The Live Seahorse Trade in Los Angeles

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Abstract

Global seahorse populations (*Hippocampus* spp.) are under pressure from habitat degradation, accidental capture (bycatch), and direct exploitation. Seahorses are primarily traded for use in traditional Chinese medicine and its derivatives, but they are also sold as dried curiosities and live for ornamental display in aquariums. In 2002, all seahorse species were included on Appendix II of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES). The listing came into effect in May 2004. This 2005 survey carried out in Los Angeles (LA), California, a major destination for the ornamental aquarium market, suggests that the CITES listing of seahorses affected the live trade of seahorses into the United States. In establishing relationships with eight LA area marine wholesalers, the researchers learned that the CITES listing implementation resulted in a number of changes in the Los Angeles live trade. A *de facto* moratorium on live seahorse imports occurred for nearly a year in response to the listing taking effect – apparently because Parties (CITES member governments) were devising export controls. After trade resumed, the dominant source countries for live seahorses had changed as the two main pre-CITES sources, Brazil and the Philippines, had ceased export. Wild seahorses post-CITES at the participating wholesalers hailed mainly from Indonesia and Vietnam while tank-raised seahorses came mainly from Vietnam and Sri Lanka. Post-CITES trade volumes were depressed by 45-59% and species compositions changed at the participating wholesalers. Aquacultured animals became more prevalent in trade. The wholesaler operations that carried cultured seahorses noted that the cultured stock produced fewer husbandry concerns, which had historically been a major barrier to keeping seahorses in aquariums. Changes in source regions for wild seahorses and the growing role of aquaculture led to decreases in the size of the animals in trade. Further responses to the CITES listing included the end of the LA traders' previously minimal re-export of seahorses from the USA, and a doubling in prices of live seahorses. The results of this live trade case study in LA suggested that the live seahorse trade was responsive to regulation under CITES, and that aquarium wholesalers were generally receptive to future collaboration on research into the live seahorse trade.

I. Introduction

Global seahorse populations (*Hippocampus* spp.) are under pressure from habitat degradation, accidental capture (bycatch), and direct exploitation and they are now regulated in international trade (Foster and Vincent, 2005). Seahorses are primarily traded for use in traditional Chinese medicine and its derivatives, but they are also sold as dried curiosities and live for ornamental display in aquariums (Foster and Vincent, 2005). In 2002, all seahorse species were included in the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) under Appendix II (Foster and Vincent, 2005). The Appendix II listing stipulates that all Parties exporting seahorses internationally must guarantee that trade does not damage wild populations (i.e. the international trade must be sustainable; Foster and Vincent, 2005). The listing came into effect in May 2004 (Foster and Vincent, 2005).

Trade surveys of both the dried and live seahorse trade have been conducted to assess the extent of the global seahorse trade and to determine the appropriateness of suggested practical tools (namely a minimum size limit) for ensuring the enforcement of the CITES Appendix II listing. Seahorses are one of the largest trade issues by volume under CITES and monitoring of the trade is necessary to ensure the health of wild populations (Foster and Vincent, 2005). Management of seahorse populations is difficult given the limited understanding of seahorse population dynamics and fishing mortality. CITES suggested a minimum size limit (or MSL) of 10 cm for all seahorse species as a tool for regulating

international trade for sustainability.[1] A minimum height of 10 cm would allow most of the internationally traded seahorse species to reach sexual maturity and reproduce before being harvested (Foster and Vincent, 2005). To assess the effectiveness of the 10 cm MSL, Project Seahorse initiated an MSL Project which consisted of surveys of both the dried and live seahorse trade. The main objectives of the MSL Project were to (1) assess the size at maturity of the seahorses in trade, (2) develop a trade height metric that could be used as an easy proxy for seahorse height, (3) refine the proposed MSL as needed with the new data, (4) learn more about the global seahorse trade, and (5) investigate shifts in the seahorse trade with the implementation of CITES (Morgan and Vincent, 2005). Dried trade surveys were conducted in Hong Kong SAR, Taiwan, Province of China, and Vancouver, Canada, in 2004-2005 with the help of the local traditional Chinese medicine (TCM) communities (Morgan and Vincent, 2005). The purpose of this paper is to summarise the live trade survey conducted in Los Angeles in October 2005 with the aid of local aquarium wholesalers.

II. Methods

Survey Coverage

The United States (USA) is a major destination for the live aquarium trade and Los Angeles, California, is a major import center, making it the focus of this live trade investigation. Ornamental fish are a luxury item and marketing is targeted at a select group of high-end consumers (Tlusty, 2002). Fifty to sixty percent of traded marine aquarium fish are destined for the USA where the majority are sold to individual hobbyists, and a lesser number are purchased by public aquariums (Tlusty, 2002; Wabnitz et al., 2003). United States Fish and Wildlife Service (USFWS) reports from 2005 indicate that between October 2000 and October 2005, almost half of all commercial seahorse imports to the USA arrived through Los Angeles (USFWS, 2005), making it the hub of the live seahorse trade in the USA. Trade surveys for the live portion of the minimum size limit project were conducted in two major marine wholesaler districts in Los Angeles and the surrounding area from October 2-16, 2005.

The objectives of the study were to: (1) establish an understanding of species, size, sex and reproductive status of the individuals in the live trade in Los Angeles; (2) assess size at maturity for data poor species to further inform the current minimum size limit recommended by CITES; and (3) collect information on data poor species in order to derive a trade height measurement for Customs agents to use when assessing a large number of seahorses. At the same time, the study aimed to obtain an overall picture of the Los Angeles live seahorse trade and of the industry's reaction to the CITES Appendix II listing of seahorses.

Within Los Angeles, the marine wholesale industry appeared to be concentrated in pockets. Five of the participating wholesalers were situated on 104 Street. Located next to LAX airport, this street is locally recognized as the center of the marine wholesale industry in the city. Three of the participating wholesalers were located in the nearby city of Inglewood, California. Other wholesalers, which the lead researcher observed to be comparable in size and product, were also identified – they were more dispersed throughout the Los Angeles area. Gardena, Inglewood, Ontario and Los Angeles (near LAX) appeared to have the highest densities of marine wholesalers in and around Los Angeles.

How does Los Angeles compare to other USA seahorse import centers? The researchers could not estimate the total number of wholesalers in the Los Angeles region that carried seahorses. However, USFWS reports indicated that between October 2000 and October 2005, 30 commercial importers

[1] https://cites.org/sites/default/files/eng/notif/2004/033.pdf

brought seahorses into the United States through Los Angeles compared to a total of 38 importers that commercially imported seahorses through all other locations in the USA (n=68 importers total; USFWS, 2005). Four commercial importers brought in seahorses through San Francisco, California, but the other major commercial import ports were New York, New York (n=9 importers) and Miami, Florida (n=7 importers; USFWS, 2005). Seahorses were also imported through Chicago, Tampa, Agana (Guam), Honolulu, Dallas/Fort Worth, Atlanta, Seattle and Blaine (USFWS, 2005). Seahorses may also be obtained from domestic sources. Florida and Hawaii are reported to be the main collecting areas for marine products within the country (Bruckner, 2001; Larkin and Degner, 2001).

The Los Angeles study focused on seahorse importers and wholesalers to obtain a preliminary picture of the live seahorse trade in the USA. During the fourteen-day study period a total of 12 wholesalers who currently or previously sold seahorses were approached to participate in the study. Eight companies decided to participate. Seven of these companies stocked seahorses at the time of study. One company did not carry seahorses at the time of the survey but had carried them prior to the May 2004 implementation of the CITES Appendix II listing. Seven of the eight companies were classified both as wholesalers and importers, and certain companies acted as exporters and trans-shippers as well. For the sake of clarity, the companies who participated in the study will simply be referred to as wholesalers from this point onwards. Refer to Table I.a for more information on company and respondent designations in this study.

Eight companies participated in the Los Angeles live trade study and some notable differences were observed among them. The companies surveyed ranged in size from four to approximately 80 employees. The lead researcher visited seven of the eight participating companies.[2] Six of the participating companies had large warehouses with rows of tanks, packing tables, attached offices and highly visible signs facing onto the street. The seventh wholesaler the researcher visited had a small warehouse with plastic bins for housing animals and an attached office with no visible signage (this was the company with the fewest employees). Although eight different companies participated in the study, seahorse measurements were only taken at four different wholesalers, as well as the Long Beach Aquarium of the Pacific (LBAP) in Long Beach, California (i.e. five different locations total). The LBAP participated in the project as a partner institution and was not included in the total number of study respondents or wholesaler descriptions unless explicitly noted.

Table I.a. Company type and respondent sample size from the Los Angeles live seahorse trade field study (October 2005).

The aquarium refers to the Long Beach Aquarium of the Pacific (LBAP), which participated as a partner institution in this study. Seahorses were sampled at this location to obtain data for one data poor species (*H. erectus*) because this species was not observed at any of the participating wholesalers. Since the study was focusing on the live seahorse trade however, LBAP was not included in the company or respondent sample size.

Company type	Company sample size	Respondent sample size (interviews)	Places where seahorses measured
Wholesale/Export	1	1	0
Wholesale/Import/Trans-shipping	3	6	2
Wholesale/Import/Export/ Trans-shipping	4	5	2

[2] One of the wholesale owners owned two of the eight companies referred to in this study. The researcher visited only one of their two companies. Thus, the researcher visited only 7 out of the 8 companies in the study. The wholesale operation owner was interviewed about both of the companies they owned.

Aquarium	n/a	n/a	1
TOTAL	8	12	5

Table I. b. Job description of respondents and number of each type of respondent in the Los Angeles live seahorse trade field study (October 2005).

Job description of respondent	Respondents sample size
Owner/President/Vice-president	6
Senior sales manager/representative	3
Warehouse manager/husbandry	3
TOTAL	12

Potential study participants for the Los Angeles study were identified through a number of different avenues. The UBC Behavioral Research Ethics Board (BREB) and the UBC Committee on Animal Care approved the MSL project and the lead researcher interacted with study participants in accordance with these ethical guidelines. Wholesalers' e-mail addresses were obtained from previous contact with traders (spring 2005), internet searches, and other wholesalers' advice during interviews. Other wholesalers proved useful in this capacity as they usually knew about the large importers/wholesalers in the area through their work contacts. LBAP staff also knew of which companies might carry (and which have carried) seahorses, and they provided some connections and made initial contact with one of the wholesalers. Wholesalers and the LBAP sometimes had contact and were able to suggest people knowledgeable about seahorses within the companies they recommended. This was helpful because wholesalers' websites and correct contact information were sometimes difficult to locate. Wholesalers and the LBAP were also helpful in distinguishing importer/trans-shipper-wholesaler supply relationships. Understanding the connections between different actors in the Los Angeles aquarium wholesale community was critical for evaluating how animals moved through the system.

Wholesalers were approached either via e-mail or in person to participate in the study. Only eight of the twelve companies that were originally contacted decided to participate in the study. Seven companies were contacted initially via e-mail with a brief note of introduction to the project and the lead researcher, as well as a formal letter of introduction and project consent form. The researcher contacted the rest of the businesses (n=5) in person during work hours. The researcher introduced herself as a research assistant with Project Seahorse, a marine conservation research unit at The University of British Columbia in Vancouver, Canada. She explained the project and its goals, and presented the potential respondents with a business card, a project information sheet and a consent form. The researcher also asked for permission to examine, measure and photograph the stock and premises. The researcher then answered any questions the potential study participants had about the project.

Measurements

All but one of the wholesalers who agreed to participate in the project had seahorses in stock, but only a sub-sample of these seahorses was measured. Sampling was conducted at four of the traders and the LBAP (see Table I.a.). The LBAP bred its own seahorses and pseudoreplication of seahorse samples was not an issue at the time of study. Sampling sites were chosen by considering shipping dates, species availability at different companies, logistic constraints, and a list of criteria that determined the seahorse sampling priorities (listed below). Consequently, the lead researcher measured only a sub-sample of the seahorses observed at the wholesalers visited in Los Angeles. In an initial visit, the researcher surveyed the wholesalers' warehouses, attempted to identify the seahorse species in stock,

assessed the range of maturity of the stock, and then discussed shipment dates with sales managers so sampling priorities could be organized.

Sampling priority guidelines aimed to maximize the number of seahorses sampled from data poor species to obtain (in order of importance) size at maturity curves and trade height relationships. To meet these data collection objectives, seahorses were selected to be sampled based on a list of prioritization criteria:
(1) whether Project Seahorse already had sufficient data on the available species from the dried trade work or live field work;
(2) what species were available at the wholesalers during the field study period;
(3) whether the seahorses at the wholesalers spanned the transition from juveniles to adults and whether enough seahorses of appropriate sizes were available to generate size at maturity curves;
(4) whether enough seahorses over a range of sizes were available to generate trade height relationships for a species; and
(5) whether the seahorses available were tank-raised or wild; wild seahorses were preferred but tank-raised individuals were sampled when insufficient numbers of a particular species were available.

All seahorse sampling was conducted onsite at the respective wholesalers/aquarium and the sampling process involved a number of steps. To sample the seahorses, the lead researcher filled buckets with water from the wholesaler's tank system and equipped them with oxygen pumps or water inflow. Seahorses were given holdfasts (e.g. false corals, plastic tubing) to minimize stress. The researcher then handled the animals as follows.

1) She measured them underwater with calipers and wire. Length measurements, pouch development stages and reproductive status were assessed.
2) Time permitting, she weighed each animal on a portable electronic balance, placing each in a small pre-weighed container of water.
3) She then transferred them to an adjoining recovery tank or to a portion of the tank separated by divider (to keep measured and unmeasured individuals separated).

In some cases, the lead researcher transferred seahorses to another tank, photographed them, and returned them to the recovery tank or their original tank. Sub-samples of the seahorses measured were photographed when: (1) the researcher needed to confirm species identification with other Project Seahorse experts; (2) unusual characteristics (e.g. coloration/markings, skin fronds) were observed; (3) clear examples of typical injuries (e.g. skin lesions) or illnesses (e.g. eye infections) were noticed; or (4) clear examples of pouch development stages were exhibited in the animal being sampled.

Interviews

All interviews with the wholesalers were conducted in accordance with UBC BREB guidelines. Written consent was obtained from the study participants with consent forms before interviews were conducted. At the beginning of the interview, the respondent was reminded that participation was voluntary and that they could decline to answer questions or stop the interview at any time. Oral permission was also obtained to include the company's name in the acknowledgements of the trade report. Most participants appeared appreciative of the offer of public acknowledgement. Interviews typically lasted 45-60 minutes. A set list of questions was used to guide the interview, but other related issues were explored depending on the respondent's level of knowledge on the interview topics and their comfort level.

Seahorse identification

Seahorses are commonly recognized as being difficult to identify to the species level, and the depth and detail of the respondents' seahorse identification knowledge varied from wholesaler to wholesaler. The lead researcher found that wholesalers' identification proficiency ranged from total lack of knowledge of different species names to the ability to identify species and diagnose different seahorse diseases. Wholesale operations that were less interested in seahorse identification and husbandry (n=6) usually identified the seahorses they received as whatever species name was listed on the shipping papers. However, these papers often identified some or all of the seahorses in the shipments incorrectly. For example, the researcher observed instances where shipments labeled *Hippocampus comes* could also contain *H. kuda* and *H. kelloggi* individuals. In addition, the researcher observed that *H. spinosissimus* was widely misidentified as *H. histrix*.

Seahorses were sorted and identified at the wholesalers in a number of ways, including: (1) by species; (2) by shipment;[3] (3) tank-raised or wild;[4] (4) size; (5) no sorting; or (6) a combination of two or more of these criteria. Stock identification specificity varied from wholesaler to wholesaler, and sometimes the stock was labeled simply as "seahorse." Respondents consistently commented that retail store customers, and consequently the wholesalers' customers, were generally more concerned with a seahorse's color and size than its species. The lead researcher inferred that because of this customer preference, common seahorse names that typically pertained to color or markings such as "ring-tailed seahorse," "black seahorse" or "yellow seahorse" were often used. This became problematic for identifying seahorses to species level as a "yellow seahorse" from Asia alone could describe a number of species, including *H. comes, H. histrix, H. barbouri, H. kuda,* and *H. kelloggi,* among others. Permits and shipping lists typically included species and/or common names, but they also frequently mentioned colour and/or size. Thus, colour and size were often included in labeling at all stages in the chain of custody. Other wholesalers used proper scientific names. At some locations, the seahorses were also explicitly identified as tank-raised or wild. From her interaction with the wholesalers, the researcher observed that the wholesalers were very cognizant of which items in stock were wild and which were tank-raised (n=4 wholesalers carried tank-raised seahorses).

Knowledge regarding seahorse husbandry also varied from wholesaler to wholesaler. Businesses with more knowledge about seahorse identification and husbandry appeared to derive it from an employee who was interested in seahorses as a hobbyist and was willing to pay extra attention to the seahorses even though they were not a major business interest from a financial point of view. These businesses (n=2) often had a seahorse identification/husbandry guide available and made some attempt to confirm that the shipping papers were correct. The businesses that were more knowledgeable about seahorses were also more concerned overall with animal feeding, controlling disease outbreaks, minimizing animal stress and mortality, and working with suppliers on stock quality concerns.

Gaps in Data

i) Lack of traceability in marine ornamental sourcing once the products enter the USA.

Marine ornamental sourcing can be very complicated and tracing their chain of custody for seahorses may be problematic once they enter the USA. Connections among importers, trans-shippers and

[3] Shipments could either contain mixes of species or just one species. Moreover, they could be made up of tank-raised, wild, or sometimes tank-raised and wild individuals. Wild shipments of seahorses from Asia often contained a mix of different species that could include *H. kuda, H. barbouri, H. spinosissimus/histrix, H. comes, H. kelloggi*, and *H. trimaculatus.*

[4] Tank-raised refers to all aquacultured individuals in this report (no distinction is made between F1 and F2 individuals). Wild refers to animals caught in the wild.

wholesalers are sometimes complex and difficult to distinguish if companies have different divisions under different names or parent-child companies with different names. Moreover, many wholesalers may purchase from one importer, leading to difficulties in tracking seahorses from their entry into the USA to their point of sale. When sampling at different wholesalers, the lead researcher had to be aware of: (1) the source company(ies) for the wholesaler; and (2) the destination company for the seahorses to prevent resampling of seahorses. USFWS records displayed which companies were importing seahorses, but there was no way for the researcher to confirm whether the records captured all of the companies importing seahorses. Moreover, these records did not provide information as to exactly how many wholesalers were selling seahorses (i.e. because not all importers are also wholesalers and vice versa).

ii) Deriving seahorse throughput values from traders' recollections has inherent problems.

Seahorse import and export numbers and values in this report were derived largely from traders' memories in interviews, and as a result, some error was likely. At each participating wholesaler, the lead researcher spoke with at least one respondent. At wholesalers where the researcher interviewed multiple respondents, she used the volumes estimated by the respondent who had the most experience and long-term knowledge of the seahorse imports/sales/species. The researcher calculated all of her throughput estimates with the shipment timing assumptions relayed to her by the respondents. Consequently, although the values may not be precise, they were the best estimates that could be generated. These respondents had a clear knowledge of the species (at the very least, as recorded on permits or by common names), sources, destinations, volumes, and values of stock.

iii) The results of this study cannot be extrapolated to the USA as a whole.

Los Angeles is the major importing hub for seahorses in the USA (USFWS, 2005), but the wholesalers in this study represented only a portion of the businesses that participated in the live seahorse trade in Los Angeles. As such, the findings from the eight wholesalers interviewed in Los Angeles are likely a sizeable under-representation of Los Angeles' seahorse trade. This means that the seahorse import numbers in this study, if extrapolated to provide a picture of the entire USA trade, would result in an underestimate of national trade.

III. Seahorse trade

Reported effect of CITES on the live trade

Testimony from Los Angeles wholesalers suggested that the implementation of the CITES listing for seahorses disrupted the live trade. All respondents interviewed indicated that a de facto moratorium on imports for at least seven months resulted from the listing, apparently because of regulatory concerns. They also noted that live seahorses from the Philippines and Brazil were eliminated from live trade. These responses indicated that regulation can have an effect on the live trade.

Post-CITES, live-trade volumes were depressed, values had doubled, and more seahorses were sourced from captive breeding facilities. Respondents reported that by the spring of 2005, permitting was established in exporting countries, and consumer demand motivated all of the companies except one to start importing seahorses. Because of the disruption of trade following the implementation of the CITES listing, trade values and information in this section will largely be divided into pre- and post-CITES categories.

Seahorse chain of custody

In the interviews, many of the respondents were unsure of the initial steps in the chain of custody for live seahorses. However, two respondents who had worked and lived in seahorse exporting countries indicated the following chain of custody for live wild seahorses being shipped to the USA:

1) seahorses captured in wild → [5] 2) transferred to potential exporter holding facility→ 3) held in exporter holding facility (3-7 days; feeding ceased and purging of digestive tract encouraged to prevent water fouling in bag during transport)→ 4) packaged for export→ 5) transported to airport→ 6) wait for flight departure→7) flight (air time between import and export countries)→ 8) arrive in United States→ 9) clear Customs and Fish and Wildlife Service inspection→ 10) seahorses picked up at airport by importer/wholesaler/trans-shipper→ 11) seahorses transported to wholesaler.

Two other respondents (who had long-term experience working in the marine wholesale industry and worked at wholesalers that imported tank-raised seahorses) indicated that tank-raised seahorses followed steps 4-11 listed above. These steps aligned with the steps in shipping marine ornamentals outlined in Wabnitz et al. (2003). Larger wholesalers (n=3 in study) often imported seahorses themselves, while medium-smaller (n=5 in study) wholesalers typically received seahorses through an importer or trans-shipper, but this rule did not always hold true. In addition, a broker was sometimes used to handle the shipment paperwork. From the interviews, the lead researcher deduced that none of the wholesalers were buying seahorses from other participant companies at the time of study, so double counting of seahorse stock should not be a problem in the post-CITES data. Some pre-CITES data may have been double counted for up to six of the participating companies in this study, but the researchers did not have any information to confirm or disprove this notion.

Personal ties did not appear to exist between export and import markets as they often did in the dried trade. Only one wholesaler who was interviewed expressed that he had business investments in exporting companies in source countries.

The interview respondents indicated that the total travel time for imported seahorses differed by provenance and whether the seahorses were wild caught or tank-raised. Two respondents indicated that wild caught seahorses from Asia typically took 6-9 days from arrival at the exporter's holding facility to arrival at the Los Angeles holding facility. Another respondent indicated that wild seahorses from the USA (e.g. Florida) would spend less time en route because of the shorter flight and the lack of need to clear USFWS and Customs. Tank-raised seahorses from Asia (i.e. Sri Lanka, Vietnam) however, may take only 1-2 days to reach the wholesaler in the USA from their supplier. One respondent indicated that the shorter travel time for tank-raised seahorses reflected the lack of transport time from the wild and/or holding time in the exporter facilities.

Freight costs varied by source country (i.e. by transport distance), shipment volume, and shipment weight. From interviews with the respondents, the lead researcher inferred that species, source region, etc. typically figure into the price of seahorse only in so much as they determined the size and colour of the seahorses, as well as the shipping costs. Wabnitz et al. (2003) suggested that shipping charges may result in discrepancies between source country price and retail price for marine ornamentals. Because importers must pay for freight costs on top of their price per animal, respondents (n=6) noted that they often pack animals very tightly to minimize their freight costs per piece. All respondents asked about packing procedures indicated that seahorses were typically packed one per plastic bag, with 16-50 bags

[5] Many steps often occur between this first capture step and the transfer to the exporter holding facility (Vincent, pers comm), but these were not indicated by the respondents.

per box. Usually, the bags were filled with enough water to cover the animal's body, or to fill the bag halfway. The rest of the bag volume was filled with oxygen. All respondents (n= 12) commented that medications were not used in transit.

Respondents indicated that seahorses were typically packed in separate boxes from other non-seahorse species. USFWS acknowledged that this practice was becoming increasingly common since CITES implementation, however approximately 50% of the shipments containing seahorses that arrive in the USA have the seahorses mixed in boxes with other non-seahorse species. USFWS also indicated that packing preference typically depends on the shipper, and was usually done to facilitate shipment permitting and labeling (Townsend, pers comm). Annex A details more information on USFWS inspection practices and confiscations.

After the seahorses arrived at the wholesaler, the respondents said that they were put through an acclimation process so that they could be added to the wholesaler's tank system without a severe pH, temperature, or chemical shock to their physiology. The lead researcher observed that the sophistication of this acclimation process varied between wholesalers. In all cases, the bags containing the seahorses were cut open and the seahorses were placed into bins with the bag water. At two wholesalers where the researcher observed employees who were more conscientious about animal husbandry, this process was carried out in a section of the warehouse with dimmed lighting to reduce stress as the seahorses emerged from the dark shipment boxes. After speaking with respondents (n=4) from different companies and observing unpacking procedures at four companies, the researcher determined that 20-50 seahorses were added to each bin, depending on their size.

One simple type of acclimation process observed at two wholesalers and described by three respondents involved running a small tube with tank system water into a bucket with the seahorses. The inflow of tank water slowly diluted bag water in the bucket, flushing out the ammonia and residual waste that had accumulated during transport. The bins containing the seahorses were often floated in existing system tanks or allowed to overflow as new system water diluted the remaining bag water in the bin. This process typically took 30-60 minutes, after which the seahorses were added to the warehouse tank system.

More sophisticated wholesaler acclimation processes typically relied on water pH readings to determine the duration of acclimation. This process was described by two respondents at two different wholesalers. The pH of the incoming bag water was read with a pH meter. System water was consequently treated to match the pH of the bag water and then added to the bin with the seahorses to flush out the waste and ammonia laden bag water. Inflowing system water pH was slowly raised until it matched the pH of the warehouse system. The speed of this process depended on the stress level and condition of the animals. The respondents did not explicitly state what common signs of stressed or acutely damaged seahorses would be, but in the lead researcher's observation these could include: laboured breathing; buoyancy problems; increased respiration rate; listlessness; unresponsiveness; visible skin/eye/other infections; or other physical injuries such as skin lesions. The pH was raised more slowly for shipments with very visibly stressed animals to allow for more time to physiologically adapt to the changing water conditions. The animals were then added to the main tank system. Seahorses in the study were observed to be put up for sale, no matter what their condition. Only one wholesaler was observed to quarantine seahorse shipments that arrived in poor condition (for example, with visible white skin patches suspected by the wholesaler to be parasites). This quarantine treatment typically consisted of keeping the animals in a separate tank system with nitrofurazone (an antibiotic) in the water for approximately one week (or until the shipment needed to be sold). This treatment was

also used by the LBAP. Please see Annex B for information on seahorse husbandry, diseases, and mortality.

Import trade routes

The main seahorse source countries typically changed at the companies interviewed following the CITES listing of seahorses. Pre-CITES, the main source countries for seahorses were Brazil (n=7) and Philippines (n=6) for the interviewed wholesalers (n=7). Indonesia and Sri Lanka were the next most common sources (both n=3). The so-called "Brazilian seahorse" may have been either *H. reidi* or *H. erectus,*[6] and respondents said that these seahorses were preferred by consumers because they were large and colorful. The Philippines was reportedly a popular source possibly because of the comparatively low cost of the seahorses from this region. The survey suggested that these and other mixtures of wild seahorses from Asia were comprised mainly of *H. kuda*, followed by *H. comes* and *H. spinosissimus*, with some *H. barbouri* and few *H. kelloggi*.

Other pre-CITES source countries were also indicated by the wholesalers. Some traders cited Indonesia (mixed species) and Sri Lanka (*H. fuscus)* as the next most common sources (both n=3). The Caribbean (inferred by the lead researcher to possibly be *H. erectus*) and Mexico (*H. ingens*) were also named as sources for wild seahorses. A few companies reported receiving irregular or limited trial period pre-CITES shipments of tank-raised seahorses from Australia (*H. abdominalis, H. barbouri, H. whitei*) and Florida (species unknown).

Table II. **Source countries and seahorse provenance pre- and post-CITES, as reported by live trade wholesalers participating in study (n=8).**
a = aquacultured; w = wild caught; # Americas; * Asia

Company	Australia		Brazil #		Caribbean #		Florida #		Hawaii #		Indonesia*		Mexico #		Philippines*		Sri Lanka*		Vietnam*	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
A			w								w	w			w					
B			w									w			w		w			w/a
C	a		w				a	a		w	w		w		w			a		
D			w		w	w					w				w		w	a		
E			w																	
F			w																	w/a
G			w												w					a
H			w									w			w		w			
Total no. companies and provenance	1a	0	7w	0	1w	1w	1a	1a	0	1w	3w	3w	1w	0	6w	0	3w	2a	0	2w/3a

From responses obtained through the interview process, the researchers learned that the main species and sources of live seahorses had changed post-CITES, although the number of wholesalers trading seahorses had remained constant (n=7).[7] No respondents reported importing seahorses from either the Philippines or Brazil since CITES implementation. The Philippines banned trade of seahorses post-

[6] Please see the "Trade Volumes" section for more information on "Brazilian" seahorses and *H. reidi* vs. *H. erectus* identification.

[7] One wholesaler decided to stop carrying seahorses while another who had not stocked seahorses in the past decided to start selling them. The rest of the wholesalers resumed stocking seahorses. As a result, the number of wholesalers carrying seahorses in the study pre and post-CITES remained constant.

CITES (Vincent, pers comm) and the respondents noted that Brazil also severely restricted seahorse trade. Some respondents (n=3) indicated the Brazilian government had tightened its controls on seahorse export, and all companies that had previously carried these seahorses responded that Brazilian seahorses were virtually impossible to obtain. The researchers could not discern from the respondents' answers whether the possible aim of this new control was to bring permitting up to speed, address conservation concerns, or possibly a combination of both. Wholesaler accounts as well as analysis of the marine ornamental fish trade in the main exporting state in Brazil indicated that neither the marine ornamental trade nor the status of wild marine aquarium species population numbers in Brazil were carefully monitored prior to the implementation of the Appendix II CITES listing (Monteiro-Neto et al., 2003). A national expert supported the notion that Brazilian marine ornamental fisheries and trade were poorly regulated, adding that in 2001, Brazil had not yet compiled an official list of threatened marine fish or list of marine fish species permissible for capture (Rosa, unpublished data). Moreover, poor permit and quota enforcement, and frequent misidentification of Brazilian seahorses as *H. kuda* (an Asian species) was also noted. At the same time, the author indicated that national concern over the marine aquarium trade was growing, and stock assessment, monitoring and regulatory initiatives were being discussed in Brazil (Rosa, unpublished data). This information appeared to add weight to the respondents' assertion that the Brazilian government was attempting to improve regulatory and stock assessment concerns over seahorse populations with the advent of the CITES Appendix II listing, and as a result it severely restricted seahorse exports.

Post-CITES, respondents indicated that most seahorses at Los Angeles wholesaler facilities still came from Asia and the Americas. Indonesia (n=3) and Vietnam (n=2) had become the principal exporters of live wild seahorses, namely *H. barbouri, H. comes, H. kelloggi, H. kuda,* and *H. spinosissimus*. A considerable number of seahorses also came from aquaculture facilities in Vietnam (n=3)[8] and Sri Lanka (n=2; *H. reidi*). Other source countries for wild and tank-raised seahorses at time of study - all in the Americas – included Hawaii (wild *H. kuda*), Florida (tank-raised *H. erectus*), the Caribbean (inferred by the lead researcher to possibly be wild *H. erectus*), and Brazil (likely wild *H. reidi* and/or *H. erectus*).[9] The surveyed Los Angeles traders reported importing large numbers of tank-raised *H.kuda/kelloggi* from Vietnam, followed by tank-raised *H. reidi* (Sri Lanka), wild *H. comes* (Vietnam, Indonesia), and wild *H. kuda* (Vietnam, Indonesia).

Seahorse export routes

The wholesalers interviewed indicated that Los Angeles may be a sink as opposed to a source for seahorses, with very low levels of exports compared to imports. Pre-CITES, wholesalers re-exported very small volumes of seahorses; one wholesaler estimated <150 seahorses per annum. They recounted that re-export of seahorses pre-CITES from the USA was typically to Canada and Mexico. One wholesaler also indicated that seahorses were exported to Europe and Asia. Export of seahorses was reported to always have been a very minor part of the interviewed wholesaler's business in seahorses. None of the interviewed companies had, however, exported seahorses since CITES implementation in May 2004. One company was applying for CITES export permits at the time of study.

Domestic trade all over the USA was indicated to be very common. All wholesalers (n=8) indicated that their stock was largely shipped out of the Los Angeles area and out of state, but remained in the

[8] These tank-raised seahorses from Vietnam were reported to be *H. kelloggi* by all of the respondents. However, after viewing photos of the animals and considering the habitat of *H. kelloggi* (a deepwater species), Project Seahorse taxonomy experts suspect they were actually *H. kuda*. This assertion could not be confirmed however.

[9] One wholesaler anticipated that it would receive its first post-CITES shipment of Brazilian seahorses shortly following the LA study period.

USA. Most respondents indicated that they shipped most of their stock to all regions of the USA. Two respondents indicated that they thought that the Midwest and East Coast were major destinations.

Customers

According to respondents (n=7), the main customers of the wholesalers interviewed were overwhelmingly retail pet stores, which bought 90-100% of the wholesalers' overall stock. One wholesaler in this study was an exception - other wholesalers bought approximately 90% of their overall stock. This wholesaler, however, dealt mainly in importing and trans-shipping, but was still involved in wholesale. The other companies focused primarily on wholesale to retail pet stores, public aquariums, and private customers. These general sales patterns should be reflective of seahorse sales.

Sales in the marine aquarium market depend highly on supply and demand, and may fluctuate. Seasonal fluctuations in the aquarium wholesale market were identified by virtually all of the study respondents. October to late April is the peak season for marine ornamental sales; presumably during the winter hobbyists are likely to spend more time indoors with their aquariums (Monteiro-Neto et *al*., 2003).

Respondents consistently noted that their customers were looking for large and brightly colored seahorses. Large seahorses and seahorses that are bright red, orange and yellow (in order of desirability and rarity) were favoured by retail store customers, and thus by marine wholesalers.

Supply and demand

All respondents indicated that seahorses were not a large part of their businesses. When CITES was implemented and the supply of seahorses was cut off (as described above), all of the wholesalers (n=8) responded that this did not noticeably affect their businesses overall. Even the one wholesaler in the study who decided to stop carrying seahorses following the CITES implementation expressed this sentiment. Most wholesalers only started carrying seahorses again in the early spring to summer of 2005 in response to customer demand and the renewed availability of the seahorse supply. Please see the CITES section of this report (section III) for more information on CITES related shifts in seahorse supply.

Supply and demand balances have changed with CITES implementation. All wholesalers who were interviewed stated that before CITES the supply of seahorses met the demand. At the time of the interviews (October 2005), the respondents also noted that supply was meeting demand, but a few respondents qualified their statements by noting (1) supply was meeting demand for Asian varieties, but not for large colorful seahorses or (2) that there had been a pent-up demand because of the lack of supply after CITES implementation, and that seahorse sales could not be maintained at current levels. Two respondents predicted that there will likely be an oversupply of seahorses in the near future; they proposed that as the renewed supply started to meet the pent-up demand, seahorse sales would drop from the levels observed at the time of study and stabilize in early 2006. One respondent indicated, however, that demand could increase if more large colorful seahorses became available on the market.

Seahorse size

The CITES listing appeared to have affected the size of seahorses only due to changes in species traded and their provenance. Large size and often bright colours made larger Brazilian seahorses (*H. erectus/H. reidi*) an industry staple pre-CITES. One respondent indicated that the wild Brazilian seahorses pre-CITES were typically over 10 cm in height. As already mentioned, these large-bodied

industry staples were not available post-CITES, which likely reduced the average size of traded seahorses.

Wild seahorses both pre- and post-CITES typically arrived at the wholesalers at a larger size than tank-raised individuals. Five respondents indicated they typically received wild seahorses in the 6.5-15 cm range, but that 50-100% of their post-CITES wild stock was over 10 cm in height. Three respondents indicated that tank-raised individuals ranged from 5-8 cm in height on average. They did not indicate whether the average height of seahorses changed with the implementation of the CITES listing. According to the lead researcher's observations and the respondents' comments, most tank-raised seahorses were shipped as juveniles, while most wild seahorses arrived at the wholesalers as adults. Although tank-raised individuals were becoming more common in trade, demand for wild seahorses may have been partially fueled by the demand for larger animals at time of purchase (n=3 respondents).

Trade volumes

The standing stock volume at the wholesalers interviewed varied between approximately 40-300 seahorses, but may not be a good indicator of throughputs. Seahorses were often sold or shipped-off to meet customer orders soon after shipment arrival. As many respondents noted, supply and demand could also fluctuate greatly, leading to variable numbers in the facility.

The respondents indicated seahorse throughput numbers in interviews, and according to calculation from these estimates, the number of seahorses at the wholesalers visited during the study has decreased since the implementation of CITES by 45-59%. Pre-CITES seahorse import numbers were calculated for the period leading up to the May 2004 implementation of the CITES Appendix II listing of seahorses. Post-CITES numbers were calculated for the time period when each importer started importing seahorses again (typically in Feb-July 2005) until time of field study (October 2005). Figure 1 displays seahorse volume trade patterns for each of the wholesalers interviewed. Figure 2 and Tables III.a. and III.b. indicate trends for the group of wholesalers interviewed as a whole.

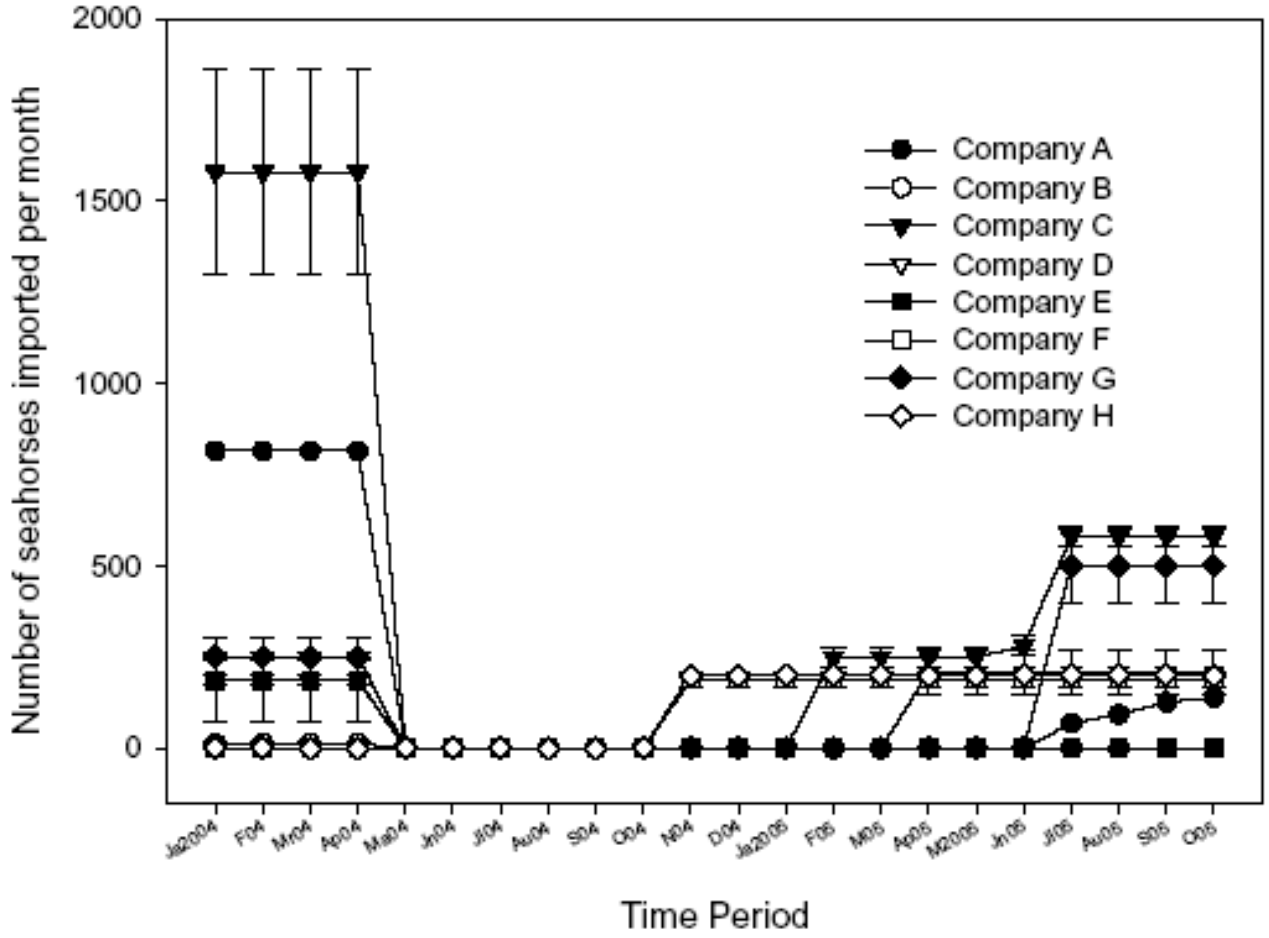

Figure 1: Effect of the CITES Appendix II listing (May 2004) on the volumes of seahorses imported by traders interviewed in Los Angeles (n=8). Monthly totals represent summed volumes for all species handled by a given trader. Where monthly volumes were cited as a range, data points represent mid-values, and error bars represent high and low estimates.

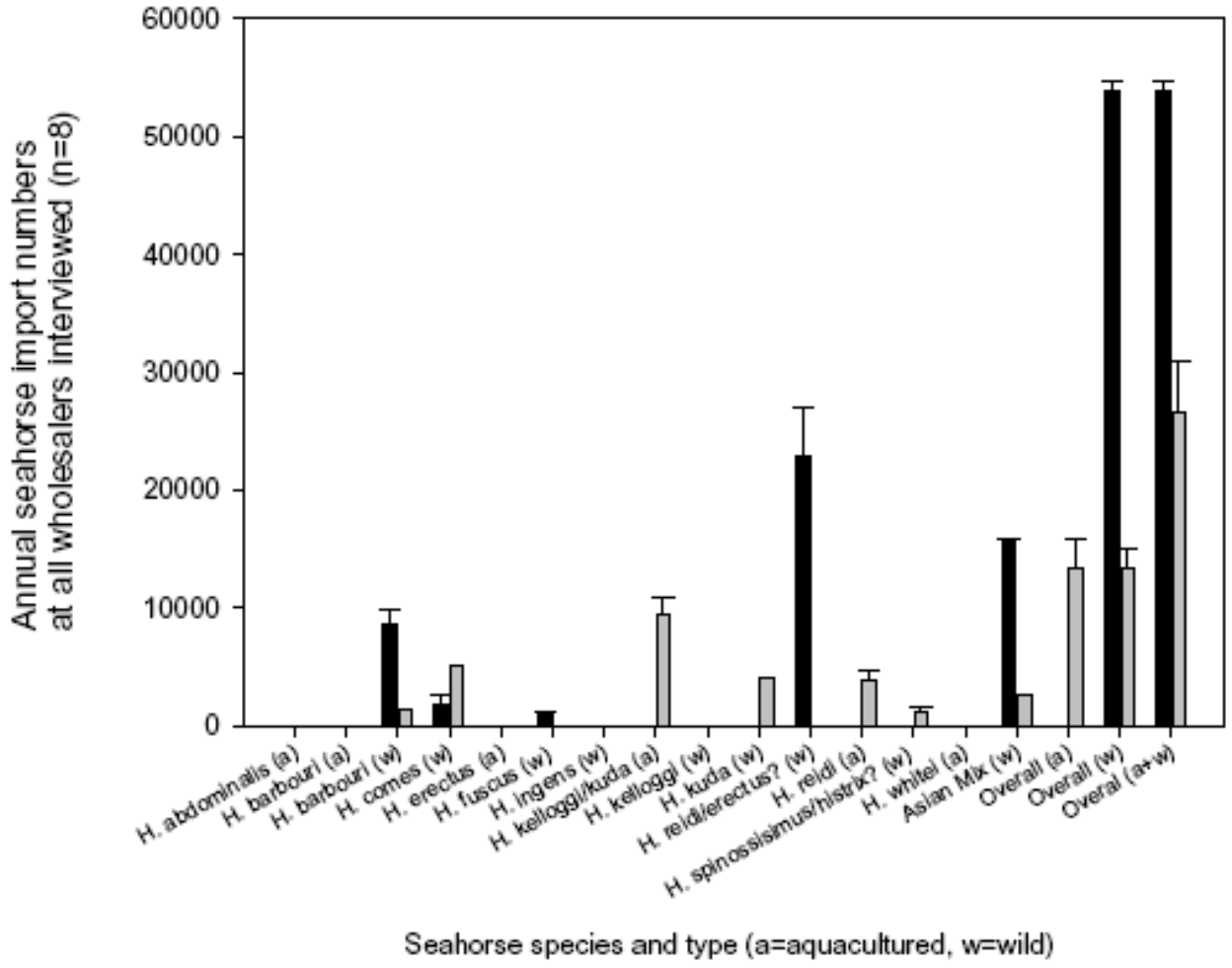

Figure 2. Estimated annual volumes of live seahorses traded pre-CITES (black) and post-CITES (gray) for wholesalers interviewed in Los Angeles (n=8). Histogram bars represent the estimated annual volume, based on extrapolated monthly volumes by species over all traders. Values came from wholesalers' oral estimates, and from one set of sales records. Information regarding seasonal changes in the number of seahorses imported was applied to the corresponding months of the year (usually May-end of September). This information was not always available for each species. Error bars denote the range of the data (i.e. lowest and highest import numbers estimated by the respondents). Pre-CITES, annual values were calculated based on recollected monthly trade volumes. Post-CITES, annual values were calculated based on monthly estimates from the time when each importer resumed imports (typically in Feb-July 2005) until surveys took place (October 2005).

Pre-CITES, the staple trade species for the participant wholesalers was the commonly referred to "Brazilian seahorse" (n=18,520-27,080 individuals per annum). The researchers had trouble distinguishing from the respondents' comments whether the species they were referring to was *H. reidi* or *H. erectus*, or a mixture of both. Both species are found in Brazil. They are both large and can be bright yellow, orange, red, brown or black in colour. One of the most distinguishing morphological features between the two species is body type: *H. reidi* have a slender trunk while *H. erectus* have a very deep one (Lourie et al., 1999; Baum and Vincent, 2005. Rosa (unpublished data)) suggests that *H. erectus* is the fifth most commonly exported marine aquarium fish in Brazil and it is the more commonly traded of the two species. Rosa also acknowledged that collectors typically did not

distinguish between the two species when collecting them. Because of the difficulties associated with seahorse species identification, and less stringent pre-CITES labeling codes on exporter, USFWS and Customs permits, the researchers suspect that these two species were often mixed together in shipments. Given the respondents comments on important factors in customers' selection criteria, the researchers suspect that size and colour specifications likely took precedence over species-based categorization. A few traders indicated that the seahorses in question were *H. reidi*. However, as taxonomic knowledge, identification accuracy, and Latin name familiarity varied greatly between wholesalers, most wholesalers referred to them only as "Brazilian seahorses." Consequently, the researchers could not separate suspected numbers of *H. reidi* from *H. erectus* in this "Brazilian seahorse" category.

The next most commonly traded species was likely *H. kuda* (n=15,940 individuals per annum, high estimate), but again there was a confounding factor in this estimation. Shipments from Asia often arrived with a variety of species mixed together. Because of taxonomic identification difficulties and inaccuracies in shipment labels and papers, it was often difficult to distinguish how many of each species were imported. This was a problem both pre- and post-CITES, but according to an USFWS official, identification had improved since the implementation of CITES (Townsend, pers comm). The researchers found that identification of the numbers of each separate wild Asian species being imported into the USA was not feasible. Mixed species wild shipments often arrived from the Philippines or Indonesia pre-CITES, and interviewed wholesalers indicated that either labeling or wholesaler species specific identification knowledge was inaccurate or lacking. Based on the trader's estimates, however, volumes of *H. spinosissimus*/*H. histrix*[10] and *H. comes* were likely comparable to *H. kuda* numbers or slightly lower, followed by *H. barbouri*. The lead researcher also noticed that *H. kelloggi* was mixed into some shipments, but in very low numbers.

[10] The lead researcher found that seahorses often labeled as *H. histrix* were in fact *H.* spinosissimus in virtually every case. The researcher assumed that this held true for both pre and post-CITES data.

Table III a. Pre-CITES (2004) annual import numbers for each traded seahorse species and variety (aquacultured (a) or wild (w)) at each company interviewed (n=8)). The numbers are derived from interviews with traders and estimates should hold true for approximately the five-year period leading up to the CITES implementation.

* The values with the symbol 'm' included a mix of *H. kuda, H. comes, H. spinosissimus*/*H. histrix* and possibly other Asian species. Extracting exact numbers for each species in this mix was not possible. The high numbers indicated and starred for each of these species included the total mix figure (2600) for each species. Thus, this number is counted repeatedly, and the high numbers in the chart will not sum to give a total high of all species. Please see actual throughput numbers below (each mix will only be counted once in the overall total).

Species	*H. abdominalis* (a)	*H. barbouri* (a)	*H. barbouri* (w)	*H. comes* (w)	*H. fuscus* (w)	*H. ingens* (w)	*H. kelloggi* (w)	*H. kuda* (w)	*H. reidi/ erectus* (w)	*H. spinosissimus/ histrix* (w)	*H. whitei* (a)
Company											
A			m10400	m10400			m10400	m10400	180	m10400	
B			m75-100	m75-100	25-50		m75-100	m75-100		m75-100	
C	300 (1 year only)	300 (1 year only)	m10400-1560	1040-2600		6	m10400-1560	m10400-1560	15600-20800	m10400-1560	300 (1 year only)
D	1200 (2002 only)		m1800		1200			m1800	900-1200		
E									800-3600		
F			2080								
G			5200-7880								
H			m2080	m2080			m2080	m2080	1040-1300	m2080	
Total low	?	?	8060	1040	1225	6	0	0	18520	0	?
Total high	?	?	11000*	15180*	1250	6	14140*	15940*	27080	14140*	?

Annual total: tank-raised (a) = ? (0 on average)
wild caught (w) = 52826-54756
Annual overall =52826-54756

Since the implementation of CITES, both changes in stock type and volume have occurred. Tank-raised species from Vietnam appear to be traded in the highest numbers (n=8,060-11,000 individuals per annum). Tank-raised seahorses from Vietnam were carried by three of the wholesalers interviewed. As mentioned earlier, this species was identified by the supplier as *H. kelloggi*, but difficulties in identifying juvenile seahorses have led the Project Seahorse team to question whether these seahorses are in fact juvenile *H. kuda*, or another species (Figure 3). Tank-raised *H. reidi* (n=2,817-4,767 per annum), wild *H. comes* (n=5,206 minimum per annum) and wild *H. kuda* (n=4,006 per annum) were the next most commonly traded species from the wholesalers interviewed.

Figure 3. Tank-raised seahorses reported by wholesalers to be *H. kelloggi*, but believed by Project Seahorse experts to possibly be *H. kuda*

Table III. b. Post-CITES (2004) annual import numbers for each traded seahorse species and variety (aquacultured (a) or wild (w)) at each company interviewed (n=8). The numbers are derived from interviews with traders and estimate the annual imports assuming that trade continues at current levels.

* The values with the symbol 'm' include a mix of *H. kuda, H. comes, H. spinosissimus*/*H. histrix* and possibly other Asian species. Extracting exact numbers for each species in this mix was not possible. The high numbers indicated and starred for each of these species includes the total mix figure (2600) for each species. Thus, this number is counted repeatedly, and the high numbers in the chart will not sum to give a total high of all species. Please see actual throughput numbers below (each mix will only be counted once in the overall total).

† - These numbers indicate that the number represents a combined total between the two cells as the wholesaler reported for two wholesalers at the same time and did not provide enough information to split the number between the two wholesalers.

Species	*H. barbouri* (w)	*H. comes* (w)	*H. erectus* (a)	*H. kelloggi* (w)	*H. kelloggi/ kuda* (a)	*H. kuda* (w)	*H. reidi* (a)	*H. reidi/erectus* (w)	*H. spinosissimus/ histrix* (w)
Company									
A	1332	6		26		626			907
B		5200†		some		some			
C		m2600*	?		780-1040	3380 + m2600*	867-1300	?	m2600*
D		1/0					1950-3467		
E									
F					2080				104-624
G					5200-7880				
H		5200†		some		some			
Total low	1332	5206	?	26	8060	4006	2817	?	1011
Total high	1332	7806*	?	26	11000	6006*	4767	?	5142*

Annual total: tank-raised (a) = 10877-15767
wild caught (w) = 11581-15112
Annual number overall = 22458-30879

Trade Values

Seahorses are priced per piece and their value is determined by a combination of factors, but two of these are predominate – size and colour. Large seahorses and seahorses that are (in order of rarity) bright red, orange and yellow are highly desirable to retail store customers, and thus to the marine wholesalers. Species, source region, etc. typically only figure into the price of seahorse in how they relate to determining the size and colour of the seahorses. Freight costs are also added on top of the suppliers' price. Respondents also indicated that freight costs varied by providence, shipment volume, and shipment weight.

According to the respondents' accounts, the overall price that wholesalers pay per seahorse approximately doubled from the pre-CITES price of $7 (USD) to around $14 (USD) post-CITES. As seen in Figure 4, wild varieties experienced approximately threefold increases in price, with wild Asian seahorse prices post-CITES six times greater than pre-CITES prices. Pre-CITES, tank-raised prices were perceived as prohibitively expensive, at 2.5-3 times the price of wild seahorses. Post-CITES, however, prices for tank-raised seahorses, particularly from suppliers in Asia have become comparable to prices for wild seahorses.

Three of the respondents indicated that higher prices should mean that seahorses are less disposable to consumers, and represented more of an investment. Two respondents also noted that retail shoppers purchasing seahorses are now more knowledgeable in their husbandry practices and many are conscious of conservation concerns which have increased the demand for tank-raised animals. Three

wholesalers indicated that this has produced a change in the type of retail pet store customer, and consequently the wholesaler's buying practices.

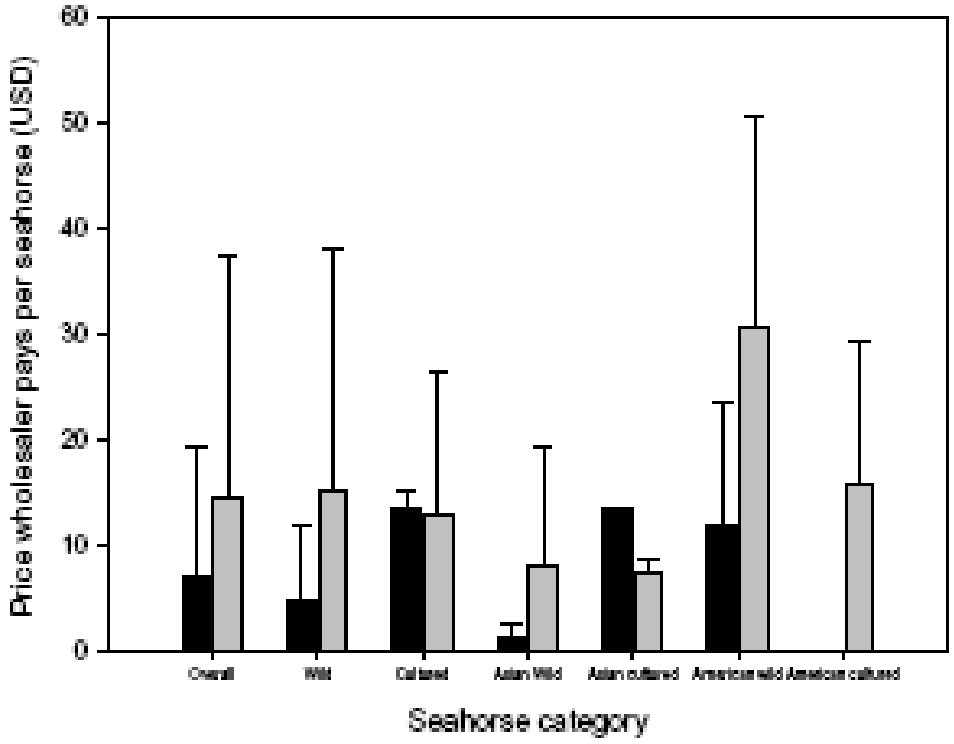

Figure 3. Prices wholesalers paid for live seahorses pre- (black) and post- (gray) CITES. Histograms represent the midpoint of individual prices cited by traders, while error bars indicate the range. See Annex C for additional seahorse value information to accompany Figure 2 and this section.

III. CITES

Trader reactions – CITES Appendix II listing

The trade of seahorses has been affected in a number of ways by the implementation of the CITES Appendix II listing. Wholesalers indicated that they were informed about planned CITES regulation of seahorses in 2003, however they also suggested that in 2004 when the listing was implemented, the industry was not prepared for the trade restrictions. It was not exactly clear to the researchers whether the lack of trade represented a lack of supply and/or increased regulation in exporting countries or tighter controls on imports by USA authorities. Most respondents believed that the lack of trade was caused by slow permit implementation or restrictions due to concerns over seahorse population status in supply nations, such as Brazil (this example was explained earlier in the text). One respondent, however, suggested that they were able to start importing again earlier than other companies post-CITES because of their extensive experience with CITES permitting, so permitting on the USA wholesalers' side could also have played a role in this lack of supply. Although some wholesalers reported knowing of incidents of traders smuggling animals without appropriate permits in the period from May 2004 (CITES implementation) to the spring of 2005, most suppliers stopped carrying seahorses during this period because of lack of supply. Some respondents (n=3) mentioned that this seahorse "blackout period" was a blessing in disguise because CITES initially provided a legitimate justification for them to stop trading seahorses. Traders preferred to avoid the husbandry challenges associated with seahorses (live food, animals arriving in poor condition). By the spring of 2005,

permitting issues seemed to have been resolved, and consumer demand motivated wholesalers to return to trading seahorses post-CITES only as a service to customers, rather than as profitable species. From conversations with the respondents, the researchers inferred that this renewed supply availability was a result of both exporters and importers adjusting to the new CITES permitting process.

Knowledge regarding CITES and specifically the Appendix II Hippocampus genus-wide listing varied among wholesalers. The researcher inferred that because of a 2003 USFWS announcement regarding the pending CITES listing, wholesalers at the very least were aware that it would restrict seahorse trading. The level of knowledge about what the listing actually meant varied, from general inference that there must be concerns regarding seahorse populations in the wild, to detailed knowledge of what the different CITES Appendices denoted. More knowledgeable wholesalers seemed to have gained their familiarity with CITES from dealing with CITES permitting for corals. Black corals were listed on Appendix II in 1981, and all hard corals have been listed since 1990 (Green and Hendry, 1999).

Most respondents (n=11) were neutral or generally positive about the effects of the Appendix II listing for seahorses. Respondents acknowledged conservation concerns associated with seahorse exploitation and degradation of marine habitats (n=5) and declared that they favoured the controls if they helped to protect wild populations (n=5). Some wholesalers (n=2) said they viewed the seahorse trade restrictions as a test case for potential listings of other marine ornamental species on CITES. Answers may, however, have been affected by the fact that the interviewer was known to work for a conservation group. One wholesaler said that he was behind controls if they were needed, but that they were hurting business (apparently because higher prices reduce demand; see Values section above). Conversely, another trader said that increased prices were good for business. Some wholesalers (n=3) contended that regulations relating to seahorses should concentrate on the TCM trade since that represented most consumption.

Trader reactions – Proposed 10 cm minimum size limit

Although no respondents were familiar with the proposed 10 cm minimum size limit for seahorses in trade, after an explanation, respondents were mainly (n=9) in favour of the proposed limit. Large seahorses are desirable in the live trade and/or some traders thought that the regulation would be beneficial to conserving wild populations. Most noted that the wild seahorses they imported were typically over 10 cm (n=6), while others (n=2) said that the MSL might affect up to 50% of their seahorses. However, seahorse trade comprised a small proportion of most marine ornamental businesses, so the 10 cm MSL was not perceived as a significant concern (n=7). The researcher did not mention that F2 individuals from approved breeding operations were exempt from CITES control, and she was not aware of the level of awareness of this issue among wholesalers.

Some traders argued against the 10 cm size recommendation. One respondent argued that larger, successfully breeding seahorses should be left in the wild, while juveniles should be extracted (a biologically valid argument). Another argued that instead of being selective in their catch (i.e. targeting larger animals) fishers would collect more seahorses to maximize the number of animals over the MSL. In general, however, fishers get paid by size, driving removal of larger animals, and fishers already collected all they find, such that a size limit should also serve as something of a quota reduction.

IV. Acknowledgements

This is a contribution from Project Seahorse. Project Seahorse deeply appreciates the generous financial support from (1) the Forestry Bureau, Council of Agriculture, Taiwan, (2) the CITES Secretariat, and (3) the Government of Switzerland. We also thank the John G. Shedd Aquarium and Guylian Chocolates Belgium, whose wonderful contributions facilitated travel logistics and assembly of this report.

We are very grateful to the companies and employees at the marine wholesalers in Los Angeles who graciously volunteered their time and knowledge in addition to allowing access to their facilities and stock. We are also grateful to our very enthusiastic and helpful colleagues at the Long Beach Aquarium of the Pacific, and in particular to Sandy Trautwein, Nate Jaros and Kathy Dorset. Finally, thank you to the U.S. Fish and Wildlife Service for taking the time to answer our many questions and queries.

We also thank the Project Seahorse team for their support, particularly Shannon Charney for working out all of the logistics of getting AM to and from Los Angeles; to Rebecca Ng for her insights on seahorse trade field work; and to Sara Lourie for her help with seahorse identification and taxonomy.

V. References

Baum, J.K. & Vincent, A.C.J. 2005. Magnitude and inferred impacts of the seahorse trade in Latin America. Environmental Conservation, 32(4): 305-319.

Blundell, A.G. & Mascia, M.B. 2005. Discrepancies in Reported Levels of International Wildlife Trade. *Conservation Biology*,1-6.

Bruckner, A.W. 2001. Tracking the trade in ornamental coral reef organisms: The importance of CITES and its limitations. *Aquarium Sciences and Conservation,* 3: 79-94.

Green, E.P. and Hendry, H. 1999. Is CITES an effective tool for monitoring trade in corals? *Coral Reefs*, 18:403-407.

Foster, S.J. and Vincent, A.C.J. 2004. Life history and ecology of seahorses: implications for conservation and management. *Journal of Fish Biology*, 65: 1-61.

Larkin, S.L. & Degner, R. L. 2001. The U.S. wholesaler market for marine ornamentals. *Aquarium Sciences and Conservation,* 3:13-24.

Lourie, S. A., Foster, S.J., Cooper, E.T.W., and Vincent, A.C.J. 2004. *A Guide to the Identification of Seahorses*. Project Seahorse and TRAFFIC North America. Washington D.C.: University of British Columbia and World Wildlife Fund.

Monteiro-Neto, C., De Andrade Cunha, E., Carvalho Nottingham, M., Araujo, M.E., Rosa, I.L., & Leite Barros, G.M. 2003. Analysis of the marine ornamental fish trade at Ceara State, northeast Brazil. *Biodiversity and Conservation,* 12: 1287-1295.

Morgan, S.K. and Brady, L. Unpublished. Morphological Indicator or Reproductive State Technical Report.

Perante, N.C., Pajaro, M.G., Meeuwig, J.J., and Vincent, A.C.J. 2002. Biology of a seahorse species, *Hippocampus comes* in the central Philippines. *Journal of Fish Biology,* 60: 821–837.

Rosa, I.L. Unpublished data on the Brasilian seahorse trade.

Tlusty, M. 2002. The benefits and risks of aquacultural production for the aquarium trade. *Aquaculture,* 205:203-219.

USFWS (U.S. Fish and Wildlife Service). Unpublished documents obtained from USFWS on 7 December 2005 at the request of Anna Magera. LEMIS 2000 Declarations Standard Report for all live seahorse imports into the USA from 1 October 2000 through 31 October 2005.

Wabnitz, C., Taylor, M., Green, E., Razak, T. 2003. From Ocean to Aquarium: The Global Trade in Marine Ornamental Species. *Biodiversity Series, 17*. Cambridge: UNEP/WCMC.

ANNEXES

ANNEX A – United States Fish and Wildlife Service (USFWS) inspection procedures and confiscations

Information on United States Fish and Wildlife Service inspection procedures and confiscations was obtained from telephone conversations with a USFWS officer in October 2005. Unless otherwise noted, all information in this section was derived from these communications.

The officer indicated that on a weekly basis, approximately 200 shipments of live aquarium fish arrived at LAX (Los Angeles International Airport). The boxes were required to pass USFWS and Customs inspections before they could be released from the airport. USFWS had 9-10 inspectors that examined fish and wildlife shipments (dead and alive) into LAX. Sundays were typically the busiest days for fish shipments, and 60-70 separate shipments, each comprised of numerous boxes, arrived at the airport. Saturdays were the next busiest day, with 40-50 shipments.

The physical limitations of USFWS staff numbers did not allow inspectors to check each box of fish upon arrival. With smaller shipments, the officer indicated that this was sometimes feasible, but with large shipments USFWS officers reviewed the shipping documents, and further searches and inspections were determined by the number of discrepancies and omissions on the documents. High numbers of inconsistencies or other problems in the shipping documents indicated the more suspicious shipments and accordingly, the contents of these shipments were scrutinized more closely.

All CITES regulated animals, including seahorses, must be listed on separate CITES permits as well as on the shipping lists. Before the implementation of the CITES listing, seahorses were often listed simply by genus, or sometimes under a wide range of more general (or incorrect) categories including live marine invertebrates and live marine fish. The detail and accuracy of seahorse shipment labeling improved since the CITES listing to include 74 different codes for seahorses (live and dried), including species names.

USFWS officers are responsible for shipment inspections and as necessary, confiscations. When inspecting shipments, USFWS officers typically checked for incorrect numbers of animals (e.g. a shipment of 100 seahorses when the CITES permit is only for 50 seahorses), incorrect species listings on the packing lists, or failure to declare certain items in the shipment. If the legality of a shipment appeared questionable because of the presence of unlisted animals (i.e. excess numbers or unlisted species) or improper documentation, all or part of the shipment could be confiscated. Confiscated seahorses were typically sent to the Birch Aquarium at Scripps, LBAP, or other aquariums that were available to pick-up the animals. At the time of writing, shipments of fish could not be confiscated because they were in poor condition, as USA federal humane regulations only pertained to mammals, birds and reptiles. However, under a humane provision to the Lacy Act, a shipment arriving at USFWS mostly dead when it was supposed to be alive could be confiscated. The definition of "mostly dead" in this situation was a grey area, especially in the fish trade where 30% shipment mortality was standard.

The USFWS respondent indicated that outright smuggling of seahorses (i.e. trading without permit) had not yet been encountered, but overages and misidentification of species was common. This was a typical problem with newly listed CITES species, and a number of the same issues were encountered when the first species of corals were listed in 1981. Although CITES animals required separate permits from non-CITES animals, the two did not need to be shipped in separate boxes. The

wholesalers/importers interviewed in the study all indicated that their seahorses were always packed in separate boxes, but USFWS estimated that directly after CITES implementation, only 30% of shipments were separated into CITES and non-CITES boxes, while 70% were mixed together in the same boxes. Whether the CITES animals were mixed together with non-CITES animals depended mainly on the shipper, and USFWS speculated that this was done both for ease of re-distributing orders to different wholesalers from the trans-shipping level, as well as possibly for smuggling. The trend at the time of the interview was currently towards shipping the two categories of animals separately, and the shipments arrived approximately 50% mixed and 50% separated.

After a shipment passed USFWS inspection, it was transferred to a U.S. Customs inspection. U.S. Customs did not check the contents of the boxes, and it usually deferred to the USFWS decision. Dried seahorse products also required clearance from the USDA, but live seahorses did not require this clearance.

USFWS could release information under the Freedom of Information Act regarding numbers of seahorses arriving at ports annually that could be useful for cross-referencing wholesalers' estimates. The records typically went back at least five years from the request date. Seahorse importers in the USA, USA ports of entry, exporting companies, source countries, wild or aquaculture status of the stock can also be ascertained from USFWS documents. This information can theoretically be very useful for estimating and cross-referencing live seahorse throughputs in the USA (Blundell and Mascia, 2005).

ANNEX B – Seahorse health, disease and mortality observations

The respondents identified a number of conditions that commonly afflict seahorses. The researcher inferred from interviews that none of the wholesalers hired veterinarians for diagnostic work or treatment of their animals. However, the wholesalers were able to describe common seahorse health problems. The primary seahorse husbandry concern appeared to be the reluctance of wild seahorses to feed in captive environments. Often seahorses arrived from the suppliers in an emaciated state. In the wild, seahorses typically feed on small fish, crustaceans and other invertebrates (Foster and Vincent, 2004). In captivity, respondents indicated that seahorses are often fed frozen food (e.g. frozen mysid shrimp) or pellet food, and wild seahorses often refuse to eat. One respondent indicated that live food sources (e.g. brine shrimp) are available to retail store customers, but they are typically harder to obtain than the frozen or pellet food for retail store customers. This respondent added that large, wild seahorses are the most difficult seahorses to get to feed, which is problematic considering that one of the primary seahorse selection criteria for retail customers was seahorse size. Another respondent indicated that they were able to solve their seahorse feeding problems after some trial and error, but the researcher observed that other wholesalers tried to sell seahorses as fast as possible so that they do not have to address husbandry and health problems.

In contrast, a number of distributors (n=3) that carry tank-raised seahorses noted that the tank-raised animals often arrived much healthier, are hardier, and feed better than the wild specimens they have encountered. Tank-raised individuals typically take well to frozen or pellet food. A respondent indicated that this was a benefit both at the wholesaler level as well as at the retail customer/home hobbyist level. In the opinion of the respondent, seahorses used to be advertised as being relatively easy to care for, which was a false assertion, especially because of the feeding problems associated with wild seahorses. With tank-raised seahorses, this respondent suggested that seahorse husbandry is now as simple as it was originally purported to be.

Besides feeding concerns, the wholesalers also identified a number of seahorse health issues. The researcher observed these health problems while in the wholesaler facilities. These conditions were typically pre-existing when the seahorses arrived at the wholesalers/importers. For more information on seahorse diseases please refer to the Project Seahorse sygnathid husbandry manual at https://projectseahorse.org/resource/syngnathid-husbandry-in-public-aquariums/.

1) White patches/skin lesions

White patches on the seahorses' skin or spines appeared to have a number of potential causes. One warehouse worker who was interviewed claimed that they were ammonia burns, caused by poor water quality and overcrowded tanks in the exporter holding facilities, as well as poor water quality in the shipping bags. Other respondents were skeptical of this hypothesis and suggested other reasons for the white patches. One respondent indicated that ammonia burns are a problem in fish shipments, but typically not in seahorse shipments. They claimed that ammonia will typically affect the most fragile tissues first, and fish with ammonia burns will typically have "melted fins. Gills are actually damaged first, but gill damage is difficult to observe (H.J. Koldewey, pers comm). Fin damage was not observed in the seahorses the researcher worked with in Los Angeles. The researcher noted that one respondent in this study seemed to have invested more time into seahorse husbandry that any of the other respondents, and this respondent had made a number of interesting observations. After taking scrapings from infected seahorses, observing the tissues under a microscope, and researching fish diseases, this respondent claimed that the majority of the white skin patches found on seahorses are caused by

ciliated protozoans, primarily *Brooklynella* and *Uronema*. One Project Seahorse colleague experienced in seahorse husbandry also suggested that *Vibrio* bacteria are another common cause of the skin patches (H.J. Koldewey, pers comm). For more information on these fish diseases, please consult one of the following references:

1. Michael K. Stoskopf. 1992. Fish Medicine. Elsevier.
2. Edward J Noga. 2000. Fish disease: diagnosis and treatment. Ames: Iowa State University.

The respondents also indicated that the white patchiness may be caused by other external protozoans, internal flagellates and or lack of oxygen. One respondent added that the white patches often appeared or grew larger in the summer months. As a result, they thought that water temperature may also affect the growth of the parasites or the susceptibility of the seahorses to infection.

Skin sloughing revealing white patches was also observed by the researcher. According to the respondents' assertions and the researcher's inferences, this may have been caused by later stage infestation of protozoans, excessive handling in packing and transport, or possibly fishing gear. This skin sloughing could have been minor or it could have covered up to approximately 1/3 or more of the animal's body in some observed cases. Small skin lesions were also noted, likely caused by handling/transport/capture damage (researcher's inference). One Project Seahorse colleague also suggested that the skin sloughing was most likely to be induced by stress-related bacterial infection caused by handling/transport; the patches do not necessarily directly relate to point of handling (H. J. Koldewey, pers comm.). The white patches referred to in this section were observed all over the seahorses' bodies: surrounding spines, on the head, the torso, and especially the tail. Please see Figure 5 for examples.

2) Discoloration of pouches on males

On respondent indicated that males often arrive with discolored pouches. They presumed this was caused by broods dying in transit. A bacterial infection, particularly of the pouch wall was another likely cause (H. J. Koldewey, pers comm.).

3) Inflamed eyes or clouded eyes

Both of these conditions were observed by the researcher and reported by respondents. The researcher suspected that some of these cases may have been caused by the same ciliated protozoans noted earlier (e.g. *Uronema*). Emaciation, bacterial infection, poor water quality and physical damage in capture or transport are also possible causes (H. J. Koldewey, pers comm.). Individuals with clouded eyes were often unresponsive during sampling, and did not follow the researcher's movements with their eyes as many of the healthy seahorses did. This may have been a sign of blindness or lack of energy (researcher's inference). Please see Figure 4 for examples.

4) Bubbles under the skin

Skin bubbles are a common problem in seahorses that have not been diagnosed to a single cause. Possible causes include (1) Capture at depth and rapid ascent causing air bladder expansion/damage, (2) gas becoming released in airplane transport due to pressure changes or (3) stress and water quality causing 'gas bubble disease' caused by stress and water quality issues (H. J. Koldewey, pers comm.). Aquarists at the LBAP also suggested that infection induced edema may cause the skin bubbles.

One warehouse worker indicated that *H. spinosissimus* individuals sometimes arrive with these types of injuries, and other varieties do not seem to be affected in the same manner. One hypothesis suggested by a Project Seahorse researcher noted that *H. spinosissimus* may often be found at deeper depths (up to 70 m) than the other commonly observed wild species in this study (Foster and Vincent, 2004), and as a result this species may commonly exhibit these injuries while other species do not. Animals that arrive with these visible bubbles under the skin were normally said to die quite soon after arrival at the wholesalers.

5) Damaged jaw/snout

The researcher noticed that some individuals arrived at wholesalers with damaged jaws, and could not close them properly. This may have been physical damage caused by handling in capture and transport. White patches on the end of snout we also noticed in a few cases, possibly indicating bacterial infection.

6) Emaciation

A number of individuals that the researcher observed were severely emaciated, with skin sunken deeply between the ridges on the torso. Some wholesalers also identified this as a problem with wild shipments, which is not surprising considering the starvation period prior to transport indicated by the wholesalers interviewed.

7) Weakness/listlessness/unresponsiveness/inactivity

Individuals often with visible infections or wounds often were very weak and unresponsive compared to other individuals. The researcher deduced that the following signs were indications of unhealthy animals: minimal muscle tension, lack of effort to escape during handling, or lack of tail gripping to the researcher's hand. Individuals that failed to swim around or grip onto structures when placed in the tanks often appeared very unhealthy as well.

8) Laboured breathing

Especially in the very weak and inactive animals, the researcher noticed laboured breathing, often to the extent where opercula were puffed out for extended periods of time as the animals attempted to ventilate. The researcher believes that this may have been caused by parasites or other infections on the gills (as mentioned above – including ammonia burns), or other causes.

Wholesaler/importer responses varied with regards to treating unhealthy animals. Some wholesalers said they made no efforts to treat these conditions, sold the animals as is, and treated the animals that died from the infections in their facility as losses. Other wholesalers said they paid little attention in these conditions, and either had little interest in what may be causing them or were interested in how they could treat these conditions but were unsure of what they were or what actions to take. Some wholesalers said they used antibiotic treatments, such as nitrofurazone, and quarantined sick individuals. One wholesaler acknowledged that the water running through the tank systems constantly can spread infections between individuals, tanks and species, and seahorses may acquire new infections at the facilities. Some wholesalers did not treat their systems regularly with any chemicals, but two treated their water regularly with formaldehyde, malachite green or copper sulfate to control parasites.

Some wholesalers said they had discovered better husbandry techniques for treating these conditions but were uncomfortable sharing these techniques because of the competition in the business.

Figure 4. Seahorse illnesses. A. (Top left) Tail lesion with possible skin sloughing producing a white patch. B. (Top right) White patch on seahorse's back. C. (Middle left) White patch surrounding a spine on the seahorse's head. D. (Middle right) Missing skin patch on seahorse tail. The arrow points to the protruding trunk ridges, with the skin deeply sunken between the ridges. This indicates and emaciated state. E. (Bottom left) Seahorse with severe skin discoloration and sloughing. The arrow indicates a blurry eye. F. (Bottom right) The arrow indicates an inflamed, puffy eye. All seahorses in the photos are *H. spinosissimus*, except for F, which is *H. barbouri*.

Mortalities

From conversations with the respondents, the researcher found that seahorse mortality occurred at a number of stages in the transport or holding process: (1) in transit (i.e. animals are dead on arrival), (2) upon arrival at the wholesaler/importer during the acclimation process (as the seahorse adjusted to new oxygen, temperature, pH, chemical, and light conditions and physiological stress was high), (3) in the wholesaler tank system, and (4) at the customer facility. Dead on arrival animals appear to be the most common source of premature deaths out of the first three options. While respondents indicated that tank-raised seahorse mortalities in shipments or otherwise were virtually nil, dead on arrivals and other mortalities in shipments of wild animals varied widely. All six wholesalers who were asked indicated that under 13% mortality was quite average for their business. One wholesaler indicated that 5% mortality was acceptable and standard for their business. These standards differ from Marine Aquarium

Council (MAC) standards (www.aquariumcouncil.org) but the researcher did not inquire into MAC affiliations. The businesses that carried seahorses from the Philippines pre-CITES indicated mortality in these shipments was especially high. One respondent also indicated that mortality for their wild Vietnam shipments was on average 30% upon arrival, but 100% was not uncommon. Similarly, USFWS also indicated that for marine fish shipments, 30% mortality was quite common.

The researcher observed the arrival of one shipment that the wholesaler professed was in especially poor condition. Out of a shipment of approximately 140 seahorses, 38 arrived DOA or died within the first 36 hours after arrival (i.e. 27% mortality). Compared to the percentage of *H. barbouri* individuals in the shipment, 6% more *H. barbouri* died than expected according to the proportion of the shipment composed of *H. barbouri* individuals. Seven percent fewer *H. kuda* died than predicted, and roughly the same percentage of *H. spinosissimus* died as expected. Please see Table IV for more information on mortality numbers in this shipment. The researcher observed that most individuals in the shipment (dead and alive) had skin lesions, white patches, skin sloughing and showed other general signs of ill health. The number of *H. kelloggi* and *H. comes* in the shipment was too low to provide any conclusive information.

Table IV. Seahorse mortalities within 36 hours of shipment arrival at one observed wholesaler in Los Angeles

Species	% of shipment comprised of each species (n=140 individuals)	% mortality (in first 36 hours after shipment arrival; n=38 individuals)
H. barbouri	47	53
H. spinosissimus	34	34
H. kuda	18	11
H. kelloggi	~1	3
H. comes	~1	0

Other observations

The respondents also had a number of interesting comments about mortality and disease in different seahorse species. Wild seahorses from the Philippines (pre-CITES) were consistently noted by respondents as having the most health problems and mortalities. Wild *H. fuscus* (Sri Lanka) and wild Brazilian seahorses (*H. reidi*/*H. erectus*) were repeatedly noted as being generally very healthy and hardy varieties. Wild varieties post-CITES have also been noted as having more health problems than tank-raised varieties. *H. spinosissimus*/*H. histrix*, and *H. barbouri* were noted by respondents as being the most susceptible to mortality and health problems (*H. spinosissimus* especially for white spot infections on the skin). *H. kuda* and *H. comes* individuals, even if they arrived in the same shipments as *H. spinosissimus* and *H. barbouri* were typically observed to be less susceptible to mortality and disease. A possibility of a species-specific effect on susceptibility to disease and tolerability of transport and handling is possible. The Zoological Society of London reported matching observations from the Customs seizures they received (H. J. Koldewey, pers comm.).

Tank-raised individuals arrived in better health than wild specimens and had fewer health problems overall. Respondents noted, however, that tank-raised individuals were still susceptible to infections, especially from the white spot skin infections. One respondent speculated that they were likely contracting the infections from pathogens in the system water, and that tank-raised individuals were possibly more susceptible to infections in the wholesaler's tank system over the long term than wild

individuals because of their lack of previous exposure to wild diseases. Tank-raised *H. reidi, H. abdominalis, H. barbouri* and especially *H. whitei* were all noted as being susceptible to contracting white patch skin infections.

ANNEX C – Additional notes on seahorse values to accompany Figure 2

Table VII. Values of seahorses at the wholesalers interviewed (n=8) pre- and post-CITES implementation

NB: Values refer to the prices that the wholesalers/importers pay for the seahorses, not prices of sales to retail stores or aquariums. Freight costs are not included in most numbers, but for some numbers, this value was too difficult to extricate. The price midpoint is the midpoint of the range of values given by the respondents.

			Pre-CITES 1999-2004	Pre-CITES 1999-2004	Post-CITES Spring 2005-October 2005	Post-CITES Spring 2005-October 2005	
Species	Aquaculture/ Wild	Source Region	Price Midpoint	Range	Price Midpoint	Range	Comment
H. abdominalis	A	Australia	$13.50	$12-15			
H. barbouri	A	Australia	$13.50				
H. barbouri	W	Indonesia, Philippines	$1.15	$0.80-$1.50	$4.50		
H. comes	W	Indonesia, Philippines, Vietnam	$1.90	$0.80-$3	$6.75	$4.50-$9	with yellow coloration and tail rings, more expensive
H. erectus ?	W	Caribbean	$2		$11	$10-$12	
H. erectus	A	Florida			$10		
H. fuscus	W	Sri Lanka	$1.05	$1-1.10			
H. reidi/ erectus	W	Brazil	$9	$6-$15			black least expensive, then yellow, and orange and red most expensive
H. reidi	W	Brazil			$50		black least expensive, then yellow, and orange and red most expensive
H. ingens	W	Mexico	$25				
H. kelloggi	W	Indonesia, Philippines, Vietnam	$1.15	$0.80-$1.50	$6.75	$4.50-$9	yellow individuals generally more expensive
H. kelloggi/ kuda ?	A	Vietnam			$7.25	$6-$8.50	yellow individuals generally more expensive
H. kuda	W	Indonesia, Philippines, Vietnam	$1.15	$0.80-$1.50	$6.75	$4.50-$9	yellow individuals generally more expensive
H. kuda	w	Hawaii			$20		
H. reidi	A	Sri Lanka			$21.50	$8-35	black least expensive, then yellow, and orange and red most expensive

H. reidi	W	Brazil			$50		black least expensive, then yellow, and orange and red most expensive
H. spinossisimus/ histrix	W	Indonesia, Philippines, Vietnam	$1.15-$13.50	$0.80-$1.50	$15.75	$4.50-$27	yellow individuals generally more expensive
H. abdominalis	A	Australia	$13.50	$12-$15			
H. whitei	A	Australia	$13.50	$12-$15			
OVERALL	MEAN PRICE		$7.00	$0.80-$25	$14.57	$4.50-$50	Mean 96-108% increase post-CITES
TOTAL	MEAN PRICE	WILD	$4.84	$0.80-$15	$15.19	$4.50-$50	Mean 190-214% increase post-CITES
TOTAL	MEAN PRICE	CULTURED	$13.50	$12-$15	$12.92	$8-$35	Mean 4% decrease post-CITES
TOTAL	MEAN PRICE	ASIAN WILD	$1.26	$0.80-$3.00	$8.10	$4.50-$27	Mean 400-545% increase post-CITES
TOTAL	MEAN PRICE	ASIAN CULTURED	$13.50		$7.25	$6-$8.50	Mean 46.3% decrease post-CITES
TOTAL	MEAN PRICE	AMERICAN WILD	$12.00	$2-25	$30.50	$10-50	Mean 154% increase post-CITES
TOTAL	MEAN PRICE	AMERICAN CULTURED	n/a	n/a	$15.75	$8-$35	