20,000 (US\$10,500) per year unless the data collected by Environment Australia were highly inaccurate. Even if the figures for the dried trade from Mainland China and Hong Kong were seahorses not pipehorses, the total fishery was less than US\$100,000 in 1998, the year of greatest export volumes. Total fisheries production (including aquaculture) from Australia was estimated to have a gross value of A\$1.86 billion (US\$1.2 billion) in 1999 (Bureau of Rural Sciences, 2000). Thus, seahorses represented between 0.001-0.01% of total gross fisheries revenue. The total number of fishers involved in collection of wild seahorses was approximately 30 individuals and none of these relied solely on seahorses for their income.

The captive-bred market had expanded rapidly over the period 1999-2000 but even so, it represented less than A\$50,000 (US\$30,000) in export value. The number of people employed by the aquaculture companies was approximately 10-15 individuals.

It appeared that the domestic market for live seahorses was the largest sector of the seahorse trade economically, with retail sales of up to A\$250,000 (US\$130,000). However, trade was diffuse, spread over a large number of aquarium shops throughout the whole country. There were no individuals (fishers or traders at any level) who appeared to derive their sole income from seahorses.

PIPEFISH, PIPEHORSE, AND SEADRAGON TRADE IN AUSTRALIA

There has been confusion in the literature over the use of common names for some syngnathids, particularly the term 'seadragon'. The Chinese term for animals in the genus *Solegnathus* is 'hai lung' which is often translated as seadragon – however in English these animals are known as pipehorses. *Solegnathus* species are used in TCM. In English (and in Australia in particular) the term 'seadragon' refers to two species of endemic syngnathid, *Phycodurus eques* and *Phyllopteryx taeniolatus*. A third species of syngnathid, *Haliichthys taeniophorus*, has been referred to as both the ribboned pipefish (Dawson, 1985) and the ribboned seadragon (Kuiter, 2000). None of these latter species is used in TCM. The convention in this document is to use the term 'pipehorse' for *Solegnathus* spp., to use 'seadragon' for *P. eques* and *P. taeniolatus* and to use 'pipefish' for *H. taeniophorus*.

Pipefishes, pipehorses, and seadragons in Australia

Local species

As with seahorses, Australia has extremely high diversity of other syngnathids. Dawson (1985) recognized over 200 species of syngnathid in 52 genera. Of these, 93 species in 38 genera were identified as occurring

in Australian waters (Dawson, 1985; Table 13). Furthermore, at least 39 species and 14 genera were described as endemic to Australia (Dawson, 1985). Thus, it was estimated that 20-25% of syngnathid

Table 13. Species of pipefish, pipehorses and seadragons known from Australia (endemic species or subspecies are marked with an asterisk). Source: Dawson (1985).

Species or subspecies		
<i>Acentronura australe</i> *	<i>Festucalex scalaris</i> *	<i>Micrognathus natans</i>
<i>Acentronura larsonae</i> *	<i>Filicampus tigris</i> *	<i>Microphis brachyurus brachyurus</i>
<i>Acentronura tentaculata</i>	<i>Halicampus boothae</i>	<i>Microphis manadensis</i>
<i>Bulbonaricus brauni</i>	<i>Halicampus brocki</i>	<i>Mitotichthys meraculus</i> *
<i>Bulbonaricus davaoensis</i>	<i>Halicampus dunckeri</i>	<i>Mitotichthys mollisoni</i> *
<i>Campichthys galei</i> *	<i>Halicampus grayi</i>	<i>Mitotichthys semistriatus</i> *
<i>Campichthys tricarinatus</i> *	<i>Halicampus macrorhynchus</i>	<i>Mitotichthys tuckeri</i> *
<i>Campichthys tryoni</i> *	<i>Halicampus mataafae</i>	<i>Nannocampus pictus</i>
<i>Choeroichthys brachysoma</i>	<i>Halicampus nitidis</i>	<i>Nannocampus subosseus</i> *
<i>Choeroichthys cinctus</i>	<i>Halicampus spinostrus</i>	<i>Notiocampus ruber</i> *
<i>Choeroichthys latispinosus</i> *	<i>Haliichthys taeniophorus</i>	<i>Phoxocampus diacanthus</i>
<i>Choeroichthys sculptus</i>	<i>Heraldia nocturna</i> *	<i>Phycodurus eques</i> *
<i>Choeroichthys suillus</i> *	<i>Hippichthys cyanospilus</i>	<i>Phyllopteryx taeniolatus</i> *
<i>Corythoichthys amplexus</i>	<i>Hippichthys heptagonus</i>	<i>Pugnaso curtirostris</i> *
<i>Corythoichthys flavofasciatus</i>	<i>Hippichthys parvicarinatus</i> *	<i>Siokunichthys breviceps</i>
<i>Corythoichthys haematopterus</i>	<i>Hippichthys penicillus</i>	<i>Solegnathus dunckeri</i> *
<i>Corythoichthys intestinalis</i>	<i>Hippichthys spicifer</i>	<i>Solegnathus hardwickii</i>
<i>Corythoichthys ocellatus</i>	<i>Histiogamphelus briggsii</i> *	<i>Solegnathus lettiensis</i>
<i>Corythoichthys paxtoni</i> *	<i>Histiogamphelus cristatus</i> *	<i>Solegnathus robustus</i> *
<i>Corythoichthys schultzi</i>	<i>Hypselognathus horridus</i> *	<i>Solegnathus spinosissimus</i>
<i>Cosmocampus banneri</i>	<i>Hypselognathus rostratus</i> *	<i>Stigmatopora argus</i> *
<i>Cosmocampus darrosanus</i>	<i>Kaupus costatus</i> *	<i>Stigmatopora nigra</i>
<i>Cosmocampus howensis</i>	<i>Kimblaeus bassensis</i> *	<i>Stipecampus cristatus</i> *
<i>Cosmocampus maxweberi</i>	<i>Leptoichthys fistularius</i> *	<i>Syngnathoides biaculeatus</i>
<i>Doryrhamphus dactylophorus</i>	<i>Lissocampus caudalis</i> *	<i>Trachyrhamphus bicoarctatus</i>
<i>Doryrhamphus excisus excisus</i>	<i>Lissocampus fatiloquus</i> *	<i>Trachyrhamphus longirostris</i>
<i>Doryrhamphus janssi</i>	<i>Lissocampus runa</i> *	<i>Urocampus carinirostris</i>
<i>Doryrhamphus negrosensis malus</i> *	<i>Maroubra perserrata</i> *	<i>Vanacampus margaritifera</i> *
<i>Doryrhamphus negrosensis negrosensis</i>	<i>Micrognathus andersoni</i>	<i>Vanacampus phillipi</i> *
<i>Festucalex cinctus</i> *	<i>Micrognathus brevirostris pygmaeus</i>	<i>Vanacampus poecilolaemus</i> *
<i>Festucalex gibbsi</i>	<i>Micrognathus micronotopterus</i>	<i>Vanacampus vercoi</i> *

genera and species were endemic to Australia. Further species have described since 1985 and Pogonoski *et al.* (2001) quote a figure of 333 species in 55 genera for world syngnathid diversity with approximately 120 (or 37%) occurring in Australian waters. Whichever figures are used, it is clear that Australia is extremely important for syngnathid diversity.

A number of Australian species of syngnathid other than seahorses were listed in the IUCN Red Data Book (Hilton-Taylor, 2000) – five were listed as Vulnerable (all species in the pipehorse genus *Solegnathus*) while a further four were listed as Data Deficient. Summaries of the distribution and biology of these Red Data Book species, along with other species of syngnathid known to be traded from Australia are given in Table 14. Pogonoski *et al.* (2001) listed a further eight species that they proposed to be listed as Data Deficient on an Australia-wide basis or Lower Risk (least concern).

Species traded/imported

The following species was seen for sale in TCM shops in Australia:

- *Syngnathoides biaculeatus* (double-ended pipefish). Males and females from 150-220 mm SL.
- *Solegnathus spinosissimus* (spiny pipehorse). Males and females, size unrecorded.

Table 14. Characteristics of species of Australian pipefish and pipehorses known to be exploited (endemic species indicated by asterisk). Source: Dawson, 1985; Kuitert, 2000; Pogonoski *et al.*, 2001.

Species	Common name	IUCN Status	Habitat & Distribution	Biology	Trade
<i>Doryrhamphus dactyliophorus</i>	Banded or ringed pipefish	DD	Wide ranging Indo-Pacific species. WA, NT and Qld in Aust. Coastal reefs, crevices and boulders 0-56 m	Length to 200 mm with males brooding at 90 mm. Found in assoc. with cleaner shrimps. Juveniles in groups and adults normally in pairs.	No known from Aust. Live trade from Phils & Indonesia
<i>Heraldia nocturna</i> *	Upside-down pipefish	Not listed	NSW to WA. Known from rocky reefs at 2-15 m.	Length to 100mm with males brooding at 63mm. Swims upside-down in caves during day. Adults in pairs. Brood up to 100 eggs.	Single record of live trade from Vic
<i>Phycodurus eques</i> *	Leafy seadragon	DD	Found in SA, Vic & WA. Found among macroalgae to 25 m.	Length to 350 mm. Breeding season Nov-Jan. Brood of 250-300 eggs. Gestation about 56 d and hatch at 35 mm over 6-7 d.	Live trade from SA
<i>Phyllopteryx taeniolatus</i> *	Weedy seadragon	DD	NSW to WA including Tas. Found among macroalgae at 2-50 m.	Length to 470 mm with males brooding at 214 mm. Breeding season Oct/Nov-Feb. Usually single brood of 250-300 eggs	Live from Qld, Vic & WA
<i>Solegnathus dunckeri</i> *	Duncker's or red-and-gold pipehorse	VU A1d+2d	Central NSW to southern Qld & Lord Howe Island. Trawled between 75-140 m.	Length to 500 mm with males brooding at 337 mm	Dried trade from Qld
<i>Solegnathus hardwickii</i>	Hardwick's or red-and-gold pipehorse	VU A1d+2d	Qld, south China Sea and Japan. Trawled 12-200 m	Length to 500 mm with males brooding at 296 mm	Dried trade from Qld
<i>Solegnathus lettiensis</i>	Günther's pipehorse	VU A2d	WA & Indonesia. Trawled from 42-180 m.	Length to 525 mm	Possible dried trade from WA
<i>Solegnathus robustus</i> *	Robust pipehorse	VU A2d	Southern Australia west of Bass Strait. Trawled 42-68 m	Length to 400 mm, males brooding at 300 mm	Dried trade from SA?
<i>Solegnathus spinosissimus</i>	Spiny pipehorse; spiny seadragon	VU A1d+2d	Bass Strait, Tas to southern Qld and New Zealand. Recorded from 2-550 m	Length to 500 mm with males brooding at 206 mm. Enter shallow water where light penetration poor	Dried trade from Vic
<i>Stigmatopora argus</i> *	Spotted pipefish	Not listed	Southern NSW to Shark Bay, WA and Tas. Commonly found in seagrass to 8m in bays and estuaries; and in offshore floating Sargassum	Length to 270 mm with males brooding at 112 mm.	Two records of live trade from Vic and WA
<i>Stipeocampus cristatus</i> *	Ring-backed pipefish	Not listed	Vic, Tas and SA. Found among brown and red algae in sheltered reef habitats to 15 m and seagrass in large estuaries.	Length to 240 mm with males brooding at 190 mm. Breeding season Sep onwards. Brood of 100 eggs takes 28 d to gestate	Single record of live trade from Vic
<i>Syngnathoides biaculeatus</i>	Double-ended pipefish	DD	Widespread from E. Africa to Red Sea & Japan. WA, NSW, Vic & Qld. Found in coastal shallows over/among veg; among floating Sargassum	Length to 300 mm with males brooding at 180 mm.	No trade known from Australia
<i>Vanacampus magarati</i> *	Mother-of-pearl pipefish	Not listed	Southern Qld to Vic and WA. Found over sand, rubble and Zostera 0.5-10 m.	Length to 200 mm with males brooding at 129 mm	Single record of live trade from Vic
<i>Vanacampus phillipi</i> *	Port Phillip pipefish	Not listed	Southern NSW, southern WA & Tas. Found in estuaries in weed & seagrass to 24 m and rockpools and estuaries in Tas.	Length to 195 mm with males brooding from 94 mm	Single record of live trade from Vic

The following species were reported for sale in aquarium shops in Australia:

- *Corythoichthys* sp. (most commonly *C. intestinalis* A. Kendrick pers. comm.).
- *Doryrhamphus* sp.
- *Phyllopteryx taeniolatus* (common or weedy seadragon)
- *Vanacampus* sp.

Size and sex were not noted for any of the above and species identification was not possible for some genera. Other reports indicated that a variety of pipefish were occasionally seen in aquarium shops.

Only *Solegnathus hardwicki* was seen for sale as curios in Australia. Size and sex unrecorded.

Uses

Dried pipefish and pipehorses have been used in TCM in Australia in a similar way to seahorses (see **Uses**), although reports in 2001 suggested that pipehorses were no longer being sold, primarily because demand was very limited due to high cost.

Pipefish and seadragons have been sold and kept in aquaria in Australia. Pipefish have sold in aquarium shops and kept by hobbyists. Generally, seadragons have been restricted to public aquaria due to their demanding husbandry, high cost and protected status. Seadragons have been displayed in Aquarium of Western Australia (Perth), Seahorse World (Beauty Point, Tasmania), Darling Harbour Aquarium (Sydney) and Melbourne Aquarium.

There was a single report of pipehorses being sold as curios.

Legislation

As much of the legislation in Australia, particularly Commonwealth legislation, refers to syngnathids as a family, the same provisions apply as detailed in the seahorse section above. However, there are additional provisions for some other species of syngnathid. In South Australia, Victoria and Western Australia the leafy seadragon, *Phycodurus eques*, was a totally protected species, although ministerial exemptions were issued for live capture for the aquarium trade. In 1998, the leafy seadragon was designated as the marine symbol for South Australia. In New South Wales and Victoria the common or weedy seadragon, *Phyllopteryx taeniolatus*, was also a fully protected species, although again ministerial exemptions were issued for aquarium capture.

PIPEFISH, PIPEHORSE, AND SEADRAGON CATCH IN AUSTRALIA

Target fisheries

Target fisheries for these syngnathids in Australia were for the aquarium trade including capture for display in public aquaria. The largest aquarium fishery was in Western Australia with 13 transferable licences in operation in 2001 under the Marine Aquarium Fish Management Plan. The total permitted harvest under this plan was 750 animals but the precise distribution of effort between seahorses (*H. subelongatus*) and other syngnathids was not known. Weedy seadragons were caught for display at the Aquarium of Western Australia (G. Moore, pers. comm.). In South Australia there was a single ministerial exemption allowing the catch of one pregnant male leafy seadragon and three weedy seadragons for the aquarium trade. In Tasmania a ministerial exemption was issued for the collection of approximately 50 individuals of local syngnathid species of five species for display in a public aquarium. Pipefish were caught for the aquarium trade in Queensland but no data were available on the number of licences, species or individuals caught. Pipefish and seadragons were also caught and exported from Victoria for the aquarium trade but the number of licences was not known. No information on target fisheries was available for New South Wales and Northern Territory.

Bycatch

Pipehorses of the genus *Solegnathus* were the most significant component of the syngnathid trade from Australia. These animals were caught as incidental bycatch during commercial oceanic trawling operations, dried and exported. The two main fisheries that caught *Solegnathus* were the Queensland East Coast Trawl Fishery (QECTF) and the South-East Trawl Fishery (SETF). Both fisheries catch a diverse range of species with a variety of gear types, operating from many home ports. Details of the target species, value of each component, gear types, effort distributions etc. for the fisheries are available at for the SETF in Fishery Status Reports 1999 (Bureau of Rural Sciences, 2000) and at the Australian Fisheries Management Agency website (www.afma.gov.au). Similar details for the QECTF can be found in Connolly *et al.* (2001).

In the QECTF, two species of *Solegnathus* (*S. dunckeri* and *S. hardwickii*) were caught by trawlers targeting a variety of prawn species in depths of approximately 25-180 m. The number of vessels involved in this fishery was approximately 900, but the number operating in the appropriate depth range varied according to the relative price of different prawn species (Connolly *et al.*, 2001). *Solegnathus dunckeri* and *S. hardwickii* were shown to have fairly disjunct distributions and appeared to be associated to some extent with reef areas (Connolly *et al.*, 2001). Anecdotal information in Connolly *et al.* (2001) reported that catches of these animals had increased with technological advances (GPS, sonar) allowing fishing closer to reefs and catches could be very high following weather disturbances to reef and near-reef areas. Connolly *et al.* (2001) calculated catch-per-unit-effort values of 3.8-8.3 pipehorses per boat per day from trawler logbooks and 20.1-24.8 from processor logbooks.

Less information was available about bycatch in the SETF, but reported catches were of *S. spinosissimus* by a fleet of approximately 16 Danish seine vessels targeting finfish (flathead) from home ports in Victoria (Lakes Entrance and Eden). Gloerfelt-Tarp & Kailola (1984) reported catches of Günther's pipehorse, *S. lettiensis*, in trawl fisheries from NW Australia but it is not known whether this species was traded. Similarly, there was no information on bycatch of the robust pipehorse, *S. robustus*, in South Australia (Pogonoski *et al.*, 2001).

An observer programme by NSW Fisheries for estuarine prawn (1989-1992) and fish (1993-1997) trawls recorded catches of pipefish and *S. spinosissimus* respectively. Catches were generally low with 28 pipefish caught from 2181 trawls in 385 days for prawn trawling (= 0.01 individual per trawl, 0.07 per day) and 103 *S. spinosissimus* caught from 2,580 trawls of 1,105 days (= 0.04 individuals per trawl, 0.09 per day). Other experimental work has recorded zero or low catches of syngnathids in the Northern Prawn Trawl and Torres Strait Fisheries (Stobutzki *et al.* 2000, 2001).

DRIED PIPEFISH AND PIPEHORSE TRADE IN AUSTRALIA

Trade routes, imports, volumes, and values

The primary use of dried pipefish and pipehorses in Australia was in TCM. The majority of TCM shops surveyed that had dried seahorses also had dried pipefish (n=1 of 2 in 1999; n=5 of 6 in 2001). These pipefish were invariably the double-ended pipefish, *S. biaculeatus*. Although this species is found in Australian waters (see Takahashi, 2000) all the TCM traders interviewed that provided a source country reported it from Hong Kong (n=3). These traders reported the same trade routes as for seahorses (see ***Dried seahorse trade in Australia***). Few data on volume traded were obtained but two TCM practitioners stated that pipefish were generally included in prescriptions including seahorses. Given that pipefish were considerably lighter per individual than seahorses (approximate weight of each pipefish was 2-3 g) an estimate range of 20-40 kg of pipefish per annum were imported into Australia using similar assumptions as for seahorses. In 1999 *S. biaculeatus* cost A\$0.50 (US\$0.32) per animal and in 2001 prices ranged from A\$0.16-0.40 (US\$0.08-0.21) per g. Thus total retail value of sales was approximately A\$3200-16,000 (US\$1,700-8,300) per annum, considerably less than seahorses.

In 1999 one TCM shop had spiny pipehorses (*Solegnathus spinosissimus*) for sale but no data were collected on trade routes or volumes. One individual retailed for approximately A\$3.50 (US\$2.25). In 2001 none of the TCM traders kept pipehorses and two retailers reported that they used to keep them but

there was no demand because the animals were too expensive and customers bought dried seahorses instead.

There was a single report of dried *Solegnathus* sp. being sold as curios in Cairns, Queensland in 2000 for A\$10 (US\$3.70) per individual. These were reported to be from local trawlers but no further data were collected.

Exports, volumes, values

Trade routes for dried *Solegnathus* were more complex and involved more fishers and traders at a variety of different trade levels than other syngnathid fisheries in Australia. For the QECTF there were at least five processors (level 2/3) who bought *Solegnathus* directly from the trawlers (level 1), from wholesalers (level 2) and from each other (Connolly *et al.*, 2001). Connolly *et al.* (2001) recorded trade from seven ports with anecdotal information that trade had occurred at two others and at least 77 different parties were involved in the trade. After the introduction of mandatory Authority to Export conditions in 1998, consignments were recorded by Environment Australia to Hong Kong, Mainland China and Taiwan.

No quantitative data on trade routes for *S. spinosissimus* from the SETF were available but animals were reported to be bought from the vessels by wholesalers and processors, consolidated and exported in a similar fashion as those from the QECTF (AFMA, pers. comm.).

Prior to 1998, data on volumes of pipehorses exported were not recorded separately. It is likely, however, that the volumes reported in Table 7 for exports of dried syngnathids referred to pipehorses, particularly given that the majority of the exports were from Queensland and Victoria. Approximately 1,550 kg were caught in the period Jul 1995-Jan 1997 (equivalent to approximately 1,000 kg per year) and 632 kg in Jan-Dec 1997. These data were in general agreement with import data recorded from Taiwan (Table 15), although data from Hong Kong were not available. The import record of 4,168 kg from Mainland China in 1994 was considered unreliable as no imports were recorded in subsequent years and the price of US\$5 per kg was at least an order of magnitude lower than any other record. It is suggested that this represented a miscoding of data.

Data on catches, export volumes and prices from 1998-2000 were obtained from a variety of sources: official export statistics provided by Environment Australia, logbook data from the SETF supplied by AFMA, official import statistics supplied by Hong Kong, Mainland China and Taiwan and calculations from processors, logbook returns and fishery-independent trawling detailed in Connolly *et al.* (2001). There were considerable discrepancies between these different data sources. Export data from Environment Australia were smaller than the other estimates (Table 15) and did not record any exports of *S. spinosissimus* despite recorded catches in logbooks. Export data recorded exports of 2,144 kg in 1998, dropping to 256 kg in 1999 and 212 kg in 2000. However, in the same time period combined data from Hong Kong, Mainland China and Taiwan showed imports of 2,458 kg, 1,241 kg and 857 kg respectively. An additional 292 kg (1998), 132 kg (1999) and 100 kg (2000) recorded as seahorses were probably pipehorses (Table 8). This would give import totals of 2,750, 1,373 and 957 kg for 1998-2000 respectively.

Connolly *et al.* (2001) calculated the volumes exported from processors in Jun-Dec 1999 as 632 kg (\approx 1,264 kg for all 1999) and 837 kg for 2000. These values are remarkably consistent with the import data from Hong Kong, Mainland China and Taiwan. It appeared unlikely that the processor or import data were over-reported and it was unclear why the Environment Australia data were so low, unless they were based on incomplete or

Table 15. Bycatch of syngnathids from South-East Trawl Fishery from logbooks. Approximate dry weight has been calculated assuming mean dry weight of 27 g per animal. Source: AFMA.

Month	# Syngnathids recorded	Approx. dry weight (kg)
Aug 1999	22	0.59
Sep	173	4.68
Oct	206	5.57
Nov	166	4.49
Dec	27	0.73
Total 1999	428	11.57
Jan 2000	219	5.92
Feb	328	8.86
Mar	263	7.11
Apr	225	6.08
May	75	2.03
Jun	73	1.97
Jul	137	3.70
Aug	136	3.68
Sep	187	5.05
Oct	135	3.65
Nov	8	0.22
Total 2000	1786	48.27

earlier database versions. Connolly *et al.* (2001) estimated an average dry weight of 27 g thus 1,000 kg (1 tonne) of *Solegnathus* represented about 37,000 individuals. All sets of data showed declines over the period 1998-2000 but there are not enough data on spatial and temporal distribution of fishing effort to ascertain whether this represented a decline in CPUE or a change in the allocation of effort.

Wholesale prices for *Solegnathus* from the QECTF were reported from A\$3.5-10 (US\$1.8-5.2; R. Connolly, pers. comm.) per individual, equivalent to A\$130-370 (US\$68-193) per kg. Thus, using the higher volumes from the import statistics and Connolly *et al.* (2001) the value of the fishery was estimated have been A\$0.32-0.91 million (US\$0.20-0.57 million) in 1998, A\$0.16-0.46 million (US\$0.10-0.30 million) in 1999 and A\$0.11-0.32 million (US\$0.06-0.19 million) in 2000. Declared values from importing countries were similar in 1999 and 2000, although the calculations overestimated the value of the fishery in 1998 (Table 16). Prices paid per kg in importing countries fluctuated from US\$52-202 in an unpredictable manner from year to year which may have reflected the size or quality of the individuals that were caught.

There was only one data set from the SETF, which was not fishery-independent, only extended from Aug 1999-Nov 2000 and was acknowledged probably to be an underestimate of true catches (AFMA, pers. comm.). However, it provided a minimum estimate of catches in this fishery. Recorded catches varied from 8-328 animals per month giving total annual catches of approximately 28 kg in 1999 and 52 kg in 2000 (Table 15). If *S. spinosissimus* was of the same value as the other species of *Solegnathus* then these volumes represented a minimum value of A\$3600-19,200 (US\$1,900-10,000), at least an order of magnitude less than QECTF. Accurate, quantitative data needs to be gathered from the SETF to determine whether bycatch of *S. spinosissimus* is significant in terms of Australian syngnathids.

LIVE PIPEFISH AND SEADRAGON TRADE IN AUSTRALIA

Trade routes

Live pipefish and seadragons were exported from Australia to the following countries: Japan, Mainland China, Netherlands, Portugal, Singapore, Spain, Switzerland, Taiwan, U.K., U.S.A. The majority of these fish (77-100%) were exported from Victoria by a single collector/exporter (level 1), while the remainder was exported from one company in Queensland and one in Western Australia (both level 1). Although Environment Australia statistics record exports from Queensland, these seadragons were caught in Western Australia (or were progeny of these animals). In all cases, the animals were exported by the collectors and were sent by air from Melbourne, Cairns and Perth respectively. Generally, for the seadragon species, brooding males were collected and the eggs allowed to hatch in captivity. The young were then raised to market size (approximately 60-80 mm SL) over a period of at least 3 months. One collector reported that the juveniles thus produced would feed on frozen food and suffered lower stress levels than wild-caught fish. Mortalities were reported to be low (<10%) and most animals were sold to public aquaria.

Volumes and Values

Prior to 1998, statistics on exports of syngnathids were not mandatory. However, data were available from Victoria and Western Australia from 1994-1997 on exports of *P. eques* and *P. taeniolatus* (Environment Australia, unpub. data). In subsequent years (1998-2000), these two species made up 98-100% of live syngnathid exports (excluding seahorses). As Victoria and Western Australia were also the main exporting states, these figures probably accurately represented total exports. During the period 1994-1997 a mean of 132 ± 63 (sd) *P. taeniolatus* and 34 ± 28 (sd) *P. eques* were exported (Table 17). From 1998-2000 these mean exports were 207 ± 107 (sd) for *P. taeniolatus* and 52 ± 38 (sd) for *P. eques*, a slight increase (Table 18). However, this probably represented increased survival not increased numbers being collected from the wild.

Table 16. Recorded exports of dried *Solegnathus* pipehorses from Australia during period 1998-2000. Import categories were as follows: China – pipefish & hippocampi; Hong Kong – pipefishes; Taiwan – pipefishes. Nd = no data. Source: Environment Australia and Country of Import Statistics.

Year	State	Australian Export Statistics			Country of Import Statistics					
		Country	Quantity (kg dw)		Total	Country	Quant. (kg dw)	Value ('000s)	Value (US\$ 000s)	Value per kg (US\$)
			<i>S. dunckeri</i>	<i>S. hardwicki</i>						
1994		Mainland China	nd	nd	nd	Mainland China	4168	-	22	5
Total 1994							4168		22.0	5
1995		Mainland China	nd	nd	nd	Mainland China	0	-	-	
		Taiwan	nd	nd	nd	Taiwan	962	NT\$ 2070	78.1	81
Total 1995							962		78.1	82
1996		Mainland China	nd	nd	nd	Mainland China	0	-	-	
		Taiwan	nd	nd	nd	Taiwan	501	NT\$ 1597	60.3	120
Total 1996							501		60.3	120
1997		Mainland China	nd	nd	nd	Mainland China	0	-	-	
		Taiwan	nd	nd	nd	Taiwan	800	NT\$ 2105	76.5	96
Total 1997							800		76.5	96
1998	Qld	Hong Kong	767	608	1375	Hong Kong	1674	HK\$ 917	118.5	71
	Qld	Mainland China	0	150	150	Mainland China	0	-	-	
	Qld	Taiwan	94	525	619	Taiwan	784	NT\$ 1323	46.1	59
Total 1998		All	861	1283	2144		2458		164.6	67
1999	Qld	Hong Kong	16	111	117	Hong Kong	883	HK\$ 1387	178.7	202
	Qld	Taiwan	3	122	125	Taiwan	358	NT\$ 774	23.1	65
	Qld	Unknown	4							
Total 1999		All	23	233	256		1241		201.8	163
2000	Qld	Hong Kong	91	121	212	Hong Kong	732	HK\$ 1102	141.5	193
		Taiwan				Taiwan	125	NT\$ 202	6.5	52
Total 2000		All	91	121	212		857		148.0	173
2001 (to Mar)		Hong Kong	nd	nd	nd	Hong Kong	339	HK\$ 333	42.7	126

McGlone (1994) reported that one individual of *P. eques* was sold in Hong Kong for A\$13,000 (US\$10,000) but this was presumed to be a record price. Pogonoski *et al.* (2001) reported values of A\$100-400 (US\$52-200) per individual for both *P. eques* and *P. taeniolatus* from a personal communication with an aquarium collector (level 1) for captive-raised animals. This aquarium trader was known to be the sole supplier of *P. eques* and a major supplier of *P. taeniolatus*. Another aquarium trader (level 2) suggested that wholesale prices were higher than this at A\$500-1,000 (US\$260-520) for *P. taeniolatus* and A\$1,000-2,500 (US\$520-1,300) for *P. eques* but this individual was not personally involved in the trade. Using the values supplied by the known collector gave a total value for the trade in

both species of seadragon as A\$11,300-161,000 (US\$5,900-84,000) per annum. Using the higher estimates gave total values in the range A\$60,000-200,000 (US\$31,000-104,000) per annum for *P. taeniolatus* and A\$30,000-150,000 (US\$15,600-78,000) per annum for *P. eques*.

There were 13 other pipefish exported from Australia during 1998-2000: one *Heraldia nocturna* from Victoria to Japan

in 1998; two *Stigmatopora argus* from each of Victoria and Western Australia to Japan in 1999; two *Stipecampus cristatus* from Victoria to U.S.A. in 1998 and three each of *Vanacampus margaritifer* and *V. phillipi* from Victoria to Japan in 1998. There were no data on the value of these exports but they were likely to be negligible.

Table 17. Recorded exports of weedy and leafy seadragons from Victoria and Western Australia during period 1994-1997. Source: Unknown.

Year	State	<i>Phyllopteryx taeniolatus</i>			<i>Phycodurus eques</i>		
		Wild	Cultured*	Total	Wild	Cultured*	Total
1994	Vic	113	14	127	27		27
1995	Vic	57	86	143	10		10
1996	Vic	61	144	205	65	7	72
	WA				3		3
1997	Vic	20	31	51		22	22
	WA				2		2

* cultured refers to eggs from a wild pregnant male hatched and then raised in captivity

ECONOMIC IMPORTANCE OF THE PIPEFISH, PIPEHORSE, AND SEADRAGON FISHERY IN AUSTRALIA

It can be seen from the above data that the economic importance of the pipefish, pipehorse and seadragon fisheries are far greater than for seahorse fisheries in Australia for both the dried and live trade. The dried trade in pipehorses may represent a value of up to approximately A\$1 million in some years and the aquarium fishery for seadragons, similarly may be worth up to A\$0.25 million. There were a considerably greater number of people involved in the pipehorse fisheries (over 80) and a number of these may have derived a significant proportion of their income from the trade. Although few people (3-5) were involved in the aquarium trade for seadragons, again they may have derived significant income from the animals.

Table 18. Recorded exports of live Australian seadragons for period 1998-2000. Note that figures for 2000 were probably incomplete. Source: Environment Australia.

Year	State	Destination	<i>Phycodurus eques</i>	<i>Phyllopteryx taeniolatus</i>
1998	Vic	Japan	21	55
	Vic	Mainland China	3	6
	Vic	Portugal	10	10
	Vic	Singapore		4
	Vic	Switzerland	2	8
	Vic	Taiwan	2	
	Vic	U.K.	11	25
	Vic	U.S.A.	41	54
	Vic	Not specified		97
	WA	Japan		35
	WA	Mainland China		6
WA	U.S.A.		12	
Total			90	312
1999	Qld	Japan	9	
	Qld	U.S.A.		36
	Vic	Japan	13	49
	Vic	U.S.A.	26	85
	Vic	Not specified	5	11
	WA	Japan		27
	WA	Switzerland		4
Total			53	212
2000	Qld	Netherlands		18
	Qld	U.S.A.		4
	Vic	Japan	3	15
	Vic	Spain	3	3
	Vic	Taiwan		10
	Vic	U.K.	2	19
	Vic	U.S.A.	6	30
Total			14	99

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN AUSTRALIA

Increasing demand and decreasing supply in Australia

There was no evidence for increased demand or decreased supply of seahorses in Australia. None of the TCM respondents reported increased demand for dried seahorses over the period 1998-2001 – indeed, two TCM retailers suggested that demand had decreased due to increased prices following a slump in the Australian dollar. The aquarium trade was more difficult to assess, as it was more driven by supply rather than demand i.e. when seahorses were available they could be sold.

Reported wild catches of seahorses had declined in the period 1998-2000 but there was no information on fishing effort or distribution of this effort. Anecdotal information from an aquarium trader (level 2) suggested that fishers were not targeting seahorses in 2001 to the same extent that they had in previous years.

Population declines

No quantitative declines in populations of seahorses have been documented but there have been few studies on wild populations. The only data that detailed temporal trends were logbook data from the South-East Trawl Fishery – these were only available from Aug 1999-Mar 2000 and also aggregated all syngnathid species, so were of limited use in assessments. References in Johnson (1999), Lourie *et al.* (1999) and Pogonoski *et al.* (2001) suggested that *H. dahli* had declined in Moreton Bay, Queensland and *H. subelongatus* had declined in the Swan River, Western Australia. All of the other 19 putative seahorse species in Pogonoski *et al.* (2001) were assessed as ‘no evidence of population declines’.

Catches of pipehorses in the QECTF had declined from 1998-2000, but again there were no data on the distribution of fishing effort. These data would be needed to quantitatively assess whether CPUE had in fact declined during the same period. Pogonoski *et al.* (2001) stated that there was no evidence of decline for any of the pipehorse species but noted that levels of exploitation might not be sustainable. None of the other pipefish species assessed by Pogonoski *et al.* (2001) were considered to show evidence of population declines, including the two exploited seadragons, *P. eques* and *P. taeniolatus*.

Habitat loss and degradation

Habitat loss and degradation were probably the largest concerns for syngnathids in Australia. Both have been identified as major concerns facing the marine environment in Australia (Zann, 1995). The environmental issues that were considered to be more important were: degradation of estuaries and coastal lakes, declines in temperate seagrasses (Butler & Jernakoff, 1999), loss of mangroves and salt marshes, unsustainable coastal development, effects of fishing, introductions of foreign organisms and population increases in native species (*Drupella* snails and crown-of-thorns starfish). Most Australian syngnathids are found in coastal habitats, those most threatened by habitat degradation or loss.

Australia has addressed these issues at both Commonwealth and State level. Australia’s Oceans Policy was launched in 1998 which included specific commitments to accelerated development and management of marine protected areas, support for mandatory water quality standards and increased understanding of commercial and recreational impacts on marine habitats (Australia’s Oceans Policy, 1998). Similarly, State governments had policies and projects in place to prevent further degradation or restore habitat including the establishment of representative marine protected areas e.g. Tasmania Marine Protected Area Strategy – DPIWE (2001). NGOs and government agencies were involved in many projects ranging from habitat restoration through stormwater treatment to marine protected areas.

Verco’s pipefish (*Vanacampus vercoi*) was identified as being particularly vulnerable to habitat loss, disturbance or alteration due to its restricted geographical range in South Australia and its apparent preference for shallow (2-3 m depth) habitats (Pogonoski *et al.*, 2001).

Aquaculture issues

The major issues surrounding seahorse aquaculture are:

(1) Creation of new markets: As seahorse aquaculture in Australia has been exclusively an economic activity, there has been, and will continue to be, pressure to sell as many animals as possible. This includes promoting the sale of animals to countries/areas that did not trade in seahorses historically and investigating new uses for animals. If such new demand cannot be supplied solely from aquaculture or can be sourced more cheaply elsewhere, pressure on wild populations will increase.

(2) Environmental impacts: Broodstock for aquaculture is taken from the wild and will need to be in the future to ensure that inbreeding depression does not occur. While the numbers of animals taken have been few, there has been no quantitative monitoring of the effects of broodstock removal on wild populations. Furthermore, seahorse aquaculture involves obtaining food supplies (generally from wild sources) and

discharge of wastewater with the possibility of accidental disease or seahorse release back into the wild. While there are technical solutions to these issues, they need to be considered and factored into management of aquaculture operations.

(3) Global effects: Seahorse aquaculture will only have positive benefits for wild seahorses if demand remains relatively constant and switches from wild to cultured animals. If demand simply increases to match increased supply there is no net conservation benefit.

COMPARISON TO 1996 SURVEY FINDINGS

The most important development since seahorse trade was first examined in Australia (Vincent 1996) has been the introduction of legislation providing Commonwealth protection for syngnathids. Prior to 1998, all marine fishes were listed on Schedule 4 of the Wildlife Protection Act, which meant that they could be caught and traded without restriction. Syngnathids were the first fish family to be removed from Schedule 4 on Jan 1 1998. This meant that export permits were required for syngnathids which would only be issued by Environment Australia under approved management plans. The Wildlife Protection Act was superseded by the Environment Protection and Biodiversity Conservation Act in 2000/2001 but the provisions of the previous legislation were incorporated. The implications of these changes are that Australia has the legislation necessary to control trade in syngnathids.

There was no evidence of changes in supply or demand of dried syngnathids into Australia from 1996 to 2001, although quantitative data were not available separately for syngnathids. There were significant changes in the volumes of dried pipehorses exported from Australia from 1994-2000. These volumes were generally similar to those estimated in Vincent (1996) – approximately 1,000 kg per annum – although there was a significant increase in recorded catch in 1998.

Volumes of live seahorses exported by Australia were considerably higher than reported in Vincent (1996), but the increase was primarily due to exports of cultured *H. abdominalis*. Seahorse aquaculture expanded substantially since 1996 with commercial scale production of thousands of animals per year from 1998/1999 onwards. Despite initial claims about supplying the TCM market, the vast majority of these animals were sold in the aquarium trade.

Volumes of live seadragons exported also increased since 1996. These increases were primarily due to better survival of captive-born offspring, as the number of wild-caught animals remained low.

CONCLUSIONS FOR THE SYNGNATHID TRADE IN AUSTRALIA

Australia is an extremely significant country with respect to syngnathids. Syngnathid diversity is the highest in the world, there are a large number of endemic species and there is a huge diversity of habitats. Public awareness and appreciation of seadragons and seahorses in particular has been high and there has been considerable community involvement in marine issues.

Legislation regulating and managing harvest of syngnathids was strong and adequate at federal level, although variable at State level. In general, it appeared that legislation was sufficient if compliance was ensured. During the period 1996-2001, Australia was a net importer of dried seahorses, while it was a net exporter of dried pipehorses and live seadragons. During this period, seahorse aquaculture developed significantly and Australia was probably the most technically advanced country in the world in this respect.

The biggest threats to syngnathids in Australian waters were loss or destruction of habitat for all species and potential overexploitation of *Solegnathus* pipehorses from trawl bycatch. Other issues included irresponsible syngnathid aquaculture and target fisheries for the aquarium trade.

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CHAPTER 8. SYNGNATHID TRADE IN NEW ZEALAND¹

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ABSTRACT

New Zealand has relatively low syngnathid diversity with a single species of seahorse, *Hippocampus abdominalis*, and six species of pipefish of which four are endemic. In 2001, no syngnathids were protected by legislation except those living in marine protected areas. There was a small import trade in dried syngnathids for use for traditional Chinese medicine. These imports were estimated to be very small (<20 kg per year worth less than US\$10,000). A small trade was reported in live seahorses for home aquaria, but this was unquantified.

There was no target fishery for syngnathids but they were caught as bycatch in coastal and offshore fishing operations, primarily trawling. The most important species was reported to be the spiny pipehorse, *Solegnathus spinosissimus*, although official statistics also recorded bycatch of seahorses and pipefish. It is presumed that the majority of these data actually referred to *S. spinosissimus*. There were considerable disagreements between different sets of official figures for a variety of reasons including: failing to record catches of syngnathids, ignorance of codes or mistakes in use of codes for syngnathids. Thus, catch figures probably underestimated considerably the catch of syngnathids. Annual minimum mean catches from 1990-2000 were 400-735 kg wet weight year⁻¹ (=174-320 kg dry weight) although catches of up to 5,451 kg wet weight were recorded (2,370 kg dry weight) in 1995. There were very large fluctuations in recorded catches from year to year but the unreliable nature of the data precluded drawing conclusions about the status of populations. Similarly, prices were not accurately recorded but the value of the trade was estimated as US\$840-28,800 per year, making it a relatively minor fishery. Population dynamics and stock assessment of the fishery were not quantified and should be a priority for research.

Experimental seahorse aquaculture was initiated in the period 1995-2000 but there were no commercial operations selling seahorses.

Conservation concerns for syngnathids in New Zealand included habitat degradation and unsustainable exploitation of bycatch, but these were considered to be low risk.

BACKGROUND FOR NEW ZEALAND

New Zealand has a coastline of approximately 15,000 km and under the United Nations Convention on the Law of the Sea has territorial claims over water to 200 nm (370.4 km) from the coast, giving a total area of 1.3 million nm² (4.4 million km²). Syngnathid diversity is low with only seven species recorded in total from territorial waters, although four of these (57%) are endemic. Similarly, syngnathids have generally been poorly researched in New Zealand (but see Woods, 2000a, b; van Dijken, 2001). Public awareness of syngnathids has been low, although a public participation programme, Survey Seahorse 2000, was initiated to collect distribution data and raise awareness.

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Information sources in New Zealand

Information for this section was obtained from the following sources:

- NZ government – Ministry of Fisheries (MinFish); Department of Conservation (DoC).
- Seahorse researchers – Chris Woods, National Institute of Water and Atmospheric Research (NIWA); Schannel van Dijken, University of Auckland.
- Industry bodies – Seafood Industry Council (SeaFIC).
- NGOs – Mike Percy, Survey Seahorse 2000; Barry Weeber, Forest & Bird.
- Public aquaria – Portobello Marine Discovery Centre, Otago; Island Bay Marine Life Centre, Wellington; Kelly Tarlton's Underwater World, Auckland

Interviews were conducted in May 2001 in three traditional Chinese medicine (TCM) shops in Auckland. Interviewees were asked whether they stocked syngnathids, the origin, volumes and prices of those syngnathids and whether there had been any change in these parameters over the past five years.

Syngnathids in New Zealand

Local species

Seahorses

Lourie *et al.* (1999) recognized only a single species of seahorse from NZ, although Kuitert (2000) split this species into two on the basis of snout length. Genetic work has found no evidence that there is more than one species (Paul Armstrong, pers. comm.). Thus, the convention of Lourie *et al.* (1999) has been followed, recognizing only the big-bellied seahorse, *Hippocampus abdominalis*. This species has been listed on the IUCN Red List as Vulnerable (Hilton-Taylor, 2000). *Hippocampus abdominalis* has been studied to some extent in NZ, in both the laboratory (Woods, 2000a, b) and in the wild (van Dijken, 2001). Information on its distribution and biology are given in Table 1.

Pipefish and Pipehorses

There has been confusion in the literature over the use of common names for some syngnathids, particularly the term 'seadragon'. The Chinese term for animals in the genus *Solegnathus* is 'hai lung' which is often translated as seadragon. *Solegnathus* species are used in TCM. New Zealand Ministry of Fisheries uses seadragon and the code SDR for *S. spinosissimus*. However, the convention in this document is to use the term 'pipehorse' for *Solegnathus* spp., restricting 'seadragon' for two endemic species of Australian syngnathid that are not used in TCM.

New Zealand has low diversity of pipefish and pipehorses. Dawson (1985) recognized six species in four genera as occurring in New Zealand waters. Four of these are endemic to New Zealand and one (*S. spinosissimus*) is listed on the IUCN Red List (Hilton-Taylor, 2000). Summaries of distribution and biology are given in Table 1. Further work is needed to ascertain the correct taxonomic status of the NZ species of *Solegnathus* – Dawson (1985) suggested that the NZ population of *S. spinosissimus* might be a separate subspecies, while Kuitert (2000) elevated it to specific status, *S. naso*.

Species traded/imported

Dried seahorses were only observed for sale in one TCM retailer in NZ. These seahorses were not positively identified but were tentatively assigned to either *Hippocampus barbouri* or *H. histrix*. In 1997, there was a report of seahorses caught in the South Island being sold in Auckland – these could only be *H. abdominalis* (Marea Neill, pers. comm.). Dried *H. abdominalis* and *S. spinosissimus* were occasionally observed for sale as curios (Chris Woods pers. comm.). There were no later reports of local seahorses for sale. However, one TCM interviewee reported that dried seahorses and pipefish from SE Asia were sold in Auckland. There were also reports of exotic seahorses such as *Hippocampus kuda* for sale in aquarium shops but data on numbers and species were not known (Chris Woods, pers. comm.). Pipefish (probably *Solegnathus* spp. because of their size: 35-40 cm) were seen for sale in New Zealand in 1997 (Tom Montague, pers. comm.).

Table 1. Details of species of New Zealand syngnathids (endemic species indicated by asterisk). Source: Dawson (1985), Hilton-Taylor (2000), Kuitert (2000), Poortenaar *et al.* (2001), van Dijken (2001), Chris Woods (pers. comm.).

Species	Common name	IUCN Status	Habitat & Distribution	Biology	Trade
<i>Hippocampus abdominalis</i>	Big-bellied seahorse, kiore moana	VU A2d	Throughout NZ from Bay of Islands to Stewart Island. Algae, sponges, seagrasses, rocky reefs, artificial structures. 0-80 m depth.	Breeding Oct-Feb but reproductively active animals found throughout year; Gestation 28 d at 17°C; brood size 300-1000+; found in singletons, pairs and groups. Population densities generally low.	Dried trade from trawl bycatch?
<i>Leptonotus elevatus</i> *	High-body pipefish	Not listed	Throughout NZ from Auckland to Stewart Island and from the Auckland Islands around piers and wharves to depths of 62-120 m in trawl collections including over bryzoan/shell habitat	Length to 170 mm SL with males brooding at 100 mm	No known trade
<i>Leptonotus norae</i> *	Long-snouted pipefish, NZ long-snout pipefish	Not listed	Hawkes Bay in the North Island to Stewart Island. caught in mid-water and benthic trawls in the depth range 37-212 m	Length to 240 mm SL with males brooding at 146 mm.	No known trade
<i>Lissocampus filum</i> *		Not listed	Known from throughout NZ and Chatham Islands. Found in algal beds to depth of 10 m	Length to 115 mm SL with males brooding at 70 mm.	No known trade
<i>Solegnathus spinosissimus</i>	Spiny pipehorse	VU A1d+2d	Throughout NZ and SE Australia. Generally caught 29-232 m but recorded from 400-550 m. Found in shallow water (<15 m) in Fiordland.	Length to 500 mm with males brooding at 206 mm.	Dried trade from trawl bycatch
<i>Stigmatopora macropterygia</i> *	Long-snouted pipefish	Not listed	Known from southern tip of North Island, east coast of South Island and Auckland Islands. Found to 10 m in algal habitats.	Length to 375 mm TL with males brooding at 240 mm	No known trade
<i>Stigmatopora nigra</i>	Wide-bodied pipefish	Not listed	Known from tip of North Island to northern South Island and throughout Australia. Found in shallow coastal waters, particularly in seagrass beds and algal-reef areas.	Length to 175 mm TL with males brooding at 65-70 mm. Females develop very broad trunk and red stripes during courtship.	No known trade

Uses

Seahorses were reported for use in traditional Chinese medicine (TCM) within ethnic Chinese communities, particularly in Auckland. One TCM retailer stated that small volumes of seahorses were sold as part of TCM prescriptions to increase 'kidney' function (term for general body health). They were also reported to be incorporated in patent medicines that were imported from China.

Seahorses (*H. abdominalis*) were displayed in public aquaria at Portobello Marine Discovery Centre, Otago; Island Bay Marine Life Centre, Wellington; Kelly Tarlton's Underwater World, Auckland and Paihia Aquarium, Paihia.

There was a small, unquantified aquarium trade importing exotic species of seahorse.

Individuals were permitted to collect seahorses for their home aquaria but no information existed on the scale of this collection. Dried syngnathids (*H. abdominalis* and *S. spinosissimus*) were occasionally seen for sale as curios.

No evidence of traditional use of seahorses by Maori was found.

Legislation

The Fisheries Act 1996 is the main piece of legislation covering fisheries in NZ. Under this Act, only species of fish that are part of the Quota Management System (QMS) may be legally targeted as a fishery. No species of syngnathid is part of the QMS and therefore they cannot be targeted. However, commercial fishers may retain syngnathids if they are caught as incidental bycatch during normal fisheries activities. These syngnathids may be legally sold to Licensed Fish Receivers (LFR's) at a rate of <10 kg/24hrs per fisher. Licensed fish receivers can sell syngnathids to other LFRs or export from NZ with no restrictions.

Aquaculture ventures require a permit to culture and sell seahorses which are issued by the Ministry of Fisheries. People may collect wild seahorses for 'personal use', e.g. home aquaria, with no limits. Syngnathids cannot generally be collected for display in public aquaria unless a permit has been issued under section 64 of the Fisheries Act 1996.

New Zealand has no separate Customs codes for syngnathids – dried syngnathids are included in the category 0305.59.00 (Other dried fish, whether or not salted but not smoked) while live fish are included in the category 0301.10.00 (ornamental fish).

The Ministry of Fisheries keeps records of 'greenweight' (i.e. wet weight before any kind of processing) of bycatch species through a mandatory logbook system (catch-effort forms). Licenced Fish Receivers are also required to provide records of total landings. These data have been provided to the author and others by the Ministry of Fisheries. However, as with much logbook data, there have been concerns about the accuracy of the figures. Estimated catch recording is only mandatory for the top five species caught, fishers may not know the codes for syngnathids or they may not be recorded as they are of limited value (Stephen Black, MinFish pers. comm.). There have been no observer validation studies comparing recorded catches with actual catches, records have been kept for differing time periods (i.e. calendar year versus 'fishing year') and codes for syngnathid species appear to have been confused. Furthermore, a considerable amount of quota in the NZ fisheries are caught by foreign vessels with have no incentive to accurately report bycatch (SeaFIC, 2001). Thus, the figures were regarded as general indicators only and of limited utility for assessing temporal trends.

The Marine Reserves Act 1971 provides for the establishment and administration of marine reserves in which all taking of fish is prohibited. In 2001, there were 15 of these reserves around the coast of NZ and a further reserve around the Kermadec Islands.

SYNGNATHID CATCHES IN NEW ZEALAND

Bycatch

No target fishery existed for syngnathids in NZ. As non-Quota Management System species syngnathids cannot be targeted by commercial fishers. However, syngnathids were obtained as bycatch from a number of fisheries. In 2000, NZ fisheries and aquaculture production was approximately 650,000 tonnes per year worth NZ\$1.56 billion (US\$0.69 billion) employing approximately 10,600 people (New Zealand Official Yearbook on the Web, 1999; Seafood Industry Council, 2001). The majority (80%) of wild fisheries catch was from mid- and deep-water fish harvested primarily by trawling, particularly hoki (*Macruronus novaezealandiae*). This method of fishing produced highest levels of syngnathid bycatch, recorded as either pipefish or pipehorses (New Zealand Ministry of Fisheries, 2001). Inshore fishing operations included dredging for scallops, traps for lobsters and blue cod and set nets (gill nets) for a variety of fishes – all of these methods were reported to have collected syngnathids (seahorses, pipefish and pipehorses) as bycatch (New Zealand Ministry of Fisheries, 2001). The statistical areas that syngnathid bycatch was reported from were: the Bay of Plenty and the Firth of Thames on the east coast of the North Island;

central west coast of the North Island; north-east coast of the South Island (Kaikoura to Akaroa) and two offshore areas on the edge of the EEZ (central east and central west).

A trawl fisher in Otago reported occasional catches of seahorses in depths up to 80m and fishers targeting paddle crabs in Hawkes Bay found seahorses on the buoy ropes of the crab pots and then sold them to a nascent aquaculture venture.

DRIED SYNGNATHID TRADE IN NEW ZEALAND

Domestic trade, imports, volumes and values

Sales of dried seahorses within NZ were probably low, although few quantitative data were obtained. In 1997, one 'seafood' shop was reported to be selling *H. abdominalis* in packs of 10-15 animals for NZ\$80 (US\$55) and *Solegnathus* pipehorses for NZ\$3.50 (US\$2.40) each (Marea Neill, pers. comm.). Only one of three TCM retailers interviewed in 2001 stocked seahorses. This interviewee estimated the volume of seahorses sold as 1 or 2 per week. These animals were obviously imported as they were exotic species (either *H. barbouri* or *H. histrix*), although the retailer was uncertain of their precise origin. As the animals were bleached, it is probable that they originated from Hong Kong (Vincent, 1996). Prices were approximately NZ\$5 (US\$2.20) for a 10 cm SL bleached seahorse or about NZ\$50 (US\$22) for a liang (37.5 g). No data were obtained about changes in supply over the previous years.

In total there were 22 TCM businesses listed throughout NZ (NZ Yellow Pages, 2001), the majority of which were in Auckland (13) with small numbers in Wellington (4), Hamilton (3) and Christchurch (2). Assuming that between one-third and two-thirds of retailers stocked seahorses and a range of volumes traded (1-4 per week) for seahorses with a mean weight of 4 g provided estimates of 1.9-15.3 kg/year for all NZ, representing a retail value of NZ\$2500-20,400 (US\$1,100-9,000).

Exports

Given the low estimates of dried syngnathid use within NZ, it is assumed that the majority of recorded catches were exported. It was clear from the catch data supplied by MinFish that codes for seahorse (SHO), pipefish (PIP) and pipehorse (SDR) were not used in a consistent manner as there was high complementarity between the data sets (i.e. records of SHO were high when PIP & SDR were zero etc. – Tables 2-4). One value indicating a catch of 100 kg of pipefish (code PIP) in 1994 (Table 2) was assumed to be the result of a mistake in coding as the catch method was listed as 'hand collected'. It is probable that this statistic referred to a catch of a type of bivalve, the pipi, which has a very similar code (PPI). Similarly, different codes were used in different years for catches of syngnathids from the same statistical area and adjacent statistical areas in the same year. Anecdotal information suggested that almost all of the catch statistics referred to pipehorses rather than other syngnathids (Chris Woods, pers. comm.; Mike Percy, pers. comm.). This assumption was supported by import data from Taiwan that recorded imports of *Solegnathus* and/or other pipefish from New Zealand in 1998 whereas no imports of seahorses were recorded.

Volumes, values, and destinations of exports

Reported data for the landings of syngnathids varied significantly from year to year and by method of reporting (estimated catches, reported landings from catch-effort forms or reported landings from licenced fish receivers; Tables 2-4). It was unclear whether any of these fluctuations represented changes in supply or were a reflection of poor data collection or management. Thus, it was decided to use the means for each of the data sets to provide an approximate minimum estimate for catches of syngnathids.

Using this method the mean annual wet weight catches of syngnathids in the period 1990-2000 were 96 kg (± 44 se) for estimated catches and 399 kg (± 164 se) for total landings (Table 2). Estimated catches were only calculated for the top five bycatch species, so syngnathids would often not have been recorded although they were caught. For landings estimated from catch-effort forms the mean for the fishing seasons 1992/93-1999/00 was 476 kg (± 157 se; Table 3). Highest estimated volumes were from licenced

Table 2. Wet weight landings of syngnathids in New Zealand 1989-2001. Source: NZ Ministry of Fisheries (2001).

Year	Total Landings (kg wet weight)				Estimated Catch (kg wet weight)			
	Seahorses (SHO)	Pipefish (PIP)	Pipehorse (SDR)	Total Syngnathids	Seahorses (SHO)	Pipefish (PIP)	Pipehorse (SDR)	Total Syngnathids
1989					0	25	0	25
1990	127	0	0	127	5	0	0	5
1991	47	0	0	47	0	0	0	0
1992	662	0	3	665	170	0	0	170
1993	25	47	18	90	0	0	28	28
1994	0	243*	812	1055	0	0	125	125
1995	0	7	0	7	0	525	0	525
1996	0	347	0	347	0	0	0	0
1997	30	44	0	74	0	0	30	30
1998	4	163	0	167	0	0	0	0
1999	37	55	0	92	1	150	34	185
2000	405	38	1278	1722	60	0	0	60
2001	121	2	0	123	1	0	0	1

* 100 kg of this value is assumed to be the result of a mistake in coding (see text).

fish receiver returns with a mean for 1991-2000 of 731 kg (± 535 se). Connolly *et al.* (2001) determined a dry weight:wet weight conversion factor for *Solegnathus* spp. from Queensland of 27:62. If it is assumed that the majority of the landings were *S. spinosissimus* the equivalent minimum mean dry weights per year were 42-318 kg.

However, there was abundant anecdotal information significant amounts of pipehorse catches were not reported. For example, in 1996 a trader (level 2) reported that dried *S. spinosissimus* were exchanged for beer with fishers, then consolidated and sold to China. Another report, in 2000, was that 40 kg of dried pipehorses were not recorded as bycatch on a foreign vessel fishing legally in NZ waters, as they were retained by the crew (Chris Wood, pers. comm.).

New Zealand did not collect any official statistics on the value of the syngnathid fishery specifically. There were a number of conflicting reports for prices paid for *Solegnathus*. The trader (level 2) mentioned above reported that prices were NZ\$1,000 per kg (US\$690) for trawl-damaged specimens or NZ\$2,000 (US\$1380) for undamaged specimens in 1996. These estimates appeared to be exaggerations. In May 1997, *Solegnathus* were on sale locally in NZ for NZ\$42.95 (US\$30) per kg wet weight (equivalent to US\$69 per kg dry weight using the conversion factor of Connolly *et al.*, 2001; Tom Montague, pers. comm.). Similarly, in 1997, dried *Solegnathus* were reported for sale for NZ\$3.50 each (US\$2.40) in TCM retailers (Marea Neill, pers. comm.), equivalent to approximately NZ\$130 per kg (US\$89 per kg). In 1998, Taiwan imported 1,167 kg of dried *Solegnathus* from NZ at a declared value of NT\$161,000 (US\$4800) equivalent to US\$4.11 per kg. This value was substantially smaller than the equivalent price for Australian species of *Solegnathus* for the same period (US\$50 per kg). Finally data supplied by SeaFIC for all dried fish exported in 1999 and 2000 gave mean unit prices of NZ\$35 (US\$19) and NZ\$57 (US\$26) per kg. Using estimates of US\$20-90 per kg dry weight gave a total minimum economic value of the fishery of US\$840-28,800 per year.

Table 3. Wet weight landings of syngnathids in New Zealand from catch-effort forms during fishing seasons 1992/93-2000/01. Source: NZ Ministry of Fisheries.

Fishing Year	Catch-effort forms data (kg wet weight)			
	Seahorses (SHO)	Pipefish (PIP)	Pipehorse (SDR)	Total Syngnathids
1992/93	687	1	21	709
1993/94	0	288	55	343
1994/95	0	6	757	763
1995/96	0	12	0	12
1996/97	0	379	0	379
1997/98	30	162	0	192
1998/99	20	44	0	64
1999/00	21	44	1278	1343
2000/01	3	4	0	7
(incomplete)				

Dried syngnathids were sold to licenced fish receivers but were consolidated within the general code for dried seafood at that point and could not be traced separately. In 1999 dried seafood was sold to Australia, Fiji, Germany, Hong Kong, Malaysia, Singapore, Taiwan, U.S.A. and Vietnam and in 2000 to Australia, Hong Kong, Japan, Malaysia, Singapore, Taiwan, Thailand, U.S.A. and Vietnam (SeaFIC, 2001). It was likely that Hong Kong and Taiwan were the main destinations for *Solegnathus*, as these were the main destinations for congeneric species from Australia.

Table 4. Wet weight landings of syngnathids recorded by Licenced Fish Receivers. Source: NZ Ministry of Fisheries.

Year	Seahorse (SHO)	Pipefish (PIP)	Total syngnathids
1991	21	0	21
1992	0	0	0
1993	0	208	208
1994	0	1071	1071
1995	0	5451	5451
1996	0	448	448
1997	71	0	71
1998	0	41	41
1999	0	0	0
2000	0	0	0

LIVE SYNGNATHID TRADE IN NEW ZEALAND

In 2001, four public aquaria in NZ displayed *H. abdominalis* that were collected locally in New Zealand under permits from MinFish. Each of these aquaria had displays of 15-50+ individuals. Aquarists at Island Bay Marine Life Centre, Wellington and Portobello Marine Discovery Centre, Otago reported breeding success in captivity and that the majority of the animals on display were captive-born or captive-bred offspring (Judy Hutt, pers. comm.; Adelle Heineman, pers. comm.). One aquarium had been releasing captive-bred offspring back into the wild.

Exotic seahorses including *H. kuda* were reported for sale in one aquarium shop in Christchurch (Chris Woods, pers. comm.), but no further information was available on the source or volumes of these animals. A figure of NZ\$35 (US\$15) per individual was given as the wholesale price to the aquarium trader (Chris Woods pers. comm.). There were 60 aquarium shops throughout NZ in 2001 with the greatest number in Auckland (15), Christchurch (4), Hamilton (3) and Rotorua (3; NZ Yellow Pages 2001). Estimates from Australia suggested that only 10% of aquarium shops would have seahorses, so it is presumed that aquarium trade in NZ was small, involving less than 10 shops.

There was little reported evidence that live syngnathids were collected and exported. Data from SeaFIC (2001) showed that only 100 live ornamental fish were exported from NZ to Japan in 1999 with a total value of NZ\$2,500 (US\$1,125), and that none were exported in 2000.

Live *H. abdominalis* were collected for aquaculture broodstock (see ***Live seahorse trade in Australia: Sources, Aquaculture and captive breeding***) but there were no data on the number of animals taken. One start-up venture received seahorses as bycatch from paddle-crab pot operations varying from 0-10 animals per week.

Values

The economic importance of the seahorse fishery was probably low. Although the total value of the fishery could be over NZ\$66,000 (US\$28,800) per year, it was diffuse. There were no reported examples of fishers or fish receivers that relied on syngnathids for their income.

Sources

Aquaculture and captive breeding

Interest in seahorse aquaculture in New Zealand and subsequent experimental development expanded considerably in the period 1995-2001. In 2001 there were no commercial aquaculture ventures producing seahorses for export. However, there were at least four operations involved in experimental aquaculture. The most advanced of these was research on seahorse biology and husbandry at NIWA. This began in 1997 and was directed towards developing suitable husbandry for intensive culture of *H. abdominalis* (Woods, 2000a, b; James & Woods, 2001; Poortenaar *et al.*, 2001). However, as most of NIWA's work was government funded it was intended to solve technical problems for nascent ventures, rather than

commercial production of seahorses *per se*. NIWA received numerous enquiries about culturing seahorses from individuals and companies that were involved in aquaculture (primarily mussel farms) and seeking to diversify (Chris Woods, pers. comm.). In 2001 the most advanced of these ventures were operating in Hawkes Bay, Nelson and Otago. One of these operations was intending to produce 100,000 seahorses per year for the TCM market. However, there was no intensive market analysis to quantify potential demand, nor research on the acceptability of *H. abdominalis* for the TCM market. The long-term economic viability of seahorse aquaculture in a country with high costs such as NZ remains questionable.

As with seahorse aquaculture in Australia, there have been serious concerns about the conservation benefit of seahorse aquaculture in NZ. All the operations described above except NIWA were commercial ventures that were initiated to generate profit for owners or investors. Undoubtedly, these operations have the potential to produce large numbers of seahorses. However, to be of conservation benefit, there have to be consequent reductions in the catches of wild animals which has yet to be demonstrated. New Zealand has not been a large supplier of seahorses to the TCM or aquarium trade and *H. abdominalis* has not been traded for TCM (Vincent, 1996). Whether seahorse culturing reduces the exploitation of wild populations will partly depend on its effects on subsistence fishing communities in source countries. Seahorse fishers are commonly so poor that they cannot stop catching seahorses unless they earn money in other ways. One outcome of aquaculture in countries that do not traditionally exploit seahorses might be reduced prices in source countries. This would either (a) force fishers to catch more in order to meet their basic needs (if effort can be increased) or (b) move them from one diminished resource to another. Both of these scenarios exacerbate conservation problems. Aquaculture is likely to be of greatest conservation value where it facilitates seahorse fishers becoming seahorse farmers, thereby directly reducing pressure on wild populations.

If seahorse aquaculture is successful there is strong pressure to seek new markets, either trading species that have not been utilized previously and/or seeking new uses for these animals. Furthermore, once trade has commenced, natural populations have a value which may encourage exploitation of wild animals, particularly if they cannot be distinguished from captive-bred animals.

Aquaculture operations have the potential to disrupt natural populations of seahorses, either through direct removal of broodstock or through discharge of effluent and/or disease.

It is possible to address these concerns and responsible aquaculture ventures should ensure that: (1) the international impact on subsistence fishers (and thus wild seahorses) has been addressed; (2) international conventions such as the Convention on Biological Diversity are respected; and (3) the culturing operation will not promote new trade - or increase existing trade - in wild seahorses.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN NEW ZEALAND

Population declines

There has been no evidence of population declines of syngnathids in NZ. However, this has been due primarily to lack of data. There was no information on the biology, life history and population dynamics of the most-heavily exploited species, *S. spinosissimus*, and this should be a high priority for syngnathid research in NZ. The status of fisheries bycatch information was assessed as 'very limited' and the trend as 'unknown' by SeaFIC (2001).

Habitat loss and degradation

Habitat loss and degradation has been recognized as a major conservation concern in NZ coastal waters (Parliamentary Commission for the Environment, 1999; Oceans Policy, 2001). Threats to coastal waters have been identified to be primarily from coastal development and pollution, with exotic species and damage from fishing gear also important (Parliamentary Commission for the Environment, 1999).

New Zealand has addressed these issues through the production of its Oceans Policy and the creation of marine protected areas.

Aquaculture issues

The major issues surrounding seahorse aquaculture are:

- (1) Creation of new markets: As seahorses aquaculture in New Zealand has been initiated as an economic activity, there will be pressure to sell as many animals as possible. This includes promoting the sale of animals to countries/areas that did not trade in seahorses historically and investigating new uses for animals. If such new demand cannot be supplied solely from aquaculture or can be sourced more cheaply elsewhere, pressure on wild populations will increase.
- (2) Environmental impacts: Broodstock for aquaculture is taken from the wild and will need to be in the future to ensure that inbreeding depression does not occur. While the numbers of animals taken have been few, there has been no quantitative monitoring of the effects of broodstock removal on wild populations. Furthermore, seahorse aquaculture involves obtaining food supplies (generally from wild sources) and discharge of wastewater with the possibility of accidental disease or seahorse release back into the wild. While there are technical solutions to these issues, they need to be considered and factored into management of aquaculture operations.
- (3) Global effects: Seahorse aquaculture will only have positive benefits for wild seahorses if demand remains relatively constant and switches from wild to cultured animals. If demand simply increases to match increased supply there is no net conservation benefit.

COMPARISON TO 1996 SURVEY FINDINGS

Since a previous study (Vincent, 1996), there has been an amendment to the legislation so that seahorses can be farmed in land-based aquaculture facilities. Since 1996, quantitative data on the volume of seahorses, pipefish and pipehorses caught have been made available, but the quality of these data was poor due to omissions and mistakes in coding. There was confirmation that dried syngnathids were used to a limited extent in TCM in New Zealand and anecdotal information that *H. abdominalis* was used to a limited extent. In general, however, there appeared to have been few major changes in the trade of syngnathids to and from NZ since Vincent (1996).

CONCLUSIONS

Accurate conclusions for NZ were hampered by inconsistencies in quantitative data. It appeared that during the period 1996-2001 New Zealand was a net exporter of syngnathids, the majority of these being the spiny pipehorse, *S. spinosissimus*. Imports of both dried and live syngnathids were minor and of low economic importance. No fishers, traders or aquarists relied on syngnathids for all or even a majority of their income. Experimental commercial aquaculture of seahorses took place during 1996-2001 but there was no full-scale commercial production. The economic viability, environmental sustainability and conservation utility of seahorse aquaculture remained unproven. Habitat degradation and unsustainable bycatch of *S. spinosissimus* appeared to be the greatest threats to New Zealand syngnathids but these threats were considered to be low risk over the short-medium term (5-10 years). The highest priorities for research were considered to be assessment of the sustainability of the pipehorse bycatch.

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CHAPTER 9. SYNGNATHID TRADE IN THE SOUTH PACIFIC¹

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ABSTRACT

Syngnathid diversity in the South Pacific region (17 countries and territories) is high with at least five species of seahorse and 67 species of pipefish and pipehorse. However, syngnathid exploitation in the area appeared to be negligible with only one record of syngnathids traded during the period 1996-2001 (three live seahorses exported from the Solomon Islands to Germany in 1998). There were no provisions for syngnathids in fisheries regulations but it appeared unlikely that syngnathids were caught by any of the artisanal or commercial fisheries that operated. In general, there were no concerns over the status of any syngnathid in the South Pacific region but expanded data collection may be required.

BACKGROUND FOR THE SOUTH PACIFIC

For the purposes of this document, the South Pacific region is defined as the area north and east of Australia within the region bounded by 15°N, 23°S, 134°E, 138°W. Australia and Indonesia are excluded. There are 17 countries or territories in this area: American Samoa, Cook Islands, Fiji, Federated States of Micronesia (FSM), French Polynesia, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. These countries are spread over an enormous geographic area and have jurisdiction through exclusive economic zones (EEZs) over 27 million km² of ocean (Table 1). Except for Papua New Guinea, the land area of these countries and territories is very small (total less than 100,000 km²), as are their populations (approximately 2 million). Papua New Guinea is much larger with a land area of almost 0.5 million km² and a population of 4.6 million.

Information sources in the South Pacific

Information for this section was obtained from the following sources:

- Government/International Organizations – Pacific Islands Forum, Fisheries Forum Agency, Food & Agriculture Organization (FAO) of the United Nations.
- Researchers – Cathy Hair (ICLARM), Greg Bennett (SIG/ACIAR Life Reef Fish Project), Blake Dinkin.

Syngnathids in the South Pacific

Local species

Seahorses

The South Pacific region has moderate diversity of seahorses with five species recognized by Lourie *et al.* (1999), and a further three (all from Papua New Guinea) by Kuitert (2000). Froese & Pauly (2000) list *Hippocampus whitei* as present in the Solomon Islands, but both Lourie *et al.* (1999) and Kuitert (2000) consider this species to be an Australian endemic. The record from FishBase is probably a mis-

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Table 1. Summary statistics and fisheries legislation for South Pacific countries. Source: Pacific Islands Forum, Forum Fisheries Agency.

Country	Land Area (km ²)	Size of EEZ (million km ²)	Fisheries Legislation
American Samoa	197	0.43	
Cook Islands	240	1.83	Marine Resources Act 1989, Conservation Act 1986-7
Fiji	18,272	1.26	Fisheries Act
Federated States of Micronesia	700	2.98	Title 24 – Marine Resources – of Code of FSM
French Polynesia	3,500	5.00	
Kiribati	600	3.60	Fisheries Act 1977
Marshall Islands	181	2.13	Marine Resources 1997
Nauru	21	0.32	Fisheries Act 1997
Niue	258	0.39	Territorial Seas and Exclusive Economic Zone Act 1997 Domestic Fisheries Act 1995
New Caledonia	22,405	1.74	
Papua New Guinea	462,840	3.12*	Fisheries (Torres Strait Protected Zone) Act 1984, Fisheries Management Act 1998
Samoa	2,857	0.12	Fisheries Act 1988
Solomon Islands	29,785	1.63	Fisheries Act 1972
Tokelau	10	0.31	
Tonga	697	0.70	Fisheries Act 1989
Tuvalu	26	0.76	Fisheries Act
Vanuatu	12,189	0.68	Fisheries Act 1982

* Defined as 'offshore seas' rather than EEZ

identification. Given the instability in the taxonomy it was decided to use the species of Lourie *et al.* (1999), while recognizing that the status and conservation information may have to be revised. Information on the five species recognized by Lourie *et al.* (1999) is given in Table 2.

Three of these species were listed as Vulnerable in IUCN Red List (four if *H. whitei* is included) and one as Data Deficient (Hilton-Taylor, 2000). These species were assessed in 1996 and the criteria for their listings were generally small area of occupancy and/or small population sizes.

Pipefishes and pipehorses

Pipefish and pipehorse diversity is high in the South Pacific region with at least 67 species in 22 genera recorded from 18 countries and territories listed above (Table 3). South Pacific countries with highest diversity of syngnathids are Papua New Guinea (42 species), Marshall Islands (29), New Caledonia (28) and Fiji (21), although this may reflect to some extent the distribution of sampling effort (Dawson 1985). Most of the genera and species were distributed over at least two countries. No syngnathids at all were recorded for Nauru, Niue, Tokelau and Tuvalu (FishBase 2000).

Two species (*Doryrhamphus dactyliophorus* and *Syngnathoides biaculeatus*) were listed as Data Deficient in IUCN Red List (Hilton-Taylor, 2000).

Uses

There no reports of syngnathids being used in the South Pacific since 1994 (reported in Vincent, 1996). It was likely that there was other use of syngnathids in Traditional Medicine (TM) or as curios, but sources of information were very limited.

There were no reports of syngnathids for sale in South Pacific nations after 1994 when a few dried seahorses were noted for sale in Fiji (Vincent, 1996).

Table 2. Seahorse species from South Pacific region. Country codes: AS = American Samoa, F = Fiji, FP = French Polynesia, FSM = Federated States of Micronesia, NC = New Caledonia, PNG = Papua New Guinea, Sa = Samoa, SI = Solomon Islands, To = Tonga. Sources: Lourie *et al.*, 1999; Hilton-Taylor, 2000; Kuitert, 2000; Froese & Pauly, 2000.

Species	Common name	IUCN Status	Country	Habitat	Biology	Trade
<i>H. bargibanti</i>	Pygmy seahorse	DD	NC, PNG	Only known from Muricella gorgonians. 16-40+ m	Breeding Mar-Nov; found alone or paired	No known trade
<i>H. fisheri</i>	Fisher's seahorse	Not listed	NC?	Unknown	Unknown	No known trade
<i>H. histrix</i>	Thorny seahorse	VU A2cd	FP, FSM, NC, PNG, Sa, To	Associated with soft corals, sponges and ascidians occasionally with algal / rubble reef. 6-15+ m	Unknown	No known trade from South Pacific
<i>H. kuda</i>	Yellow seahorse, spotted seahorse, estuary seahorse	VU A2cd	AS, F, FP, FSM, NC, PNG, Sa, SI, To	Estuaries, seagrasses, mangroves, algae 0-50 m	Breeding in wet season (Indonesia); gestation 20-28 d; brood size 20-1000; may occur in pairs	No known trade from South Pacific
<i>H. trimaculatus</i>	Three-spot seahorse, low-crowned seahorse	VU A1cd+2cd	PNG	Algal reefs; trawled from gravel & sand. 0-20 m	Breed May-Sep; brood size 400-1000	No known trade from South Pacific
<i>H. whitei</i> ?† (<i>H. procerus</i>)	White's seahorse, Sydney seahorse	VU A2cde	SI	Seagrasses, sponges, algal reefs, artificial structures 0-25 m	Breed Oct-Apr; gestation 21-22 d; brood size 100-250; generally found in monogamous pairs	No known trade

† This species is considered to be an Australian endemic by Lourie *et al.* (1999) and Kuitert (2000) and the record from FishBase (2000) probably refers to a different species (*H. procerus* according to Kuitert (2000)).

Legislation

Fisheries legislation varied between South Pacific nations but generally legislation placed restrictions on the type of gear used (e.g. mesh size for nets), quota for certain species (e.g. groupers) and access rights for local and foreign vessels (Table 1). There were no specific provisions for syngnathids under any of the fisheries legislation.

SYNGNATHID CATCHES IN THE SOUTH PACIFIC

Bycatch

Much of the fishing industry in the South Pacific is artisanal, utilizing gleaning, spearing, trolling, handlines, gillnets and scoop nets. These methods have low potential for bycatch of syngnathids, although no data were available. Commercial fishing in the EEZ of South Pacific nations was primarily for species of tuna using long-lines, pole-and-line or purse seines. Again, no data were available but the methods and location of the fisheries suggested that bycatch of syngnathids were negligible.

Table 3. Pipefish and pipehorse species from South Pacific region. Country codes: AS = American Samoa, CI = Cook Islands, Fi = Fiji, FSM = Federated States of Micronesia, FP = French Polynesia, Ki = Kiribati, MI = Marshall Islands, NC = New Caledonia, PNG = Papua New Guinea, Sa = Samoa, SI = Solomon Islands, To = Tonga, Va = Vanuatu. No species listed for Nauru, Niue, Tokelau or Tuvalu. Source: Dawson, 1985; FishBase, 2000; Kuitert, 2000.

Species	Country	Species	Country
<i>Acentronura gracilissima</i>	NC	<i>Halicampus marquesensis</i>	Fi, FP
<i>Apterygocampus epinnulatus</i>	PNG	<i>Halicampus mataafae</i>	AS, MI, NC, PNG, Sa
<i>Bhanotia fasciolata</i>	PNG	<i>Halicampus nitidus</i>	Fi, NC, PNG
<i>Bhanotia nuda</i>	PNG	<i>Halicampus spinirostris</i>	AS
<i>Bulbonaricus brauni</i>	FSM	<i>Haliichthys taeniophorus</i>	PNG?
<i>Bulbonaricus davaoensis</i>	Fi, SI	<i>Hippichthys cyanospilus</i>	Fi, PNG
<i>Choeroichthys brachysoma</i>	FP, PNG	<i>Hippichthys heptagonus</i>	PNG, SI
<i>Choeroichthys cinctus</i>	Fi, PNG, Sa	<i>Hippichthys penicillus</i>	PNG
<i>Choeroichthys sculptus</i>	AS, Fi, FP, FSM, Ki, MI, PNG, Sa, To	<i>Hippichthys spicifer</i>	PNG, Sa, SI
<i>Corythoichthys amplexus</i>	Fi, NC, PNG, Sa	<i>Micrognathus andersonii</i>	NC, PNG, Sa, To
<i>Corythoichthys flavofasciatus</i>	AS, CI, FP, FSM, MI, PNG, Sa	<i>Micrognathus brevirostris pygmaeus</i>	FP, MI, NC, PNG, Sa
<i>Corythoichthys haematopterus</i>	FSM, NC, PNG, Sa, SI, Va	<i>Micrognathus natans</i>	Fi, NC
<i>Corythoichthys intestinalis</i>	FP, FSM, MI, NC, PNG, Sa, To	<i>Microphis argulus</i>	Fi, FP, PNG, SI
<i>Corythoichthys nigrippectus</i>	FP, FSM, MI, NC	<i>Microphis biocellatus</i> ^{FW}	Fi, PNG
<i>Corythoichthys ocellatus</i>	PNG, SI	<i>Microphis brachyurus brachyurus</i> ^{FW}	AS, Sa
<i>Corythoichthys schultzi</i>	FP, MI, NC, PNG, To	<i>Microphis brevidorsalis</i> ^{FW}	Fi, PNG, SI
<i>Corythoichthys paxtoni</i>	NC	<i>Microphis cruentus</i> ^{FW}	NC
<i>Corythoichthys polynotatus</i>	FSM,	<i>Microphis leiaspis</i> ^{FW}	Fi
<i>Cosmocampus banneri</i>	FI, MI, NC, PNG	<i>Microphis mento</i> ^{FW}	PNG
<i>Cosmocampus darrosanus</i>	FSM	<i>Microphis manadensis</i> ^{FW}	FSM, SI
<i>Cosmocampus howensis</i>	Fi, SI	<i>Microphis retzii</i> ^{FW}	PNG
<i>Cosmocampus maxweberi</i>	MI, PNG, Sa	<i>Microphis spinachioides</i> ^{FW}	PNG
<i>Doryrhamphus chapmani</i>	NC	<i>Minyichthys brachyrhinus</i>	Fi
<i>Doryrhamphus dactyliophorus</i>	AS, FP, MI, NC, PNG, Sa	<i>Minyichthys myersi</i>	FSM, PNG
<i>Doryrhamphus excisus excisus</i>	AS, CI, Fi, FP, FSM, MI, NC, PNG, Sa, SI	<i>Penetopteryx taeniocephalus</i>	Ki, Va
<i>Doryrhamphus janssi</i>	FSM, PNG, SI	<i>Phoxocampus belcheri</i>	Fi, PNG
<i>Doryrhamphus negrosensis negrosensis</i>	PNG, Va	<i>Phoxocampus diacanthus</i>	MI, NC, PNG, Sa
<i>Festucalex erythraeus</i>	NC, SI, Va	<i>Siokunichthys herrei</i>	Fi, SI
<i>Festucalex gibbsi</i>	NC	<i>Solegnathus hardwickii</i>	NC
<i>Festucalex wassi</i>	AS, Fi	<i>Syngnathoides biaculeatus</i>	FSM, MI, NC, PNG, Sa
<i>Halicampus boothae</i>	Fi, NC	<i>Trachyrhamphus bicoarctatus</i>	NC, PNG
<i>Halicampus dunckeri</i>	Fi, FSM, NC, PNG, SI	<i>Trachyrhamphus longirostris</i>	PNG
<i>Halicampus brocki</i>	MI	<i>Urocampus carinirostris</i>	PNG
<i>Halicampus macrorhynchus</i>	PNG, SI		

FW Freshwater species.

DRIED SYNGNATHID TRADE IN THE SOUTH PACIFIC

There were no reports of dried syngnathid exploitation from any South Pacific nation (Greg Bennett, pers. comm.; Blake Dinkin, pers. comm.). Import data from Hong Kong and Taiwan did not list any South Pacific country as the source for dried syngnathids.

LIVE SYNGNATHID TRADE IN THE SOUTH PACIFIC

Exports

The only confirmed exploitation of live syngnathids from the South Pacific was trade data from Europe in 1998. Three wild-caught seahorses (recorded as *Hippocampus* spp.) were exported from the Solomon Islands to Germany for commercial purposes. FAO (1998) reports that there was a single exporter in each of the Cook Islands and Vanuatu exporting aquarium fish and live rock to Europe and the U.S.A. However, it appeared that seahorses were not among the species targeted by these collectors.

ECONOMIC IMPORTANCE OF THE SYNGNATHID FISHERY

The economic importance of syngnathid fishery in the South Pacific was considered to be negligible.

CONSERVATION CONCERNS ABOUT SYNGNATHIDS IN THE SOUTH PACIFIC

The only real conservation concern regarding syngnathids in the South Pacific region would be habitat degradation and direct mortalities associated with destructive fishing methods such as dynamite or cyanide fishing. These destructive methods of fishing are outlawed in all of the countries and territories listed, but there may still be illegal use. Fiji, Marshall Islands, Tonga and Samoa have exported considerable amounts of coral and aquarium fish but the trade was much smaller than from the Philippines and Indonesia (Green and Shirley, 1999). Combined with lower human population density, incidences of overfishing have been lower and thus pressure to use destructive fishing methods lower.

COMPARISON TO 1996 SURVEY FINDINGS

There appeared to have been no changes in the use (or lack thereof) of syngnathids in South Pacific nations since Vincent (1996). There have been some additions to species lists and distribution records.

CONCLUSIONS

It appeared that syngnathids were not used locally in the South Pacific or caught and traded elsewhere in the world. These conclusions were based on rather limited information, but there were many inferential reasons to suggest that syngnathids were not exploited to any real extent. Most of the South Pacific nations have very small populations relative to the amount of available marine habitat for syngnathids. Furthermore, much of the fishing effort was artisanal in nature, using gear that was unlikely to catch syngnathids. Commercial fishing was almost exclusively for various species of tuna, again using methods that did not catch syngnathids. Finally, there did not appear to be historical use of syngnathids.

Issues that may affect syngnathids in South Pacific countries are related to habitat degradation. Unselective and/or destructive fishing methods (dynamite, cyanide) have the potential to kill syngnathids or degrade their habitats.

More data are needed on all aspects of syngnathid biology and trade from South Pacific nations.

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