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Abstract

In 2004, global seahorse trade fell under the auspices of CITES, requiring all signatories to regulate international trade for sustainability, and in the Philippines resulted in a complete ban on seahorse extraction. Pre-CITES official data was scarce but preliminary surveys in 1995 suggested that the Philippines was an important seahorse supplier. To assesses the Philippines seahorse trade pre-CITES interviews of fishers and traders (n=145) were conducted between 1998 and 2001, and triangulated with the official trade data. The Philippines was confirmed as a major exporter of dried and live seahorses with consistent estimates of catch for the dried trade at $\sim 10\,000$ kg year⁻¹, but highly variable estimates of catch for the aquarium trade ranging from a mean of 145 000 – 1 000 000 seahorses year⁻¹ depending on the data source. The survey data offers an important baseline for future studies on the effectiveness of CITES.

KEYWORDS: *Hippocampus*, non-food fisheries, small-scale fisheries, syngnathid, wildlife trade

Introduction

The magnitude of the global trade of seahorses (genus *Hippocampus*) for use in Traditional Chinese Medicine, as dried curios, and live for the aquarium industry had led to concerns that seahorse exploitation was unsustainable (Vincent 1996). The IUCN Red List of Threatened Species (IUCN 2009) lists seven seahorse species as Vulnerable due to overexploitation, although most seahorse species are listed as Data Deficient. As a conservation measure all seahorse species were listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; CITES

2002), in 2002. Since the listing was implemented in May 2004, all 175 signatory nations to CITES have been required to certify that their exports of seahorses are not detrimental to wild populations and are sourced legally.

While pre-CITES formal records of seahorse trade were scarce, early and brief trade surveys in 1993 and 1995 suggested that the Philippines was a leading exporter of seahorses for traditional medicines in Asia, aquarium display in Europe and North America, and curios globally (Vincent 1996). However, these surveys were limited to a few areas within the Philippines, and a more comprehensive survey was needed to understand the national scope of the seahorse fisheries and trade.

The Philippines is a centre of seahorse diversity, with at least nine species in its national seas (Lourie, Vincent & Hall 1999; Lourie & Vincent 2004), but conservation concerns arose from earlier surveys of fishers in 1995 in the central Philippines which indicated that seahorse catches had declined about 70% from 1985-1995 (Pajaro, Vincent, Buhat & Perante 1997). Additionally some aspects of seahorse life history, such as site-fidelity and obligate parental care, raise concerns about their resilience to fishing pressures and other environmental changes (Foster & Vincent 2004).

After implementation of the CITES Appendix II listing of seahorses, the Philippines enacted a complete ban on seahorse fishing, with the consequence that seahorse exports from the Philippines are now prohibited. This universal ban on exploitation is a concern to the small-scale fishers who depend on seahorse trade for their livelihood, and conservation groups as the ban may provoke illicit trade and/or overexploitation of other species. If, however, the Philippines wished to create domestic law which did allow for the sustainable extraction of seahorses, as intended by CITES, a thorough understanding of the species, the fisheries and the trade is needed.

In this study, trade surveys done from 1998 to 2001 were used to expand on previous survey data and create a more comprehensive analysis of the scope, scale, importance and impacts of the seahorse trade in the Philippines pre-CITES. Official records may not capture the possible illegal trade; therefore, the survey methods used in

this study offers important baseline information on the exploitation and trade of seahorses in the Philippines before the ban on seahorse fisheries. This study will allow future studies to better understand the impact of the CITES on the trade and exploitation of seahorses in the Philippines.

Materials and Methods

Surveys

Data on the seahorse trade in the Philippines were collected from field interviews conducted in September 1998 and April 1999 to March 2001. The study attempted to obtain a comprehensive national view of catch and trade, so survey areas were selected based on prior knowledge (e.g. Vincent 1996) and from reliable contacts who recommended areas likely to have a seahorse fishery and/or trade. Of the 65 coastal Philippine provinces, 26 were identified as having a seahorse fishery or seahorse trade. A total of 145 respondents were interviewed in 22 of those 26 coastal provinces (Table 1), including people involved at different levels of trade such as fishers, buyers, exporters, retailers, government officials, academics and non-government institutions. The respondents were found using a snowball method through contacts and inquiries. The sample size was, therefore, limited by the number of respondents found during the period of the study.

Interviews were conducted by the senior author, a Filipina, in local Filipino or Cebuano languages, in a semi-structured manner. Supplemental data from Cebu, Manila, Mindoro, Palawan, and Tawi-Tawi were obtained by three other researchers affiliated with a conservation non-governmental organisation and aided by local translators. Peace and order problems in Sulu and Zamboanga (southern Philippines) precluded new visits so data was based on 1995 surveys. During each survey, participants were asked about gear used to catch seahorses, daily catch rates, fishing effort, trade routes, volumes traded, prices obtained, and any changes in these parameters.

Estimates of catch volumes

Total annual seahorse catch was estimated separately for the dried and live trades. Daily catch rates provided by fishers were used to calculate the average daily catch (\bar{C}) (seahorses day⁻¹ fisher⁻¹) for each gear type (j), pooling across all geographic areas. Where fishers provided a range of catches, the mid-point was used as the estimate for that individual fisher. Total annual catch (A_j , seahorses yr⁻¹) for each gear j was then calculated by extrapolating \bar{C}_j to a fixed number of days fished (d_j) (days⁻¹ fisher⁻¹) and estimated number of fishers (f_j) using that gear derived from surveys of fisheries experts; as

$$A_j = \bar{C}_j d_j f_j \quad (1)$$

The 95% confidence limits for the reported \bar{C}_j were also extrapolated to provide a measure of variation in total catch estimates. For gear with sample size ≤ 5 , data range was used instead of the 95% confidence limits. Upper and lower estimates of total catch, therefore, reflect only the variation in daily catch rates reported by fishers. Conversions between numbers of specimens and weights (kg) for dried seahorses were based on the mean of estimates provided by 10 buyers (300 seahorses kg⁻¹). One exception is catches from Sulu, which were primarily smaller seahorse (likely the smaller *Hippocampus barbouri*, Jordan and Richardson) destined for the curio trade. To avoid overestimations, catches and trade from Sulu were converted separately using the conversion estimate of a Sulu buyer of 1000 seahorses kg⁻¹.

Estimates of trade

Following the methodology used in the preliminary global trade review (Vincent 1996) estimations were made of volumes consumed (throughputs) rather than amounts held (standing stocks). Approximations of the volume were derived for each trade level by multiplying the throughput estimates given in interviews with buyers by the number of persons estimated to be involved at that level. Buyers were categorised according to

maximum volumes reportedly traded each month: small (≤ 5 kg), medium (6-20 kg), or large-scale (> 20 kg). Volumes of trade were estimated for low (rainy) season (May to February) and high (dry) season (March to April), in keeping with how exporters reported their trade volumes. Exporters gave low and high estimates providing a range for their annual trade.

Official trade data

Official trade data was obtained from several different sources. Although no one source should be considered 'correct', the triangulation of the data from the sources affords a broader and more comprehensive view of trade in the Philippines.

Limited official Philippine export data were obtained from the Bureau of Fisheries and Aquatic Resources (BFAR). Permits from BFAR were required to export marine fishery products from the Philippines. Seahorses, however, were commonly exported in mixed shipments with other marine products (e.g. sea cucumber, shark fin) in which often only the major product was declared in BFAR records. In Palawan, local regulations required that buyers obtain permits from the Municipal Agricultural Office (MAO) to ship seahorses to exporters in Manila. Invoices presented to MAO generally listed shipments by the number of "bayongs", native sacs that held plastic aerated bags (about 120 cm x 90 cm) containing live seahorses. Government officers estimated that each "bayong" held 100 seahorses.

Official data (1998-2003) were also obtained on seahorse imports from four key destinations; European Union (EU), Hong Kong SAR, Taiwan and the USA. Since 1997, seahorses have been listed on Annex D of the European Union's legislation on wildlife trade, and live and dried seahorse imports by the EU were recorded in the CITES Trade database maintained by the United Nations Environment Program – World Conservation Monitoring Centre (UNEP-WCMC 2004). Records of dried seahorse imports were obtained from the Hong Kong SAR, Census and Statistics Department and the Republic of China (Taiwan) Customs statistics. Accuracy of data relies on traders declarations and

there are certain to be omissions and errors (Clarke 2004). Import data for USA were obtained from the United States Department of the Interior, Fish and Wildlife Service (USFWS), through their Office of Law Enforcement. Imports and exports of wildlife (whole or parts) are recorded by the USFWS in the Law Enforcement Management Information System database. Seahorse shipments were classified as live or under a number of description codes indicating dried specimens (bodies, dead specimens, medicines, shells, shell products, skeletons, and scientific specimens).

Data (1999-2001) were also obtained from the Global Marine Aquarium Database (GMAD), maintained by the United Nations Environment Program-World Conservation Monitor Centre (www.unep-wcmc.org/marine/GMAD). Data for GMAD were provided on a voluntary basis by participating aquarium companies, trade associations and government organizations, and will not represent a complete coverage of the trade.

Results

Species occurrence and distribution

At least six species of seahorses (following Lourie, Vincent & Hall 1999) were recorded to be collected and traded in the Philippines. *Hippocampus comes* Cantor, *H. kelloggi* Jordan and Snyder, *H. kuda* Bleeker, *H. spinosissimus* Weber, and *H. trimaculatus* Leach were reported throughout the Philippines, while *H. barbouri* was caught only in the country's southwest, along the Palawan and Sulu archipelagos. All six species were encountered in the dried trade while only four were commonly observed to be sold to the live trade; *H. barbouri*, *H. comes*, *H. kuda* and *H. spinosissimus*. The other three seahorse species from Philippines' waters (*H. bargibanti* Whitley, *H. denise* Lourie and Randall and *H. histrix* Kaup: Lourie & Vincent 2004) were not reported or encountered in trade. Fishers reported catching seahorses at different depths: *H. barbouri*, and *H. kuda* at about 0.5 to 4 m; *H. spinosissimus* and *H. trimaculatus* from 5 to 20 m; and *H.*

kelloggi in waters estimated to be as deep as 35 to 75 m. *Hippocampus comes* was reportedly landed both in shallow water and water as deep as 20 m.

Description of the fishery

Seahorse catches were documented in 20 provinces (Fig. 1), sold either live or dried based on the availability of a buyer and the prices offered. This study conducted surveys in 22 out of the 26 provinces identified as having a seahorse fisheries, or seahorse trade. In most areas surveyed, the only market was for dried seahorses (Fig. 1). Where both markets existed, the decision to sell to the live versus dried market was often based on seahorse size. Seahorse value increased with size in the dried market, but was fixed per individual for live seahorses. Fishers in Jandayan Island (Bohol), for example, opted to sell small seahorses to live buyers rather than dried as this doubled their value. Conversely, larger specimens were sold to the dried market, where they fetched a higher price.

Numerous small-scale fishers across the Philippines targeted seahorses, collecting them by hand while free or compressor diving or in scoop or push nets. Fishers and coastal dwellers, including children and the elderly, also collected seahorses from intertidal flats when exposed at low tide. While targeted fishing was the only source for the live trade, it also supplied the dried trade. Most fishers opportunistically caught seahorses as one of several economically useful species, including food fishes, sea cucumbers and ornamental fishes. But some fishers in Bantayan (Cebu), Bohol, Palawan, Quezon, and Samar directed considerable effort specifically to catch seahorses for certain months each year.

Seahorses were also incidentally caught in trawls, beach seine nets or push nets that targeted shrimp, prawn and pelagic fishes. Much of the bycatch probably came from trawlers illegally operating in municipal waters, which the Philippines Fisheries Code designates as extending 15 km from shoreline. Incidental capture of seahorses

reportedly also occurred in other gear types, albeit at lower frequency, including crab traps, gill nets, and enclosure pens set on seagrass beds and coral reefs.

Dried seahorse trade in the Philippines: trade routes, volumes and prices

Trade Routes

Most seahorses landed were destined for export, although some were sold locally for traditional medicine or as charms. Seahorses were observed for sale as curios in Cebu, Manila, Palawan, and Zamboanga. Six of 11 traditional Chinese medicine (TCM) shops surveyed in Manila sold seahorses. It is not known if these seahorses were sourced locally or were imported; suggestions were heard that the ethnic Chinese who primarily use TCM may have preferred to import seahorses from Hong Kong SAR, even though the specimens may have originated in the Philippines.

Seahorses landed in the diffuse fishery were concentrated through local buyers, who delivered their seahorses to exporters in one of four centers: Cebu, Manila, Tawi-Tawi, or Zamboanga. Dried seahorses were most commonly exported for TCM, usually to mainland China, Hong Kong SAR, Singapore, and Taiwan. Dried seahorses for the curio trade apparently went to Europe, the United States, and Japan, according to a Zamboanga curio exporter. Seahorses were also sent from southern Philippines to Malaysia, likely through unofficial trade; two merchants in Tawi-Tawi reported sending their seahorses directly to Sabah, Malaysia, while three traders in Malaysia reported their seahorses came from Zamboanga (A. Perry, personal communication). Some seahorses sent to Malaysia may have been re-exported to Hong Kong SAR or Singapore, according to one trader in Tawi-Tawi.

Volumes

The 57 interviews of fishers and buyers in the 22 of 26 provinces identified as having seahorse fisheries (Table 1; Fig 1) were used to estimate daily seahorse catch representing four types of gear targeting seahorses and three that landed them as by-

catch, as well as the number of days spent fishing in a year (Table 2). Fisheries experts interviewed estimated a total of 2650 fishers using these four gear types in the Philippines. This data was then extrapolated to infer that fishers in the survey areas (predominantly compressor and lantern fishers) landed an estimated 4 million seahorses (2 – 6 million) into the dried trade, representing approximately 10 000 kg yr⁻¹ (5000 – 15 000 kg yr⁻¹: Table 2).

Buyer and exporter estimates of trade were similar to totals for estimated catches. The Philippines is not known to be an entrepôt of trade, so these traders are assumed to deal primarily with locally sourced seahorses. The annual trade from an estimated 70 buyers operating in the areas surveyed was approximately 12 700 kg yr⁻¹ (Table 3); most (65%) occurred in Masbate where 7 buyers, of whom three were interviewed, reportedly traded 8800 kg yr⁻¹ (Table 3). From surveys and BFAR records, 21 exporters operating in the Philippines were identified (13 for TCM, 8 for curios). Using export data gathered from interviews, total exports were estimated at 5800 – 7800 kg yr⁻¹ (Table 4). Official BFAR data of exports from Cebu, averaging 4429 ± 722 kg yr⁻¹ between 1999 and 2003, were double that reported by exporters (Table 5). Conversely, BFAR data for Manila, averaging 1211 ± 527 kg yr⁻¹ for 2000, 2002 and 2003, was half that reported by exporters (Table 5).

Official trade data from importers showed the Philippines to be a main source for dried seahorses prior to the domestic ban. Import data obtained from four key destinations (EU, Hong Kong SAR, Taiwan, and USA) showed average imports of 8674 ± 3048 kg yr⁻¹ (range 5796 – 13620 kg yr⁻¹) from the Philippines between 1998-2003 (Table 5), primarily by Hong Kong SAR and Taiwan. The Philippines was the second most important source for dried seahorses in these jurisdictions' official trade data, behind Thailand, with the former accounting for 36% and 15% of all imports recorded by Hong Kong SAR and Taiwan, respectively (Kwan, Lee & Vincent in review).

Live trade

Trade routes

Live seahorse fisheries were found in eight coastal provinces (Fig. 1), all supplied by target fishers diving or using nets. Palawan, in particular the northern part, appeared to be the major source for live seahorses, with large numbers also taken from Bohol. Live seahorses were purchased by local buyers and sent to exporters in either Cebu or Manila. Exporters cited Europe, USA, and Japan as the main importers of live seahorses from the Philippines. Official import and GMAD data recorded 21 destinations that had received live seahorses from the Philippines from 1999-2001; the main destinations were the USA (42% of total exports reported), Taiwan (24%), Japan (17%), Hong Kong SAR (8%), and Europe (5%).

Volumes

Fishers and traders provided information on catch volumes for the live trade (Table 2). Only 12 fishers that targeted live seahorses were available for interview and in two cases there were only one representative of gear type used. Due to the small sample size the volume estimates should be interpreted cautiously. About one million seahorses (range of 200 000 – 2 000 000 seahorses yr⁻¹) were caught for the live trade each year based on reported daily catch rates, estimates of effort and total number of fishers operating (Table 2). Most of the variation was for seahorses caught by nets in northern Palawan, based on the reported catch of only one fisher, which ranged from 3 to 50 seahorses day⁻¹ (Table 2).

Live trade estimates based on surveys of buyers in three provinces and exporters obtaining their supply from four provinces were smaller, but still substantial, with a median of 410 000 (range of 250 000 and 570 000) seahorses yr⁻¹ (Table 6), with most coming from northern Palawan. The three live exporters interviewed provided highly variable estimates of annual trade (1820, 8653 and 12 000 seahorses respectively). If the average of the three exporters (~7500 seahorses) were

extrapolated to the 45 active marine ornamental fish exporters reported in the Philippines (Vallejo 1997), total export from the Philippines would be 337 500 live seahorses annually. If 20% of live seahorses die in captivity at the holding facility, as reported by one exporter, this would indicate total trade of ~400,000 live seahorses, which is within the range suggested by buyers.

Limited official data from MAO offices in Palawan provided conflicting results. Records from MAO offices in mainland Palawan reported shipments of 27 800 seahorses between February and April 1999 by two buyers from mainland Palawan, which alone was more than the buyers' upper estimate of annual trade for that region. Conversely, in Coron, Northern Palawan, 97 200 seahorses were apparently shipped between January to August 1996 by eight buyers. Extrapolated over a full year, the latter tally would total 145 000 seahorses, rather less than estimated from fisher and buyer interviews. The completeness of data was not known and volumes were based on an estimated 100 seahorses per bag (bayong). One buyer in northern Palawan mentioned he puts as many as 150 seahorses (rather than MAO's average of 100 seahorses) inside each bag to minimise transportation costs; were this practice widespread, it would add 50% to the estimates.

There were few official data on imports of live seahorses. Data from the EU and USA combined showed imports of 4173 ± 810 seahorses annually from the Philippines (Table 5). Data from the GMAD, provided by participating Philippine exporters, indicated that 47% of exports went to these two countries (USA= 42%; EU = 5%) with the rest primarily to Taiwan (24%), Japan (17%), Hong Kong SAR (8%). In official import records, the Philippines was a key source for live seahorses; third for the EU behind Indonesia and Sri Lanka and second for the USA behind Australia, constituting 19% and 23% of recorded imports into each country respectively. The discrepancy in the import and export data is explored further in the discussion.

Economic importance of the trade

No fisher reported relying on seahorses as their sole source of income, but these fish may contribute important portions of their small overall earnings. Five out of 22 interviewed fishers who target seahorses estimated that they earned 25-50% of their daily income from seahorses. Fishers using compressor or free diving ($n = 7$) in Bantayan (Cebu), Bohol, Iloilo, and Masbate reported earning PhP100-200 (USD 2.41-4.82) daily from a multi-species fishery including seahorses, abalone, cuttlefish, sea cucumber and other food fish. Using reported median catch rates, 6 and 13 seahorses day⁻¹ for lantern and compressor fishers, respectively, and a median price of 3PhP per seahorse suggested that seahorses constituted approximately 20% of daily income. Two fishers in Bantayan reported occasionally earning 500-1000 PHP (USD 12-24) from a single night of seahorse fishing.

Dried seahorse buyers and exporters also usually had additional sources of income. Most of the larger buyers of dried seahorses interviewed also bought other dried marine products such as sea cucumbers, abalone, shark fins, pipefishes and seaweeds. Six of the buyers also owned shops selling a variety of consumer goods and three itinerant buyers on Bohol bought recyclable aluminium. Buyers ($n = 7$ of 27) of dried seahorses who commented on the portion of their income from seahorses gave estimates between 5 and 50%. Two exporters estimated approximately 5 to 10% of their income came from seahorses. Half of the buyers ($n=3$ of 7) and all of the exporters of live seahorses interviewed ($n=2$) also traded other live ornamental or food fishes.

Trends in supply of seahorse products

Most fishers and buyers reported a decline in seahorse catch over the 5-10 years prior to 2000. Of the 18 seahorse target fishers who responded, 15 reported declines in catches over the previous 10 years, with seven of these reporting declines of 50-95% over the previous 2-10 years. Three other fishers — who only caught seahorses opportunistically — noticed no change. All of the seahorse buyers who responded

($n=13$ dried; $n=3$ live) reported declines in supply over the previous 5 years; four of whom estimated declines in the range of 80-85% over 5 years.

Fishers responding to interviews in the communities and at a consultative workshop (November 2000) cited overfishing, increased competition from more fishers, and indiscriminate catch of seahorses in non-selective gear for the declining catches. They also cited habitat damage and proliferation of illegal fishing methods such as dynamite, cyanide, trawl, and fine-meshed nets as indirect causes. Environmental violations were perceived by fishers to receive little attention with few resources from the law enforcement officers, purportedly because they were preoccupied with insurgency and political unrest. By contrast, buyers attributed seahorse population declines primarily to competition with other buyers, perceived better enforcement of a ban in use of trawl or seine nets and diversification of the marine catch to include sea cucumber products and seaweed culture.

Discussion

The Philippines was a major source of both dried and live seahorses for the international market prior to 2004. Most seahorses were landed in targeted fisheries and constituted a useful source of income for poor, small-scale fishers. Anecdotal evidence suggested that seahorse catches had declined during the 1990s, attributed to overfishing and habitat degradation. Declines in catches may also have resulted from increases in numbers of fishers and buyers competing for the same resources. It remains to be seen what effect the CITES listing in 2004, and the consequent ban on seahorse fishing in the Philippines, will have on seahorse populations and/or seahorse fishers. This work indicates that interviews within and across trade levels can produce consistent estimates of trade volumes, but should still be approached with caution in cases where sample size is severely limited.

Six species of Philippine seahorses that were found to be traded in this study; *H. barbouri*, *H. comes*, *H. kuda*, *H. spinosissimus* and *H. trimaculatus* are listed as Vulnerable

on the IUCN Red List of Threatened Species (IUCN 2009). The remaining species in trade, *H. kelloggi*, is classified as Data Deficient because existing information is too sparse to permit an assessment of its population. These six species have also been reported in catch and trade in other areas of southern and southeast Asia (Vincent 1996; Giles, Truong, Do & Vincent 2005; Salin, Yohannan & Nair 2005). The volume of trade found to occur in this study, as well as declining seahorse catches by Philippines fishers from other studies (Vincent, Meeuwig, Pajaro & Perante 2007) raises further conservation concerns for these species.

Seahorses caught for the dried and live trade came primarily from target fishing. This differs from other areas where seahorses for the dried trade were mostly taken from bycatch of fisheries targeting other species (McPherson & Vincent 2004; Baum & Vincent 2005; Giles, Truong, Do & Vincent 2005). India also had a significant target fishery supplying seahorses to the dried trade, at least prior to a 2001 ban on the capture of seahorses (Salin, Yohannan & Nair 2005). Seahorses were generally but one part of a multi-species fishery including abalone, sea cucumbers, and food fishes. The seahorse fishery was conducted by large numbers of small-scale fishers throughout the Philippines, with catches concentrated through a series of buyers to exporters in one of the main export centres of Manila and Cebu (dried and live), or Tawi-Tawi and Zamboanga (dried only).

The Philippines landed and exported more than 10 000 kg of dried seahorses (~4 million individuals) annually prior to the domestic ban on seahorse capture in 2004. The volume estimates from fisher and buyer surveys are rough but comparable and received further validation from official data collated at export destinations; these averaged 8 000 kg yr⁻¹ and reached 11 000 kg in some years. The Philippines was the second largest supplier of dried seahorses to Hong Kong SAR and Taiwan, after Thailand. Official import data may however, be viewed as a minimum estimate of trade as some dried seahorses imports likely went undeclared or were combined in shipments with other marine products. Official import data were also lacking for known

destinations for Philippine seahorses, such as mainland China, Japan, Malaysia, and Singapore.

The Philippines exported hundreds of thousands of live seahorses each year; however the small sample sizes and high variance of the data suggests interpretations must be made with caution. Buyers and exporters estimated the live trade at a median volume of 412 000 seahorses annually, a lower but perhaps more reliable median estimate than obtained from fishers (i.e., 1 000 000 seahorses yr⁻¹). Exporter surveys and limited official data from Palawan also corroborated trade in the hundred thousands. Import data from Europe and USA, therefore, appeared to have underestimated the scale of the live seahorse trade. The accuracy of these data was questionable; exporters reporting to GMAD, for example, reported shipping more seahorses from the Philippines to USA than appeared in all USFWS data. Inconsistencies in USFWS data have already been reported for seahorse (Baum & Vincent 2005) and for wildlife products in general (Blundell & Mascia 2005). Prior to CITES regulations, seahorses may have been imported into the USA under the generic designation “Marine Ornaments”. In addition, a substantial portion (perhaps as much as 50%) of live seahorse exports from the Philippines went to other markets for which official data on live seahorses were limited or unavailable (i.e., Hong Kong SAR, Japan, Singapore, and Taiwan). The large discrepancy between survey estimates and official trade data highlights the need for CITES trade documentation.

Most trade participants reported large declines in the number of seahorses caught or traded both in the earlier 1993-1995 (declines noted from 1977-1993), and the 1998-2001 surveys (declines noted from 1990-2000). Whether this reflects declines in seahorse populations or increased competition for the resource due to increased numbers of fishers/buyers could not be determined. Fishers attributed the declines to overfishing, habitat destruction and increased numbers of fishers while buyers believed increased competition resulted in the declines. Official import data from Hong Kong show no evidence of declining supply, but without knowledge of how fishing effort and

spatial pattern have changed over time in the Philippines, it is impossible to draw conclusions about local seahorse populations from these trade data. The decline in catch rates, however, at a minimum raises concerns over the sustainability of seahorse fisheries and most definitely was a problem for fishers with already low incomes.

The data in this paper will provide important baseline data on trade that occurred before the absolute and unfocused ban on seahorse fisheries in the Philippines – a direct response to the listing of seahorses by CITES. At the time of the surveys, most seahorse trade, both dried and live, went entirely unrecorded and unregulated. By imposing an automatic ban on seahorse capture, the Philippines continue to avoid the need to manage the seahorse fishery and trade. There is, however, considerable controversy over the effectiveness of trade bans as a tool for species conservation, especially in areas where enforcement is lacking (Cooney & Jepson 2006). Visits to importers in Hong Kong SAR and Taiwan in late 2004 revealed continuing imports of substantial volumes of dried seahorses from the Philippines, but aquarium wholesalers in Los Angeles reported they no longer received live seahorses from the Philippines post-CITES situation (Magera, Koldewey, Morgan & Vincent in prep). Future trade studies will be able to use this information to determine the effectiveness of the CITES policy on trade, and comparisons with the management developed by other countries for sustainable catch may help the Philippines to develop management more compatible with CITES intentions.

Illicit trade may continue, at least in part, because seahorses were financially useful to over a thousand small-scale Filipino fishers with few other sources of income (pers. obs.). Indeed, fishers who shifted away from seahorses may well be putting pressure on other vulnerable marine taxa (e.g. cuttlefish, sea cucumbers or bivalves) with unintended consequences for those species. It may be necessary to impose low or zero quotas for certain vulnerable seahorse populations in the Philippines, but these restrictions might be better respected if they were clearly directed at management objectives, rather than resulting from an indiscriminate and unintended reaction to a

global decision for more conservative trade regulation. Table 1. Interviews conducted showing market (dried and live trade) and trade role. 'Others' include government officials, academics and non-government institutions.

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Figure 1. Seahorse catches were documented in 20 provinces in the Philippines. Catch was sold either live or dried.

Table 1. Interviews conducted showing market (dried and live trade) and trade role. Others' include government officials, academics and non-government institutions.

Province	Dried Seahorse Trade				Live Seahorse Trade			Retailers	Other
	Target Fishers	Bycatch Fishers	Buyers	Exporters	Target Fishers	Buyers	Exporters		
Albay									2
Antique									2
Agusan Sur									1
Bohol	4	2	3			2			0
Camarines Sur		1	1						2
Capiz									2
Cavite*									
Cebu	5		3	2			1		3
Davao †									2
Iloilo	3	1	3						5
Leyte									2
Manila †				1			1	11	3
Marinduque*									
Masbate	2	1	4						8
Misamis Oriental									2
Mindoro									3
Palawan	2	1	1		1	4		1	2
Pangasinan*									
Quezon			1		2	1			3
Samar	1	2	3						3
Sorsogon		2	4						5
Sulu			1						1
Surigao Norte/Sur	1	1	3						6
Tawi-Tawi	1			2					
Zambales*									
Zamboanga †				1					1
Total	19	11	27	6	3	7	2	12	58

* Not visited but reported to have trade

† Trading only, no fishery reported

Table 2. Estimates of annual seahorse catch from interviews by market (dried or live), and by gear type. Annual estimation were calculated by multiplying reported daily catch rates by the reported days fished annually (Days), and number of gear units operating (Gear) in areas surveyed. The confidence limits were based on the (a) 95% confidence limits where $N > 5$, and (b) the data range where $N \leq 5$ of reported daily catch rates. Conversion from numbers to weight was 300 seahorses kg^{-1} , except for Dried-Targeted Net fishers reported as 1000 seahorses kg^{-1} .

Fishers Gear	Seahorse day ⁻¹ fisher ⁻¹					Days (#)	Gear (#)	# Seahorses yr ⁻¹			Seahorses kg yr ⁻¹		
	N	X	SD	Lower	Upper			X	Lower	Upper	X	Lower	Upper
Dried - Targeted													
Compressor	6	13	6	7	19	250	280	910 000	469 237	1 350 763	3033	1564	4503
Lantern	6	6	3	3	9	250	485	727 500	345 768	1 109 232	2425	1153	3697
Gleaning	2	6	6	1	10	60	100	36 000	6000	60 000	120	20	200
Net	3	61	38	37	105	250	100	1 525 000	925 000	2 625 000	1694	1028	2917
<i>Total Targeted</i>								<i>3 198 500</i>	<i>1 746 005</i>	<i>5 144 995</i>	<i>7273</i>	<i>3764</i>	<i>11 317</i>
Dried - Bycatch													
Trawl	11	3	1.6	2	4	170	1085	553 350	355 086	751 614	1845	1184	2505
Push Net	2	2		1	3	130	205	79 950	26 650	79 950	267	89	267
Beach Seine	5	2		1	3	135	395	159 975	53 325	159 975	533	178	533
<i>Total Bycatch</i>								<i>793 275</i>	<i>435 061</i>	<i>991 539</i>	<i>2644</i>	<i>1450</i>	<i>3305</i>
<i>Total Dried Trade</i>								<i>3 991 775</i>	<i>2 181 066</i>	<i>6 136 534</i>	<i>9917</i>	<i>5215</i>	<i>14 622</i>
Live - Targeted													
Compress or	4	2	5	1	6	250	220	110 000	55 000	332 308			
Lantern	6	7	4	3	11	250	130	227 500	91 073	363 927			
Nets	1	26		3	50	250	100	650 000	75 000	1 250 000			
Gleaning	1	17		5	30	60	20	20 400	6000	36 000			
<i>Total Live Trade</i>								<i>1 007 900</i>	<i>227 073</i>	<i>1 982 235</i>			
Total Trade								4 999 675	2 408 139	8 118 769			

Table 3. Estimates of weight of dried seahorse traded from buyer surveys. Reported monthly trade volumes (kg month⁻¹) for low season (Low: 10 months) and high season (High: 2 months) from buyers surveyed (N) were multiplied by the estimated number of total buyers operating at different scales of trade for each province to estimate annual trade (kg year⁻¹).

Province	Scale	N	Seahorses kg month ⁻¹			Seahorses kg yr ⁻¹		
			Low	High	Total Buyers	Low	High	Total
Bantayan	Medium	2	6	20	5	300	200	500
	Large	1	4	150	2	80	600	680
Bohol	Small	4	0.5	3	16	80	96	176
	Large	1	5	50	4	200	400	600
Camarines Sur	Medium	1	5	20	5	250	200	450
Iloilo	Medium	3	5	20	5	250	200	450
Masbate	Large	2	50	250	6	3000	3000	6000
	Very Large	1	200	400	1	2000	800	2800
Palawan	Small	1	1	5	3	30	30	60
Samar/Leyte	Small	2	1	5	8	80	80	160
	Medium	1	2	10	4	80	80	160
Sorsogon	Small	2	3	5	3	90	30	120
	Medium	1	5	20	1	50	40	90
Surigao	Small	1	1	5	3	30	30	60
	Medium	1	5	10	1	50	20	70
Tawi Tawi	Large	1	3	50	3	90	300	390
TOTAL					70	6660	6106	12 766

Table 4. Estimates of weights of dried seahorse exported from the Philippines based on surveys of exporters. Reported low and high annual exports (kg yr⁻¹) from surveys (N = number of surveys) was multiplied by the estimated total number of exporters of a similar size in each province, to calculate total exports.

Province	N	Reported kg year ⁻¹		Estimated Exporters	Estimated kg year ⁻¹		
		Low	High		Low	High	
Cebu	1	600	720	1	600	720	
	1	500	600	1	500	600	
	1	300	500	3	900	1500	
<i>Subtotal</i>						<i>2000</i>	<i>2820</i>
Manila	1	500	600	1	500	600	
	1	300	550	4	1200	2200	
<i>Subtotal</i>						<i>1700</i>	<i>2800</i>
Zamboanga	1	33	44	8	264	352	
Tawi-Tawi	1	600	600	3	1800	1800	
<i>Subtotal</i>						<i>2064</i>	<i>2152</i>
TOTAL				21	5764	7772	

Table 5. Official data of seahorse trades (a) Annual exports of dried seahorses (kg) from the Philippines as recorded by BFAR offices in Cebu and Manila (only national export known prior to 1999), (b) Annual imports of dried (kg) and live (number) seahorses into key destinations as recorded in each destination's official data, for 1995 – 2003.

Sources for data are described in the Methods.

<i>a) Export Source</i>	1995	1996	1997	1998	1999	2000	2001	2002	2003	<i>X (SD)</i>
Cebu					3710	4834	3741	5394	4467	4429 (722)
Manila						698		1750	1184	1211 (527)
Total Exports	1546	1620	192	562	3710	5532	3741	7144	5651	5517 (1393)

<i>b) Import Destination</i>	1995	1996	1997	1998	1999	2000	2001	2002	2003	<i>X (SD)</i>
Dried										
Hong Kong				6502	7189	5874	4512	8607	10838	7254 (2221)
Taiwan	1575	290	136	196	321	898	965	2262	2635	1213 (1011)
USA				132	81	136	297	306	60	169 (107)
EU				47	67	0	22	11	87	39 (34)
Total Dried Imports				6876	7657	6908	5796	11 186	13 620	8674 (3048)
Live										
EU				4956	4564	3107	2770	2410	3623	3572 (1011)
USA				4	3	1766	351	815	667	601 (661)
Hong Kong									536	
Total Live Imports				4960	4567	4873	3121	3225	4290	4173 (810)

Table 6. Estimated annual trade in live seahorses from surveys. Reported lower, upper and median monthly trade volumes (seahorses month⁻¹) from surveys (N = number of surveys) were extrapolated to the estimated total number of buyers and 12 months to produce estimate of annual trade (Seahorses year⁻¹)

Location	N	Seahorses month ⁻¹			Total	Seahorse yr ⁻¹		
		Median	Lower	Upper	Buyers	Median	Lower	Upper
Cebu	1	12.5	5	20	8	1200	480	1920
Bohol	2	1150	300	2000	4	55 200	14 400	96 000
Quezon	1	600	200	1000	1	7200	2400	12 000
Palawan (mainland)	1	300	100	500	3	10 800	3600	18 000
Palawan (northern)	4	3250	2200	4300	8	312 000	211 200	412 800
Pangasinan	1	250	200	300	1	3000	2400	3600
Zambales	1	375	250	500	5	22 500	15 000	30 000
TOTAL		5937.5	3255	8620	30	411 900	249 480	574 320