

Fisheries, large-scale trade, and conservation of seahorses in Malaysia and Thailand

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ABSTRACT

1. All seahorse species (genus *Hippocampus*) are listed under CITES Appendix II, requiring that exports of these fishes must be regulated for sustainability. Preliminary trade surveys and anecdotal reports suggested Malaysia and Thailand represented an important source for seahorses used globally in traditional medicine, curios, and aquarium display, but few historic trade or fisheries data are available. Baseline information about pre-CITES catch and trade is essential for managing seahorse fisheries and trade under CITES, and for understanding present-day effects of CITES regulation on the seahorse trade.

2. In 1998–1999, seahorse fisheries and trade in both countries were assessed by interviewing participants at many levels of the trade and corroborating those surveys with official trade documents.

3. Seahorses were found to be landed primarily as trawl bycatch. Malaysia's catch of 2900 kg year⁻¹ was less than the estimated domestic consumption (5500–6000 kg year⁻¹), whereas Thailand's catch of 6600 kg year⁻¹ apparently far exceeded domestic consumption (~520 kg year⁻¹).

4. Both countries imported seahorses from and exported to other Asian nations. Import statistics from Hong Kong SAR and Taiwan recorded maximum annual trade from Malaysia at 1280 kg year⁻¹. Trade surveys indicated that Thailand exported at least 5000 kg annually (similar to the estimation of catch), but national Customs records reported 10 500 kg year⁻¹ in exports, supported by official import records from Hong Kong SAR and Taiwan which indicated that Thailand was the source of up to 11 400 kg year⁻¹.

5. Fishers and traders in both countries reported decreasing availability of seahorses, raising conservation concerns. These apparent declines, in combination with substantial domestic consumption, point towards the challenges that Malaysia and Thailand face in establishing sustainable levels of exports under CITES. Copyright © 2010 John Wiley & Sons, Ltd.

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INTRODUCTION

Seahorses (*Hippocampus* spp.) are traded extensively for use in traditional Chinese medicine (TCM), as aquarium fish, and as curiosities, on a global scale that was historically unlikely to have been sustainable (Vincent, 1996). In response to concerns about potential impacts upon wild seahorse populations, the international trade in all seahorses came under the control of Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora in 2002 (CITES,

2002), which was implemented in May 2004. The CITES listing allows continued international trade, in recognition that seahorses play economic, medicinal, cultural, and educational roles, but requires that all 175 signatory nations (Parties) ensure that their exports are both sustainable (i.e. not considered detrimental to wild populations) and legally sourced. Implementing the listing is challenging, however, because of a relative dearth of knowledge on seahorse biology, fisheries, and trade. Few seahorse populations have been surveyed, effectively no landings data are available, and few

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countries have historically recorded any aspect of seahorse trade, to the point where many officials did not realize before 2004 that their countries were involved (A. Vincent, pers. obs.). Official CITES export documentation (<http://www.unep-wcmc.org/species/sca/scs.htm>) dates only from 2004 and is still somewhat incomplete. Given these challenges, Parties are seeking advice on how best to implement the listing, and information about current and historical seahorse exploitation and trade is urgently needed.

In the absence of formal, comprehensive records, surveys of resource users (e.g. fishers, traders) represent the best available means of gathering such information within feasible timeframes and over large geographic areas. The first seahorse trade surveys were conducted from 1993–1995, and revealed that the dried seahorse trade totalled at least 45 000 kg annually in four Asian regions alone (mainland China, Hong Kong SAR, Singapore, and Taiwan), and involved at least 32 nations (Vincent, 1996). Demand for species used in TCM increased greatly from the mid-1980s, at least partly as a result of economic reforms in mainland China (Vincent, 1996). Simultaneously, the live seahorse trade also increased, perhaps because new technology made it more feasible to keep marine aquarium species (Vincent, 2006).

The original surveys on seahorse trade also indicated worrying trends in seahorse abundance, with catch and trade declining relative to effort, in some cases on the order of 15–50% over 5 years (Vincent, 1996). A combination of direct and indirect fishing pressures and/or environmental impacts led to the inclusion of all seahorses in the IUCN Red List as Endangered, Vulnerable, or Data Deficient (IUCN, 2009). All seahorse species studied to date appear to grow quite quickly and to mature relatively early but other elements of their life history, such as obligate parental care and mate- and site-fidelity, may make these fishes particularly sensitive to perturbations in their populations and environment (Foster and Vincent, 2004). They are also very vulnerable to non-selective and destructive fishing gear that operates in many of their key habitats (seagrass beds, coral reefs, mangroves, and estuaries; Hodgson, 1999; Kaiser *et al.*, 2002). Further degradation of these habitats in response to other human pressures is also presumed to have negative consequences for seahorse populations (Tun *et al.*, 2004).

A second wave of trade surveys, which was launched in the late 1990s, added to concerns that many populations or species of seahorses might be threatened as a result of overfishing, non-selective fishing methods, and habitat degradation (McPherson and Vincent, 2004; Baum and Vincent, 2005; Giles *et al.*, 2005). The seahorse trade appeared to have expanded globally, drawing supplies for TCM from distant sources such as Africa and Latin America (McPherson and Vincent, 2004; Baum and Vincent, 2005). Heavy exploitation appeared, moreover, to have contributed to population declines in some of these regions (Latin America: Baum and Vincent, 2005) as well as in regions with a longer history of seahorse fishing (Vietnam: Giles *et al.*, 2005).

To date, little is known about seahorse fisheries and exploitation in two southeast Asian countries, Malaysia and Thailand, which have long been inferred to contribute to the trade. In the mid-1990s, trade statistics from Taiwan and anecdotal reports from China and Hong Kong suggested that Malaysia was an important source of dried seahorses, while Taiwan's official Customs records indicated that the

jurisdiction imported more dried seahorses from Thailand than from any other source (Vincent, 1996). There were also hints about potentially significant domestic consumption of seahorses for traditional medicine (TM), particularly TCM, in both Malaysia and Thailand (Vincent, 1996).

We undertook this study to obtain both quantitative and qualitative understanding of seahorse trade and domestic use in Malaysia and Thailand in 1998–1999. The objectives were to: (1) determine seahorse species in trade; (2) identify trade routes, including source and destination markets; (3) quantify numbers and/or volumes of seahorses, both live and dried, that were caught, consumed, and traded; and (4) assess trends in seahorse catch rates, supply, demand, domestic use, imports, and exports, particularly where such patterns might indicate declines in Malaysian and Thai seahorse populations. The findings provide baseline information that pre-dates the CITES listing, and is therefore essential for detecting and assessing the current impacts of CITES implementation on catch and trade. This understanding will help to guide monitoring and management measures for seahorse fisheries, trade, and conservation in these countries, not least by assisting these Parties to meet their obligations under CITES.

METHODS

Interviews and formal records

Seahorse catch and trade information was gathered in Malaysia and Thailand through interviews with fishers, buyers, wholesalers, retailers, exporters, government officials, and other experts (Table 1). The senior author conducted 312 interviews in Malaysia from October to November 1998 and April to May 1999 (Figure 1; Table 1), and 170 interviews in Thailand from November to December 1998 and in June 1999 (Figure 1; Table 1). Surveys covered urban centres and fishing regions that were known or likely to participate in the trade, according to prior surveys (Vincent, 1996) and anecdotal reports, and additional regions that were mentioned during interviews. Surveys included coastal areas in Peninsular and eastern Malaysia, and in Thailand, along the Andaman Sea and Gulf of Thailand (Figure 1). Participants in the seahorse trade were categorized according to their roles (e.g. fisher, primary buyer, secondary buyer, exporter, importer, wholesaler, retailer, and consumer), although an individual

Table 1. Number of respondents interviewed during seahorse trade surveys in Thailand and Malaysia, listed by occupation

Respondent type	Number of respondents	
	Malaysia	Thailand
Fishers and gleaners	124	52
TCM and TM traders	83	49
Dried marine product traders	16	31
Aquarium fish traders	20	10
Marine curio and charm traders	12	10
Fisheries scientists and officers	22	3
Trade or Customs officials	5	0
Academics	4	3
Conservationists	5	3
Others (e.g. boat owners, local residents)	21	9
Total	312	170

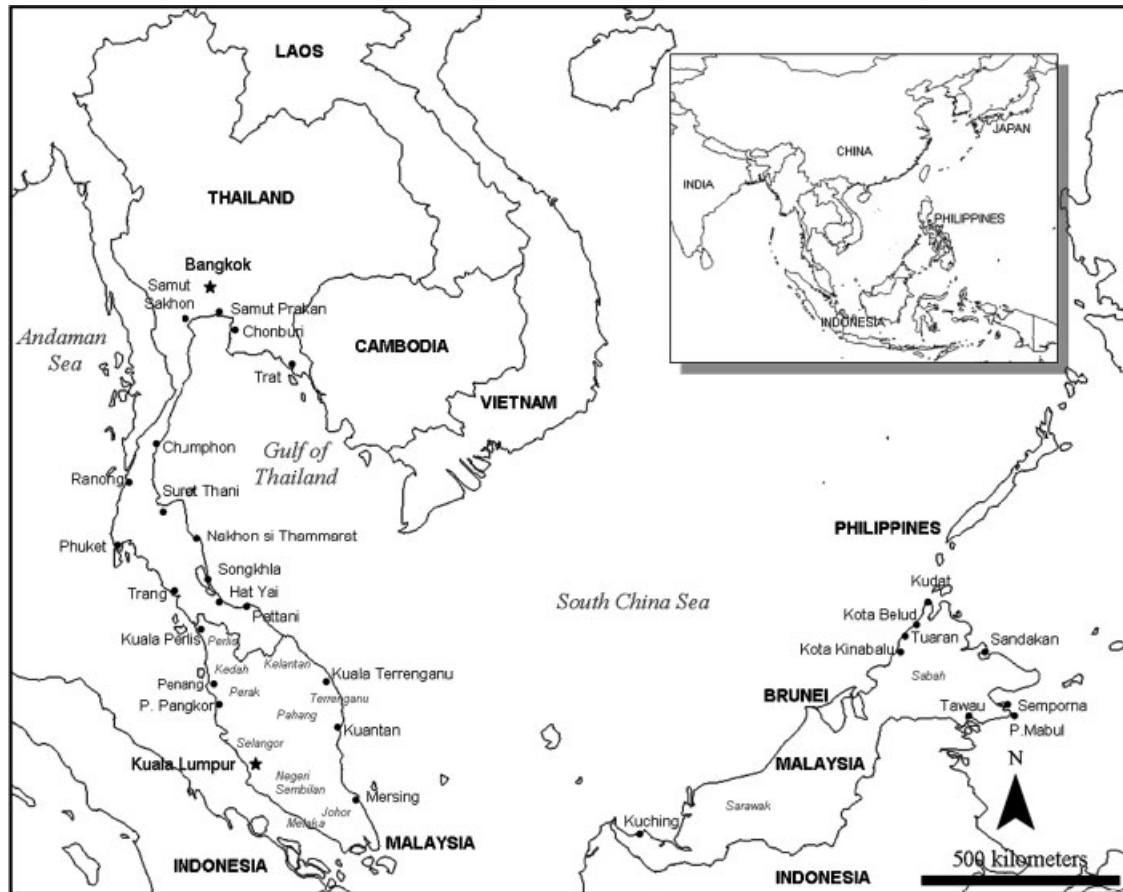


Figure 1. Sites surveyed in Malaysia during October–November 1998 and April–May 1999, and in Thailand during November–December 1998 and June 1999. Stars locate capitals of Malaysia and Thailand, both of which were surveyed.

could be active in more than one role. Traders were also generally categorized according to trade 'levels'; seahorses followed trade routes beginning with lower-level traders (e.g. fishers and primary buyers), through intermediate-level traders (e.g. secondary and tertiary buyers), to higher-level traders (e.g. exporters, wholesalers), although the actual number of levels within individual trade routes varied. Questions and answers were interpreted between English and Malay, Thai, or Chinese dialects (including Cantonese, Hakka, and Mandarin) by local research assistants.

Respondents were located through a combination of haphazard sampling (e.g. of fishers, TCM shops) and snowball sampling (a method where new respondents are located through already established contacts; Gubrium and Holstein, 2001) amongst respondents who were more difficult to locate, such as seahorse importers or exporters. Interviews were semi-structured and sought to obtain information on past and present trade routes, volumes, values, demand, supply, uses, and availability. Information was cross-checked within interviews by rephrasing key questions, and by comparing information provided by participants within and across trade levels. Information provided by respondents who were considered to be unreliable was excluded from the analyses.

Respondents were generally communicative in both countries (particularly at lower levels of the trade), possibly because seahorses represented only a minor source of income for most respondents. However, participants were guarded about revealing specific sources of supply, especially TCM

retailers in Malaysia and exporters in Thailand. Trade details were particularly difficult to obtain in the Malaysian states of Sabah and Labuan, where some seahorses appeared to be imported from the Philippines through illicit and rarely discussed trade routes (i.e. without passing through Malaysian Customs), and in Ranong, Thailand, where a language barrier hampered interviews.

Data obtained through interviews were complemented by official fisheries and trade statistics produced by the Malaysian government and the Royal Thai government. Other key sources included seahorse import records from other nations. Such records from the Taiwanese Directorate General of Customs began in 1983, while records from the Census and Statistics Department in Hong Kong SAR date from 1998. Data from Hong Kong SAR were particularly important because of the region's role as a key entrepôt in the seahorse trade (Vincent, 1996). More recently, both Taiwan and Hong Kong SAR have provided official CITES records on seahorse trade, the latter through its Agriculture, Fisheries and Conservation Department (AFCD).

Species

Traded seahorse species were identified by examining specimens, where possible, sold by aquarium, TCM, TM, and curio retailers (with reference to Lourie *et al.*, 1999) and in interviews with fishers and traders. Respondents were also asked to describe the colour, size, and texture of the seahorses

they caught and/or sold. Fishers were also surveyed specifically about habitat types and depths where they obtained seahorses, and traders were asked about the probable origins of the seahorses they bought and sold.

Seahorse catch estimates

Annual seahorse bycatch volumes (seahorses year⁻¹ and kg year⁻¹) were calculated for Malaysia by combining seahorse landing estimates obtained from trawl fishers and boat owners with trawl fleet statistics from the Department of Fisheries (Anon., 1998, 1999). Reports from individual respondents on landings for discrete time periods (i.e. per week, trip, month, or year) were roughly scaled to annual estimates after accounting for apparent seasonal variation in catches. Within each region, catch estimates for individual trawlers were then combined to calculate mean catch per unit effort (seahorses per vessel per year), which in turn was multiplied by the assumed number of trawl vessels of each type operating in each region, to obtain a rough estimate of total annual seahorse trawl landings. Seahorse numbers were converted to kilograms, using the average weight of collected specimens that were caught by Malaysian vessels (3.18 g per seahorse, $n = 56$). Numbers of trawlers on each coast of Peninsular Malaysia were estimated by multiplying the proportion of trawlers within each size class of inboard-powered vessels (i.e. classes designated 'A', 'B', 'C' and 'C2' according to gross registered tonnage; Anon., 1998) by the number of inboard vessels of each size for each coast (Anon., 1998). It was assumed that the number of trawl vessels in Malaysia did not change significantly from 1996–1997, the last date for which government statistics were available at the time of the surveys.

Bycatch figures for Thailand were also derived using estimates from trawl fishers and boat owners in combination with official fisheries statistics (Anon., 1997, 2001). Since seasonal variability was not always reported, a closed season of 3 months was assumed, in accordance with national restrictions on large fishing vessels. Catch estimates were calculated across all size classes of vessels, because trawl fishers were often unsure about the official size classes of their vessels and so individual catch estimates could not be segregated according to vessel size. For central Thailand, where fishers were not surveyed, potential landings were estimated from the number of fishing vessels registered for the area and the estimated seahorse catches by eastern Thai fishing boats (which were lower and therefore more conservative than estimated catches by southern Thai boats). Seahorse catch estimates were converted from numbers of seahorses to kilograms based on the average weight of Thai-caught specimens gathered during surveys (3.13 g per seahorse, $n = 96$).

Trade volumes

Quantities of dried and live seahorse imports and exports were estimated based on respondents' reported trade volumes at all levels of the trade. These estimates were then extrapolated to account for all exporters and importers that were reported from surveys to operate in the country, and summed to determine annual export and import volume estimates. Estimated trade quantities were compared across all levels of the trade, and then against national export and import

statistics, customs records, and CITES reports (some of which were already available before this reporting became mandatory in 2004).

Domestic consumption and pricing

Sales volume estimates were provided by TCM retailers ($n = 38$, Malaysia; $n = 45$, Thailand) for defined lengths of time (e.g. daily, weekly) and were standardized to annual quantities. Resulting volumes were converted to kilograms, using the average retail seahorse size in each country (based on samples gathered during surveys: 3.15 g per seahorse, $n = 134$, Malaysia; 2.86 g per seahorse, $n = 16$, Thailand) and extrapolated to the total estimated number of TCM shops that may have carried seahorses. The total numbers of TCM businesses in both countries were determined from field observations and local telephone (Yellow Pages) directories. Given that these directories did not provide a comprehensive listing of TCM businesses, it was necessary to incorporate the proportion of surveyed shops that were represented in these directories into calculations. Annual volumes for Bangkok shops were estimated separately from the rest of Thailand because sales in Bangkok were relatively higher than in the rest of the country.

Annual seahorse volumes could only be estimated for three curio retailers in Malaysia, and none in Thailand. Estimated annual volumes from surveyed marine aquarium traders for Malaysia ($n = 8$) and Thailand ($n = 2$) and assumed to be representative of all aquarium shops known from surveys in both countries.

Reported prices for seahorses were converted from Malaysian Ringgit (MYR) and Thai Baht (THB) into United States dollars (USD) using average rates of exchange from the time of surveys (3.8 MYR = 1 USD; 35.8 THB = 1 USD). Prices are reported by weight and by number because considerable variation in the size and species of dried seahorse sold or traded precluded meaningful conversion. Within the dried trade in both Malaysia and Thailand, values were more frequently provided by fishers and retailers than by informants at higher trade levels, such as exporters, importers and wholesalers. Wherever respondents provided a range of values, the midpoint was used in calculations. Means are presented \pm one standard deviation.

RESULTS

Species and distributions

All six seahorse species that were known to occur in Malaysian waters were traded within the country: *H. barbouri* (the most common species in TCM, but also sold live), *H. comes* (TCM and curio), *H. histrix* (curio), *H. kuda* (TCM and live), *H. spinosissimus* (TCM, local TM, and curio) and *H. trimaculatus* (TCM and curio). Four of the possibly five species in Thai waters occurred in Thai trade: *H. kelloggi* (TCM), *H. kuda* (TCM, live, and curio), *H. spinosissimus* (TCM, live, and curio) and *H. trimaculatus* (TCM). Although *H. mohikei* occurred in Thai waters, no evidence was found of this species in trade. It was difficult to determine the precise origins of seahorses caught and/or traded in both countries because fishers covered wide areas that extended beyond

national waters, and most traders did not segregate seahorses according to source of supply or species.

Domestic use

Dried seahorses were most commonly used throughout Malaysia and Thailand for TCM, sold either unprocessed or chemically whitened ('bleached'). All evidence from seahorse trade research indicates that bleaching is only carried out in Hong Kong (Vincent, 1996), suggesting that bleached seahorses sold in Malaysia or Thailand had probably been imported or reimported from Hong Kong. Seahorses were also sold dried (or kept by fishers) for Indonesian-style TM (known as *jamu*), other traditional and folk medicines, curios, or magic charms. Live seahorses were also traded and kept as aquarium pets in both countries.

Dried seahorse trade

Trade structure

Malaysia. Trade routes for dried seahorses caught and sold in Malaysia were complicated. Fishers in Malaysia sold to dockside buyers, retailers (of TCM, local TM, curios, and magic charms), wholesalers, exporters, and to TCM users. Thereafter, seahorses were reportedly sold to consumers, traded between eastern and Peninsular Malaysia, or exported for TCM markets in other Asian countries. In addition to Malaysian-caught seahorses, the domestic market also sold imported seahorses. These were purchased either from established wholesalers (in Malaysia or abroad) or from itinerant salespeople from within Malaysia, or from Hong Kong SAR, Indonesia, the Philippines, or Singapore. Re-exports of imported seahorses were described as well, particularly from Sabah.

Thailand. Fishers in Thailand sold dried seahorses to primary buyers in ports throughout the country. Higher-level buyers either purchased seahorses directly from local fishers or travelled between key ports to gather their stock from primary buyers. Retailers of dried seahorses ($n=20$) reported that they bought these from wholesalers ($n=10$), itinerant agents ($n=8$), fishers ($n=9$), and/or directly from Hong Kong SAR and mainland China ($n=5$). Some retailers preferred to buy from wholesalers, which were reportedly only located in Bangkok.

Seahorse catches

Nearly all of the dried seahorses originating in Malaysia and Thailand were landed as bycatch, mostly by large-scale trawlers, but also in other fishing gear. Some small-scale trawlers and divers occasionally targeted seahorses by concentrating their fishing efforts in known seahorse habitats.

Malaysia. Trawlers in Malaysia caught seahorses incidentally off the coasts of Peninsular Malaysia, Sarawak, Sabah, and Labuan, as well as in waters near Brunei, Indonesia, and Thailand. According to Malaysian fisheries statistics, trawlers accounted for approximately half of all recorded marine fish landings in the country, even though they only comprised 18% ($n=6035$) of licensed fishing vessels in 1998 and 1999 (Anon., 2002). Trawlers of all size classes landed seahorses in Malaysia

Table 2. Estimated annual trawl catches of seahorses in Malaysia, by region and size category of trawlers, 1998/1999 based on surveys and trawl fleet statistics from the Department of Fisheries (Anon., 1998). Number-to-weight conversions based on a conservative average of 3.18 g per dried seahorse

Region	Average catch (seahorses · trawl vessel ⁻¹ · year ⁻¹) (n)			Estimated no. of trawl vessels			Average catch × no. of trawl vessels			Total annual catch per region			
	A	B	C	A	B	C	A	B	C	Number	Weight (kg)		
East Peninsular Malaysia	4 (1)	229 (3)	330 (2)	702	434	271	136	2808	99 386	89 430	130 968	322 592	1027
West Peninsular Malaysia	72 (1)	206 (5)	122 (6)	1065	840	450	89	76 680	173 040	54 900	9612	314 232	999
Sarawak	?	11 (2)	394 (5)	292	141	105	108	?	1551	41 370	1080	44 001	140
Sabah	1.2 (5)		462 (21)	894		503		1073		232 386		233 462	742
Labuan	n/a		1092 (4)	n/a		5		n/a		5460		5 460	17
TOTAL												919 747	2924

Trawl vessels are categorized by size as follows: A < 19.9 Gross Registered Tonnage (GRT), 20 < B < 39.9 GRT, 40 < C < 69.9 GRT, C2 > 70 GRT. Sample sizes (n) indicate numbers of interviews on which the presented 'Average annual catches' are based. Source: Authors' research and Malaysian fisheries statistics (Anon., 1998, 1999). Size categories are combined where precise vessel sizes could not be determined during surveys.

(Table 2). All sizes of vessels trawled year-round, with the exception of those operating on the eastern coast of Peninsular Malaysia, where rough monsoonal conditions precluded fishing for approximately 1 month annually. Nets were typically set for approximately 3 hours, after which some seahorses were reportedly still alive, and so could theoretically have been returned to the ocean.

Malaysia's artisanal and commercial trawl fleet caught an estimated 920 000 seahorses (2924 kg) as bycatch in 1999 (Table 2). The greatest incidental seahorse catches were obtained by commercial trawlers (i.e. size classes 'B', 'C' and 'C2'), rather than inshore fishers (class 'A') (Table 2). Among commercial trawlers, there was no clear relationship between vessel size and seahorse landings. The largest estimated annual catch per boat was for eastern Peninsular Malaysia, where 'C' and 'C2' fishers estimated catches of 0–50 seahorses per 8–10 day trip ($n = 4$), followed by Labuan, where trawlers generally caught three to ten seahorses per 1–3 day trip ($n = 4$). The greatest quantities of seahorses were caught on the east coast of Peninsular Malaysia, followed by the west coast, and then Sabah (Table 2). Labuan had the largest average catch per trawl vessel but relatively few vessels in the area ($n = 5$, over all size categories) (Table 2). Not all seahorses obtained as bycatch entered the trade. Of the 60 trawl fishers or owners who specified the fate of seahorses caught by their vessels, 52% ($n = 31$) sold some or all of the seahorses they caught, 50% ($n = 30$) kept some or all for personal use, and 23% ($n = 14$) threw some or all seahorses away.

Thailand. Thai trawlers captured seahorses incidentally in both the Gulf of Thailand and the Andaman Sea, fishing in Thai, Burmese, Cambodian, Indonesian, Malaysian, and international waters for trips ranging in length from one night to as long as one year ($n = 22$, median = 21 days). Boats fishing for longer than 10 days at a time ($n = 14$) usually travelled beyond Thai waters. Otter-board trawlers in Thailand comprised 30% ($n = 6441$ of 21470) of the total number of licensed fishing vessels in 1999. Pair and beam trawlers also fished in Thai waters, although in much smaller numbers, and were not encountered during surveys. Therefore, all subsequent mention of trawling refers specifically to the otter-trawl fishery. Of the trawl fishers interviewed, 87% reported having caught seahorses at some point ($n = 26$ of 30).

Thailand's trawl fleet caught an estimated total of 2.1 million seahorses (6600 kg) annually (Table 3), based on

average catch volumes from surveys and vessel numbers from official statistics (Anon., 2001). Most seahorses were landed in southern Thailand, followed by central coastal Thailand (estimated by the average catch in eastern Thailand multiplied by the number of vessels in this region), and eastern coastal Thailand (Table 3).

Domestic consumption of dried seahorses

Malaysia. Malaysia may have consumed 3000 kg of dried seahorses annually for TCM. Annual volume estimates ranged from 0.04–10 kg sold per year per retailer (mean = 2.32 kg year⁻¹, $n = 38$). Using a rough estimated total of 1700 shops in Malaysia and assuming that 78% of these shops sold seahorses, in accordance with the proportion of shops that sold seahorses among those surveyed ($n = 54$ of 69), some 1300 Malaysian TCM shops may have traded seahorses from 1998–1999. Multiplying the mean annual shop volume with the estimated number of TCM shops that may have carried seahorses yielded a rough approximation of 3016 kg sold by TCM retailers per year, or approximately 964 000 average-sized seahorses.

Smaller amounts of dried seahorses were consumed for purposes other than TCM. Sales estimates from *jamu* retailers ($n = 7$) suggested that approximately 472 kg of seahorses were traded annually in seahorse-based pre-packaged *jamu* medicines. Combining this average for the 30–50 *jamu* shops in Kuala Lumpur and taking into consideration the proportion of *jamu* shops surveyed that carried seahorse-based *jamu* ($n = 7$ of 9), it was estimated that approximately 1572–2620 kg of seahorses could have been sold annually as *jamu* in Kuala Lumpur alone. In addition, the annual reported volume of dried seahorses sold by three curio traders totalled 2.5 kg.

Thailand. At least 520 kg were estimated to be consumed annually for TCM in Thailand, based on approximate numbers of shops and retailers' estimates of annual sales. In Bangkok, total annual sales were estimated at roughly 480 kg year⁻¹, based on average volumes reported by TCM retailers (3.0 ± 1.6 kg year⁻¹, $n = 7$), and an estimated 159 retail shops that were believed to sell seahorses. Shops outside of Bangkok sold an annual average of 2.1 kg ($n = 8$); together, the 19 known TCM retailers outside of Bangkok may therefore have sold approximately 40 kg year⁻¹ around 1998. The combined minimum estimate of 520 kg sold in the domestic TCM trade

Table 3. Estimated annual catch volumes of seahorses by Thai otter-board trawlers, based on median catch volumes from surveys, and vessel numbers from Anon. (2001). Number-to-weight conversions were based on a conservative average of 3.13 g per dried seahorse. Annual volumes for 'Central Thailand' were roughly estimated based on an average catch equivalent to Eastern Thailand and the number of otter trawlers for the remainder of the country (Anon., 1997)

Region	Median annual catch (seahorses · trawl vessel ⁻¹ · year ⁻¹)(n)	Number of vessels	Total annual catch per region	
			Number	Weight (kg)
Eastern Thailand	218 (10)	1124	245 032	767
Southern Thailand	421 (16)	3439	1 447 819	4532
Central Thailand	218	1878	409 404	1281
Total		6441	2 102 255	6580

Values given in italics are contingent upon the assumption that fishers in the 'Central Thailand' caught similar numbers of seahorses to fishers in Eastern Thailand. Sample sizes (n) indicate numbers of interviews on which the presented 'Median annual catches' are based. *Source:* Authors' research, with vessel numbers from Anon. (1997) and Anon. (2001).

around 1998 would equal roughly 180 000 seahorses, using the average weight of 2.86 g for retailed seahorses in Thailand. The total number of shops in Thailand was, however, almost certainly higher than estimated here, given that not all regions were surveyed. Although the wholesale trade was concentrated in Bangkok, it was not possible to estimate the number of wholesalers sufficiently to assess trade volumes at that level.

In Thailand, the volume of seahorses used for medicines other than TCM was not estimated, although seahorses were reportedly used in folk medicines. Seahorse curios were observed for sale in Bangkok, Bang Saen, and Phuket retail outlets, but no retailers reported annual sales volumes.

Dried seahorse imports

Malaysia. Of 65 dried seahorse traders who discussed sources of supply, 51% indicated that some or all of their seahorses came from outside Malaysia. Malaysian-based TCM retailers who purchased imported seahorses from Malaysian wholesalers ($n = 13$) suggested that imports originated from mainland China, Hong Kong SAR, Indonesia, Japan, the Philippines, Singapore, and Thailand.

Thailand. No estimate was obtained for dried seahorse imports to Thailand, although some Thai retailers ($n = 5$ of 45) reported ordering seahorses directly from Hong Kong SAR and mainland China.

Dried seahorse exports

Malaysia. Exports of Malaysian seahorses were reported from several areas of the country. Surveys indicated that seahorses destined for Thailand were exported primarily from Peninsular Malaysia, while exports from Sandakan (Sabah) went to Hong Kong SAR and Singapore, as well as to national destinations in Peninsular Malaysia. Exports from Sabah probably included seahorses from the nearby southern Philippines, along with Malaysian-caught supplies. Similarly, retailers in Labuan and Kota Kinabalu who sold dried seahorses to Hong Kong SAR, Taiwanese, and Chinese tourists probably traded a mixture of Malaysian and Filipino seahorses. Hong Kong SAR Customs records (1998–2004), and Taiwan Official

statistics (1983–2004), corroborate the fact that Malaysia exported to both these countries.

Although estimates from interviews were not sufficient to allow for extrapolation to overall export volumes of seahorses from Malaysia, available information did suggest the relative importance of the two principal trade destinations. Hong Kong SAR Census and Statistics Department records showed imports from Malaysia in annual volumes of 40 kg year⁻¹ (in 2004) to 985 kg year⁻¹ (in 2003; Figure 2). Taiwanese official data included reports of annual seahorse import volumes from Malaysia of 64 kg year⁻¹ (in 1997) to 302 kg year⁻¹ (in 1998; Figure 2).

Thailand. According to respondents ($n = 17$), dried seahorses were sent from Thailand to Hong Kong SAR ($n = 11$), Taiwan ($n = 8$), mainland China ($n = 4$), Singapore ($n = 2$), Japan ($n = 2$), and South Korea ($n = 2$). Only two of an estimated minimum of five exporters in Thailand provided annual trade volumes, which averaged 1000 kg year⁻¹. If this volume were representative of all five exporters, then at least 5000 kg year⁻¹ may have been exported around 1998. This quantity was similar in scale to that estimated by the country's largest exporter, who stated that Thailand's annual export volume totalled roughly 7000–8000 kg year⁻¹. Thai official records (based on voluntary declarations) only showed exports to

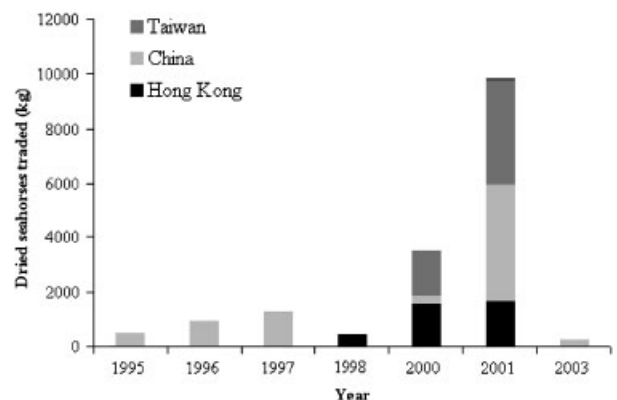


Figure 3. Dried seahorse exports reported by Thailand to the Thai government and CITES for mainland China, Taiwan, and Hong Kong SAR from 1998–2003. No data were available for 1999 and 2002.

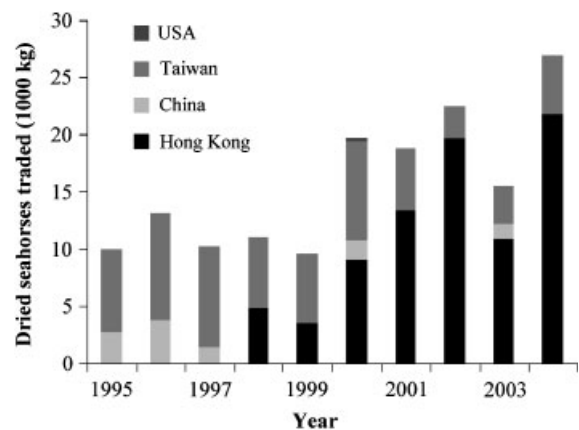


Figure 4. Dried seahorse imports reported by Taiwan, mainland China, Hong Kong SAR, and the USA as coming from Thailand.

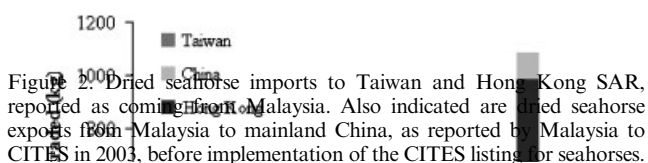


Figure 2. Dried seahorse imports to Taiwan and Hong Kong SAR, reported as coming from Malaysia. Also indicated are dried seahorse exports from Malaysia to mainland China, as reported by Malaysia to CITES in 2003, before implementation of the CITES listing for seahorses.

Hong Kong SAR, Taiwan, and mainland China (Figure 3), ranging in total from 540 kg year⁻¹ (in 1995) to 10 538 kg year⁻¹ (in 2001).

Government trade statistics from Hong Kong SAR and Taiwan reported imports from Thailand totalling approximately 11 400 kg in 1998 and 10 000 kg in 1999. From 1995 to 2004, imports from Thailand to Hong Kong SAR, the People's Republic of China, and Taiwan reportedly averaged 15 400 kg (Figure 4). The figures from Hong Kong SAR Census and Statistics were about 4.5 times greater than the official statistics for CITES purposes that are kept by the Hong Kong SAR Agriculture, Fisheries, and Conservation Department. In contrast, Mainland China reported receiving an average of only 2640 kg/year from Thailand between 1995 and 1997, and smaller quantities in 2000 and 2003 (Figure 4), and Taiwan reported average imports from Thailand of approximately 6300 kg/year between 1995 and 2004. During trade surveys in other regions, importers in Hong Kong SAR and Taiwan (B. Kwan unpub. data) commented that the seahorses they obtained from Thailand were generally larger and of higher quality than those from countries such as the Philippines, Indonesia, and Brazil, and were thus more desirable.

Dried seahorse prices

Malaysia. Dried seahorse prices in Malaysia varied widely, both within and across regions. Seahorse prices generally increased with seahorse size, and were higher for bleached seahorses, and in major urban centres. Traders who supplied seahorses to wholesalers or retailers were typically paid USD 53–79 kg⁻¹ in 1998, but these prices were highly variable. Large seahorses (> 15 cm) were highly valued and were sold to retail TCM customers in Tawau (Sabah) for approximately USD 921 kg⁻¹. Prices reportedly had increased by an average of 356+/-182% over 12 years ($n = 10$), a rate of increase far greater than rates of inflation, even given the impact of the Asian Economic Crisis in the late 1990s.

Thailand. Prices for dried seahorses in Thailand varied with seahorse size, perceived quality, and region. Export prices were difficult to gauge from the interviews; the only exporter who commented on buying prices reported purchasing seahorses for USD 17–28 kg⁻¹, less than fishers apparently received. Respondents noted that prices increased with seahorse size; for example, fishers in Phuket sold smaller seahorses (< 15 cm) for USD 0.06–0.84 and larger seahorses (~23 cm) for USD 3.35 each. Bleached seahorses also earned traders higher prices than unbleached specimens with bleached seahorses retailing for USD 684 kg⁻¹ ($n = 5$ retailers) compared with USD 528 kg⁻¹ ($n = 17$ retailers) for unbleached seahorses. Differences in prices among regions may have reflected regional differences in traded species. For instance, fishers and primary buyers in Ranong earned much higher prices than their counterparts in other regions, possibly because they traded primarily in large *H. kelloggi* seahorses.

Live seahorse trade

Live seahorse target fishery

Fisheries for live seahorses were seemingly non-existent in Malaysia and relatively minor in Thailand. Divers in the

Chonburi, Phuket, and Rayong regions of Thailand collected seahorses for the aquarium market, usually on order from buyers. The only known seahorse diver in Chonburi reported catching approximately 400–500 seahorses during the month of April and many fewer during the remainder of the year. When demand for the live trade was low, this fisher apparently sold seahorses on the dried market instead.

All six aquarium buyers in Phuket and Bangkok who described sources of supply reported buying live seahorses from Phuket, an area surrounded by Marine National Parks and where the collection of aquarium fishes would theoretically be prohibited. Phuket-based fishers were reluctant to discuss illegal fishing activities, but fishers from two villages did admit to being actively involved in the seahorse fishery. An estimated six participants operated out of one of these villages. Before the enforcement of legislation restricting fishing within a nearby Marine National Park in 1981, more than 100 fishers in one village were apparently involved in the trade, each collecting small numbers of seahorses. One Phuket-based compressor diver estimated that he had caught fewer than 100 seahorses during his 20 years of fishing. Another fisher from one of these villages estimated his annual catch at approximately 200 individuals. If this value were representative of the other five divers working in his village, their combined annual catch may have been roughly 1200 seahorses year⁻¹.

Live seahorse sales and imports

Malaysia. According to the fishers, traders, retailers, and wholesalers interviewed in Malaysia, all live seahorses that were sold or traded in the country had been imported. Collectively, the eight marine aquarium retailers surveyed sold a minimum of 1600 live seahorses year⁻¹, and named their sources as Indonesia ($n = 5$), the Philippines ($n = 3$), Singapore ($n = 5$), and Thailand ($n = 1$).

Thailand. Approximately 9000 live seahorses were sold annually in Thailand, based on the number of major aquarium shops in Bangkok ($n = 7$) and the average sales of individual retailers interviewed (30–800 month⁻¹, median = 108). In addition to these larger shops that were known to trade seahorses, approximately 20 other retailers sold smaller quantities of marine fishes which may have included seahorses. Many of the live seahorses sold in Thai retail shops had probably been imported. Based on two Bangkok retailers' volume estimates, at least 500 seahorses month⁻¹ (or 6000 seahorses year⁻¹) came from the Philippines. A third surveyed shop ordered undisclosed quantities from Indonesia.

Live seahorse exports

Malaysia. Officially, marine aquarium fish exports were prohibited by law in Malaysia (Wood, 2001), and none of the traders surveyed reported such shipments. Nonetheless, European import figures for Italy in 1998 and 1999, the Netherlands in 1999, and the United Kingdom in 2001 named

Malaysia as the source country for a few small shipments of live seahorses (European Commission, unpublished data).

Thailand. Three seahorse species (*H. histrix*, *H. kuda*, and *H. spinosissimus*) were among the 400 fish species for which live exports have been prohibited since 1988, if the fish are caught in Thailand (Entry and Exit of Goods Act, 1979). However, illegal exports apparently still occurred. Hong Kong SAR Census and Statistics Department records show imports from Thailand of 152 live seahorses in 1998 and 53 live seahorses in 2000. Thailand reported exports of two live seahorses to Belgium in 2000, and aquarium retailers in India and Pakistan stated that some live seahorses they sold came from Bangkok (A. Perry, unpub. data). Such exports may have been purchased from retailers rather than from fishers or wholesalers, and so may be included within our estimates of retail volumes.

Live seahorse prices

Malaysia. Traders in Malaysia reported consistent prices for live seahorses. Retail prices varied depending on seahorse colour, with dark individuals selling for slightly less (USD 3.40–7.90; $n = 8$ retailers) than brightly-coloured individuals (USD 6.60–26.30; $n = 4$ retailers). These colour-specific differences were also apparent in prices at the import level, with buying prices for dark seahorses ranging from USD 1.84–5.00 ($n = 6$), and for coloured individuals varying from USD 2.63–13.16 ($n = 3$). Importers did not comment on price differences in relation to source country.

Thailand. Prices for live seahorses varied according to seahorse colour. Fishers in Chonburi and Phuket ($n = 3$) reportedly sold plainly coloured seahorses for USD 0.84 and brightly coloured individuals for USD 2.79–5.59. One retailer in Bangkok reported buying seahorses for USD 2.79 from Phuket-based fishers and from the Philippines. According to this retailer, imported Indonesian seahorses were slightly more expensive, at approximately USD 3.63. An aquarium shop owner in Phuket described buying live seahorses from local fishers for USD 1.12. Aquarium retailers in Bangkok sold Thai and imported seahorses for roughly similar prices, ranging from USD 3.35–28.00 ($n = 6$).

Seahorse conservation

Seahorse catches in both countries were generally believed to have diminished over time, as had the availability of dried seahorses in trade. A general inference seemed to be that wild populations in the region had declined, although we are not able to quantify changes in effort. Changes in seahorse demand were more difficult to infer, as respondents' opinions varied with trade level and region, but relatively high rates of price increase in both countries suggest that, overall, demand for seahorses exceeded supply in the Malaysian and Thai markets.

Malaysia. Most of the fishers who discussed seahorse population trends suggested that population numbers or catches had declined ($n = 37$ of 52) or stayed the same ($n = 14$ of 52), whereas only one fisher believed they had

increased. According to fishers who quantified decreased catches, declines averaged $68 \pm 24\%$ over 12.5 years ($n = 25$). Most of those who noted declines remarked simply that there were many fewer seahorses ($n = 28$ of 37), but some ($n = 9$ of 37) believed that these reductions may have been the result of increased local fishing pressure. Although it is possible that fishing effort had increased, official statistics indicate that the number of trawl nets in Malaysia had remained stable in preceding years, with about 62 000 nets in operation each year from 1993 to 1996 (Anon., 2002). Changes in fishing practice or location may also have occurred, but there was no indication that this drove the observed decline in catches, particularly considering the multiple sites surveyed. Individuals' declining catches may therefore have suggested overexploitation, rather than simply reflecting an increasing number of boats or individual effort. These general trends were further supported by more specific, local accounts. For example, marine product traders in Semporna recounted how the area had once supported a significant trade in dried seahorses (as well as in coral and sea cucumbers), through buyers from the Philippines and Japan who first visited the region in the late 1970s or early 1980s. Local trade apparently continued as late as 1990, by which time local seahorse populations had reportedly been depleted.

Malaysian dried seahorse traders noted decreased availability of seahorses across trade levels. More than half of traders who commented on trends in supply ($n = 13$ of 20) stated that dried seahorses had become more difficult to obtain over the previous 10 years; fewer suppliers reportedly came to sell seahorses, and individual suppliers brought smaller quantities than previously. Five other dried seahorse traders indicated that seahorse availability had not changed, while only two traders suggested that they obtained seahorses more easily than they had in the past. Temporal trends in the number of dried seahorse traders operating in Malaysia were unknown, and so could not be compared with changes in seahorse availability. However, no traders implied that decreasing supplies were the result of increased competition. Most fishers and traders in Malaysia who were asked about trends in seahorse size stated they had not noticed any change ($n = 26$ of 38). All others described decreasing seahorse lengths over time.

Prices for both dried and live seahorses had apparently increased in Malaysia. According to 24 of 29 respondents who commented on price trends, prices had increased, while only two suggested that prices had decreased, and three responded that there had been no change. Actual measures of increase reported by fishers and retailers in the dried trade were highly variable, ranging from 20–1900% over 1–30 years, with an average increase of $356 \pm 182\%$ over 12 years ($n = 10$). This level of change was far greater than rates of inflation, even considering the impact of the Asian economic crisis. For example, the average annual consumer price index from 1995–1999 was only 3.5% (EIU, 2000a), or about 50% if compounded annually for 12 years. A dried seahorse trader in Sabah further supported this observation, indicating that seahorse prices had risen disproportionately to prices for other medicinal ingredients. Three retailers in the aquarium trade indicated that prices for live seahorses (see above) had risen by 50–126% over 2–10 years.

Trends in seahorse demand differed among respondent categories in Malaysia. Eight of the nine fishers who commented

on these patterns described increased interest from buyers. Six of these fishers further commented that in the recent past (between 2 and 20 years previously) they had thrown away seahorses because buyers were uninterested, particularly in eastern Malaysia. In contrast to fishers, 35 of 40 dried seahorse traders who discussed trends in demand described it as stable or decreasing with only five suggesting that demand had increased. Some TCM proprietors ($n = 4$) stated that interest in traditional medicines had diminished in favour of western medicines, whereas others ($n = 5$) noted that demand had increased with improved public knowledge about TCM. Four of five live seahorse traders indicated that demand in the trade was relatively stable, while one trader felt demand had decreased.

Thailand. As in Malaysia, most respondents in Thailand who described trends in seahorse populations or catches indicated that these had declined over time. Among fishers and traders who dealt in seahorses collected by Thai vessels, 81% claimed that seahorse catches had decreased ($n = 30$ of 37), and the remaining 19% reported that these had remained unchanged over time ($n = 7$). Respondents who attempted to quantify the reported declines ($n = 19$) suggested a seahorse supply decrease of 22–96% over 2.5–15 years. Possible reasons given for declining supplies included increases in the number of boats ($n = 3$) and changes in fishing grounds and/or landing sites ($n = 5$). A primary buyer in Trang believed that seahorse populations had declined in Thai waters, despite the fact that he was able to trade larger volumes than previously, which he attributed to an overall increase in the number of fishing vessels. In contrast to such views about rising vessel numbers, however, Thai fisheries statistics suggest that the number of otter-board trawlers had actually decreased over the mean length of time for which fishers noted decreased catches. Between 1991 and 1999, the number of registered otter trawlers gradually fell from 8117 to 6441 (Anon., 2001). A buyer in Chumphon reported a drop in trade volumes of 50% over 12 years and believed that this decline reflected diminished seahorse catches from local vessels being shared among a relatively constant number of dried seahorse buyers. Reports of declines in seahorse availability were also heard from upper-level traders. For example, one wholesaler and exporter in Bangkok reported that suppliers brought fewer seahorses, and less frequently, than they had 10 years previously, while another exporter explained that he could no longer obtain thousands of kilograms of seahorses for immediate export, as he had been able to in the past. Most fishers and traders in Thailand who were asked about trends in seahorse size stated that they had not noticed any change ($n = 24$ of 36), but all others noted declines in seahorse lengths.

Evidence of price increases was stronger in the dried than live trades. Of the 21 respondents who commented on price trends in dried seahorses, 16 suggested that prices had increased, three stated that prices had remained constant, and two said that prices had fallen over reported timeframes of 3–10 years (mean = 8.9 years, $n = 17$). According to respondents who quantified increased prices, rates of increase ranged from 25–400% (mean = 154%, $n = 15$) over 3–10 years (mean = 8.8 years, $n = 15$). For the 11 respondents who quantified both the increase and period of time, the average annual rate of increase was 16.8%. However, inflation for the period 1994–1998 was only 5.1%, according to the consumer

price index (EIU, 2000b). This suggests that changes in seahorse prices may have reflected increased demand or diminished supplies, and were not solely related to more general trends within the Thai market. Within the live trade, two fishers who targeted seahorses for the live trade described increased selling prices, while a retailer in Bangkok stated that prices had remained the same for the previous 5 years.

Of the 21 respondents in the Thai dried trade, 51% reported no changes in seahorse demand, while 33% said demand had decreased, and 10% that demand had increased over timescales of 3–50 years (mean = 18.7 years, $n = 19$). Reasons given for decreases in demand included the Asian Economic Crisis ($n = 2$ of 21) and, more generally, diminishing interest in traditional medicines among younger generations ($n = 2$ of 21). Reports of trends in demand for live seahorses were conflicting.

DISCUSSION

This first analysis of seahorse trade in Malaysia and Thailand reveals that Thailand is the most significant known seahorse exporter in the world, supplying the international market with 11 400 kg in 1998 (cf global: Vincent, 1996; East Africa: McPherson and Vincent, 2004; Vietnam: Giles *et al.*, 2005; Latin America: Baum and Vincent, 2005; Australia: Martin-Smith and Vincent, 2006), and that recorded trade volumes have continued to increase over time. Malaysia was also a major contributor to the international trade in dried seahorses, but exports never exceeded 1000 kg during years for which import records from Hong Kong SAR and Taiwan were available (1983–2004). Most seahorses traded by Malaysia and Thailand were sold for use as TCM, either domestically or in other Asian markets. In contrast, the live seahorse trade in both countries operated on a relatively minor scale and appeared entirely dependent on imports. Live seahorse exports were prohibited by law, although minor exports reportedly occurred.

Virtually all seahorses caught in Malaysia and Thailand were obtained as bycatch in non-selective fishing gear, although regions varied in the volumes traded, perhaps because of a combination of local differences in seahorse abundance and habitats, fishing effort per vessel, and level of interest by buyers and fishers. The Thai trawling fleet caught twice as many seahorses as Malaysian trawlers, despite having a similar number of vessels. Within Malaysia, vessels in Sabah and Sarawak caught more seahorses than did vessels in Peninsular Malaysia, and trawlers in southern Thailand caught almost twice as many seahorses as in eastern Thailand. Some of the variation in trade volumes probably reflected differences in the extent to which primary buyers were stationed at ports, but fishers also differed in their use of seahorses. Thai trawlers sold most bycatch into trade, and even targeted seahorses in some instances. In contrast, only about half of seahorses trawled in Malaysia entered the trade, and fishers in eastern Malaysia had only recently begun to retain their seahorse bycatch. Most fishers in both countries mentioned that profits from seahorse sales comprised only a small percentage (up to 20%) of their annual earnings.

Both countries apparently consumed substantial quantities of dried seahorses domestically, along with comparatively low numbers of live animals. In 1998, Malaysia consumed approximately 3000 kg of seahorses for TCM uses, while Thailand consumed 520 kg for TCM uses, even though the

latter had a larger ethnic Chinese population (Malaysia: 24% of the total population of 21 million, and Thailand: 14% of the total population of 60 million) (CIA, 2006). CITES does not require record keeping or regulation for domestic trade, yet such consumption will have to be considered as Thailand and Malaysia attempt to determine sustainable levels of export; even small exports might prove unsustainable if added to already large domestic use. A further difficulty lies in ascertaining the real source of some seahorses, which may have arrived from foreign waters along illicit routes.

Significant discrepancies were found between Thailand's records of exports (before implementation of the CITES Appendix II listing), and other jurisdictions' declared imports from Thailand. For example, in 1998, official Thai export figures indicated exports of about 500 kg year⁻¹ at a time when Hong Kong SAR and Taiwan reported imports of 11 400 kg year⁻¹ of seahorses from Thailand. Perhaps imports to Hong Kong SAR or Taiwan that reportedly originated in Thailand may have been sourced outside of Thailand and then re-exported. It is known, for example, that some Malaysian seahorses entered Thailand, brought both by Thai fishers operating in Malaysian waters and Thai buyers operating in Malaysian ports. Nonetheless, field surveys also indicated that Thai fishers probably landed more than 6600 kg in 1998, about half of the amount in imports declared by Hong Kong SAR and Taiwan from Thailand. The best inference is that Thai export figures, based (at the time) on voluntary reporting were far from comprehensive.

Fishers in both Malaysia and Thailand described declines in seahorse bycatch volumes, which raise concerns about the status of seahorse populations in these countries. Given that trawl vessel numbers were either stable (Malaysia) or had fallen in recent years (Thailand), diminished catches may indicate that seahorse populations in these areas are declining, possibly as a result of overfishing and/or habitat degradation. Corroboration for this apparent trend comes from rising prices for seahorses – at rates much greater than inflation – which may have reflected declining supply for traders. Such price increases would not normally be expected to drive changes in bycatch landings of a species, although at least one Thai trawl fishery was known to specifically target seahorses, an unusual practice that could potentially spread if seahorse market values continued to climb. In addition, seahorse coastal habitats are at high risk for damage from human activity, development, and pollution. For example, most of the estimated 84% loss of Thailand's original mangroves has occurred since 1975 (Hodgson, 1999), seagrass habitat in southeast Asia has experienced a 30–60% loss (Tun *et al.*, 2008), and 88% of coral reefs in southeast Asia are considered at risk from destructive fishing methods and overexploitation (Burke *et al.*, 2002). While these findings suggest that seahorse populations in the two countries are likely to have declined, the ability of snapshot interview data to conclusively quantify long-term population trends is limited, and better understanding of declines will require ongoing monitoring and field-based biological assessments.

Although it is difficult to discern the exact status of seahorse populations, fishers' estimated rates of decline add emphasis to the need for precautionary conservation and fisheries management measures. Some respondents felt that TCM was losing popularity, at least in Malaysia and Thailand, with younger generations opting for Western medicines more often than traditional treatments, but global trends suggest

that consumption of herbal remedies has been increasing (WHO, 2005). However, even if domestic demand for dried seahorses decreased, this would not necessarily reduce fishing pressure on seahorses in the region, given the considerable quantities caught incidentally each year by non-selective fishing gear and the high levels of demand in other Asian nations. Recent seahorse trade data for Malaysia and Thailand, while limited, indicate that seahorse exports have continued from both nations following the CITES Appendix II listing. Records from the CITES database (<http://www.cites.org/>) suggest that Thailand remains the largest global exporter of dried seahorses, with average annual reported exports of 16 200 kg year⁻¹ from 2004–2007, while Malaysian exports may have decreased in recent years, averaging 430 kg year⁻¹ from 2005–2006.

Under the CITES Appendix II listing for seahorses, Parties are required to ensure that exports are not damaging to wild populations. Such assessments are sufficiently difficult that Parties need to begin by utilizing general precautionary management, based on sound ecological principles. One such measure is the universal minimum size recommended by the CITES Animals Committee (Foster and Vincent, 2005), which is likely to be most useful in managing selective seahorse fisheries. However, where seahorses are caught in non-selective fishing gear, as in Malaysia and Thailand, spatial and temporal controls may be more valuable in reducing fishing pressure.

Current findings also point towards potential impacts on other fisheries resources in the region. Seahorses are not the only marine resources for which incidental catches are significant but undocumented, population impacts are unknown, and historical trade has not been formally documented. For example, it is likely that other marine species also follow the illicit trade route from the Philippines to Malaysia, thus complicating assessment and management of their exploitation and trade. Managing the seahorse trade for sustainability may set a precedent for the future protection of other marine species of commercial importance, while efforts to protect seahorse species in the wild are likely to bring broader benefits to threatened marine habitats that are critical both for humans and biodiversity.

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