

SPECIES IN DANGER

THE INTERNATIONAL TRADE IN SEAHORSES

AMANDA C.J. VINCENT
A TRAFFIC NETWORK REPORT

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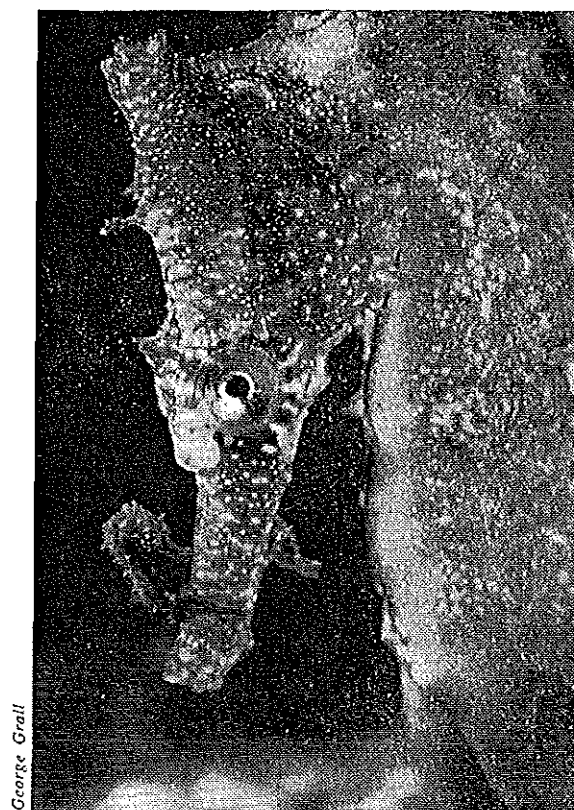
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THE INTERNATIONAL TRADE IN SEAHORSES

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Male *Hippocampus whitei* with newborn young

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Amanda Vincent

Note

Prior to 1989, the Taiwan Customs and Board of Foreign Trade used the H.S. code 15010-57 to refer to "hai ma" (seahorses). This was mis-translated into English as "walras [sic], live", as has been confirmed with the Board of Foreign Trade. This coding was listed in Chinese as live seahorses but volumes, sources, and comparability with post-1989 data for dried seahorses indicate that these early data refer also to dead seahorses. Source countries, volumes and values all blended well with later data for dried seahorses, and trends established during these years persist in later years.

Trade codes in Taiwan changed in 1989. Seahorses are thereafter listed under the correct heading of Hippocampus in both Chinese and English [CCC code 051000-4200-3].

Notes added in proof

New information acquired during the four months between revisions and proofs indicates that the seahorse trade is larger and more complex than we yet realise. For example:

Confirmation of Korean involvement comes from The Korean Pharmaceutical Traders Association, which recorded imports of 1813kg of dried seahorses in 1994 (worth US\$52 000) although only 303kg in 1995 (worth US\$70 200) (S. Kang, *in litt.*, 17 April 1996).

Nigeria is now participating in the trade, with at least one company marketing the seahorses caught in trawl nets at a price of US\$450 for small and US\$1150 for large.

Mozambique must also be added to the list of seahorse fishing countries. Seahorses are caught by hand as a target catch (about two kilogrammes wet weight daily per fisher) and by bottom trawl as a by-catch of the scad and mackerel fishery (about one kilogramme wet weight daily per boat), and then are sold to "foreigners". Cumulatively, this could be a large fishery.

Japan receives significant numbers of seahorse from at least one Hong Kong dealer, who said that much of his monthly sales of 100-200kg per month goes there. He was seeking access to a further 300kg per month in March 1995, noting that demand was "limitless".

EXECUTIVE SUMMARY

The rapidly growing trade in seahorses *Hippocampus* spp. for medicines, aquarium pets, and curios has not hitherto been investigated. This report synthesises findings about the exploitation of seahorses and considers actual and possible effects on wild populations. Its goal is to promote conservation and management initiatives to ensure the survival of seahorse populations, while recognising the needs of human communities that depend on them. Material comes from the author's extensive field surveys and interviews in Asia, a few published Customs records (notably from Taiwan), and observations by biologists, fishers, traders, and officials around the world. Seahorse taxonomy and geographic ranges remain confused but there are probably 35 species of seahorses, most of which are exploited.

The majority of seahorses go to traditional Chinese medicine (TCM) and its derivatives (e.g., Japanese and Korean traditional medicines) which have a large global constituency. Treatments including seahorses are believed to benefit a range of conditions, including respiratory disorders such as asthma, sexual dysfunctions such as impotence, and general lethargy and pain.

China's economic growth since the mid-1980s is probably the principal agent in a surge in demand for seahorses; TCM traders in China and TCM suppliers elsewhere report notable increases in Chinese consumption (up to 10-fold in 10 years). In response - and in part because other marine resources are declining - subsistence and small-scale fishers in Asia target seahorses and many obtain the majority of their annual income from these fishes. Shrimp trawl boats and other fishers add their incidental by-catch to the total harvest of seahorses. The trade involves many fishers and consumers, each of whom catches or buys relatively few seahorses. Export routes are often through unofficial channels, such as personal luggage on commercial flights.

At least 32 nations around the world are involved in trading seahorses, from Ecuador, to Italy, to the USA. The largest known net importers are those nations with many Chinese: China, Hong Kong, Taiwan. The largest known exporters are India, the Philippines, Thailand and Vietnam.

Information obtained during interviews, in combination with the few published Customs statistics available, suggest that annual consumption just within Asian nations may amount to 45t of dried seahorses annually (about 16 million individuals). The largest users appear to be China (an initial estimate of 20t), Taiwan (11.2t recorded imports) and Hong Kong (around 10t). Totals and rankings, however, should be interpreted with great caution because data are still tentative and because it was not possible to investigate other nations expected to be large consumers (e.g., Japan, Korea, Malaysia, and Singapore).

Total global consumption of seahorses will be much greater because domestic consumption cannot yet be calculated for most countries, because many nations outside Asia also absorb dried seahorses for medicines (including TCM) and curios, and because the aquarium trade probably absorbs hundreds of thousands of live seahorses, most for sale in North America, Europe, Japan or Taiwan.

Extracting seahorses at current rates appears to be having a serious effect on their populations. The impact of removing millions of seahorses can only be assessed indirectly because global seahorse numbers are unknown, taxonomic identities are unclear, geographic ranges are undefined, and fisheries undocumented. Nonetheless, most participants in established seahorse fisheries reported that catches were dwindling markedly. Indeed, fishers' reports and preliminary research indicate that seahorse numbers in sample populations from five countries could each have declined by even 50% over the past five years. Large seahorses are considered increasingly rare and even less-desirable seahorses, such as juveniles are now accepted for TCM, aquarium fishes and curios.

Seahorse biology is such that populations will be particularly susceptible to over-fishing: (a) pregnant seahorses must survive if the young are to survive; (b) lengthy parental care combined with small brood size limits reproductive rate; (c) strict monogamy means that social structure is easily disrupted; (d) *sparse distribution* means that lost partners are not quickly replaced; (e) typically low rates of adult mortality mean that fishing exerts a relatively substantial selective pressure; and (f) low mobility and small home ranges restrict recolonization of depleted areas. Key parameters such as growth rates, longevity and juvenile dispersal remain unstudied.

Demand for seahorses far exceeds supply, according to almost all those interviewed. As an example, one TCM dealer in China sought to buy one tonne of seahorses (perhaps 260 000 animals) from the author immediately, stating he could not obtain that amount elsewhere. Proprietary (patent) remedies are a big growth industry in TCM, with perhaps 30% of seahorses in China now being used for *general formulations*. Increasing demand, combined with the artisanal nature of the fishery and the paucity of other livelihood options for many seahorse collectors, means that the seahorse trade can be expected to persist even as seahorse numbers decline.

Available evidence indicates that consumption of seahorses should be reduced if long-term persistence of seahorse populations is to be assured. Conservation and management of seahorses would benefit from a series of integrated measures. These include: (a) promoting much-needed biological, taxonomic and trade research; (b) monitoring seahorse populations, imports and exports (c) enacting national and international conservation measures; (d) working co-operatively with TCM communities to *reduce demand for seahorses* by promoting alternative treatments within TCM; (e) cautioning against the purchase of seahorses as aquarium fishes — they do very badly in captivity; and (f) developing community-based fisheries management and aquaculture projects in seahorse extraction areas. Recent small-scale seahorse conservation initiatives in the Philippines and Vietnam are experiencing initial success.

This report focuses on the effects of direct fishing pressure on seahorses but conservation of their highly productive and highly vulnerable seagrass, mangrove, and coral reef habitats should also be a priority if long-term preservation of seahorse populations is to be a realistic objective. Seahorses could serve as popular flagship species around which to rally support for general concerns in marine conservation, including habitat loss and declining fish populations.

Seahorses represent a hitherto unexplored genre of fisheries, those intended primarily for medicine rather than food. Conservation schemes devised for seahorses may be applicable to some of the many other fish species employed in TCM (Tang, 1987).

INTRODUCTION

Seahorses *Hippocampus* spp. are globally exploited for use as medicines, aquarium fishes, curios, and even foods. They are also vulnerable to degradation of their seagrass, mangrove and coral reef habitats. Information from fishers and early findings from studies suggest that the number of seahorses in fished populations is declining rapidly, even as demand for seahorses expands. The greatest pressure appears to come from accelerating consumer spending in China, as a result of rapid economic growth: 14% in 1993, 11.8% in 1994 and about 10% in 1995 (Anon., 1996a). This surge in demand is recent enough to help explain why the trade in seahorses was not investigated until 1993.

No seahorses can be considered exempt from exploitation; the trade in dead and live seahorses is thought to encompass at least 32 countries and territories in all continents - thus embracing the known geographic ranges of most seahorse species - and new seahorse fisheries are appearing. The IndoPacific seahorses may be most immediately at risk because of their proximity to major markets for traditional Chinese medicine (TCM).

Seahorses should be preserved for ecological, biological, economic and medical reasons, at least:

- Syngnathids (seahorses, pipefishes, pipehorses, and seadragons) are the dominant family of fishes across a wide range of seagrass habitats in diverse geographic areas around the world (Pollard, 1984) and are important predators on benthic organisms (Tipton and Bell, 1988), so removing them could well disrupt seagrass ecosystems. Disturbing community integrity will present risks to other species and thus promote the loss of biodiversity, now internationally recognized as worthy of conservation.
- The extraordinary life history of seahorses - the male seahorse becomes pregnant and pairs are faithfully monogamous - offers an unusual opportunity to explore our understanding of the evolution of sex differences. For example, seahorses allow biologists to test theories about how parental care limits reproductive rate in one sex and thus promotes greater mating competition in the other sex (Clutton-Brock and Vincent, 1991); such competition for mates is thought to explain why one sex (usually males) becomes larger, brighter, or more ornamented. Moreover, sexual fidelity to one partner is proving sufficiently rare among animal species to make the conditions favouring seahorse monogamy particularly worthy of study (Vincent and Sadler, 1995).
- Subsistence fishers in some exploiting nations obtain a substantial portion of their annual income from seahorses. Such dependence is likely to increase as other fisheries resources continue to decline; Indian fishers, for example, turned to seahorses as sea cucumber *Holothuroidea* catches dwindled (Marichamy *et al.*, 1993). Exploitation may continue until seahorses disappear, no matter how poor the catch becomes, because artisanal fishers often catch seahorses in conjunction with obtaining food for their families, and have few other income-earning options.
- TCM employs seahorses to treat a range of conditions and ailments, some of them life-threatening. The widespread use of seahorses in Asian medicine (and their historic use in European medicine) suggests that these fishes should be evaluated for their biomedical compounds.

Among fishes, seahorses may be unusual in capturing public imagination. Indeed they could have sufficient popular appeal to provide an important focus for protection of their habitats and for conservation of other fish species. This is important because seagrasses and mangroves, which are important for seahorses, have not received sufficient conservation attention and because fishes are more commonly regarded as food than wildlife, sometimes with consequent loss of protection.

This report provides the first synthesis of the problems besetting seahorses, and is intended to promote action

for their conservation. It begins with a chapter on their biology, to provide the context for the report. The dearth of biological studies on the most heavily fished IndoPacific seahorses forces a reliance on data from captive work and from field research on Australian and Caribbean species. A chapter on methods follows, pointing out that most findings in the report emerge from the author's original research. Then follows a chapter on uses of seahorse, noting historic European medical use of seahorses but emphasizing the role of seahorses in TCM.

The core of the report is a country-by-country assessment of seahorse exploitation. Information is presented on species, uses, fishing methods, trade routes, volumes, values, economic role, and conservation problems. By necessity, much of the material is anecdotal or comes from informal sources. These chapters lead into the general Discussion section. A caveat is in order: this report is very unequal in its treatment of different countries, according to the information available. It focuses on those Asian regions that the author visited (China, Hong Kong, India, Indonesia, the Philippines, Taiwan, Thailand, and Vietnam) and provides only minimal information on other nations that may be important seahorse exploiters and/or consumers (such as Japan, Korea, Malaysia, and Singapore). The focal countries in this report are certainly among the larger and more-established players, but a precise assessment of relative roles will await further investigation. In particular, the regular references to Taiwan are owing to its detailed trade statistics and are not intended to imply that it dominates the trade. The scanty information provided for most non-Asian nations should be considered a spur to further research rather than a synopsis of their involvement; further investigative research is needed in all countries, in order to complete a definitive analysis of trade.

Other members of the same family (Syngnathidae) - the pipefishes, pipehorses and seadragons - are also exploited as medicines and aquarium fishes. Aspects of their trade are briefly presented here, as an alert that they too need to be monitored.

The concluding sections of the report include a general summary discussion of the global trade in seahorses, information on conservation action currently underway, and recommendations for future initiatives. These seek to diminish the pressures on wild seahorse populations while respecting human needs.

BIOLOGY

Seahorse species studied thus far are characterised by sparse distributions, low mobility, low natural adult mortality, small home ranges, low fecundity, lengthy parental care, and mate fidelity. These characteristics make seahorses unsuitable for intense harvesting.

Attempts to manage and conserve seahorses are severely hampered by the dearth of biological studies, particularly on the most heavily exploited species. Understanding of seahorse behaviour and ecology is based primarily on:

- one intensive underwater field study of an Australian species, *Hippocampus whitei* (Vincent and Sadler, 1995);
- one study of a Caribbean species carried out by sampling wild populations, *H. zosterae* (Strawn, 1953);
- three brief field studies, of a Caribbean species, *H. reidi* (Dauwe and Nijhoff, unpublished) and two Australian species *H. abdominalis* and *H. breviceps* (Vincent and Edmunds, unpublished);
- two intensive laboratory studies, on an IndoPacific species, *H. fuscus* (Vincent, 1990, 1994a, 1994b, 1995) and the Caribbean *H. zosterae* (Masonjones, unpublished).
- laboratory observations on several other species, including some from the IndoPacific (Fiedler, 1954; Vincent, 1990).

The only one of these better-studied species to be under heavy fishing pressure at present is *Hippocampus fuscus*, which is part of the *H. kuda* complex (see **Taxonomy and phylogeny** below). The first systematic research on IndoPacific seahorses in the wild began only in October 1994 (see **Current conservation** section).

The lack of seahorse work means that it is necessary to extrapolate from a few studies on single species to the genus in general. Findings from the author's research on nine species across the world suggest that there are indeed general patterns of seahorse biology. Early data from work in the Philippines - and anecdotal descriptions from seahorse fishers - support the view that seahorse behaviour and ecology is rather similar across species. Studies on pipefish biology have helped understand seahorse biology, where characteristics are shared by the whole family.

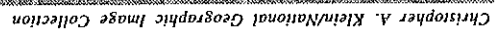
Taxonomy and phylogeny

Seahorses comprise one genus (*Hippocampus*) of the family Syngnathidae, which otherwise consists of about 35 genera of pipefishes, pipehorses and seadragons, and falls within the order Gasterosteiformes. Seahorses are thought to have evolved at least 40 million years ago (Fritzsche, 1980). Pipefishes, pipehorses and seahorses comprise a distinct part of an apparent evolutionary gradient (Meyer *et al.*, unpublished): pipefishes are long, straight fishes and have tail fins; pipehorses have heads bent at about 30 degrees to the straight body and have developed slightly grasping tails; seahorses have heads at right angles to the trunk, and have fully prehensile tails.

The taxonomy of seahorses is a chaos of synonyms and multi-species complexes, with some species still unnamed (see **Appendix 1**). All seahorse names currently in use should be considered unreliable pending a major revision now in progress. Among the approximately 150 recorded names for seahorse species, there are probably about 35 real seahorse species, all in the genus *Hippocampus*. They range in size from the newly discovered tiny Australian *Hippocampus* sp., to be named *H. minotaur*, (about 10-20 mm), to the large Pacific Seahorse *H. ingens* (300 mm).

The North American (*Hippocampus erectus*, *H. ingens*, *H. reidi*, *H. zosterae*), European (*H. hippocampus* and *H. ramulosus*), and Australian (*Hippocampus abdominalis*, *H. angustus*, *H. bargibanti*, *H. breviceps*, *H. histrix*, *H.*

Figure Biology 1



kuda, *H. minotaur*, *H. planifrons*, *H. spinosissimus*, *H. whitei*, *H. zebra*) seahorses are moderately well defined (see Appendix 1) but the IndoPacific species continue to be problematic to classify.

The four names most commonly cited for the most heavily fished IndoPacific species are *Hippocampus kuda*, *H. histrix*, *H. kelloggi* and *H. trimaculatus*. This report will employ these names for four broad complexes of species (see Methods section). None of them is a clear species: *H. kuda* has become a default name bestowed on at least ten distinct species; *H. histrix* covers a complex of least four species; the Three-spot Seahorse *H. trimaculatus*, may in fact be two species; *H. kelloggi* may indeed be one species but has not been well described. One species in the *H. kuda* complex, fished intensively in India (see India section), has been cited as *H. fuscus* (e.g., Vincent, 1990, 1994a, 1994b, 1995) and is so called in this report).

Distribution and mobility

Syngnathids are the dominant family of fishes in seagrass beds worldwide (Pollard, 1984). All seahorses are marine species, living among seagrasses, mangroves and corals in shallow temperate and tropical waters. Their range extends roughly from 45 degrees north to 45 degrees south (e.g., Figure Biology 1), with most species occurring in the West Atlantic or the IndoPacific region.

Their wide geographic ranges do not mean that seahorses of any species are vastly numerous, because they are found only in narrow strips along the coast. Although often found in water less than one metre deep, most live at between 1-15m depth, and seahorses of some species are found at 45-60m (e.g., *Hippocampus bargibanti*). They occupy only certain parts of seemingly suitable habitat, sticking to the edges of seagrass beds, for example, leaving large areas unoccupied. These microhabitat choices have not been investigated but it appears that seahorses find more food in areas of good water exchange.

Seahorse population density tends to be low. *Hippocampus whitei* in Sydney occurred at densities of about one per six square metres of preferred mixed seagrass (*Posidonia* and *Zostera*) habitat (Vincent, in prep.). The author's observations and fishers' comments suggest that this is typical of many seahorse species, but fishers have also reported occasional densities as high as 10-15 seahorses per square metre in some seagrass habitats (e.g., near India).

Seahorses will probably be slow to recolonize areas from which they have been removed. They are relatively sedate swimmers, adapted for manoeuvrability in their complex habitats rather than for speed (Blake, 1976). Moreover, seahorses show great site-fidelity, at least during the breeding season. The field study on the temperate Australian seahorse, *Hippocampus whitei*, showed that males often have a home range of only one square metre - even holding onto the same seagrass shoot for weeks - and females have a maximum home range of only about 100m² (Vincent and Sadler, 1995; Vincent, in prep.). Each female's home range is centred on that of her mate (see *Mating patterns* below), and her greater home range will reduce feeding competition within the pair. Site-fidelity over the breeding season at least has also been found in a Caribbean species and in a coral reef species currently under study in the Philippines (Nijhoff, unpublished; Perante et al., unpublished). The particularly sedentary nature of pregnant males may be explained by their heavily encumbered state.

Adults may disperse during the short-range seasonal migrations that are thought to occur in some populations (e.g., R. Kuiter, pers. comm., November 1991), but most movement to new areas probably happens when adults are cast adrift by storms or carried away while grasping floating debris. Perhaps young seahorses are more likely to colonize new or depleted areas, because they are often carried away from natal habitats despite attempts to settle into the substrate (pers. obs.). The extent of dispersal by this mechanism is unknown but it offers some possibility of gene flow among populations. It should be noted that observations of wild young moving into the substrate

contradict observations in aquaria of newborn seahorses rising straight to the surface to gulp air to fill their swim bladders (Schiotz, 1972).

Morphology, feeding and camouflage

All seahorses have the same basic body shape: a horse-like head perched at right angles to an erect body; a long tubular snout which sucks food; eyes which swivel independently in search of food; skin (no scales) stretched over a series of bony plates visible as obvious rings around the trunk; a prehensile tail usually grasping a holdfast. Seahorses have lost pelvic and caudal fins, retaining only one propulsive dorsal fin, two small ear-like pectoral fins used for stabilisation and steering, and a tiny anal fin. The eye structure is characterised by few rods, many cones and a fovea, making them adapted to diurnal vision (Engstrom, 1963).

Seahorses are voracious predators, relying entirely on live, moving food. They will ingest anything that fits into the mouth - mostly small crustacea but also small fishes - ambushing the prey by inhaling rapidly through their snout.



A. Vincent

Food is taken in through a long, tubular snout

Indeed, seahorses are thought to eat enough to affect the structure of benthic invertebrate communities (Tipton and Bell, 1988). It appears that seahorses are able to obtain prey equally well over a wide range of habitat complexity although they prefer to grasp a holdfast when feeding (James and Heck, 1994). Among their pipefish relatives, pregnant males eat more plankton than other pipefishes, perhaps because they are too slow to chase larger prey (Svensson, 1988), and this is also likely to be true for seahorses.

Growth rates have not been investigated in any detail but young seahorses are known to exhibit growth inflection points (where rates of growth change) as they switch between prey types (Boisseau, 1967; M. Wilson, pers. comm., 23 November 1995; Truong Si Ky, pers. comm., 10 January 1996). Adults grow more slowly as they grow larger (Vincent and Sadler, unpublished).

Seahorses are masters of camouflage. They can remain virtually immobile, grow long skin filaments where that blends with their habitat, and can change colour dramatically to match their background better. Most seahorses are neutral colours from beige to brown to black, but possible colour changes include fluorescent orange and deep purple, depending on species. This ability to be cryptic probably facilitates both prey capture and predator avoidance. The consequent difficulty in observing wild seahorses may partly explain why seahorses have been so little studied. However, these disguises can be penetrated by an experienced collector and, once spotted, the seahorse can easily be plucked from its holdfast.

Lifespan and mortality

Fisheries management tends to invoke the general rule of thumb that fishing mortality should be lower than natural mortality (e.g., Anon., 1990a). If natural death rates are low among adult seahorses, as may be the case, then heavy fishing will place unusual pressures on these populations.

Natural lifespan and mortality rates for seahorses - and the parameters that define them - are virtually unknown and

in need of research, because longer-lived or slower-growing fish species tend to be more vulnerable to over-exploitation (e.g., Anon., 1990a). Lifespan is only about one year in the very small species *Hippocampus zosterae* (Strawn, 1953) but has been inferred (from size distributions and captive observations) to be about four years for most medium-sized IndoPacific species. A recent pilot study, however, demonstrated that skilled aquaculture can produce *H. kuda* type seahorses measuring 16cm in just six months (M. Wilson, pers. comm., 23 November 1995). Accurate determination of seahorse age (and growth rates) in the wild awaits analysis of seahorse otoliths.

Natural adult mortality rates are likely to be low but the only data come from studying individually identified *Hippocampus whitei*. On the most closely monitored part of the study site, 86% of those seahorses that had been tagged in November (n=37) were still present in March, and losses may well have included migration as well as deaths (Vincent and Sadler, 1995). Annual mortality cannot be extrapolated directly because this observation period fell within the breeding season, when greater conspicuousness through courtship activity is likely to have made seahorses more vulnerable to predation.

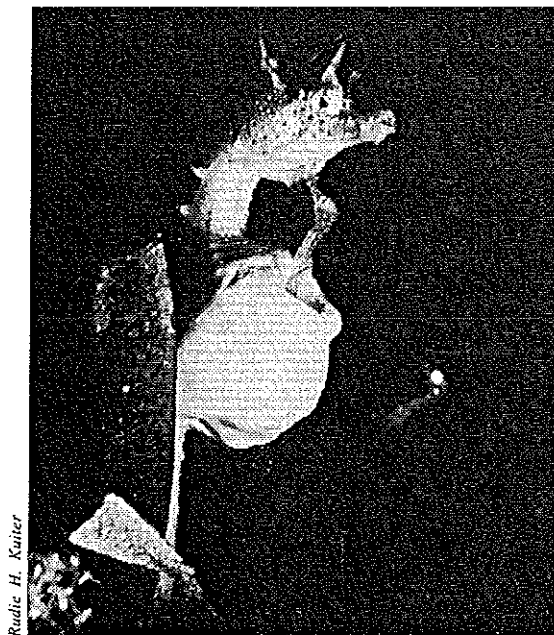
Known predators are few, but fishers' anecdotes and published sources (e.g., Herald, 1949; Wilson and Beckett, 1970) report that seahorses have been found in the stomachs of large pelagic fishes, such as tuna or Dorado *Coryphaena hippurus* and skates and rays. In New Zealand, seahorses are reputedly taken by skate Rajidae and Arhynchobatidae, Red Cod *Pseudophycis bachus*, Trumpeter *Latris lineata*, Blue Cod *Parapercis colias*, Ling *Genypterus blacodes*, and sea perch *Helicolenus* spp. (Whitley and Allen, 1958). Crabs may be among the most threatening predators, and other seahorses are taken by penguins and other water birds (pers. obs.; R. Kuitert, pers. comm., November 1991; M. Cullen, pers. comm., November 1991). It appears that few animals target seahorses as prey, probably because seahorses are both difficult to find and are rendered relatively unpalatable by their bony plates and spiny structure. High adult mortality may occur when heavy storms wrench seahorses from their holdfast and cast them adrift, for seahorses are not strong swimmers and can be found washed ashore on beaches after bad weather.

Mortality is probably highest in young seahorses, which are highly vulnerable to piscivorous fish (Vincent, pers. obs.). Young disperse and do not obviously compete for any resources, suggesting that survival may not be

affected by density. This would mean that declining seahorse numbers and hence declining numbers of young would not necessarily lead to increased juvenile survival.

Reproduction

Seahorses of the small species, *Hippocampus zosterae*, mature at three months (Strawn, 1953) while those of many other species appear to breed in the season after birth, at six months to one year (Vincent, unpublished). Sexual maturity in males can be recognized by the presence of a brood pouch, although its size will vary with reproductive state. Females mature at much the same size as males, but physical manifestation is less obvious. The length and timing of the reproductive season varies with location, and will be influenced by light, temperature, and turbulence (from monsoonal rains and high winds for example,).



Rudie H. Kuitert

Young seahorses (*Hippocampus breviceps*) are released from the brood pouch

Parental care

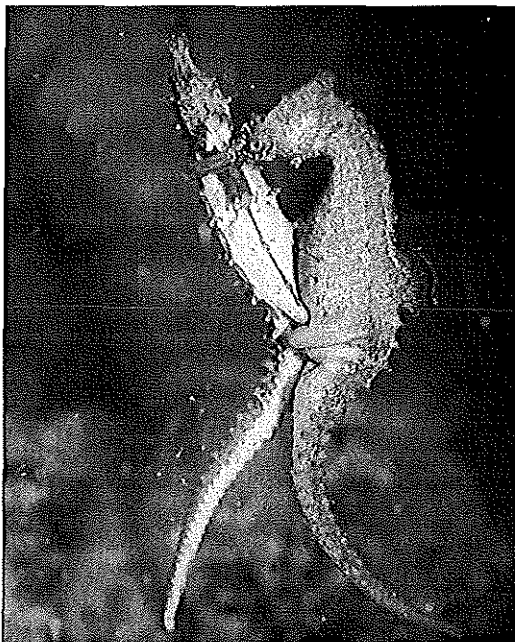
The male seahorse, rather than the female, becomes pregnant. This unusual mode of reproduction is the most extreme form of male parental care yet discovered, although it arises from a general bias towards paternal care among fishes. Prolonged and costly parental care has serious implications for the conservation of seahorses because it will be difficult for them to increase their rates of reproduction in response to exploitation. Male pregnancy means that exploitation will be particularly damaging to seahorse populations because the male must survive if the young are to survive.

The female seahorse deposits eggs in the male's brood pouch, where they are fertilised. This is indeed a pregnancy: eggs embed in the pouch wall, where tissue envelops them; they are provided with oxygen through a capillary network; the pouch environment alters from that of body fluids to that of salt water as pregnancy progresses; and the hormone prolactin in the male initiates enzymatic production of a placental fluid that nourishes the embryos (Leiner, 1934; Linton and Soloff, 1964; Boisseau, 1967; Haresign and Shumway, 1981).

Pregnancy lasts 10 days to six weeks, depending on species and water temperature (shorter at higher temperatures: Vincent and Sadler 1995). At the end of this period, the male goes into labour (usually at night), pumping and thrusting for hours to release his brood. Young are miniature adult seahorses, independent from birth, and receive no further parental care. Newborns of most species measure 7-12mm, with length more dependent on latitude than on adult size; the nearer the equator, the smaller the young (Vincent, 1990).

Seahorse fecundity (per spawning and *per annum*) is orders of magnitude lower than that of most fishes taken by large-scale fisheries. Males of most seahorse species produce about 100-200 young per pregnancy, although smaller species (e.g., *Hippocampus zosterae*) may release only about five offspring (Vincent, 1990). The maximum known brood size for seahorses is 1572 young, produced by one *H. reidi* male (Vincent, 1990). *H. whitei* seahorses near Sydney, Australia experience about seven consecutive 21-day pregnancies per year, amounting to a total production of about 1000 young per pair, *per annum* (Vincent and Sadler, 1995). Cod *Gadus morhua*, in comparison, can produce roughly 200 000 smaller pelagic eggs per spawning, though few survive.

Essentially seahorses have adopted the strategy of investing considerable energy and parental care into each young while cod produce more, cheaper young. In stable populations - of seahorses, cod or other animals - two young (on average) survive to maturity from a pair's lifetime reproduction; if more survived to reproduce, then natural populations would increase exponentially.



Hippocampus whitei : colourful courtship culminates in mating

Mating patterns

Seahorses of all species studied to date form sexually faithful pairs that endure through multiple matings and perhaps multiple breeding seasons (e.g., one species from the *Hippocampus kuda* complex (perhaps *H. comes*) (pers. obs.); one species from the *H. histrix* complex (pers. obs.); *H. reidi* (Dauwe and Nijhoff, pers. comm.; pers. obs.); *H. whitei* (Vincent and Sadler 1995); *H. zosterae* (Masonjones, pers. comm.; pers. obs.)). *H. whitei* in Australia is the most thoroughly studied of these, with all members of a population individually monitored (Vincent and Sadler, 1995). Pairs of one

male and one female mate repeatedly and exclusively with each other, and reinforce their pair bond with daily greetings (*H. fuscus*: Vincent, 1995; *H. whitei*: Vincent and Sadler, 1995). Each morning the female travels to her mate and they dance together for six to 10 minutes, performing the first few movements of courtship. They change colour, twirl around their holdfast, and promenade across the seabed. Females determine timing and duration of greeting but males control the action by leading in promenades and circling. Both sexes refuse to respond to displays by non-partners.

Greetings continue all through the male pregnancy and may help synchronize female egg preparation to the end of male pregnancy. Females were usually ready to mate again by the time the male had given birth. Either later on the day he gives birth or the next day, the routine greeting is prolonged into a courtship and remating.

Given their dependence on camouflage, it is surprising that seahorse courtships are colourful, active and lengthy, lasting up to nine hours. Eventually the pair rises through the water, aligning so the female can insert her ovipositor into the open pouch of the male. She transfers one entire clutch of hydrated eggs, after which the male seals the pouch shut. Neither sex remates during his pregnancy.



Rudie H. Kuiter

The female seahorse inserts her ovipositor in the male's open pouch

The unusual reproductive mode of seahorses provides certainty that seahorses do not mate with non-partners. Uniquely perhaps, both male and female seahorses provide visible evidence of having mated; the female girth diminishes and the male pouch fills. Male and female reproductive state changes are always synchronized within a pair and only within a pair, confirming that they are faithful to each other. No seahorse on the study site was known to abandon its partner to pair with another. Such sexual fidelity to one partner is extraordinarily rare among animal species; DNA evidence shows that most animals species practising social pairing mate with non-partners, as well as partners. Indeed, even social pairing is uncommon in fishes and previously unconfirmed in any species from a soft-bottom marine habitat (Barlow, 1984).

Possible consequences of disrupting social structure

Fishers will often catch only one member of a pair, and such pair disruption probably has serious consequences for seahorse reproduction. First, the need to re-pair interrupts reproduction. A newly single female usually stays in her old home range, whereas a newly single male waits to give birth before searching for a new female (e.g., *Hippocampus whitei*: Vincent and Sadler, 1995). Neither sex is fussy about its next partner, accepting the first single seahorse they encounter, but re-pairing takes time, probably because of low encounter rates (as a result of low mobility and low densities). Second, disruption of pairs may decrease short-term reproductive output; males that have spent less time with females prior to mating subsequently produce fewer young from that pregnancy (e.g., *H. fuscus*: Vincent, 1994a).

Wide-scale harvesting could also disrupt seahorse social structure in another way, by provoking unusual mate

competition and thus interrupting reproduction. Both sexes are active in mate competition, although males compete more to get pregnant than do females to give eggs away (*Hippocampus fuscus*: Vincent, 1994b). Competition for mates is seldom seen in the wild (Vincent and Sadler, 1995), probably because three or more unpaired seahorses rarely encounter each other simultaneously, but this could change after high mortality arising from a heavy storm or from fishing pressure.

METHODS AND DEFINITIONS

Surveys and interviews

All material in this report (including tables) not otherwise credited comes from original work by the author and associated research teams. Correspondence with biologists, consultants and conservation officers in many countries contributed to a global view of the seahorse trade beyond the Asian nations visited. The identities of other people contributing to the findings are only revealed where this was judged neither to jeopardize the person nor agency involved, nor to precipitate difficulties with future seahorse conservation work. Often references to “a wholesaler” or “the importer”, for example, must suffice.

The author and her assistants carried out extensive field research during April and May 1993 (Taiwan, Philippines, Hong Kong and China) and between December 1994 and August 1995 (Philippines, Indonesia, Hong Kong,

China, Vietnam, Thailand and India). The latter field trip also involved establishing seahorse conservation projects (see **Current conservation** chapter). A local biologist assisted the author in each country by interpreting during visits, providing extra cultural information, and verifying notes. None had specialized knowledge of TCM. The dried seahorses purchased during surveys are now being used for taxonomic study (see **Biology** section) that will help to elucidate trade routes and geographic distributions.

Findings come from a total of at least 400 surveys and interviews (197 in 1993 and 203 in 1995) with fishers, buyers, exporters, importers, wholesalers, retailers, consumers, and related experts. Interviews were generally conducted in the local language (through the assistant) without formal structure, but each interview sought to obtain information on past and present trade volumes, values, demand, supply, and availability. Discussions also addressed the medical and cultural importance of seahorses. Interviews lasted for as long as the person was prepared to talk, from a few minutes to a few hours, and addressed issues in whatever order seemed to encourage responses best. Information was cross-checked by rephrasing the same question at different stages during an interview and by asking the same questions of people at different levels of the trade. Notes were made during the visit where possible but prevailing attitudes of suspicion on the part of interviewees sometimes made it necessary to work from memory; in such cases notes were made immediately after the visit and the assistant checked their accuracy.

Participants in the seahorse trade are sometimes referred to by “level” in this report. This is to help differentiate between stages of involvement in the trade. Comparing among levels should allow verification of trade volume and price estimates for each level, if it is known how many people are active at each trade level (e.g., **Appendices 3 and 4**). Fishers are the first people to handle seahorses and are thus always level 1, while the first buyer will be at level 2. Thereafter the levels advance through successive buyers and the exporter, and from the importer through retailer to consumer. Trade routes are variable but most have six to eight levels (e.g., fisher, primary buyer, secondary buyer, exporter, importer, wholesaler, retailer, consumer). Clearly people can work at more than one level simultaneously: somebody who fishes seahorses but also buys them from other fishers is at both levels 1 and 2 and an exporter may work at levels 2, 3 and 4 if obtaining seahorses direct from fishers and also from buyers.

Trade calculations

Some volume estimates rely on fishers' and buyers' memories, with inherent imprecision. Information on sales was recorded in units used by respondents (e.g., *liang* (37.5g) or *catty* (0.605 kg) per day, number of seahorses per week, kilogrammes per month, boxes per holiday) and later converted to kilogrammes and seahorses per year (by, for example, dividing by number of seahorses per kilogramme and adjusting for seasonal variations). The validity of trade estimates was weighted by the reliability of the respondent, based on their answers to control questions with known answers. Multiplying by the number of people at each particular level of the trade allowed rough calculations of total consumption at each level in each region and comparing these estimates across levels allowed some verification of these estimates.

All volume calculations are for amounts consumed (throughputs), not for amounts held (standing stocks), which were usually very low. This is an important distinction because a pharmacy that consumes 100 seahorses a year may hold 10 or 1000 seahorses in stock, both of which mislead as to levels of exploitation. In this report, gross approximations of total trade are sometimes calculated by extrapolating from very small samples. Scaling up from three or five or seven interviews will always be questionable, but some sense of volumes is needed. Such rough estimates are generally used to examine the veracity or validity of other figures. The author fully recognizes that these are crude, but thinks them helpful nonetheless.

Data collected in the field were compared with the few published records on seahorse trade (see bullet points below). These key sets of data are referenced in most country sections, but the source data are presented only in the section for the country of origin. Deficiencies and gaps in published data emerged and are noted in the report.

- Taiwan publishes seahorse data in the comprehensive Republic of China [Taiwan] Customs Statistics (but see Note at beginning of report).
- China documented the trade only in 1990 and 1991, and data combine seahorses and pipefishes (China Customs Statistics Yearbook).
- The Philippines produced national trade data until 1987, in a category combining seahorses and pipefishes, issued by the Philippines National Census and Statistics Office. Partial seahorse trade statistics for recent years were extracted from Port of Cebu Customs Export Statistics, and the Bureau of Fisheries and Aquatic Resources (BFAR) export records from Zamboanga City.
- The Central Marine Fisheries Research Institute in India has monitored the Tamil Nadu seahorse fishery in a systematic manner, the only fishery to be so studied.

It should be noted that there are hazards associated with employing Customs data. First, it is not always clear whether import data is identifying country of origin (i.e. where seahorses were caught) or country of export/re-export (i.e. the country from where the shipment originated). Thus seahorses listed in Taiwan's Customs statistics as coming from Thailand, for example, could have been caught in Thailand or by Thai boats in other territorial waters. The United Nations recommends that import data indicate country of origin, and that export data report final destination of a commodity rather than first port of call (A. Gaski, *in litt.*, 5 January 1996), but this may not always happen. Thus origin and destination countries cited in this report may not be real catch sources or final consumers of seahorses. Second, comparisons of value can be misleading, because some declared values may include shipping costs and others may not. Dividing total published value of seahorses by weight of seahorses (from Customs data) in order to indicate price per kilogramme could be very inaccurate, but is used here as an index of price changes. Moreover, trade tariffs may lead to false declared values in order to evade taxes.

Seahorse nomenclature

Because of taxonomic disorder (see **Biology** section), this report will largely rely on the general appellation “seahorses”. Although this is unsatisfactory, the biology of most species generally does appear similar (see **Biology** section) and most species are vulnerable to exploitation. Specific names will only be used when there is no possible ambiguity.

Although neither scientific nor common names are reliable for most IndoPacific seahorses, four broad groupings of exploited species can be recognized and will be used in this report (see bullet points below). Size is an imprecise indicator of species grouping, both because young of large species can be confused with adults of small species, and because adult sizes of many fishes (and apparently seahorses) decline under fishing pressure.

- *Hippocampus kuda* complex species are medium-sized, slender, smooth seahorses with fine coronets;
- *H. histrix* complex species are medium-sized, spiny seahorses with fine coronets;
- *H. kelloggi* complex species are larger, solid-looking, smooth seahorses with thick coronets;
- *H. trimaculatus* complex species are smaller, deep-bodied smooth seahorses with no coronet, characterised by three spots on the dorsal part of the upper trunk.

Species from outside the IndoPacific region are described briefly in the appropriate national sections of the report.

Common names will not be used in this report, as they have not been standardised.

Measures, currencies, and terminology

Weights of dry seahorses vary greatly with species, size and processing (e.g., bleaching, see **Hong Kong** section) (Table Methods 1). Some measures will be used repeatedly when discussing seahorse sales.

- In China, seahorses are usually priced per 10g. One metric *catty* = 500g.
- In Hong Kong, seahorses are usually priced per *tael*. One *catty* (605g) = 16 *taels* (37.8g).
- In Taiwan, seahorses are usually priced per *liang*. One *chin* (600g) = 16 *liang* (37.5g).

THE INTERNATIONAL TRADE IN SEAHORSES

Table Methods 1

Number of dried seahorses per kilogramme in sample harvest areas

Origin of seahorses	No. dried seahorses per kilogramme*
<i>Philippines</i>	
Bohol	300-450
Jolo	800-1000
Palawan (1993)	600-800
Busuanga (1993)	800-1000
<i>Others</i>	
China (1993)	260
Hong Kong	267
India (by-catch)	800-1000
India (target catch)	350-500
Indonesia (Bali & E. Java)	500
Thailand (1989)	300
Vietnam	300-400

* Weight per seahorse varies with species, size, and processing.

Source: Author's research

Most prices in the report were converted to US dollars (Table Methods 2 and 3) although some local trends are reported in local currencies. Most trade records included US dollar equivalents but trade values from the Philippines National Census and Statistics Office had to be converted into US dollars by the author, as did 1993 and 1994 trade values for the Republic of China [Taiwan] Customs Statistics.

Table Methods 2

Approximate US dollar exchange rates for key countries, as used in this report

Country	Currency	Date	per US dollar
China	RMB	May 1993	7.4
China	RMB	April 1995	8.3
Hong Kong	HK\$	May 1993	7.5
Hong Kong	HK\$	May 1995	7.7
India	Rp	June 1995	32.1
Indonesia	Rp	Feb 1995	2207.0
Japan	¥	May 1995	87.0
Philippines*	PP	April 1993	25.6
Philippines*	PP	Feb 1995	25.0
Taiwan	NT\$	April 1993	25.9
Thailand	B	June 1995	24.7
UK	UK£	April 1993	0.6734
Vietnam	VND	May 1995	11 000.0

* Conversion rates were those received by the author at the bank. These rates for the Philippines were applied to field findings but the annual rates in Table Methods 3 were applied to Customs data.

Source: Author's records.

THE INTERNATIONAL TRADE IN SEAHORSES

Table Methods 3

Yearly average Philippine peso to US dollar exchange rate

Year	Rate	Year	Rate	Year	Rate
1983	11.11	1988	21.09	1993	27.12
1984	16.70	1989	21.74	1994	26.42
1985	18.61	1990	24.31	1995	25.71
1986	20.36	1991	27.48		
1987	20.57	1992	25.51		

Source: Reference Exchange Bulletin, Treasury Department, Bangko Sentral ng Pilipinas

Romanization of Chinese characters differs between Taiwan, Hong Kong and mainland China. This report uses romanization as given by the person or source involved. Where it was not provided, romanization is given in Pinyin as used in mainland China. All Chinese names used in this report have been written with surname first.

USES OF SEAHORSES

Seahorses in European medicine

Seahorses have long been credited with magic and medicinal value in Europe. The Greek philosopher Plutarch (circa 46-120 AD) saw the seahorse as a symbol of impudence “the creature being said first to slay his sire and then force his mother “ (Whitley and Allen, 1958). Apparently Greek fishermen thought seahorses were the miniature offspring of horse-sized parents that pulled Poseidon’s chariot.

European reports of medical use for seahorses are apparently older than Chinese records. A succession of late Greek and Roman writers, from as early as 342 BC (Menander, Strabo, Philostratus, Dioscorides, Aelian and Pliny), drew a complex picture of the medical application of seahorses (Eastman, 1915): seahorses, when roasted, prevented the retention of urine; oil of roses in which a seahorse has been dipped and killed was effective against chills and fever; ashes of seahorses mixed with liquid pitch, tallow, and oil of sweet marjoram cured baldness and pain in the sides; ashes of seahorse in wine would lead to spasmodic coughing, hot flushes in the head, discharges from nostrils, a fleshy odour, swelling of the abdomen and finally death. Seahorses have also been credited with curing hydrophobia (rabies) and infertility. Pliny the Elder, the Roman natural historian (23-79 AD), specifically cited seahorses as agents against leprosy, sea hare venom, bites from mad dogs, and baldness.

Western medical use continued until at least the eighteenth century: “The ladies make use of them to increase their milk”, noted *Gentleman’s Magazine* in England, in 1753. More recently, however, seahorses have been consumed by the West as aquarium pets, souvenirs and curios.

Seahorses in traditional Chinese medicine (TCM)

The World Health Organization recognizes TCM and other traditional medicines as viable health care options, for which national government support is solicited (Anon., 1994a). TCM is practised in China, Hong Kong, Taiwan, Singapore, and ethnic Chinese communities worldwide, is evident in Korea (where it is known as *hanyak*) and Japan (known as *kanpo*), is influential in Jamu medicine in Indonesia (an indigenous form of medicine heavily reliant on plant products), and has affected folk healing in other areas such as the central Philippines. All these forms of medicine employ seahorses.

A grasp of the philosophy of TCM is vital to understand its function but is not easy to acquire. The central tenets are *yin* and *yang*, which can be understood as two polar complements; neither can exist without the other, just as dark and light can only be understood in the context of each other (Kaptchuk, 1983). Illnesses that are characterized by weakness, slowness, coldness and underactivity are *yin*; those that manifest strength, forceful movements, heat and overactivity are *yang* (Kaptchuk, 1983). Treatment involves assessing six environmental factors (labelled for illustrative purposes as Pernicious Influences or Evils: Wind, Cold, Fire or Heat, Dampness, Dryness and Summer Heat) that are recognized as playing a part in disease, and can enter the body when the equilibrium between *yin* and *yang* is upset (Kaptchuk, 1983)

The idea of causation, central to Western medicine, is absent from TCM (Kaptchuk, 1983). Chinese patients will often employ both schools of medicine, tending to use Western medicine in acute and emergency situations and TCM in chronic situations (Kaptchuk, 1983). Some TCM treatments - such as that efficacious for eczema - are being adopted in the West (D. Atherton, pers. comm., 28 November 1995).

History of seahorse use in TCM

Seahorses probably entered into use in TCM no more than 600 years ago. The classic *Shen Nong Ben Cao Jing* [Divine Peasant's Herbal Compendium] dates from the pre-Qin dynasty (100-200 AD) and provides the basis for TCM. Seahorses are not among the 365 medical ingredients listed. According to Bensky and Gamble (1993), they first appeared in about 720 AD in *Ben Cao Shi Yi* [Omissions from the (Classics of the) Materia Medica], edited by Chen, Cang Qi. The *Ben-Cao Gang-Mu* [Compendium of Materia Medica], edited by Li Shizhen, appeared during the Ming dynasty (1368-1644) and listed 1892 medicinal products. Seahorses were mentioned by name, although the accompanying picture did not resemble a seahorse (Figure Uses 1).

The *Chinese Pharmacopoeia* lists five seahorse species: *Hippocampus histrix*, *H. japonicus*, *Hippocampus kelloggi*, *H. kuda*, and *H. trimaculatus* (Anon., 1985). Another medical tome cites seven useful seahorse species: *H. coronatus* (*guan hai ma*: crowned seahorse), *H. histrix* (*ci hai ma*: thorn seahorse), *H. japonicus* (*xiao hai ma*: small seahorse), *H. kelloggi* (*xian wen hai ma*: wrinkled seahorse), *H. kuda* (*da hai ma*: large seahorse), and *H. trimaculatus* (*san ban hai ma*: three-spotted seahorse) (Li Yue Cheng, 1994).

There are currently more than 10 000 medical ingredients in use (P. But, pers. comm., April 1995), and not all contemporary TCM texts include seahorses. A recently published book on Chinese medicine (Lin and Chen, 1988) does not mention seahorses, despite careful treatment of seven species of pipefish. Close inspection can also be needed to find seahorse listings: for example, the *Dictionary of Traditional Chinese Medicine* lists seahorses only in the Chinese characters index and not in the English index (Xie and Huang, 1984).

Ailments treated using seahorses

Interviews with TCM practitioners and users indicate that seahorses are thought to resolve an extremely wide range of health problems, are considered efficacious for sexual weakness (including reduced desire), and are taken as powerful broad-spectrum tonics. No active ingredients are known. Generally categorised as a "sweet, salty and warm" medicine, seahorses are combined with other plant and animal material before use. Seahorses are contraindicated for pregnant women, and those deficient in *yin*, or with weak digestive conditions, or susceptible to cold (Bensky and Gamble, 1993).

Patients suffering from the following ailments and conditions are reputed to benefit from seahorse-based treatments:


- general enervation, fatigue, lassitude, pain;
- throat infections and inflammations, abscesses, excess throat phlegm, and swelling, particularly in lymph nodes;
- respiratory problems, particularly asthma;
- dysfunction of sexual organs, including impotence, reduced potency, premature ejaculation, painful and unsuccessful erections, and diminished desire [all of these are generally loosely translated into English as "aphrodisiac"];
- injuries from falls, fractures, contusions and strains;
- heart disease and circulatory problems, high cholesterol, arteriosclerosis, and as a cardiac stimulant;
- kidney and liver disease, poor immune system;
- difficult or delayed childbirth;

Figure Uses 1


Page describing seahorse use from the *Compendium of Materia Medica* produced during the Ming dynasty by Li Shizhen as a revision of the *Divine Peasant's Herbal Commendium*. This page was taken from the *Additional commentary on the Ben Cao Divine Peasant's Herbal* which adds to Li Shizhen's work (Yan Xingqlao, 1989). The purported drawing of a seahorse is in the second column of pictures, between the two purported "river dolphins" and the shrimps. A rough translation of the text in the large characters, below the picture, reads "Hai ma: Sweet taste, Warm property. Supplements kidneys [here male sexual function]. Strengthens yang. Removes lumps and masses in the lower abdomen of women. Treats furuncles and toxic swellings, dystocia [difficult labour], and pain due to malfunctions in blood and vital energy."

補虛
腎 虛 補
殺 蟲 殺 蟲
補 陽


豚 河



馬 海



蝦




【河豚】甘溫有大毒。宗爽曰：修治失法，食之殺人。厚生者，芥蒜花桔梗甘草附子為頭，相反宜殺。菊萎蒿禿菜畏椒，攪甘蔗蘆根，穀稗錢云：食河豚一日內不可服湯藥，恐犯。荆芥二物大相反，予親見一人因此喪命。河豚子必不可食，曾以水浸之一夜，大如灰，實世傳中其毒者以椒攪及冰片浸水皆可解。又一方以槐花微炒與乾胭脂等分同搗粉水調灌之大妙。又按物類相感志言：凡煮河豚用荆芥同煮五七沸，換水則無毒。二

【海馬】甘溫，暖水臟，壯陽道，消癥塊，治疔瘡腫毒。婦人難產及血氣痛。時珍曰：雖雄成對其性溫，暖有交感之如蛤蚧，即君子之功也。

【蝦】甘溫，託痘瘡，下乳汁，吐風痰。中風證以蝦半斤入薑葱醬料水煮先吃，蝦次吃，汁以棉紙擦引吐出痰涎，隨證用藥。壯陽道。每

蝦 海



本草從新 蟲魚部介部 蝦 海蝦 海馬 河豚 二七六

- incontinence;
- open wounds and cuts;
- skin disease characterised by subcutaneous ulcers, or deep-rooted carbuncles;
- mental disorders.

This list was derived from discussion with TCM practitioners, and various literature sources (e.g., Li Shizhen, Ming dynasty; Xie and Huang, 1984; Bensky and Gamble, 1993; Xu, 1993). It should be noted that “aphrodisiac” (as ascribed to TCM) is an imprecise translation of the perceived benefits of seahorses; in TCM they are apparently more commonly used to improve and enhance sexual function than to promote sexual desire. The original Chinese term *zhuang yang* (usually translated as “aphrodisiac”) is defined as “invigorating *yang* by administering drugs to promote vital function, especially virility in the treatment of impotence” (Xie *et al.*, 1994).

Discussions and interviews revealed that seahorses are widely considered an effective general tonic, and to improve “nerves” and strengthen “kidneys”. Both latter terms in this context signify general morale, vigour and well-being, while kidneys also contribute to sexual function. A seahorse-based tonic will nourish *yin* [presumably enhancing *yin* in those not deficient in it - see first paragraph of this section] and strengthen *yang*.

The possibility that seahorses contain important biomedical compounds cannot be ruled out, but the Chinese generally regard historical use of TCM as testimony to a product’s efficacy, and clinical trials are rare. It has, however, been reported that “Alcohol extractions of *Hippocampus kelloggi* (*hai ma*) prolonged the oestrus period and increased the weight of the uterus and ovaries in normal female mice. It also gave emasculated mice an oestrus period. Extractions of *Hippocampus* (*hai ma*) of undetermined origin given to mice had an andronergic effect on the prostate gland, testes and levator ani” (Bensky and Gamble, 1993). Reports of the original studies have not been inspected by the author.

It is worth noting that TCM and early European usage of seahorses are not always in accord. Both medicines use seahorses to treat infertility but TCM uses seahorses against incontinence and the Romans relied on seahorses against urine retention. Moreover, seahorses fermented in wine are a good general tonic in TCM whereas ashes in wine purportedly led to death in Europe (see **Seahorses in European medicine** above).

Seahorses in tonic foods and folklore

Chinese medical treatments need not require full prescriptions issued by doctors. TCM is a de-centralised form of medicine in which many patients self-prescribe after discussions with pharmacists (Wong *et al.*, 1993). One Chinese aphorism *Yao Shi Tong Yuan* translates as “medicine and food are of the same origins”, and people will also guard their health by eating quasi-medicinal tonic foods. Just as there is no real dividing line between TCM and tonic foods, so tonic foods cannot easily be distinguished from folk remedies.

TCM practitioners and users explained that seahorses are often bought without prescription, and used in home remedies, such as the following recipe obtained at a market stall in Beihai (China) and roughly translated from Chinese below:

“Sea Treasure

Seahorse, pipefish, sea bird (real one), sea snake, and sea sparrow comprise ‘sea treasure’” (originally, “*hai ma, hai long, hai niao, hai shie*” and “*hai que*” comprise “*hai bao*”). “They each help the kidney, and serve as an aphrodisiac, to increase blood circulation, and to reduce Wind and Wetness of the body and cool the body.” (One example of Wind and Cold invading the body would be what Western medicine diagnoses as an upper respiratory infection (Kaptchuk, 1984)).

"Method of application: Put honey on the 'sea treasure' and roast over a slow fire to yellow/sooty colours. Add 10g each of dan ginseng and red olive into rice wine. Then grind the roasted sea treasure and mix with alcohols. Or stew the ground powder in chicken soup. Prolonged intake will improve health and increase life span."

Folkloric remedies include the tale that holding a seahorse in the hand would facilitate childbirth and that "seahorses with red-speckled spiders and Ping Yi's fairy pills when eaten will enable one to live underwater" (Read, 1982). The captain of a fishing boat from Penghu (also known as the Pescadores Islands) (Taiwan) reported that young fishers sometimes cut the tail tip off a live seahorse and suck the stump to extract the juices, in order to promote vigour (pers. comm., 9 April 1993).

Seahorses were eaten by Chinese during the T'ang dynasty (AD 618-907) (Chang, 1977) and are still sought in some health food restaurants, such as the Yat Chau in Hong Kong (see Figure Hong Kong 1). Dried seahorses are, however, insignificant in the Chinese diet today (Anderson, 1988).

Regional differences in the use of seahorses in TCM

TCM practitioners in China, Hong Kong and Taiwan all reported employing seahorses as powerful tonics, and to enhance sexual function. However, the author's field surveys indicated that a role in improving male "strength" (sexual) was most evident in Taiwan, whereas China and Hong Kong tended to use seahorses more commonly to treat problems of the respiratory tract, including asthma and infections, and to ameliorate thyroid gland problems. Seahorse-based treatment methods for any particular ailment were roughly similar everywhere (also see Wu, 1979). "Ethnomedical surveys have shown that different communities in China do differ in various aspects in the choice of herbs and the use of the same or similar herbs." (P. But, pers. comm., 6 November, 1993).

Preparation of seahorses for TCM

All those interviewed reported that consumers generally prefer larger, paler, and smoother seahorses. Seahorses are dried for use in TCM, usually just by laying them in the sun. Those intended for use in Taiwan are usually hung to dry as this produces a (preferred) straighter tail on the dried seahorse; the animal hangs from a string tied around its snout and flails for a holdfast. It was generally accounted important to protect dried seahorses from ants and other agents that could damage it, since the loss of eyes, in particular, diminished their value (although the reason for this is unclear). TCM outlets often display only a small portion of their seahorses, storing others in the refrigerator to preserve them.

One Chinese TCM dealer reported that seahorses were soaked in freshwater to reduce their saltiness, but this practice was never encountered. Wholesalers in Hong Kong - but not noticeably elsewhere - often bleach seahorses and coil their tail prior to sale (see **Hong Kong** section). Some seahorses on sale in TCM shops (particularly in Hong Kong but also elsewhere) had been sliced open along the ventral mid-line, either for evisceration or to check for lead that would increase seahorse weight artificially.

Practitioners of TCM usually tailor prescriptions to a patient's individual needs - thus different patients may receive different treatments for the same apparent symptoms - although this is now changing (see *Seahorses and proprietary medicines in TCM* below). If a remedy involving seahorses is suggested, the patient chooses a seahorse. A good quality seahorse is "whole, big and firm" (Bensky and Gamble, 1993). Field interviews with TCM pharmacists and consumers indicate that most patients preferred smoother, larger and paler specimens, in that order of priority, but the species itself did not matter. Spiny seahorses are considered to be of poor medicinal value and were even thought mildly noxious by one TCM dealer in China. Bleached seahorses are preferred in Hong Kong (presumably because they are so pale) although this may be changing (see **Hong Kong**

section). Consumers in Asian nations that import or re-import TCM seahorses from Hong Kong also apparently prefer bleached seahorses (e.g., Indonesia and the Philippines).

Prescription formulae for seahorses are detailed and directed to particular ailments, but there are three basic formulations, which require:

- grinding the seahorse to a powder (sometimes after burning it black), then mixing it with a liquid (warm water or a strong alcohol), to be drunk three times daily;
- grinding the seahorse to a powder and applying directly to the wound;
- placing the whole seahorse in a liquid (strong alcohol or another Chinese medicine) to be drunk (sometimes after allowing the seahorse to ferment).

For most remedies, the selected seahorse is chopped and ground and mixed with other ingredients as appropriate. The whole body is used. Pharmacists, particularly in Taiwan, suggested seahorses be used in pairs, especially to remedy male impotence and female infertility. The sex of the paired seahorses did not matter; indeed the author found that most pharmacists could not tell a male seahorse from a female.

Tonic recipes are variable. In one prescription from Hong Kong, the patient boils three *taels* (total of 113.4g) of whole seahorse into a soup, cooks it with lean pork for a few hours, then eats it directly (A. Lau, *in litt.*, 18 March, 1993). As a tonic remedy, adults would usually consume three to five *jian* (11.4 - 19.0g) of seahorse and pipefish once every two to three days, while children would take doses of two *jian* (7.6g). Several courses of treatments are generally required (Chan Cheung, pers. comm., 4 May 1993). In Taiwan, seahorses are placed in large jars of "wine" (a strong alcohol) with plant and animal matter, and allowed to ferment for months before the liquid is decanted and drunk. A Vietnamese tonic for men (*Bô Thân Tinh*) also incorporates seahorses into strong spirits.

A TCM wholesaler pharmacist in Hong Kong sometimes made his prescriptions up in tablet form, by combining seahorse powder with other powders, in order to save preparation time for the patient requiring extended treatment.

Seahorses and proprietary (patent) medicines in TCM

The search for faster remedies is prompting an important change in TCM. Gradually proprietary or pre-packaged medicines are supplanting individual prescriptions, at least in China. All TCM dealers interviewed in China noted that time was becoming more valuable than money for patients and one senior TCM importer asserted that thirty percent of seahorses may now be going to manufacture medicines in factories. At least eight of the patent medicines that include seahorses are now sold in North America (Fratkin, 1986) (see North America section).

The transition to mechanized production would seem to threaten the personalized approach of Chinese medicine, but did not appear to concern the TCM merchants interviewed, who saw a new market for sales. One TCM researcher commented that although the ideal application of Chinese medicine would involve diagnosis and prescriptions for individual patients, proprietary medicines for more convenient use have been available for centuries and their therapeutic value has still been demonstrated satisfactorily (P. But, pers. comm., 6 November, 1993). The conservation implications of this shift to prepackaged medicines may be serious, however, as virtually all seahorses can now be absorbed into patent medicines, even small ones that had previously been rejected by consumers (see China section).



Prepared medicines from China and Indonesia containing, or purporting to contain, seahorse

Patent medicines incorporating seahorses generally come either as capsules, or as round black pills, while at least one is a liquid. Six out of eight packets purchased in Chinese TCM outlets provided information in English, and one of these listed diminished sexual desire as its first indication. One very popular medicine (according to TCM retailers) is called "Seahorse Genital Tonic Pills". Seahorse constitutes 10% of the contents, and 19 other ingredients are included. Another prepared medicine, "Seahorse Balm" is as bereft of the named animal as is Tiger balm; both are rubbed into the skin to relieve aches and pains, irritations, breathing, and stomach problems, among other ailments.

Among the more widespread patent medicines are "Pills of Hippocampuses [seahorse] penis and other animals penis" (*hai ma duo bian wan*) offering the following panel in English: "This medicine is composed of many ingredients including seahorse, gecko, penis of bull, penis of donkey [sic], penis of dog, penis of marten, red ginseng, pilose antler etc." In fact, seahorses lack the penis mentioned on the label (see *Biology* section).

Seahorses in other Asian medicines

Seahorses are used to treat asthma, gas pains, and hyperactivity in the central Philippines (Aliño *et al.* 1990). They are also employed in Indonesia's Jamu medicine. Details of Jamu are kept somewhat secret but men from Java, Bali, and Sulawesi certainly ingest seahorse-based Jamu aphrodisiacs (see *Indonesia* section).

Seahorses as aquarium fishes

Aquarium seahorses are usually one of four or five species, of which one is a member of the *Hippocampus histrix* complex (pale and spiky) and three are from the *H. kuda* complex (smooth and either yellow, black or Tiger tail-striped). The fifth aquarium species is *H. erectus* (usually lined), caught off Florida.

Virtually all aquarium seahorses come directly from the wild. Seahorses are usually highly unsuitable aquarium fishes as few survive long in captivity and often suffer:

- physiological damage during collection and transport;

- poor aquarium management at importers, retailers, and hobbyists facilities;
- disease;
- unbalanced diets;
- insufficient diets or starvation;
- incompatible aquarium inhabitants;
- from lack of good information on their husbandry (J. Banquero, *in litt.*, 6 August, 1993).

They normally survive the process of capture and shipment quite well, but then die later partly as a consequence of this process: being captured abrades their skin, being held in crowded and often unsanitary conditions increases their vulnerability to disease, and being starved (as is commonly the case) or malnourished for weeks exacerbates later husbandry problems .

Adult seahorses require a steady supply of varied live foods in captivity, and a high level of cleanliness because of their vulnerability to fungal, parasitic and bacterial ailments. Those seahorses that do live will often mate readily in captivity, but the ensuing young seldom survive long, because of problems in supplying adequate and appropriate food and vulnerability to disease. Large public aquaria concur with hobby aquarists that these are among the most difficult of fishes to rear (S. Keefer, *in litt.*, June 1992; H. Hall, pers. comm., 10 June 1994). Rare advertisements offering captive-bred young seahorses usually signify merely that the pregnant male was caught in the wild, and gave birth in captivity.

The author has received hundreds of letters from aquarium hobbyists. Most have had disastrous results with seahorses but persist, presumably through fascination with seahorses and in the hope that advice in articles in aquarist magazines can assure success, yet these offer little or misguided advice. One of the few published booklets on seahorse keeping concedes the difficulties involved on a last page dedicated to making jewellery from dead seahorses (Straughan, 1961). Aquarists whose seahorses die commonly purchase more of these fishes, thus ensuring a steady market for seahorses.

Seahorses as curios

Dead seahorses are popular curios, probably partly because they retain their shape and detail when dried. Dried seahorse souvenirs (including shell scenes and mobiles) have been seen for sale in beach resorts and shell shops around the world. Huge piles of seahorse key chains, with the rings punched through their eyes, were on sale on beaches in Thailand in 1989. Jewellers also dip the dead animals into paint or spray them as ear-rings or brooches.

SEAHORSE TRADE IN INDIA

Seahorse fishing and trade in India appears to be restricted to the two southern states, Tamil Nadu and Kerala, although little is yet known about the latter. Target collecting and by-catches from shrimp boats in one small region of Tamil Nadu yield approximately 3.6t of seahorses annually. All seahorses are exported dried, mostly to Singapore. There is no known aquarium trade for seahorses in southern India.

Background for India

Information sources in India

Information in this section comes from Marichamy *et al.* (1993) and from field interviews by the author in Tamil Nadu during June 1995. These included six seahorse fishers, level 2 buyers in four villages, the dominant level 3/4 buyer, those involved in trading the by-catch from shrimp trawling (including a level 2/3 buyer), and Indian fisheries biologists from the Central Marine Fisheries Research Institute (CMFRI). CMFRI maintains an ongoing monitoring programme on seahorse catch. Interviews were conducted with assistance and interpretation from Mr. N. Ramamoorthy of CMFRI. The author was introduced to fishers and dealers as a fisheries biologist.

Seahorses in India

The taxonomy of Indian seahorses is not well defined but at least three species of seahorse are caught off Tamil Nadu. Hand-collecting near shore (from small boats) obtains a species in the *Hippocampus kuda* complex, studied in the laboratory as *H. fuscus* (Vincent, 1990; 1994a; 1994b). Landed fish measured up to about 180mm (mean=110mm, wet length). This species is found in seagrasses, often grasping sponges. Buyers reported in 1995 that one kilogramme dry weight comprised about 350-500 of these seahorses. This is probably correct because a sample of five larger seahorses bought by the author weighed a mean of 3.1g, giving 323 larger seahorses per kilogramme. This species is collected for the aquarium trade in nearby Sri Lanka (see *Other Asian* section) but not in Tamil Nadu.

Shrimp trawling farther offshore (in larger boats) brings up a species (or possibly two species) resembling *Hippocampus trimaculatus*, with a maximum size of perhaps 100mm. Fishers reported that net hauls with seahorses were more likely also to contain seagrasses (e.g., *Cymodocea serrata*). Buyers said that one kilogramme dry weight comprised 1000-2000 of these seahorses. This may be an overestimate: a sample bought by the author weighed 1.25g on average, giving 800 per kilogramme, although this sample did not include any of the smallest (25mm) seahorses.

Probably a third (or fourth) species is caught in Kerala. Three buyers noted that Kerala seahorses could measure 300mm and were heavy, with only about 100 per kilogramme.

Use of seahorses in India

Seahorses are occasionally used as medicines in Tamil Nadu, with a limited role in curing whooping cough in children. The seahorse is powdered, roasted in an earthenware pot, then mixed with honey to administer. Older people also believe that dried seahorse powder with honey will relieve asthma, in a remedy akin to those in TCM.

Seahorse catch in India

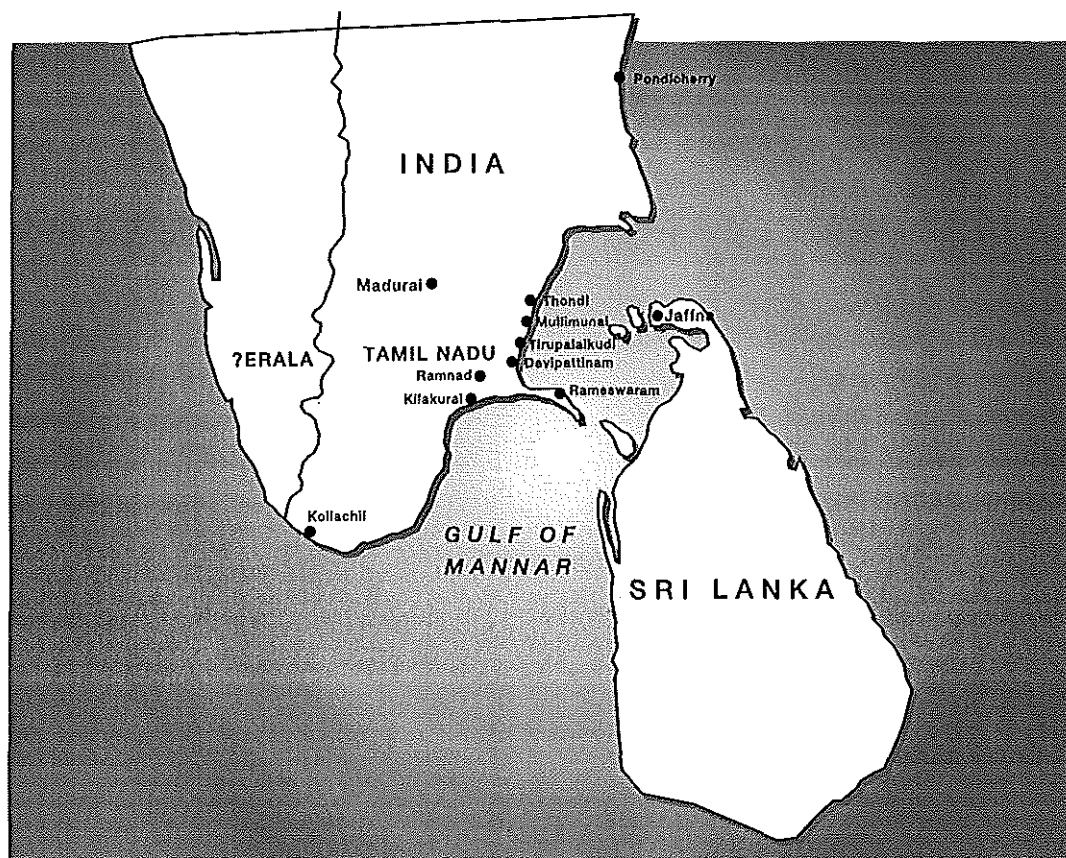
Location of seahorse catch in India

In India, seahorse trading is known only in the southernmost states of Tamil Nadu (east) and Kerala (west). The Tamil Nadu fishery is concentrated in Ramnad district near Sri Lanka (Figure India I).

All villages by Palk Bay (Figure India 1) participate in a target fishery for seahorses. Seahorses are, however, only a by-catch in the Gulf of Mannar. This is probably both because the Gulf provides less suitable habitat - Palk Bay has seagrass and sponges whereas the Gulf of Mannar is rocky - and because fishers in the Gulf can still obtain sea cucumbers and chanks (conches *Xanichus pyrum*) in sufficient numbers to obviate the need to earn money from targeting seahorses. Seahorse by-catch is also landed farther north in Pondicherry but rough seas and deeper water preclude a target catch there.

Figure India 1

Map of southern India showing seahorse trading areas, as mentioned in the text

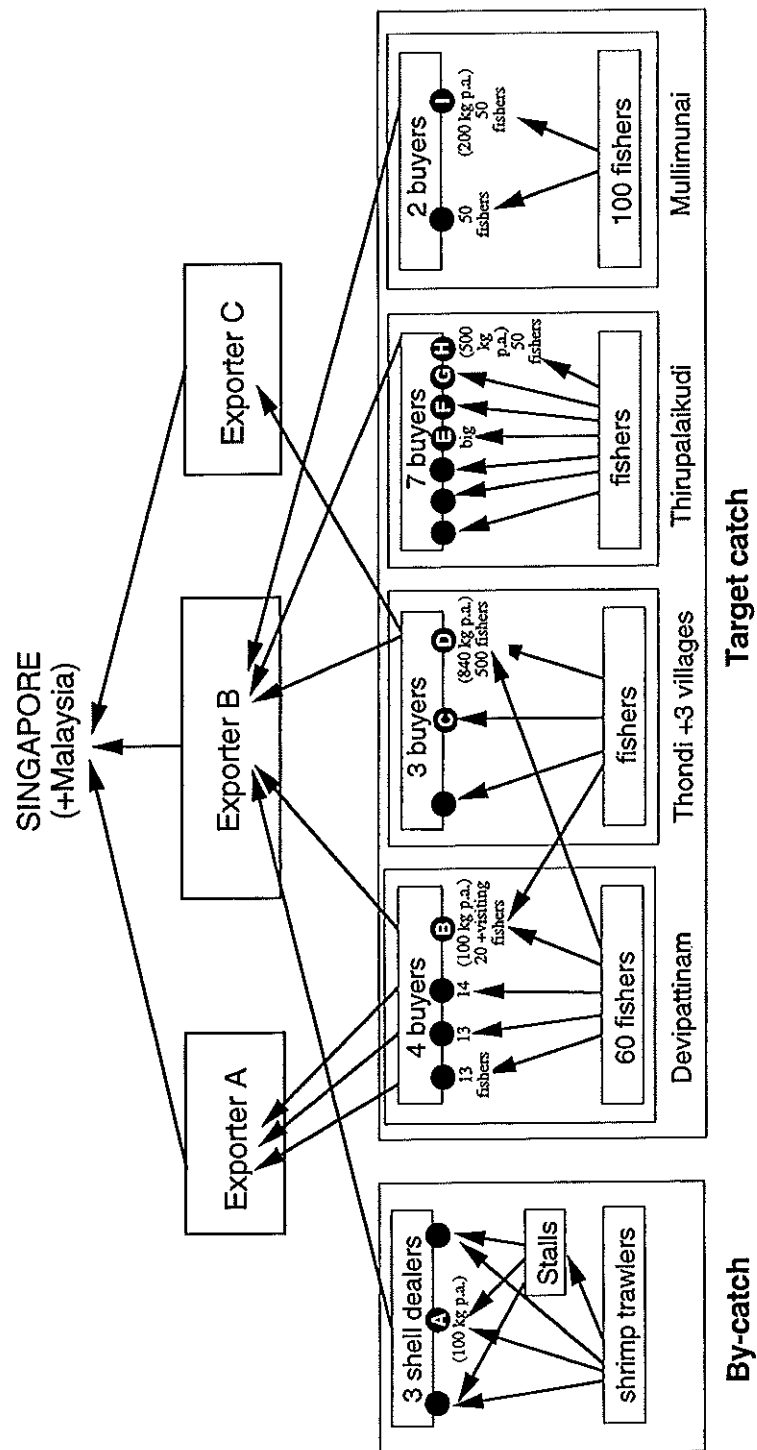


Target fishery for seahorses in Palk Bay (and Kerala)

Seahorses have been collected in Palk Bay since at least 1977 but the fishery really developed in 1990 in response to requests from one dealer in Kilakurai (Ramnad district). He is still the foremost seahorse buyer in the region (levels 2, 3 and 4), receiving virtually all locally-caught seahorses (Figure India 2). According to Marichamy *et al.* (1993), "Concomitant with the recent heavy demand for the dried seahorse in the international export market and also decline of sea cucumber fishing, there has been a sudden spurt of exploitation of sea horse along the Palk Bay coast of Tamil Nadu."

Fishers who collect seahorses also seek other marine animals such as sea cucumbers and chanks. They travel as far as three kilometres off shore, visiting different areas each day, and fish for up to five hours in the middle of the day, six days a week. Wearing a mask and wooden fins, they free-dive in water up to eight metres deep. Five or more fishers work together to seek out all the seahorses in a small area, sometimes in a square of less than 10m²,

Figure India 2
Partial diagram of the seahorse trade in Ramnad district, Tamil Nadu. Trade routes are illustrated as known and four volume estimates are indicated.
The eight unnamed buyers may not all be different people.



Source: Author's research

then move on. Seahorses are found throughout seagrass meadows, at densities of up to 15 per square metre, according to fishers. The seahorses caught nearer the shore, whether by hand or with seine nets, tend to be larger. Fishing access is in no way restricted but women are not involved in the seahorse fishery in Palk Bay, which is a Moslem area (whereas they are active in the Gulf of Mannar fishery) (see below).

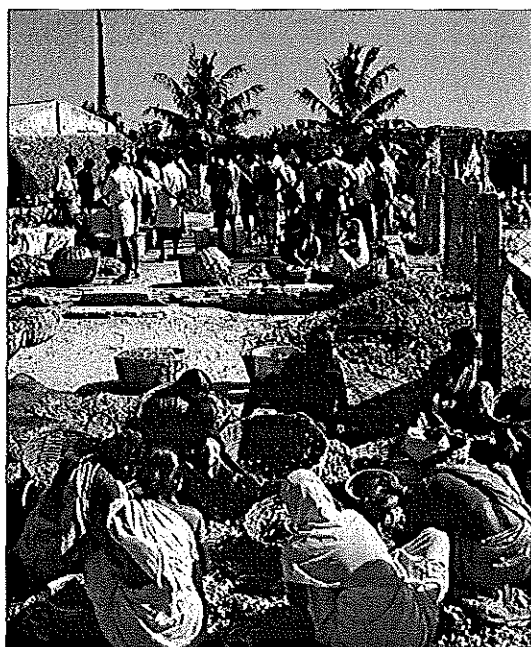
Fishers sell their catch to local buyers (level 2), who may purchase from a number of villages. One buyer had been operating for 15 years but many started only when the fishery escalated in 1990. Most level 2 buyers along the Palk Bay coast supply the same dealer in Kilakurai (Figure India 2). The largest level 2 buyer operates semi-independently, exercising choice in where he sends his seahorses, but still selling many to the dealer in Kilakurai mentioned above. This Kilakurai level 3 dealer has six staff, also trades sea cucumbers, and is by far the largest buyer in the region. Another, much smaller, buyer keeps staff in Kilakurai but usually works in Madras.

Most seahorses from Kerala are apparently sold to a buyer in Kollachil (just inside Tamil Nadu) but some also reach the Kilakurai buyer.

By-catch of seahorses in the Gulf of Mannar

Seahorses are caught incidentally, as a by-catch of shrimp trawling in the Gulf of Mannar. Boats of 11-12m long put to sea for 12-24 hours. Much of the trawling is done at night. The number of boats has increased steadily since 1980, and 410 boats operated on one average day in June 1995 (N. Ramamoorthy, pers. comm., 14 June 1995). Seahorses are extracted by sorting through the voluminous by-catch associated with the shrimps (estimates of shrimp to by-catch ratios reach 1:19) (A.P. Lipton, pers. comm., 14 June 1995). Each boat typically gets only a few seahorses per day each, but catches of 10 seahorses are fairly common and those of 25 do occur. Restrictions limit boats to three fishing days weekly in order to reduce fishing pressure, but many boats have doubled their working day from 12 to 24 hours to compensate. Women are active in the Gulf of Mannar fishery. Few seem involved in shrimp trawling, but most by-catch sorting is done by women.

In Rameswaram, a major landing area, the vast trawl by-catch is sorted at once on the docks, then seahorses are sold to a food vendor at the end of the jetty (level 2). He had accumulated about 80 on the morning checked (June 1995),



Women sorting shrimp by-catch, Rameswaram, India

and was drying them in the sun. He sells the dried seahorses to a local shell trader (one of three level 2/3 buyers in Rameswaram) who comes to the docks to visit him. Fishers with many seahorses sometimes take them directly to these same buyers, missing out a trade level. All by-catch seahorses appear to be sold on to a level 3/4 buyer in Kilakurai, the same man who buys target catch (see *Target fishery for seahorses in Palk Bay (and Kerala)*).

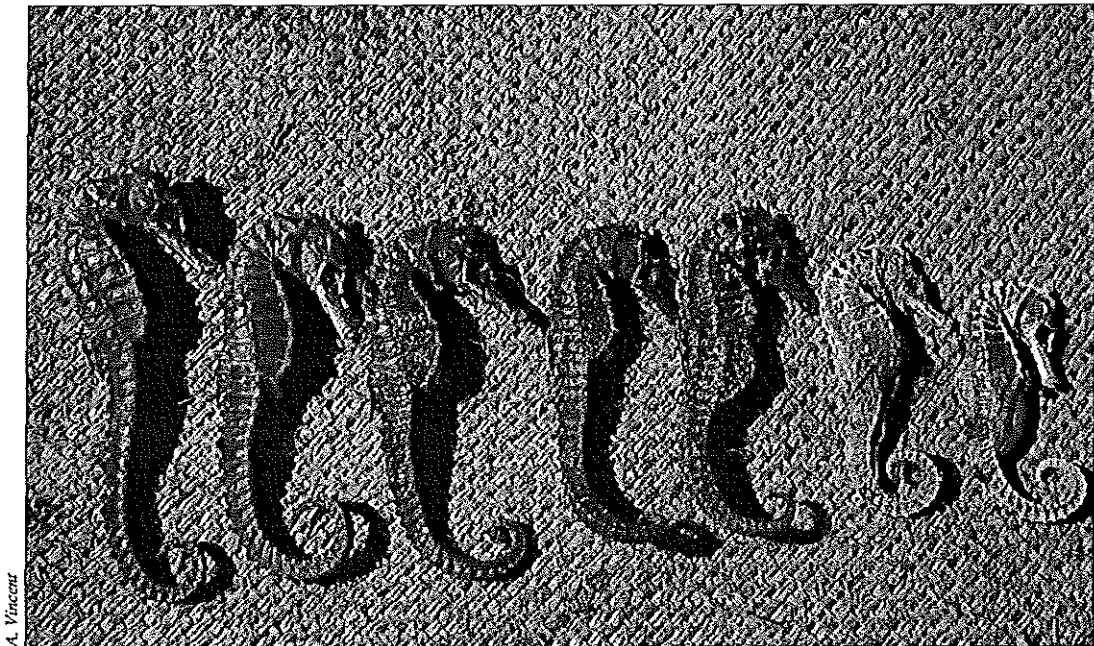
Timing of seahorse catch in southern India

Palk Bay fishers collect most seahorses either between March and October (according to one buyer) or from April to June (according to two buyers). The shrimp trawl fishery in the Gulf of Mannar operates year round, but fewer seahorses will be caught from June to August when monsoon winds limit fishing. The

coincidence of post-monsoon trawling with continued target fishing may explain why the dominant buyer for the region gets most seahorses from August to November. Fishing for seahorses coincides with their breeding season, according to collectors.

Dried seahorse exploitation in India

Most seahorses from Tamil Nadu (and adjacent Kerala) are exported to Singapore, often *via* Madras, but some go to Malaysia (Marichamy *et al.*, 1993, endorsed by all those interviewed in 1995). Occasionally Chinese merchants, usually from Singapore, had approached level 2 buyers directly to obtain seahorses. The level 3/4 buyer in Kilakurai reported that Tamil Nadu seahorses sell as "top quality" in Singapore. He credited a good drying process but it seems that the smooth texture of Tamil Nadu seahorses is also likely to have been a contributing factor, since these are preferred (see Uses section).



A. Vincent

Seahorses laid out at the premises of the Kilakurai buyer

Volumes of dried seahorses exported from southern India

Volume of seahorses in Tamil Nadu target catch

Field surveys in June 1995 indicated that fishers targeting seahorses in Palk Bay sold at least 3040kg of seahorses annually (at least 1.2 million individuals, based on an estimated 400 per kilogramme). These figures were deduced from interviewing four of the level 2 buyers at Palk Bay, as follows.

- Each level 2 buyer is estimated to buy 200kg per annum, and virtually all are traded for dried export. This figure is derived from four buyers' volume estimates which, when standardised (see **Methods** section), totalled 100kg, 200kg, 500kg, and 840kg per annum. The 200kg estimate is considered most reliable because it is derived from three different measures of volume provided by the same buyer during the same interview. He was rated an average buyer, by himself, and by others.
- The Palk Bay seahorse fishery probably comprises at least 12 level 2 buyers (Figure India 2). Eight names are known to the author. A further eight buyers cited by fishers (not named to the author) are thought to represent a minimum of at least four different people.

THE INTERNATIONAL TRADE IN SEAHORSES

- Eleven of these buyers were presumed to trade 200kg each *per annum*. The other was credited with his estimate of 840kg, since he was reputed by all to be the largest buyer and had hundreds of suppliers. This gave a total catch of 3040kg *per annum* for the region.

Volume of seahorses in Tamil Nadu by-catch

One of the three shell shops that bought seahorses in Rameswaram obtained around 100kg annually. Trawlers may thus have extracted at least 300kg annually, or 240 000-300 000 of these much lighter seahorses. This figure would be reached by Rameswaram fishers alone if each of the 410 trawlers working on one average night in June 1995 obtained about 10 seahorses per week, as seems possible.

Volume of seahorses from Kerala

A level 2 seahorse buyer estimated that Kerala delivered a further one kilogramme per day to Ramnad district buyers (approximately 350kg annually or 35 000 of these larger seahorses). Not all Kerala seahorses are traded through Ramnad (see *Target fishery for seahorses in Palk Bay (and Kerala)*, above).

Total volume of dried seahorses traded in southern India

The figures above combine to give an estimate of at least 3600kg (about 1 500 000 dried seahorses) in trade annually for this small part of the coast. This figure is probably rather conservative, because CMFRI estimated local exports of 300-400kg dried seahorse per month in 1992, with each village contributing 60-96kg monthly (Marichamy *et al.* 1993) (Table India 1). This calculation gives a total of 3600-4800kg annually for 1992, and the consensus was that volumes had increased over the intervening years (to 1995). CMFRI currently estimates that 400-500kg of dried seahorses are exported monthly, or 4800-6000kg *per annum* (A.P. Lipton, pers. comm., 14 June 1995). The dominant level 3/4 buyer in Kilakurai, who controls much of the seahorse trade in the region, was clearly underestimating when he reported sales of 500kg *per annum*.

Table India 1

Monthly catch, effort and landings of target-caught seahorses in four selected village centres along the Palk Bay coast, Ramnad, Tamil Nadu

Name of village	No. boats per day	No. persons per boat	No. seahorses caught per person	Mean no. seahorses landed per month	Dried production (kg per month)*
Thirupalaikudi	10-20	8-12	10-30	20 000	80
Morpanai	10-15	5-10	10-30	15 000	60
Mullimunai	15-20	8-10	10-30	24 000	96
Thondi	10-12	8-12	10-30	18 000	72

* This calculation used a 1993 figure of 250 seahorses per kilogramme. In 1995, participants reported there were 350-500 seahorses per kilogramme.

Source: Marichamy *et al.* 1993

Values of dried seahorses traded in southern India

Prices of dried seahorses in southern India

Prices have increased substantially since the target seahorse fishery surged in growth in 1989 or 1990 (Table India 2). In 1995, fishers received Rs0.5 to Rs15 (US\$0.01-0.47) per seahorse, according to size, with most worth Rs6 to Rs12 (US\$0.17-0.37). Level 2 buyers were paid from Rs2000-5000, but most received about Rs2000 to Rs3800 (US\$62-118) per kilogramme for dried seahorses, according to size and perceived quality of seahorse.

The largest level 2 buyer was paid rather more, from Rs4200 (US\$131: for 500 seahorses per kilogramme) to Rs5000 (US\$156: for 250 seahorses per kilogramme). He, in turn, paid the fishers supplying him Rs1-2 more than they would have received from other buyers.

Table India 2

Seahorse prices paid by and received by level 2 buyers in Tamil Nadu

Year	Prices for level 2 buyers (Rs)			
	1980 ¹	1989 ²	1992 ²	1995 ²
Buying targeted seahorses		5 each	5-15 each	6-15 each
Selling targeted seahorses	600/kg	2200/kg	2000-4700/kg	3000-5000/kg
Buying trawled seahorses	0.1-1.0 each			0.5-15 each
Selling trawled seahorses	150-500/kg			2000-3500/kg

Sources: ¹ Provided during the author's field interviews in 1995. ² Marichamy *et al.*, 1993.

Women sorting through trawl by-catch were usually paid Rs1 to Rs2 (US\$0.03- \$0.06) for seahorses 30mm and 70mm long, respectively. Their buyer received Rs2000 (US\$62) per kilogramme for seahorses under about 75mm and Rs3500 (US\$109) per kilogramme for those at least 75mm long.

Seahorses from Kerala reputedly sell to the level 3/4 buyer in Kilakurai at Rs10 000 (US\$312) per kilogramme.

Economic importance of dried seahorses in southern India

The total export value of the seahorse fishery in 1992 was at least Rs800 000 (US\$24,932) per month (Marichamy *et al.*, 1993) but has probably doubled since (A.P. Lipton, pers. comm., 14 June 1995).

Fishers considered the advent of seahorse fishing a boon because income from sea cucumber catches was declining (Marichamy *et al.* 1993). The author found that seahorses have become economically important to villagers. For example, 150 people target seahorses near the village of Devipattinam, of which 60 are locals (40% of village earners) and 90 come from elsewhere. In the village of Tirupalaikudi, 100 people (30% of village earners) collect seahorses. This high level of participation apparently holds for much of Palk Bay.

All six fishers interviewed in Devipattinam said that they earned about half of their annual income from seahorses. Two of the four level 2 buyers interviewed earned 100% of their income from seahorses. The other level 2 buyers relied less on seahorses because they also dealt in other marine animals; one traded cephalopods and another traded sharks fins, sea cucumbers, fish intestine, air bladders, chank and pipefishes.

The level 2 buyer for seahorse by-catch in Rameswaram reported making a five per cent profit on seahorses, and that these were only a small part of his business. The level 3/4 buyer in Kilakurai said he made a 10% profit on seahorses, but would not comment on their importance to his business.

Many people (including fisheries biologists) reported courier deals in which travellers received free trips to Singapore (air ticket worth Rs12 000 = US\$374) or Malaysia in exchange for filling their checked luggage with 20-30kg of dried seahorse.

Conservation concerns about seahorses in India

Increased demand and prices for seahorses in southern India

It was found that the market for seahorses had expanded rapidly, in line with the burgeoning of the target fishery around 1990. Prior to that, most seahorses were collected on an *ad hoc* basis, often by children. All those interviewed in 1995 agreed that the target catch had intensified greatly over the previous three years. The level 3/4 buyer in Kilakurai was buying at least eight times more seahorses in 1995 than in 1983. Seahorse prices had increased by perhaps 50% since the trade expanded, he said, adding that this equalled about 60% of the price increase for sea cucumber over the same period; *sea cucumber is in great demand and short supply internationally*. Higher prices are leading to more fishing activity, particularly as other resources decline.

Effect on seahorses in southern India

The general consensus was that seahorse populations were undergoing changes. For example,:

- One level 2 buyer claimed that seahorses now numbered only 25% of 1992 levels.
- The largest level 2 buyer stated that seahorse numbers in the wild were decreasing (although sizes were not), but noted that catches continued to increase (suggesting more skill or more effort from the fishers).
- Another level 2 buyer reported that seahorses in the catch were becoming smaller; one kilogramme comprised 280-300 seahorses in 1985 but 400-420 seahorses in 1995. He thought the change resulted from seahorses being fished "too small and too young". He further commented that the decline in seahorse numbers coincided with an intensification of trawling, which damages seahorse habitat. It should be noted, though, that this buyer later altered his story to claim that seahorse numbers had doubled since 1980.
- The level 2/3 buyer for by-catch in Rameswaram said he was getting greater numbers of seahorses, "probably because more trawl boats are operating". Nonetheless, increasing demand meant that he was prepared to buy very young seahorses, as small as 25mm.

Target-caught seahorses do appear to be getting smaller. There were about 250 per kilogramme in 1992 (Marichamy *et al.*, 1993), but by contrast, in 1995, local fishers and buyers cited 350-500 seahorses per kilogramme, and larger seahorses bought by the author numbered 322 per kilogramme.

Conclusions for India

A target fishery for seahorses developed rapidly in Tamil Nadu in response to one dealer's initiatives around 1990 and - in conjunction with seahorse by-catch from prawn trawling - now supplies annual exports of 3.6t (author's brief study) to six tonnes (fisheries officials' estimate) of dried seahorses annually. The seahorse fishery has become economically important for local fishers and villages, with Singapore and Malaysia as the reported main overseas buyers of their catch.

While buyers suggest declines in local seahorse populations, this has apparently not yet translated into diminished catches, perhaps because fishers' effort and skill are still increasing in this new fishery. There is a need for the Indian marine fisheries service (CMFRI) to expand its extant trade monitoring programme in order to assess the health of this fishery, and to devise management options that forestall population loss.

The large trawl by-catch of seahorses is clearly related to the problem of overcapitalisation (too many boats), which preoccupies the Indian fisheries service (A. P. Lipton, pers. comm., 14 June 1995). The present policy of limiting

days at sea seems unlikely to resolve the problem because fishers respond by increasing hours per day at sea. Trawling pressures on local seahorse populations (and other species) are expected to increase when the armed conflict in nearby Sri Lanka is resolved.



Seahorse amid by-catch, Rameswaram, India

SEAHORSE TRADE IN INDONESIA

Indonesia exports live seahorses for the marine aquarium trade, apparently hundreds of thousands *per annum*. In contrast, only small exports of dried seahorses for TCM (about 200kg *per annum*) were discovered during the limited field work. To this volume must be added the domestic trade for Jamu medicines and for curios. Seahorses in Indonesia are collected through a target fishery or as an incidental by-catch, particularly in Bali, Java, the Moluccas, Sulawesi, and Sumatra. Foreign trawlers may also be taking seahorses.

Background for Indonesia

Information sources in Indonesia

Most information in this section comes from 71 field surveys and interviews with all levels of traders and also fisheries biologists during February 1995. Most of those interviewed were not told of the author's interest in conservation. Areas visited include Bali, Java (east of Surabaya), Ambon, and Sulawesi (Ujung Pandang and Manado) (Figure Indonesia 1). Findings are supplemented by material from other sources, as indicated.

Figure Indonesia 1

Map of Indonesia showing seahorse trading areas, as mentioned in the text, in Indonesia



Seahorses found and sold in Indonesia

Indonesia is rich in seahorse species but, as everywhere else, their taxonomic identification remains unclear. Although colours are inadequate identifiers of seahorses, they can serve as general clues to species. Anecdotal descriptions (most putative species were not available for inspection) suggest that central Indonesia may have six species of seahorse (Table Indonesia 1). This estimate is far from definite and awaits confirmation from genetic analysis currently underway. The largest dried seahorse seen in Indonesia (from near Manado in northern Sulawesi) measured about 200mm long.

Table Indonesia 1**Descriptions of seahorse types in Indonesia by seahorse traders**

Type	Colour	Texture	"Belly" (brood pouch)	Habitat	Status by region
1	black	smooth	large	seagrass	<ul style="list-style-type: none"> • common but valued in E. Java/Bali • common in Moluccas • present in Sumatra
2	red	smooth	large	deeper ?	<ul style="list-style-type: none"> • rare but sought in E. Java/Bali • rare in Ambon
3	yellow	smooth	large	seagrass	<ul style="list-style-type: none"> • rare but sought in E. Java/Bali
4	brown/green	spiny	large	mangroves	<ul style="list-style-type: none"> • present in E. Java/Bali
5*			small	surface debris	<ul style="list-style-type: none"> • present in E. Java/Bali • present in Sumatra
6	pale	spiny			<ul style="list-style-type: none"> • present and sought in Ambon • present in north and south Sulawesi
7	black	spiny			<ul style="list-style-type: none"> • present in north Sulawesi

* This small, slim seahorse was reported as "*kuda laut sangut*", the meaning of which has not been ascertained.

Source: Author's research

Six aquarium fish dealers in the region of eastern Java and Bali independently reported the same four to five species (species 1 to 5 in Table Indonesia 1). At least three seahorse species are found around Ambon in the Moluccas (species 1?, 2 and 6, Table Indonesia 1). The one species seen from southern Sulawesi was pale and spiny (species 6?). Buyers in northern Sulawesi described two types of seahorse (species 6 and 7?), but the author also saw another smooth "black" species (species 1?). Migratory Bugis from Sulawesi fishers reported two types of seahorse from Sumatra, one "black" and one "white", the latter living among surface debris.

All informants noted that Indonesian seahorses are inshore fishes (e.g., living within 200m of shore in northern Sulawesi). They were said to occupy seagrass (Ambon, eastern Java, Bali, northern Sulawesi) and mangrove (Bali) habitats, but could also live in corals (northern Sulawesi) and even over sand (Bali). Areas where seagrasses, mangroves and corals meet (e.g., northern Sulawesi) were thought to provide excellent seahorse habitats. Seahorses were estimated by fishers at densities of around 0.2-1.0 seahorse per square metre in eastern Javan seagrass beds and at fewer than 0.1 per square metre among northern Sulawesi corals.

TCM retailers in Indonesia sold only bleached seahorses, all of which they claimed to import from China *via* Hong Kong and Jakarta. Pharmacists said they did not stock Indonesian seahorses because "they have a bad smell and nobody knows whether they will work." In fact, most TCM seahorses appeared to be local species. The processing (bleaching, tightly curled tail and ventral cut) suggested a trip through Hong Kong, though not China (see Hong

Kong section). Three different dried marine products exporters later confirmed that Indonesian seahorses are exported to Hong Kong, processed (simply and quickly) and re-imported to be sold as Chinese origin.

Legislation affecting seahorses in Indonesia

No direct protective measures for seahorses have been enacted. Seahorses will, however, benefit from the ban on inshore trawling in Indonesian waters, although this is often circumvented in the Riau Archipelago (between Sumatra and Singapore) and in eastern Indonesia (Moluccas and Irian Jaya).

Use of seahorses in Indonesia

Seahorses in TCM in Indonesia

Two TCM retailers in Surabaya said that the Chinese had introduced seahorse-based medicine to Indonesians. All sexes and ages buy seahorses in Indonesian TCM, particularly to keep the heart and back healthy, according to TCM pharmacies.

A high proportion of seahorse sales in Indonesian TCM were directed towards improving sexual function. A small TCM shop in Surabaya sold “one to three dozen boxes of *Seahorse Genital Tonic Pills* per week, mostly to married men”, amounting to an annual total of perhaps 1250 boxes. These pills cost Rp2500-2750 (US\$1.14-US\$1.25) per box in Surabaya and were the same preparation as sold in Hong Kong and China. Apparently such remedies should only be taken if strictly necessary, or else an “imbalance” could be created. One local TCM tonic recipe was repeated to the author by three people: it required mixing either deer foetus or seahorse with Ginseng *Panax ginseng* in strong alcohol.

Seahorses in Indonesian Jamu medicine


The role of seahorses in Jamu medicine was mentioned (unprompted) in at least 13 interviews across the country. It was difficult to discover much about Jamu but seahorse-based Jamu aphrodisiacs were popular with men from Java, Bali, and Sulawesi at least. One bottle of seahorse-based Jamu pills, bought in a Jamu medicine shop in Ujung Pandang, for Rp1500 (US\$0.0.68) was labelled as follows (Figure Indonesia 2) (translation by S. Kuriake B.):

“Health Ginjal Seahorse Ghenshen Kidney

This medicine is good for recovering from all kinds of weaknesses such as impotence, loss of energy, loss of blood, pallor, loss of memory, rheumatism, and lung congestion. Dosage: Take two tablets two times daily in the morning and at night with warm water. Contents: *Hippocampus* 40%, *Panax ginseng* 40% and three others.”


Figure Indonesia 2

Instructions on a seahorse-based remedy in Indonesia's Jamu medicine



SEHAT

SEHAT GINJAL
SEA HORSE GHENSHEN KIDNEY



JAMU

"SEHAT GINJAL SEA HORSE GHENSHEN KIDNEY" adalah ramuan obat yang memakai bahan utama TANGKUR KUDA DAN GHENSHEN yang sangat terkenal akan kemampuannya kedua bahan tersebut sangat tepat untuk menyembuhkan lemah kondisi dan juga menguatkan syaraf, setelah ditambah dengan bahan-bahan pembantu lainnya maka khasiatnya bertambah pula untuk menyembuhkan segala macam penyakit, seperti: Rheumatik, Sakit-sakit pada tulang, sakit pinggang dan kelemahan pada kandung kencing. Untuk segala penyakit tersebut diatas sangat dianjurkan untuk mempergunakan "SEHAT GINJAL SEA HORSE GHENSHEN KIDNEY" dan bagi mereka yang sering memakannya secara teratur, dapat pula mencegah segala macam penyakit dan juga menguatkan tubuh.

Aturan pemakaian : Dewasa 2 kali sehari (pagi dan malam hari) setiap kali 2 caplet diminum dengan air hangat dianjurkan setelah memakan obat ini supaya meminum air sebanyak mungkin.

Perhatian :
 Setelah menelan obat ini, warna air kencing akan menjadi biru atau kehijau-hijauan, perubahan warna ini adalah reaksi normal dan tidak perlu cemas.

Batch No. :

Reg. No. T.R. 862509122

841252

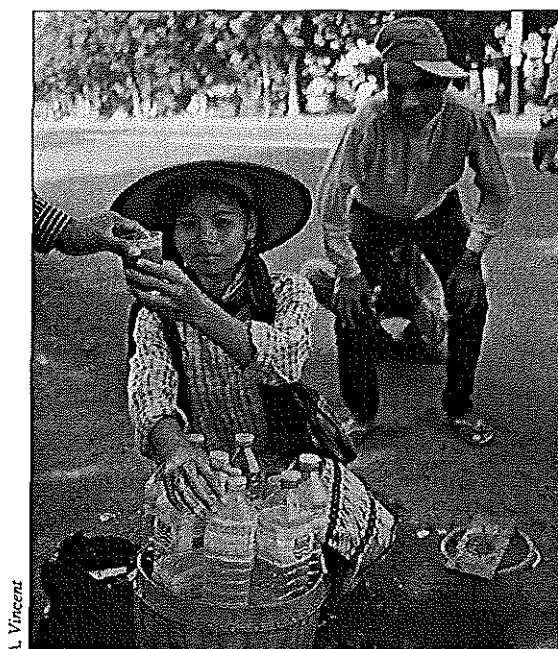
Trade Mark No. 143593

Manufactured By :

Street sellers in Surabaya offered Jamu to passers-by, mixing sachets of the chosen powdered preparation with water to treat the appropriate condition. One such sachet (reputedly containing seahorse) displayed two seahorses flanking a wheel on which a man was stretched. The accompanying information read as follows when roughly translated:

"Jamu Ramuan (Traditional) 'Tangkur Jaya'

If you are in duties with the girls, do not forget Tangkur which always gives satisfaction to both sides. After performing bodily duties, you will always be in fit condition without any pain or loss of energy. Recipe: One packet Jamu. Add one spoonful of honey. And one egg and orange juice. Mix with boiling water. Take three times weekly."



A. Vincent

Selling seahorse-based Jamu medicine, Surabaya, Indonesia

Seahorses in folk medicine in Indonesia

Some seahorse-based remedies represented a vague combination of different medical traditions with folk belief. Migratory Bugis fishers said they boiled seahorses in water for half an hour and then drank the liquid while they chanted a mantra, in order to confer sexual strength. A recipe obtained from Javanese men involved powdering seahorses into coffee as a sexual tonic. One ethnic Chinese trader in Ambon placed ginseng, sea urchin spines and seahorses in whisky and then drank it. He noted that adding guinea bark made it an anti-malarial, while adding mace made it a tonic. Some villagers in Java and Bali mixed seahorses with palm wine to drink as a general tonic, but these people had not heard of seahorses being used in Jamu.

Seahorses as curios in Indonesia

Fishers in one central Javan village dismissed seahorses as useful only for trinkets or jewellery. Ambonese sometimes use dried seahorses for gambling instead of money, with a value of US\$7-15 each (J.W. Mosse, *in litt.*, 12 October 1993). Among the more curious tales is that seahorses are associated with oil reserves. This belief may be prompted by the seahorse logo displayed by Pertamina, the Indonesian Government-owned oil and gas company. Moluccans reported that dense seahorse populations indicated oil and cited the example of Australian oil exploration near seahorse colonies in Bula, eastern Seram.

Seahorses as magic in Indonesia

Members of ethnic Chinese communities in Indonesia believed in the magical powers of seahorses, and that these fishes could help protect money. Merchants in the Moluccas also vowed that possessing a dried seahorse conferred prosperity on an enterprise. This has long been the belief: "The seahorse caught in Moluccan waters were not eaten but were used as a talisman." (Anon., 1882). Children in the Moluccas, who catch seahorses for fun, are often asked by locals to supply seahorses for talismans, as well as for tonics and aphrodisiacs.

Seahorse catches and related trade routes in Indonesia

Location of seahorse catches in Indonesia

Seahorses can be caught throughout Indonesia. They are targeted for the live trade only in those areas that are near the major international airports, Jakarta and Denpasar. These areas include eastern Sumatra, Java, Bali, and West Nusa Tenggara (Lombok and Sumbawa). Ambon used to export live seahorses but no longer does so, because of transportation difficulties. Small target catches for the dried trade have been reported thus far near Manado (Sulawesi) and around some islands in the Moluccas. Fishers in other areas of Indonesia sell dried seahorses from by-catches.

Target fisheries for seahorses in Indonesia

Target fishery for seahorses in Bali and eastern Java (primarily to be sold live)

Collectors in eastern Java and Bali target seahorses for the aquarium trade. Some are caught by hand, some in beach

seines, and others by push-nets or scoop nets. All collectors agreed that there is no need to use “medicine” (cyanide) to catch seahorses.

Most waters off southern and eastern Bali appear good for seahorses. Particularly rich in seahorses are tiny Pulau Serangan (near Denpasar), Buleleng (on Bali), and the neighbouring island of Sumbawa. One buyer on Pulau Serangan thought that most of the 300-400 families on the island could have at least one member who collected seahorses.

The fishers on Pulau Serangan combine seahorse collecting with fishing for food fish and other aquarium species. On calm days, collectors wade in shallow water over the seagrass beds, seeking seahorses through the water surface. They swim with face masks when water is rougher. Fishers either dive to pick the seahorses by hand or employ a long-handled deep net, like a butterfly net, to scoop the seahorses. At night, two collectors working together employ a nylon beach seine or barrier net measuring about 15m long. Collectors may travel up to three hours before beginning to fish.

Seahorses are apparently available all year in southern Bali with slightly more in January and February (rainy season). Nearby Javanese buyers receive far more seahorses from January to July, one buying “hundreds per week” then. This coincides with the January to April rainy season in eastern Java, and the period immediately thereafter, when seahorses are apparently easier to find in the calmer seas. Exporters in Bali obtain many of their seahorses from eastern Java with the result that, although they get seahorses most of the year, numbers for them also peak during the rainy season. Seahorses breed in eastern Java during the dry season (July to January), according to buyers. *Fishers/buyers from southern Bali had no idea of the local breeding season, despite having collected and sold seahorses for many years.*

At least six level 2 buyers and many other smaller agents obtain seahorses in northeastern Java (from Pasir Putih to Banyuwangi). Most of these go to Denpasar, as do seahorses from Bali and from the islands of Sumbawa and Flores. At least 14 marine aquarium exporters operate near Denpasar, sending their fishes to Europe (the Netherlands, Germany), North America (most enter through Los Angeles), Asia (Japan, Taiwan), and Australia.

One buyer from northeastern Java also sends his seahorses (live and dead) to Surabaya. The city is reputed to be a big supplier for the ornamental trade. Surabaya is also likely to have close ties to TCM import markets abroad, because of its large ethnic Chinese population; apparently Chinese traders sometimes come to eastern Java to seek seahorses for TCM.

Two aquarium dealers in eastern Java used to have lucrative sidelines supplying thousands of seahorses for Jamu, before seahorse numbers declined in the waters off Bali (see **Conservation concerns about Indonesian seahorses** below). Aquarium dealers could still sell all dead seahorses to either TCM or to Jamu but nowadays claim to get so few that they usually just give them away to Javanese and Balinese men who request a couple for tonics and aphrodisiacs. A large aquarium fish retail outlet in Surabaya continues to sell its dead seahorses to Jamu dealers, however.

Target fishery for seahorses in Lampung (Sumatra) (primarily to be sold live)

Seahorses are collected among the seagrass meadows near Lampung, Sumatra, according to a reliable source there. Fishers target shrimps but also seek seahorses, fishing by day with a small one-person push-net. They obtain a *Hippocampus kuda* type species, which they sell to Jakarta for the medicine and aquarium trades. A maximum of six seahorses can be caught in about five hours’ fishing effort. Some seahorses caught in Sumatra are probably sent by land and sea to Singapore, and perhaps then exported again.

Former target fishery area for seahorses (primarily to be dried) in Manado (Sulawesi)

Most seahorses caught near Manado come from seagrass beds near the village of Araken/Rap Rap (west of Manado). There is no intensive fishery for seahorses but some are hand-caught by swimmers during daylight hours, usually in about one metre of water. Seahorses are also collected when found holding onto the fine barrier nets that are placed on reef crests to catch fishes on the ebbing tide, or are picked off when encountered on fish corral traps. Fisher and buyer alike report that seahorses are most readily available in the west wind season (early in the year). The proffered explanation is that they breed then (around December and January) so become more accessible. Only very few can be found by June, and the suggestion was that they may migrate offshore.

Large volumes of seahorses were formerly exported from northeastern Sulawesi, according to local fishers and to two sea cucumber dealers in Manado. Hong Kong and Taiwanese fishing boats loaded dried marine products for TCM, including seahorses, when they visited Bitung port near Manado. Nowadays, such visiting boats apparently concentrate on food fishes - since other products have declined in availability - but will still accept seahorses as available. A renewed seahorse fishery near Manado would find ready markets. A sea cucumber dealer in Manado exports his products to Hong Kong, China, Taiwan and Korea, *via* Surabaya and Ujung Pandang, and could presumably easily add seahorses. Seahorses may seldom be sold now, though. An importer from Hong Kong contacted a trading company in Manado with orders for dried seahorses in late 1994 and early 1995. These could not be filled and were transmitted to an aquarium exporter in Bali. The recent establishment of Bunaken National Marine Park may have led to a perception that seahorse exploitation is legally unacceptable. Certainly one local dealer (selling products ranging from sea cucumbers to live corals) stated categorically that seahorses were now protected by the Government, but this is untrue.

The minimal aquarium fish exports from Sulawesi to Europe are poorly documented and may be largely illicit.

Target fisheries for seahorses (primarily to be dried) in the Moluccas

Children in the Moluccas dive for seahorses, largely as a game, but also sell them to aquarium products dealers and dried fish merchants. One biology student described catching seahorses in the Aru Islands (eastern Moluccas) in the 1980s. The children would find them at low tide, put them in the sun to dry, and then give them to Chinese merchants on the island in exchange for sweets; merchants accepted all seahorses but gave more sweets for larger ones.

Some seahorses can be caught by swimmers in Ambonese seagrass beds, particularly during the dry season (locally November to March), but yields may be only two seahorses per hour of searching. Seahorses are no longer included in the Ambonese aquarium trade, but the price in 1993, before the trade ended, was US\$4 each, free on board (FOB) (that price which includes the value of the product and any other costs associated with its distribution up to the point of its loading aboard a carrier). Aquarium fishes, including seahorses, were formerly sent from Ambon to Biak (Irian Jaya), there to board a direct flight to Los Angeles, but the discontinuation of this flight has forced trans-shipment in Jakarta instead. Local Ambonese companies cannot compete with Javanese prices on fishes found in both places (such as seahorses) and must now specialize in locally endemic species.

Kai Besar, the larger of the Kai Islands, has a small seahorse fishery with a variable catch (J. Aglionby, *in litt.*, 24 August 1993). All those questioned there could describe the four local types of seahorses. They could be caught in seagrass beds at night, using lanterns, in very shallow water. The fishers sell the seahorses to ethnic Chinese merchants.

By-catch of seahorses in Indonesia

By-catch of seahorses by migratory fishers in Indonesia (to be dried)

The Bugis of southern Sulawesi are among the best-known and best-travelled of Indonesia's many migratory fishers. Bugis report obtaining seahorses incidentally as they range from Sumatra, east to the Aru Islands (Moluccas). Riau Island (just south of Singapore) and Balaiharimao are among the better places for seahorses, apparently. Migratory trawl fishers from Buton, also in southern Sulawesi, reputedly obtain seahorses while shrimping near Irian Jaya. Nusa Tenggara (Flores and Sumbawa) and South Timor received mention as seahorse-gathering areas in eastern Indonesia.

By-catch of seahorses in southern Sulawesi (to be dried)

Fishers from Ujung Pandang in southwestern Sulawesi reported that seahorses were scarce locally and obtained only incidentally. This area was a major trading centre for marine products (corals, sea cucumbers, shark's fins, and topshells *Trochus* spp.) in the early 1980s (G. Usher, pers. comm., 21 February 1995) but was unimportant for seahorses, at least by 1995. All three exporters of dried marine products interviewed said they sent only a few dried seahorses (see *Volumes of dried seahorses traded in Indonesia* below) to Hong Kong or Singapore, with the destination determined by the exporter's personal and business connections.

Seahorses have apparently also been exported from Baubau in southeastern Sulawesi to Singapore.

By-catch of seahorses in the Moluccas (to be dried)

In the Moluccas, seahorses are said to be trapped by trawlers often, particularly by those engaged in fishing for prawns around the Aru Islands. Others are reportedly dragged in by beach seines or disentangled from their holdfasts on gill nets. In February 1995, an Ambonese company that specializes in shrimp trawling in the eastern Moluccas (among other areas) received an unsolicited order for dried seahorses from either Japan or Hong Kong (there was some confusion); it is unknown whether the order was filled.

Ambon, the capital of the Moluccas, was among the secondary-ranking export centres for dried marine products in Indonesia in the early 1980s, along with Jakarta and Surabaya (but subordinate to Ujung Pandang) (G. Usher, pers. comm., 21 February 1995). Its role has declined but importers still seek products there, seahorses among them. The recent history of seahorse trading in Ambon probably dates from 1993, when an ethnic Chinese trader from Jakarta came to Ambon seeking dried seahorses. A local animal products dealer responded and was the only Ambonese obviously trading seahorses in 1995. Some of his exports go *via* a relative in Taiwan. He also supplied seahorses to a visiting Australian in late 1994. Availability of seahorses is apparently limited, however, and his sales are usually less than 10kg each; he could not meet a recent Japanese request for 100kg of dried seahorses.

Most seahorses sold through Ambon are said to come from Seram. Seahorses were apparently exported to Surabaya from Seram in May 1993, (J. Mosse, pers. comm., 1 February 1995), but the Centre for Biological Research and Development of the Indonesian Institute of Sciences Research (LIPI) obtained no seahorses during a recent two-year beach seining programme in western Seram (near Kotania) (A. Syahailatua, pers. comm., 6 February 1995).

Dried seahorse exploitation

Domestic sales of dried seahorses in Indonesia

TCM dealers in Surabaya claim that demand for seahorses has increased substantially recently. One large TCM shop in Surabaya estimated it sold 100 large and 150-200 small seahorses weekly (13 000-15 600 annually). There were eight TCM pharmacies in the district, which could indicate total annual sales of 100 000 seahorses in the main TCM district of Surabaya. TCM outlets in Ujung Pandang, by contrast, said they only sold 1-10 per week as seahorses are "not very popular". Most seahorses sold in TCM appear to have been imported or re-imported from Hong Kong or China.

No significant consumption figures are available for the Jamu trade, which may be substantial; one level 2 aquarium fish buyer reported he sold about 8000-16 000 dead seahorses per week (mortality from his live trade) for the Jamu trade.

Volumes and destinations of dried seahorses exported from Indonesia

Total exports encountered during fieldwork amounted to less than 200kg dried seahorses annually (100 000 seahorses), although investigations were very limited in geographic scope and sample size. As examples,

- A level 2 buyer in Ambon had sold about 30kg dried seahorses since 1993, including sales of seven kilogrammes to Jakarta, six kilogrammes to an Australian, five kilogrammes to Taiwan, and two kilogrammes to a Japanese or Korean. He had been unable to meet recent orders but offered to obtain 10kg seahorses within a month if the author wanted to buy them.
- The three companies trading dried marine products in Ujung Pandang reported current sales of (i) 120kg per year (at hundreds of seahorses per kilogramme); (ii) 12-24kg monthly; and (iii) perhaps four kilogrammes per year (at 500 seahorses per kilogramme).
- One dealer in Manado said he sold 5-10kg seahorses to Hong Kong and Taiwan "every now and then".

Taiwan's trade records (see Table Taiwan 3) show that it imported only small volumes of dried seahorses from Indonesia, in the same order of magnitude as the exports from Indonesia recorded during the 1995 fieldwork.

China recorded no seahorse imports from Indonesia in 1990 and imports of only 84kg in 1991 (total value US\$17 000) (China Customs Statistics Yearbook). However, three major TCM importers in southern China (interviewed in April 1995) named Indonesia as a major source of seahorses. It is possible that these seahorses are from Indonesian waters but exported without ever landing in Indonesia. Many fishing boats from seahorse-trading countries (e.g., Hong Kong, Taiwan, Thailand) trawl the waters of eastern Indonesia, catching large quantities of shrimps in seagrass habitats where seahorses also occur (G. Usher, pers. comm.); the seahorses could be a useful by-catch (e.g., see *Vietnam* section).

One Chinese TCM importer stated that seahorses came from Indonesia *via* Hong Kong. TCM dealers in Hong Kong also cited Indonesia as a source of seahorses. Aquarium fish dealers in Bali and marine product dealers in Ujung Pandang reported they had standing orders from Hong Kong for all dead seahorses, but could not fill the requests. Taiwanese and Hong Kong boats apparently visited Indonesian ports in the course of their fishing trips (e.g., Bitung in north-east Sulawesi) and bought any seahorses.

Values of dried seahorses traded in Indonesia

Prices for dead seahorses vary greatly (Table Indonesia 2). Fishers in the Moluccas and Sulawesi must dry the seahorses they catch because there is no quick export route for live seahorses.

Collectors and buyers in Java and Bali do better to sell seahorses live, since these are worth substantially more than dried seahorses: one buyer in the aquarium trade said he could sell live seahorses at Rp3000-4000 (US\$1.36-1.82) each or dead seahorses at Rp5000-10 000 (US\$2.27-4.55) per kilogramme. Previously, he had been able to buy some seahorses cheaply for Jamu (presumably those less desirable as aquarium fishes) but now must pay live prices for all seahorses. The largest aquarium-trade exporter in Bali claimed it was not worth selling the few dead seahorses he accumulated, so he gave them away. (This is rather different from the Philippines where larger seahorses are often worth more dead than alive, and killed accordingly (see *Philippines* section).)

Table Indonesia 2**Prices paid for dried seahorses in February 1995, with live prices for comparison***

Location	Fisher	Prices (Rp1000) received by:	
		Buyer (level 2)	Buyer (level 3/4)
Surabaya, Java (aquarium shop)			1 each (versus 3-6 each live)
Surabaya, Java (TCM pharmacy)			(a) 2-15 each (b) 750-1000 /kg
E. Java		(a) 3 each (versus 5-7 each live) (b) 5-10 /kg (versus 3-4 each live)	
Bali	1.5-3 each (versus 3 live)		6 /kg in 1985-1990
Manado (N.E. Sulawesi)	25/kg (versus 25 each live)		
Ujung Pandang (S.W. Sulawesi)	(a) 2-10 each (b) 200/kg		
S.E. Sulawesi	5/kg		
Ambon (Moluccas)	5/kg bonus (+ salaries & expenses)	125 /kg (to Jakarta) 175-200 /kg (to foreigners)	
Seram, Moluccas	25/kg		

* Each entry comes from only one respondent, except where indicated by (a) and (b).

Source: Author's research

Live seahorse exploitation in Indonesia

Volumes of live seahorses traded by Indonesia

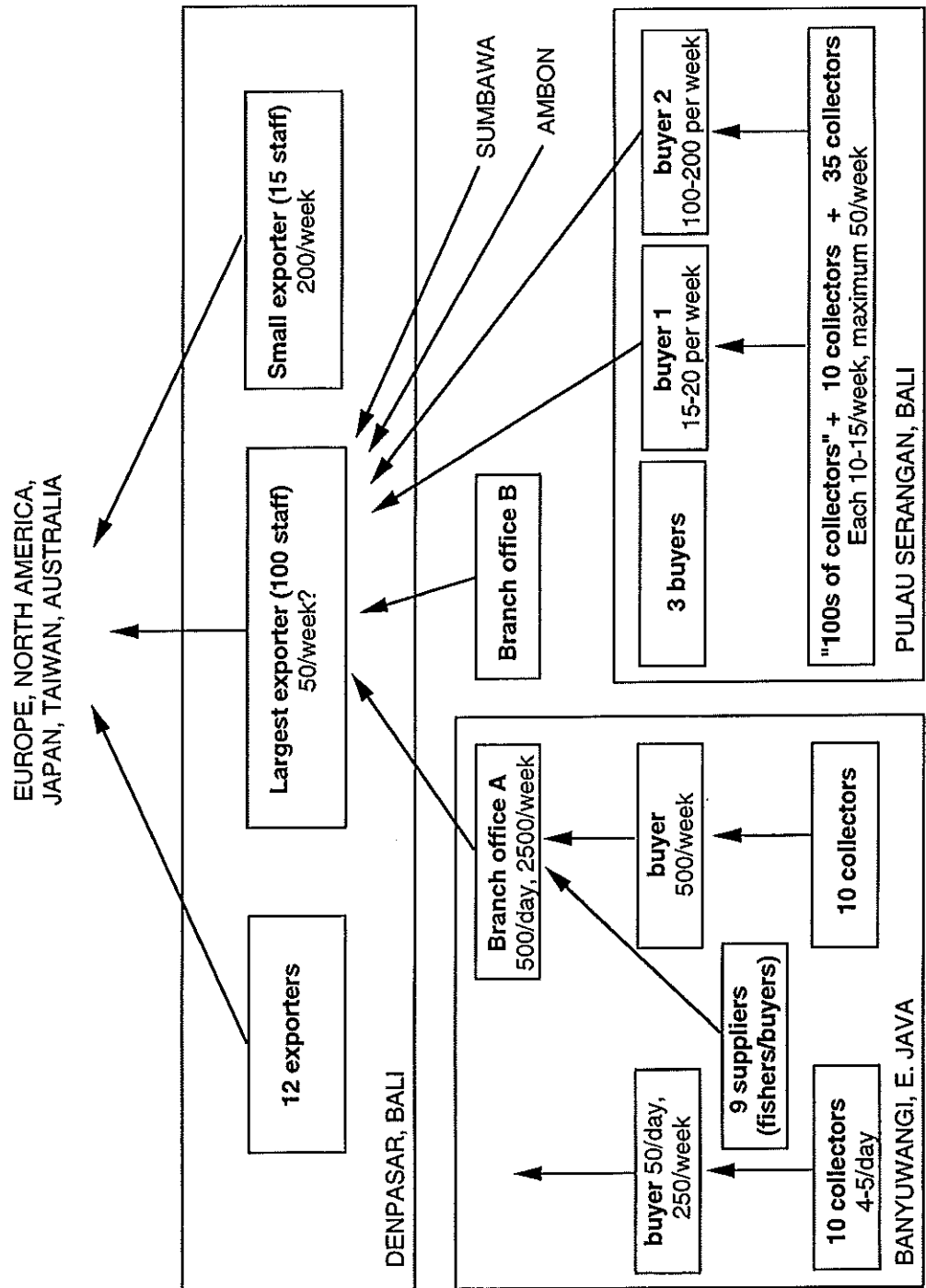
The aquarium trade is dominated by Denpasar and Jakarta, because they have international airports. At least fourteen marine aquarium exporters operate through Denpasar in Bali, among them reputedly the largest in Indonesia with over 100 employees; this latter stated that seahorses were an important part of his business, but then estimated his trade to be 50 seahorses weekly during the rainy (peak) season. Independent interviews with other participants in this large exporter's network (Figure Indonesia 3) suggest that this is implausible (Appendix 3 gives details of assessment).

Even allocating only eight weeks of seahorse catching *per annum*, information from lower levels of the trade indicates that the exporter mentioned above would probably handle 40 000 seahorses annually, or a weekly mean of about 750 seahorses, against his claimed figure of 50. The accuracy of the exporter's estimate is even more doubtful since an aquarium products exporter on Bali with 15% as many employees reported receiving "hundreds of seahorses" weekly in the wet season, and 20 seahorses weekly for the rest of the year.

There are currently about 13 other aquarium fish exporters in Denpasar alone, and many more trade from Jakarta, allowing a conservative estimate of at least 25 such dealers nationally. If the large exporter's estimate of 50

Figure Indonesia 3

Partial map of one aquarium fish exporter's trading network, with volume estimates indicated. Estimates match within and across levels with the exception of the exporter whose claimed weekly tally is very much lower. When calculating total annual volumes, seahorse fishers were conservatively estimated to fish for only eight weeks a year.



Source:
Author's
research

seahorses per week, per company, is used, Indonesia would export about 65 000 live seahorses annually. This figure seems unlikely because dealers in Australia, Europe, North America, and Taiwan cite Indonesia as a major source of seahorses, and aquarium exporters from the Philippines, who have similar sources and markets, regularly trade thousands of seahorses per week. The calculated estimate, on the other hand, of 40 000 seahorses *per annum* for the large exporter would mean that the Indonesian aquarium industry may export hundreds of thousands of seahorses annually through Jakarta and Denpasar.

Some live seahorses from Indonesia may be traded to Singapore, especially those caught by Bugis fishers round Riau Island, but these shipments may never be traced to Indonesia.

The domestic hobby market also consumes live seahorses: one large aquarium shop in Surabaya sells about 100 seahorses per week to local hobbyists, perhaps 5200 annually. In evaluating the number of fishes caught for the fish trade, it is important to remember that more are caught than are eventually sold to hobbyists; one buyer in Java suffered a seahorse mortality rate of up to 60% in his holding tanks.

Values of live seahorses traded by Indonesia

Prices for aquarium seahorses varied greatly by region and by trade level (Table Indonesia 2). Within the operation supplying the large-scale aquarium exporter in Bali (Figure Indonesia 4), collectors may receive from Rp500 to Rp3000 (US\$0.23-1.36) per seahorse, depending on seahorse size and on their level 2 buyer. One level 2 buyer from this network, based in eastern Java, bought seahorses for Rp500 (US\$0.23) and sold them live for Rp3000-4000 (US\$1.36-1.82). He insisted, however, that this seemingly high profit was sharply reduced by frequent high mortality of seahorses.

Another level 2 buyer (in eastern Java) paid his 12 suppliers Rp3000-4000 (US\$1.36-1.82) per seahorse, but received Rp5000 (US\$2.27) for each from his buyers. Among these was a hobby aquarium shop in Surabaya, which probably also bought direct from collectors since it reported paying only Rp2000-Rp2500 (US\$0.91-1.14) for preferred "black" spiny seahorses. This shop sold seahorses to aquarium hobbyists at Rp3000 (US\$1.36: small) to Rp6000 (US\$2.72: large) per seahorse.

Level 2 buyers estimated they made 33% profit and exporters could make a further 100% profit. A level 2 buyer in Java said he made several hundred percent profit on the seahorses that survived, but lost money on the others. Another level 2 buyer in Bali guessed that he earned 30% of his annual income from seahorses, but most could not or would not estimate earnings from seahorses.

Seahorse prices in Lampung were higher than those in Bali (Table Indonesia 3), but the species may well be different.

Table Indonesia 3

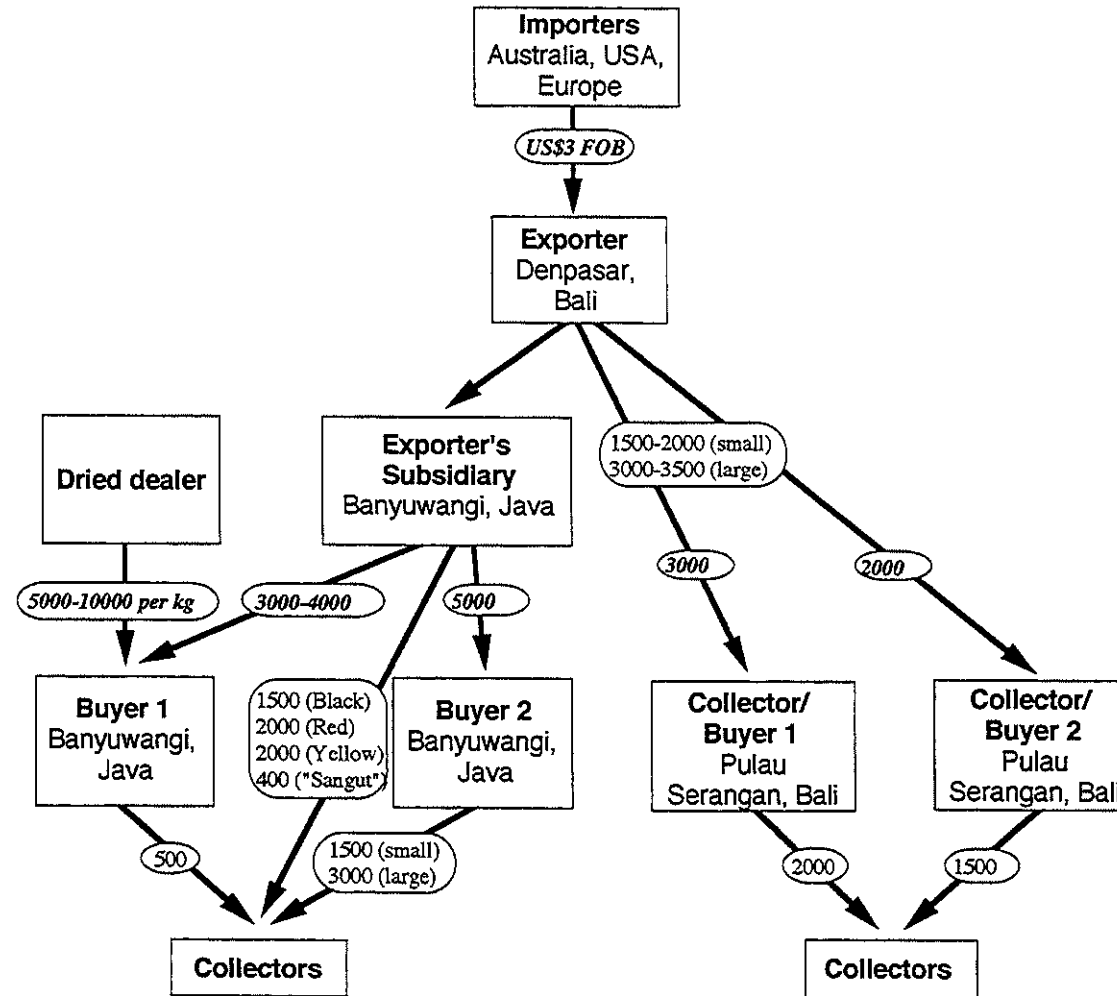
Prices for live seahorses in Lampung, Sumatra in 1995

	Price (US\$) received per seahorse		
	Small	Medium	Large
Fisher	0.32-0.68	0.91	1.13-1.81
Buyer	0.68-0.91	1.13-1.36	2.27-3.62

Source: Anon. *in litt.*, 27 April 1995

Figure Indonesia 4

Diagram to illustrate variable pricing structure in one aquarium trader's network, showing prices for seahorses. Arrows show the direction of the flow of money. All prices are in Rp per live seahorse unless otherwise stated (where Rp2200 approximately equals US\$1). Prices in plain text were supplied by the party buying and those in bold italics by the party selling.



Source: Author's research

Conservation concerns about Indonesian seahorses**Population declines**

There was near universal consensus that seahorse populations were declining, as summarised in Table Indonesia 4.

Table Indonesia 4

Comments on seahorse conservation status in Indonesia during interviews in February 1995

Location	Source	Seahorse numbers/comments
E. Java	level 2 buyer	decreased 25% in past few years
E. Java	level 2 buyer	decreased 25% in one year
E. Java	level 2 buyer	decreased 50% since 1990
Bali	fisher/buyer	decreased 50% since 1990
Bali	fisher/buyer	decreased 15% since 1990
Bali	live exporter	decreased 50% since 1990
Ujung	dried exporter	4kg per month previously
Pandang		versus 4kg per annum now
Manado	fisher	"enormous decrease" since 1990
Manado	dried exporter	"not many left in the sea"
Manado	dried exporter	"not many left ... already declining by 1990"
Ambon	dried buyer	cannot fill orders
Sumatra	fisheries expert	decreased since Jan. 1995

Source: Author's research

Habitat loss

Habitat loss was pinpointed by traders as one factor contributing to declining seahorse numbers. The National Development Planning Agency noted in a 1988 report that "Marine and coastal resource systems are being subjected to stress and degradation ... from mismanagement of the marine environment." (Anon., 1988). According to one well placed source in Sumatra, the declining number of seahorses in the Bay of Lampung is because of "decreased births and habitat damage... The seagrass, mangroves and reefs of the Bay of Lampung have been damaged." Cyanide and dynamite fishing are relatively new in Indonesia but are now employed destructively across the country (Anon., 1993a; 1995a), despite being banned.

Captive breeding of seahorses in Indonesia

The Seafarming Development Centre in Lampung, Sumatra, is actively involved in seahorse culturing, using a species in the *Hippocampus kuda* complex. It currently manages to rear 53% of young, by feeding them on copepods to 10 days and then on brine shrimp nauplii (*Artemia* sp.).

Conclusions for Indonesia

Indonesia has extensive seahorse habitat and many seahorses species. The full scale of seahorse exploitation is unknown as few areas have been visited or documented, but hundreds of thousands of seahorses are clearly taken every year for TCM, Jamu medicine, aquarium fishes, and talismans. Seahorses are target caught and/or obtained as by-catch in many areas of the country. Live seahorses are exported through Jakarta, Denpasar, or Singapore while small amounts of dried seahorses follow undocumented trade routes to destinations including other countries

in the Far East and Australia. Many exploited seahorse populations are reportedly in decline, with multiple estimates of 25% to 50% population loss over just two to five years. East Java and Bali appear to be the most seriously affected areas of those investigated, but it may be that a change was noticed more quickly because many people there target seahorses. Both habitat degradation and direct fishing pressure may be contributing to population declines.

It would be advisable for Indonesia to conduct a national audit of seahorse populations and an investigation of the trade in these fishes. The Lampung seahorse captive culturing effort should be critically assessed and its enhancement promoted, but only if it offers hope of reducing pressure on wild populations.

SEAHORSE TRADE IN MALAYSIA

Malaysia is likely to be an important participant in the seahorse trade, because there is a large ethnic Chinese population, it has expansive territorial waters with good seahorse habitat, and it is in the geographic centre of the IndoPacific seahorse trade. Little is known about its role, but it is clear that the country certainly imports and exports some hundreds of kilogrammes of dried seahorses per year.

Imports of dried seahorses to Malaysia

Seahorses have long been traded in Malaysia because of their importance for “Chinese pharmacopeia” (Stead, 1923). There have been no known attempts to ascertain the extent of Malaysia’s current trade in dried seahorses, which are often seen for sale in the country (D. Phillips, *in litt.*, 20 September 1993).

One TCM shop in Penang (visited in January 1996) displayed a jar of unbleached seahorses at RM\$45 (US\$17.70) for 37.8g, but did not stock bleached ones “because they are a processed product” (Chen H.K., *in litt.*, 11 January 1996). The practitioner said the seahorses came from Hong Kong, but noted that they could have been caught in China (Hainan).

The tangled accounts of the Philippines’ syngnathid exports in 1982 include a listing of 80kg exported to Malaysia. In addition, Sabah (Malaysia) may import seahorses from the southern Philippines (Urlanda, 1992). It should be noted that seahorse collectors were among the many fishers from the Jolo area (Mindanao, southern Philippines) moving to Sabah in recent years. This influx could be promoting or enlarging a seahorse fishery in Sabah.

Indian seahorse traders and fisheries biologists reported that Malaysia was a minor destination for Indian seahorse exports, ranking a distant second after Singapore, but probably still absorbing hundreds of kilogrammes each year (see **India** section).

Exports of dried seahorses from Malaysia

An important TCM importer interviewed by the author in Hong Kong said he obtained seahorses from Malaysia. In 1995, three major Government TCM importers in China mentioned Malaysia as a secondary or minor source of seahorses (see **China** section). Malaysian seahorses are thinner and darker than is preferred, according to TCM dealers, so are classified as being of poor quality.

Taiwan’s trade records show imports of dried seahorses from Malaysia (Table Taiwan 3); declared import values declined rapidly from 1969 until 1989, but then rose gradually, as volumes declined sharply (Table Discussion 6).

In September 1995, one dealer from Penang offered to sell 10kg dried seahorses per month to the University of Oxford (UK) for research. He was confident of being able to maintain this rate of supply over the ensuing five

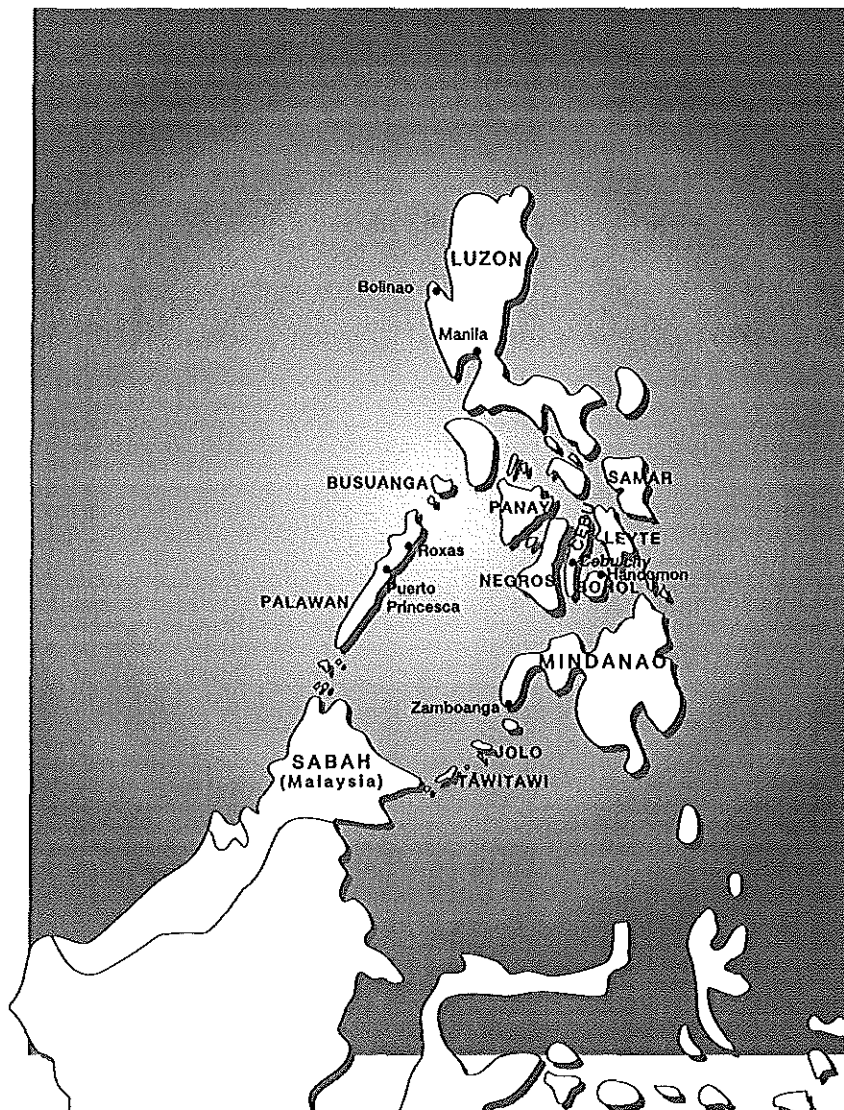
years and was sure that he could also supply other UK universities. His price was UK£2500 per kilogramme (nearly US\$4000 per kilogramme), excluding shipping and handling, substantially more than the current price of about US\$530 per kilogramme for the same seahorses in Hong Kong. The seahorses came from the Indian Ocean, and were very small, from 35-100mm long. Samples were supplied by the merchant, but the species has not yet been determined.

SEAHORSE TRADE IN THE PHILIPPINES

The Philippines is a large exporter of seahorses for TCM, for aquarium hobbyists in Asia and the West, and for curios globally. At least 3.5t of dried seahorses are traded *per annum*, and tentative calculations from field data suggest annual exports could near 11t. To these figures must be added the hundreds of thousands of live seahorses exported annually for the aquarium trade. Seahorse exploitation in the Philippines is concentrated in three large areas: Palawan including Busuanga; the central Visayas including Bohol, Cebu, and Negros; and Mindanao and the southern Philippine island provinces of Sulu and Tawi Tawi (Figure Philippines 1).

Figure Philippines 1

Map of the Philippines showing seahorse trading areas, as mentioned in the text



Background for the Philippines

Information sources in the Philippines

This section is written primarily from information gathered by the author. Field research included 89 surveys and interviews in April 1993, with the assistance of a Filipina biologist who speaks Tagalog and Visayan. Interviewees included fishers, buyers, exporters, retailers and users, as well as biologists, lawyers and fisheries officers. Only the last-mentioned three groups were told of the author's interest in conservation. Further data on trade come from a community-based seahorse conservation and management project, established in 1994 in Bohol in the central Philippines by the author and three Filipino staff, and associated surveys.

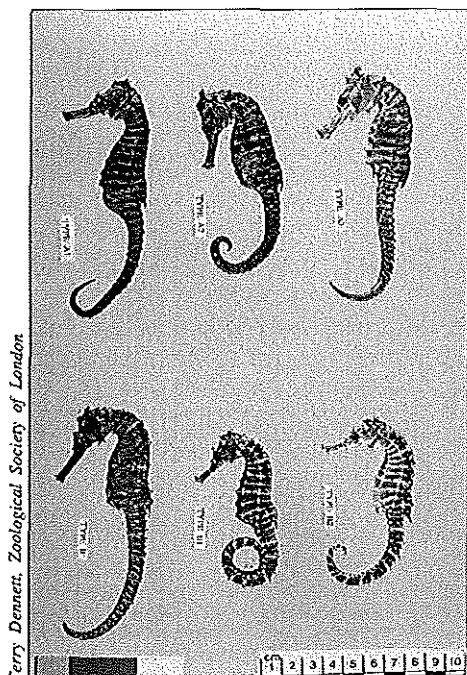
Information on Palawan and Busuanga comes primarily from 1993, on Bohol and Cebu from 1993-1995, and on Jolo and Mindanao from September 1995. One Government official, one seahorse aquaculturist, and one seahorse buyer were interviewed in Jolo in 1995; law and order difficulties precluded more meetings. One BFAR employee and three dealers in dried seahorses were interviewed in Zamboanga in 1995.

Seahorses in the Philippines

The author knows of at least eight species being traded in the Philippines, and was told of several other possible species in the archipelago. All seahorses appear to have commercial value in the Philippines, although some species are worth more than others. Most seahorses are broadly classified by the Filipinos as "yellow" (= "white") or "black" but rarer types include "red", "giant" and "tiger". Perceptions of size differed across the country, with seahorses in Zamboanga called large at just 75mm and seahorses elsewhere labelled large at 120-150mm.

- The name "yellow" seahorse embraces a complex of several species including one of the *Hippocampus histrix* type, a spiny cream-coloured seahorse with distinctive brown bar markings around its snout and radiating from its eyes. This species has for some time been "dried as a novelty item or exported for aquarium use" (Schroeder, 1980). Other species within the "yellow" complex are not spiny. "Yellow" seahorses command higher prices in the aquarium trade, because they are preferred by foreign hobbyists for aesthetic reasons. Palawan and Busuanga, where "yellow" seahorses are found primarily in seagrass beds, dominate the live seahorse trade. On Bohol, "yellow" seahorses blend well into the slopes of yellowish rocks and corals found along the coast.
- "Black" seahorses comprise at least three species, including several of the *Hippocampus kuda* complex. The most common type is found in coral reef areas, with a second type in seagrass beds and a third in deeper waters. "Black" seahorses come from all over the Philippines and most seahorses on Bohol are "black". They are known as "bald seahorses" because of their lack of spines. Live seahorse traders consider "black" seahorses to be a by-catch of the harvest for "yellow" seahorses because foreign hobbyists will buy any size of "yellow" but only larger "black" seahorses.
- At least one of the seahorse types described as "red" is another of the *Hippocampus histrix* complex, with longer black-tipped spines. But the designation "red" may include other species since informants variously claimed they had fine red stripes or were solid red, were variants of "yellow" seahorses from different habitats, or were distinctively different types from deeper waters. Most reports were that "red" seahorses came from Cavite province on Luzon.
- The uncommon "giant" seahorses are highly prized in the dried seahorse trade. They are primarily a trawl by-catch from deeper waters around Negros in the central Philippines, and dealers report receiving them only since the early 1980s.

- “Tiger” seahorses have distinctive black and yellow bands across the tail and on parts of the trunk. They apparently come from seagrass areas but are rare in most of the Philippines.
- *Hippocampus trimaculatus* was another obvious species, which may or may not be one of the “yellow” seahorses. “Jungle”, “chequered”, “spotted” and “orange” seahorses were also mentioned by fishers but were never seen by the author.



Terry Dennett, Zoological Society of London

Types of Philippines seahorses

Seahorses in the Philippines live in seagrass beds, mangroves and coral reef areas, often in water that is only one to two metres deep. They are found more densely in seagrass nearer mangroves than in that farther from mangroves. Initial work on one of the most exploited Philippines species (putative *Hippocampus comes*) on Bohol suggests that its biology is rather similar to that of species already studied in greater detail, exhibiting pair bonding and site fidelity (see **Biology** section).

Use of seahorses in the Philippines

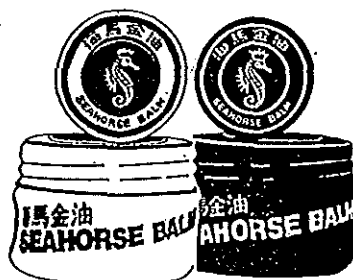
Seahorses are used variously in the Philippines, including for medical purposes. Four of eight TCM outlets visited in Manila’s Ongpin district in April 1993 were displaying dried bleached seahorses, selling them for P30-40 each (US\$1.20-1.60). All claimed the seahorses had been imported from China, but these looked very much like spiny Philippines seahorses, possibly from Palawan (see *Values of dried seahorses in the Philippines* below). Their bleached state and the ventral split suggested they had been re-imported from Hong Kong (see **Hong Kong**

section). As in Indonesia, local seahorses were dismissed by retailers as “dirty”. Seahorse balm and seahorse-based proprietary medicines were also on sale in the TCM outlets in Ongpin (Figure Philippines 2).

Figure Philippines 2

Advertisement for seahorse balm from a TCM outlet in Manila's Ongpin district, offering it as a cure for many ailments ("sakit" translates as illness). Apparently there is no seahorse among the ingredients.

NARITO NA SA PILIPINAS



== MABIBILI RITO ==

Ang **SEAHORSE BALM** ay mabisa at maginhawang pangmasahe. Presko sa dampi at haplos. May init na nagpapasigla ng dugo. At daglang lunas sa kirot.

Laging magdala ng **SEAHORSE BALM**. Subok na ito para sa madaliang lunas sa:

- | | |
|---------------------|-------------------------------------|
| • UBO | • SAKIT NG ULO |
| • PASO | • SAKIT NG TIYAN |
| • SIPON | • SAKIT NG LIKOD |
| • GALOS | • SAKIT NG DIBDIB |
| • KABAG | • SAKIT NG NGIPIN |
| • LAGNAT | • SAKIT NG KALAMNAN |
| • RAYUMA | • SAKIT NG KASUKASUAN |
| • PAGKAHILO | • KAGAT NG LAMOK/INSEKTO |
| • TAGIHAWAT | Mabisa ring: |
| • PANGANGATI | • PANGMASAHE SA KATAWAN |
| • PAMAMANTAL | • PANGKONDISYON BAGO MAGLARO |

Seahorses are also used in the Philippines as folk medicines and good luck charms.

- Herbalists in Manila's Quiapo market said they would sell seahorses if they could get them. Coastal people of Mindanao and the central Visayas use seahorses to treat asthma, gas pains, and hyperactivity (Aliño *et al.* 1990). The dried animal is slightly burnt and soaked in water, then the solution drunk.
- In Palawan, claims that seahorses cure asthma probably derive from TCM practices. The local recipe described was to roast one or two seahorses in a wok (without oil), then add four cups of water and boil down to the equivalent of one cupful of liquid, and finally grind and mash the residue and drink the extract twice daily. The taste is apparently bitter.
- On Bohol (and occasionally Palawan) seahorses were found to be used chiefly to treat stomach aches and upsets. Village shops and homes commonly had a few seahorses hung to dry, usually seahorses that were too small to be worth selling to TCM buyers. The mode of treatment was the same as that described for asthma above.

Fishers in some areas believe that ingesting a seahorse soaked in liquid will promote vigour and fertility. In Busuanga, one aphrodisiac recipe required that one take a bottle of five-year-old *White Castle* whisky, add five

live seahorses, wait for them to die (or, better yet, apparently, rot) and then drink the resultant solution. A similar concoction for virility had been introduced to the Jolo archipelago by visiting Japanese, with the difference that an odd number of seahorses was required (one additional male), and the animals had to be left to steep for 15 days before drinking the decomposed seahorse and liquid.

Merchants in southern Philippines believe that a seahorse brings profits. Some villagers in Palawan hang a seahorse in the doorway to ward off evil spirits. This belief in seahorses as a talisman is similar to that of the nearby Moluccas in Indonesia (see *Indonesia* section).

Shellcraft and the curio trade are well entrenched in the Philippines and large volumes of dried seahorses find their way into cheap seaside scenes and paperweights, mostly for export. Dealers in Zamboanga said that importers requested small spiny seahorses, which would be considered very poor quality for TCM, indicating that these were probably for the curio market.

Legislation affecting seahorses in the Philippines

The Philippines does not specifically protect seahorses. Indeed, one piece of conservation legislation apparently had an adverse effect on seahorse conservation: in February 1993, Palawan province banned the capture and trade of live coral reef species of commercial importance. The goal was to protect coral reefs from cyanide and dynamite fishing, and compliance with the ban appeared high during visits by the author in April 1993. Unfortunately, many fish collectors switched from banned species to seahorses, not included in the terms of the ban because they live mostly in seagrasses off Palawan. The Palawan ban was rescinded prior to general elections in May 1995.

Seahorse catch in the Philippines

Location of seahorse catch in the Philippines

Seahorses are commercially exploited in most regions of the Philippines but the great majority of seahorses in the trade come from Palawan province, the area around Cebu including Bohol and Negros, and the area around Zamboanga including the Jolo archipelago and Tawi Tawi. Busuanga Island was often cited as the primary source for live seahorses while Bohol and Jolo are among the most important sources of dried seahorses; Bohol contributes more to TCM and Jolo more to the curio trade.

Fishing for seahorses in the Philippines

Seahorses are most commonly collected by hand, but also with scoop net, push-net, beach seine or trawl net. This is an open access fishery with all seahorse collectors entitled to fish the same areas, although small marine reserves and sanctuaries are beginning to proliferate.

Fishers from Busuanga, aiming for live seahorses, sometimes collect seahorses by hand but more commonly work from an outrigger boat (*banca*) or bamboo raft. Most fish in the early morning in water only one to two metres deep, clearing the water surface of debris so they can search the seagrass beds. Seahorses are spotted by their tail, snout or flashing fins and caught with a small scoop net, made from a circle of netting stretched over a 125-150mm diameter ring attached to the bottom of a two-metre bamboo pole. It is easiest to work when water is shallow, less than 0.5m above the top of the seagrass. Collectors cannot see through the water surface when the sea becomes rougher, so turn to seining in pairs, employing a seven-metre-long net. They have difficulty wading in the seagrass, so only collect two to five commercial-sized seahorses per haul (and the same number of small ones, which were still being returned to the sea in 1993).

Local Busuanga buyers may hold seahorses in cages in the sea for up to a month, with supplementary feeding.

They are then packed in plastic bags, which are placed in straw bags and taken by boat or aeroplane to Manila. The three buyers consulted on Busuanga took monthly shipments of 600, 1000 and 2500 seahorses to Manila, with mortality en route amounting to less than two percent.

Seahorse fishers off Palawan usually work by day in shallow seagrass beds. They also seek seahorses for the aquarium trade and class dead seahorses as having low value. Most hand-collect but they also use push-nets in waist-deep water. Collectors reported that methods differ both in yield and in mortality rates: hand-collecting in 1993 produced 200-300 seahorses per day of which five to seven (two percent) died; push-netting yielded up to 120 per day with a mortality of perhaps 15 (11%); trawl-netting obtained more seahorses but led to greater mortality.

Fishers from Roxas (Palawan), working by day, rely on a "baby trawl" and hence accumulate many dead seahorses in pursuit of the live animals. The conical net used is about five metres long, is towed behind a *banca*, and requires two men to draw it in. In 1993, fishers could collect up to 300 seahorses per trawl if they targeted seahorses, with a maximum of four trawls daily. In hot weather, fishers need to land seahorses after only one trawl if any are to survive (having been tumbled and abraded in the net), so hand-collecting becomes more common. About 50% of all live seahorses caught in Roxas die before they reach the dealers in Puerto Princesa, despite careful attention en route: the seahorses are packed in plastic bags (to which air is added), surrounded with ice, and placed in straw bags for the journey.

Bohol fishers work at night when, they say, their seahorses are easier to find; this may represent a relatively recent shift from diurnal habits (see Box 1 of this chapter). Many Bohol species live in complex sargassum and coral habitats, whereas seahorses in Palawan are largely found among seagrasses. This seahorse fishery began locally in about 1966, when introduced to the area by a shellfish trader, and initially relied on casual catches from children. It is now a vital fishery, providing important income for local fishers: one-third of those in one village (Handumon) rely on it. Most fishers free-dive in shallow water, guided by lanterns attached to the outriggers of their small *bancas*. Some, however, work in deeper water (to 15m) breathing compressed air from the surface (by hooka rig) and light their way with headlamps. The lengthy dives and unreliable air supplies make this a dangerous enterprise.

Fishers in Jolo target seaweed and seahorses, hand-collecting the latter in shallow water in the mornings. Seahorses in Jolo are also target-caught indiscriminately in drag nets, beach seines, and push-nets.

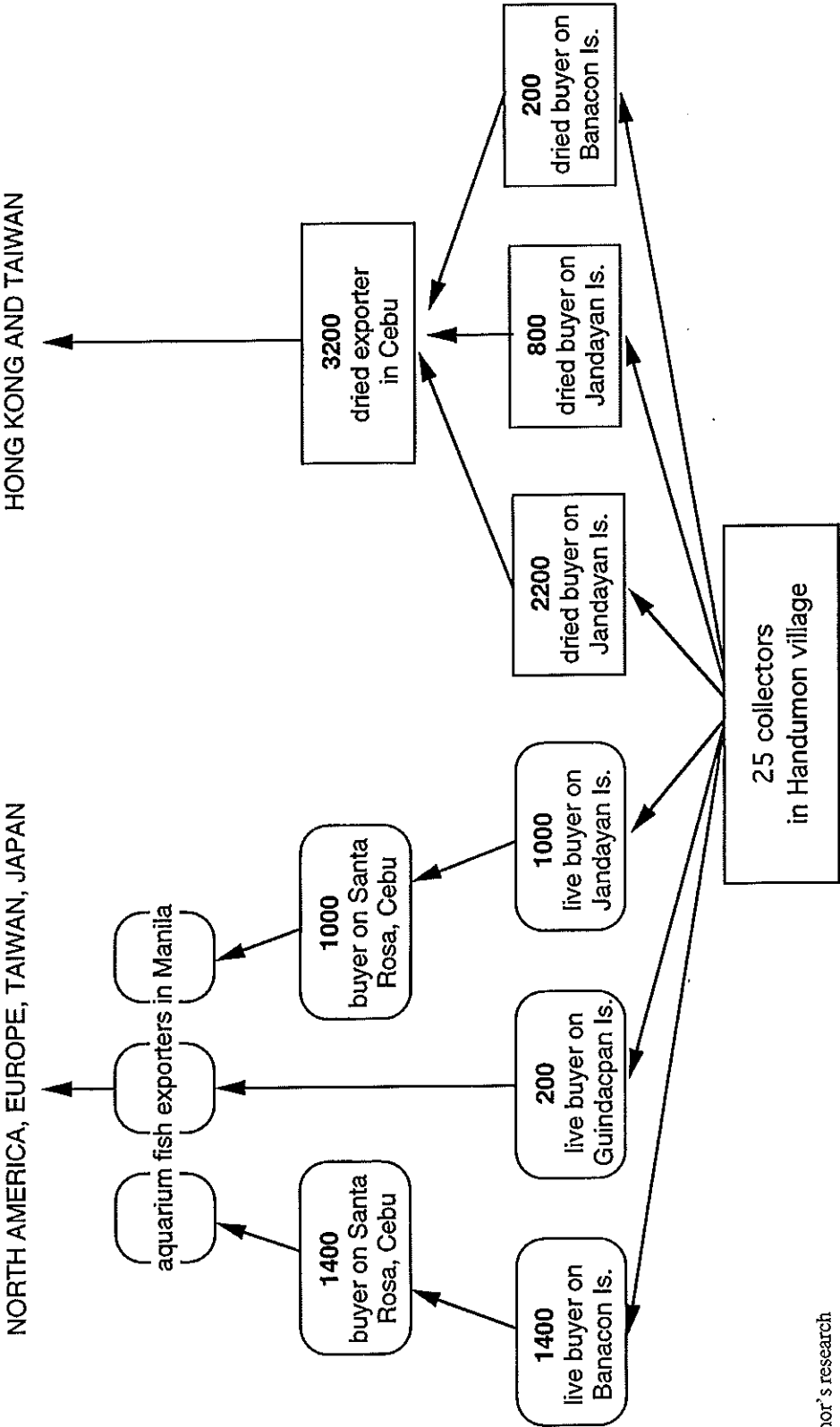
The anchovy and shrimp fisheries obtain some seahorse by-catch, but volumes are unknown. "Giant" seahorses are usually obtained as incidental catch of deep-water trawling.

Timing of seahorse catch in the Philippines

Seahorses are apparently more easily caught in the shallower water of low tides, and difficult to catch before and during storms, perhaps because they hide in the substrate. Fishers in Palawan and Jolo indicated that catches increased around new and full moons, perhaps because the greater tidal range creates shallower water.

Aquarium dealers can get seahorses year-round but usually obtain more earlier in the year (L. Ty, pers. comm., 13 April 1993). In most of the Philippines, fewer seahorses are available during the rainy season (roughly June to November). The Bohol seahorse fishery is typical, intense in December to May, after which fishers concentrate on other species such as squid or abalone *Haliotis* spp. There are no rigid rules, however, and many fishers will gather seahorses if the opportunity arises.

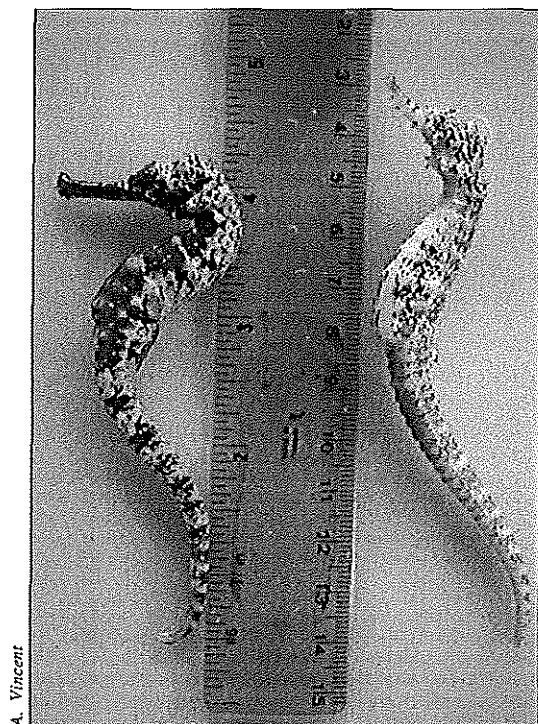
Figure Philippines 3
Flow chart for seahorse trade originating in one fishing village of the Philippines, indicating numbers of seahorses sold. There are two buyers of dried seahorses on Jandayan Island.



Dried seahorse exploitation in the Philippines

Trade routes for dried seahorses in the Philippines

A portion of the dried seahorses sold for medicines are undesirable losses from the live trade, but fishers and buyers



Seahorses caught off Bohol, Philippines

also kill seahorses by laying them flat in the sun to dry or hanging them by their snouts, with the tail flailing for a holdfast. One kilogramme consists of many seahorses that could have been sold for aquarium fishes, but killing them can be economically sensible because:

- Dried seahorses are easier to store, handle and ship. Transporting seahorses alive from remote areas to larger cities is problematic and instead more distant fishers generally accumulate dead seahorses in expectation of visits by buyers.
- Demand for live seahorses is variable whereas dried seahorses are always sought, so it may be necessary to kill live seahorses at times or risk getting no money at all.
- Large seahorses of the species favoured in TCM can be worth more dead than alive, particularly since such species are not much favoured in the aquarium trade. Fishers are paid a flat rate for live seahorses, but according to size for dead seahorses. Bohol collectors in

1995 received about P7 for each live seahorse, P7 for each dried seahorse measuring around 100mm, and P14 for each dried seahorse measuring around 170mm, so they kill the larger ones (and would consider killing the smaller ones).

- Selling live seahorses depends on buyer availability. Where no buyer for live seahorses is available, then the seahorses will be killed. Most central areas, however, have parallel trade options for live and dead seahorses.

Dead seahorses must be stored in such a way as to deter ants (either with naphthalene balls or by placing above a stove) because TCM requires seahorses to have both eyes and to be generally undamaged. Some merchants apparently will buy damaged seahorses, perhaps for curios or for pre-packaged Chinese medicines.

Dried seahorse buyers are commonly villagers, and may also be seahorse collectors (Figure Philippines 3). They take several kilogrammes at a time to their wholesale exporter in the nearest major city. Most relationships between collector, buyer and exporter are durable, with the buyer becoming the fisher's banker in times of trouble and the fisher remaining loyal to the buyer. Itinerant buyers of dead seahorses do sometimes visit areas with less developed seahorse fisheries, in the hope of purchasing such dried specimens as may be available. For example, fisherfolk in a remote northern area of Palawan speak of such a visit by a Japanese buyer around 1990, and a buyer from Cebu visits neighbouring Leyte every six months or so.

Dried seahorses for TCM are usually exported by merchants dealing in other commodities sought by Chinese markets, such as sea cucumbers and sharks fins; no exporter is known to trade only seahorses. The exporters are commonly of ethnic Chinese origin themselves and many send the seahorses to a relative in the import business in one of the consumer nations. Data and interview results indicate that most dried seahorses from Cebu are exported

Table Philippines 1**Philippines' records of dried syngnathid exports, with volumes and values**

Destination	1982		1983		1984		1985		1986		1987	
	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)
Hong Kong	*21 871	37 104	3514	120 512	1669	36 067	1331	86 404	*15 859	84 580	3065	68 252
Norway	44	410										
Japan	300	6867	73	2213	90	6382			365	427	65	64
Korea, Rep. of	*35 014	62 352										
Malaysia	80	90										
Singapore	*71 731	25 299	*117 737	10 813	683	5715	934	2003	373	2401	25	800
Taiwan	459	5858	105	10 508	103	1343			480	47 591	890	85 339
UK					3	1293						
USA	62	5228			7	1909					703	9900
TOTAL	*129 561	143 209	*121 429	144 046	2555	52 710	2265	88 407	*17 077	135 000	4748	164 356

* These particular data are so disproportionately large that officials in the Bureau of Fisheries and Aquatic Resources acknowledge they are likely to be wrong.

The 1983 exchange rate was also used for 1982, since the rate for the latter was not available.

Source: Philippines National Census and Statistics Office.

Table Philippines 2
Dried seahorse exports from Cebu, Philippines

	1990		1991		1992		1993		1994	
	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)	Volume (kg)	Value (US\$)
Hong Kong	40	2200	260	7250	585	27 584	604	28 450	697	28 720
Taiwan	1050	36 050	1250	68 750	1140	63 158	360	25 200	1690	118 300
USA									15	3500
Total	1090	38 250	1510	76 000	1725	90 742	964	53 650	2402	150 070

Source: Port of Cebu Bureau of Customs Export Statistics Division.

directly to Hong Kong or Taiwan, while those from Zamboanga go primarily to Japan, Italy or the USA. A few dried seahorses may pass through Manila. Buyers indicated that some seahorses may slip through unofficial channels, for example, ships lying off Mangsi Island (Palawan) taking cargo to Hong Kong. Cebu exporters ship seahorses every month while Zamboanga exporters each ship about once every three months.

Volumes of dried seahorses exported from the Philippines

Philippines national records of seahorse exports, Taiwan's Customs statistics, and records for two of the principal seahorse-exporting cities in the Philippines, Cebu and Zamboanga, provide official sources of information for this section.

The Philippines National Census and Statistics Office compiled export data for dried syngnathids until 1987. These records show that the Philippines exported dried syngnathids to Hong Kong, Japan, Republic of Korea, Malaysia, Norway, Singapore, Taiwan, the UK, and the USA between 1982 and 1987 (Table Philippines 1). The figures for total volume exported in 1982, 1983, and 1986 seem very high. Norway stands out as an unusual recipient of dried seahorses.

Taiwan's Customs statistics show increasing imports of seahorses from the Philippines (Table Taiwan 3). Export figures from the Philippines to Taiwan matched import figures from the Philippines to Taiwan only sporadically (see Table Taiwan 4). The later Taiwan figures may be something of an underestimate; for example, Taiwan recorded Philippines' imports of 1830kg in 1994 but the Port of Cebu alone exported 1690kg to Taiwan that year (Table Philippines 2). Taiwan reported importing 715kg of dried seahorses from the Philippines in the first four months of 1995, at a total value of US\$42 500.

The three principal cities for dried seahorse exports are probably Cebu, Zamboanga, and Puerto Princesa. The Port of Cebu Customs Division's statistics on seahorse exports (Table Philippines 2), show increasing exports to Hong Kong, a steady supply to Taiwan, and a small shipment to the USA. Growing demand from China might explain the greater shipments to Hong Kong, since many seahorses for China are imported through Hong Kong (see *Hong Kong and China* sections). Merchants in China reported continued imports from the Philippines in 1995.

Recorded seahorse exports from Cebu were 2402kg in 1994 but the data are flawed:

- Volumes appear to be incomplete. Port of Cebu statistics show total exports of 964kg in 1993 but field interviews during 1993 found that just two dried marine product exporters were shipping a total of 250 kg per month or three tonnes *per annum*. Although anecdotal trade estimates must be treated cautiously, such reports do suggest that the 20 Cebu exporters together would have exported rather more than 964kg.
- Prices are contradictory. Cebu exporters were paying their suppliers US\$112 per kilogramme of dried seahorses at the end of 1994, but the mean declared value of their 1994 exports was only about US\$70 per kilogramme (from Table Philippines 2). Values were also highly inconsistent within the Customs data. The same type of seahorses will have been exported to both Taiwan and Hong Kong, judging from seahorses available in both source and destination countries, but shipments to Taiwan had declared values of US\$70 per kilogramme, those to Hong Kong were often lower (US\$9 per kilogramme for two months, US\$45 for two months, US\$121 for one month), and those to the USA were higher (US\$233 per kilogramme) (Table Philippines 2).

Figures kept by BFAR in Zamboanga (Table Philippines 3), show recorded trade is substantially less than from Cebu and has decreased since the late 1980s. The prime importers from Zamboanga were listed as Japan and the USA. However, BFAR records of volumes also appear to be defective. For example,:

THE INTERNATIONAL TRADE IN SEAHORSES

- Only four of the known 10-12 seahorse exporters in Zamboanga appear in the original data in any given year.
- Two exporters in Zamboanga told a researcher in 1993 that they shipped an average of 10kg of dried seahorses per month (with occasional shipments of 100kg in one month). This would total 200kg, greater than all listed Zamboanga exports, even with only two of ten exporters included.
- One shell dealer sends approximately 30kg of dried seahorses every three months to Italy, but only two such shipments to Italy appear in the records between 1986 and 1994. He also sends more seahorses to the USA and Japan but only one such shipment was documented in BFAR statistics during these nine years.
- One Jolo buyer said he obtained 10-20kg of dried seahorses per month, for a total greater than all listed Zamboanga exports.

Table Philippines 3

Dried seahorse exports from Zamboanga City, Philippines

	Volume exported (kg)								
	1986	1987	1988	1989	1990	1991	1992	1993	1994
Canada		1.0							
Italy				10.0	30.0				
Japan	26.0	33.0	49.5	27.2	2.8	47.0	7.5		
Taiwan				0.3					
UK	3.0				5.0		1.0		
USA	65.0	15.0	109.0	145.0	10.0	5.0	8.0		
Other						30.0			56.0
TOTAL	94.0	49.0	158.5	182.5	47.8	82.0	16.5	n/a	56.0

Source: Bureau of Fisheries and Aquatic Resources Records, Zamboanga City

Total volumes from available data

Estimating total volumes is difficult given the flaws in both recent and historic data. A compilation of field findings, even from only a partial study of possible information sources, provides a figure of 3.6t of exports from the Philippines in 1993 (Table Philippines 4):

Table Philippines 4**Volumes of dried seahorses traded in the Philippines in 1993, from field surveys**

Location	No. seahorses per kg	Volume per buyer (levels 2 and 3)	Volume per exporter (level 3 and 4)
Puerto Princesa (Palawan)	600-800	1-5kg/month (x 7 buyers)	10-11kg/month
Roxas (Palawan)		1-2kg/week (x 1 buyer)	
Cebu	250		20 exporters: (a) 225kg/month (b) > 40-50kg/month
Jandayan Is. (Bohol)		1kg/week (x 2 buyers)	
Batasan Is. (Bohol)		1kg/week (x 1 buyer)	
Zamboanga	700-800		10 active exporters: (a) 10kg/month (max. 30kg/month) (b) 10-20kg/month (max. 100kg/month)

A sample of two exporters is provided by (a) and (b)

Source: Author's research

- 120kg from Puerto Princesa.
- 3200kg from just two of 20 Cebu exporters.
- 300kg from just two of 10 Zamboanga exporters.

These figures substantially exceed the total published annual export volumes for 1993 for Cebu (964kg) (Table Philippines 2). For Zamboanga, there are no 1993 records, but BFAR accounts of 16.5kg in 1992 and 56.0kg in 1994 would seem to be improbably small amounts.

Trade data for 1994 (Tables Philippines 2 and 3) show that a total of 2458kg of dried seahorses were exported from Cebu and Zamboanga (2402kg plus 56kg). In 1995, there were about 300-450 dried seahorses per kilogramme in the central Visayas and 800-1000 per kilogramme in Zamboanga, so a minimum of 765 400-1 136 900 dried seahorses were reportedly exported from the Philippines in 1995. This is far from the complete story, however, as the figure for Zamboanga is certainly too low, the Cebu figure seems unreliable, and other areas of the country are not included in this calculation.

It is possible that national exports could exceed 11t (4.7 million seahorses), extrapolating from the 1993 field surveys by (i) applying the lower volume estimate of 40kg monthly to all 20 Cebu exporters, at 375 seahorses per kilogramme (as of September 1995) and (ii) applying the lower volume estimate of 10kg monthly to all 12 known seahorse exporters in Zamboanga, at 900 seahorses per kilogramme (as of September 1995). Such a calculation would still not include exporters elsewhere, such as Puerto Princesa.

Values of dried seahorses in the Philippines

Prices were found to vary across the country (Table Philippines 5). Collectors were paid for each dead seahorse whereas buyers were paid by the kilogramme. Where seahorses were large and smooth, in the central Philippines, fishers earned P5-10 per dead seahorse. In contrast, where live seahorses were the target commodity, in Palawan,

fishers got less than P1 for a dead seahorse. Buyers in the central and southern Philippines were also paid at least 50% more per kilogramme for seahorses than those in Palawan, even though it took many more seahorses to accumulate one kilogramme in Palawan (perhaps 800-1000 seahorses per kilogramme in Palawan and Zamboanga and 250 in the central Philippines in 1993).

Table Philippines 5

Prices paid for dried seahorses in the Philippines in April 1993

Location	Price (P per kilogramme unless noted) for dried seahorse received by:		
	Collector (level 1)	Buyer (level 2)	Exporter (level 3)
Manila, Luzon		1000	
Bolinao, Luzon	1000		
Puerto Princesa, Palawan	1 each	1200-1400	
Tagburos, Palawan	1 each	1200-1400	
Roxas, Palawan	0.5 each	1-2 each	
[buyers must travel far to Puerto Princesa buyers]			
Busuanga, north Palawan		1000 (S) 2000 (M-L)	
Santa Rosa, Cebu	0.5 each (S) 3 each (M-L)	800	2300-2600
Jandayan Is., Bohol	10 each		2300-2600
Batasan Is., Bohol	5 each	10 each	2300-2600
Zamboanga			1900-2000 (S) 2200-2500 (M-L)

Source: Author's research

Prices in the central Philippines have increased markedly since 1987 (Figure Philippines 4), apparently along the same trajectory in all areas. "Giant" seahorses from Negros are valuable, worth P3500 (US\$140) for one kilogramme (50-70 animals) in Cebu in 1993.

Live seahorse exploitation in the Philippines

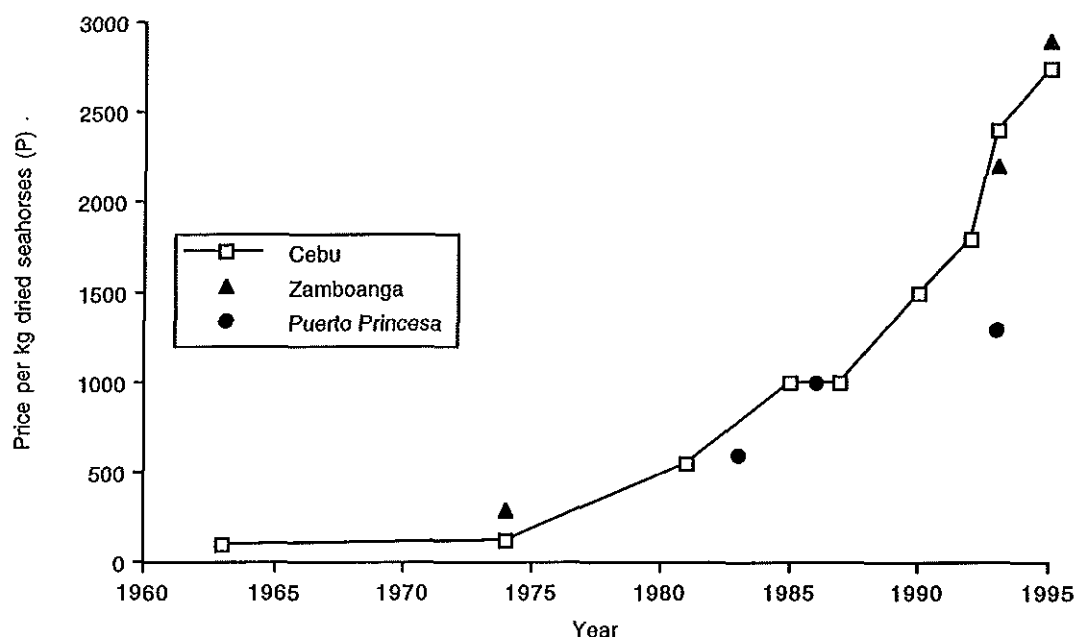
Trade routes for live seahorses in the Philippines

Live seahorses are the target of most fishers around Palawan, Bohol and Cebu. They sell the fishes immediately to buyers, who either hold seahorses in cages in the sea, or keep them in bags. Most buyers supply oxygen and are quite careful in shipping the seahorses, if only because a dead seahorse intended for aquarium sale generally means a loss of profit. Seahorses generally survive transport (perhaps two percent mortality) only to die on reaching their foreign destinations, partly from the effects of poor handling and starvation (feeding them is usually judged too difficult) during the export process. Some buyers are negligent and hold the fishes in stale water with no air for days in great heat, with consequent increased mortality; then one sees strings of seahorses drying above the bags of living animals.

Along some trade routes, a secondary buyer visits the village to purchase seahorses from the first buyer, in which case the latter makes very little profit (e.g., P0.5 (US\$0.02) per seahorse on Bohol). Otherwise the first buyer must

Figure Philippines 4

Change in prices for dried seahorse paid to buyers (level 2) in the Philippines, for three areas.



Source: Author's research

take the seahorses to the exporter. This will be done every few days (e.g., from Roxas on Palawan) or every few weeks (e.g., Busuanga), depending on local conditions and distance to the exporter.

Most live seahorses appear to be traded through the 30 or so aquarium fish exporters in Manila, to be sold in Australia, Canada, Europe, Hong Kong, Japan, Singapore, Taiwan and the USA. Markets fluctuate seasonally with greater demand for aquarium fishes in general during the northern hemisphere's winter.

Volumes of live seahorses traded in the Philippines

The few volume estimates available allow only very crude judgements of total live seahorse exports, but some consistency emerges:

- Busuanga was a major source of aquarium seahorses, with collectors there each getting 30 on a good day. The three buyers interviewed in 1993 got 200-800 each per week, from about 15-50 collectors. If they each sell an average of 500 seahorses weekly, the eight buyers' could sell a total of 16 000 seahorses monthly. Fishers suggest six good and six poor months, which leads to an estimate of well over 100 000 live seahorses sold annually by this region.
- Palawan collectors could get 50-60 seahorses per day if hand picking, or 120-150 per day if trawling in peak season. Fishers working as a group could even manage daily catches of 250 seahorses per person. The main local buyer in Roxas could obtain 6000-8000 seahorses per month, although many died. The next level buyers in Puerto Princesa (levels 2 and 3) sent 4000-10 000 live seahorses per week to Manila. Even the lower estimate would amount to 200 000 seahorses annually, without including the other known buyer from Puerto Princesa.

- Live seahorses from most collectors in Bohol and Cebu are sold to buyers on Santa Rosa (Cebu). One "below average" buyer estimated he got 100 per week in March to October and 500 per week from November to February, making an annual total of about 11 600 seahorses. Given that there are about 20 buyers in Santa Rosa, then this region may deal in over 200 000 seahorses annually.

Such estimates indicate that possibly half a million live seahorses reach exporters in Manila every year from just these three regions. This does not take account of the many aquarium fish collectors from the large island of Luzon (e.g., Bolinao fishers could obtain about 40-50 seahorses daily if targeting them) and the southern Philippines.

These calculated figures, high as they seem, are consistent with exporters' own estimates, which indicate that those in Manila (from where most seahorses appear to be exported) dispatch well over half a million seahorses annually.

There are limits to how many seahorses the live trade needs, and buyers are sometimes asked not to bring more, in which case the fish are killed for TCM and curios.

Values of live seahorses traded in the Philippines

In the aquarium trade, "yellow" seahorses were always worth at least as much as "black" seahorses, and usually more (Table Philippines 6). Most live "yellow" seahorses were worth P5-9 (US\$0.20-0.36) to the collector, although the smallest seahorses earned only about P1-2 (US\$0.04-0.08). Distance to market played a role. The main local buyer in Roxas had to transport her seahorses to Puerto Princesa by means of a long and rough bus ride, and she paid her local collectors very little. Her own profits would have been limited by seahorse mortality and also by the fact that it takes many Roxas seahorses to produce one kilogramme.

Pay to collectors and buyers apparently reflects supply and demand to some extent, but exporters will sometimes minimize price fluctuations in order to keep suppliers loyal. Prices increased about five- to six-fold between 1979 and 1993, which is greater than a compounded inflation rate of 10%. The prices paid to Batasan fishers were particularly high, given that they, like most collectors in Bohol and Cebu, sold only the smaller seahorses to the live trade.



Fisher with his *Banca*, Bolinao

Table Philippines 6

Prices paid for live "yellow" (Y) and "black" (B) seahorses in the Philippines during April 1993.

Location	Historical notes	Collector (level 1)	Price (P) per seahorse received by:		
			Buyer (level 2)	Buyer (level 2 & 3)	Exporter (level 3 & 4)
Manila (Luzon)	price up 10% from 1992-93			15-18 (Y)	25-40 (Y)
				14-15 (B)	[US\$1.0-1.6]
				or...	12-40 (B)
				10-12 (sm-med Y)	[US\$0.5-1.6]
				15 (lg Y)	
				7-8 (sm-med B)	
Bolinao (Luzon)	prices have doubled since 1979	3-4 (all)		12-16 (Y)	
				8-16 (B)	
Puerto Princesa (Palawan)	collectors got P1 in 1979	6.5 (Y)		18-20 (Y)	
		6.5 (B)		12-14 (B)	
		9 (Y in 12/92)		21 (Y in 12/92)	
Tagburos (Palawan)		5 (Y)	8 (Y)		
		3 (B)	5 (B)		
		2 (sm Y)	2 (sm Y)		
Roxas † (Palawan)		1 (sm)	5 (sm)		
		2.5 (med)	7 (med)		
		3 (lg)	8-9 (lg)		
Busuanga (N. Palawan)	collectors got P0.3-0.8 and buyers got P4 from 1973-1979	7-8 (Y)		12-18 (Y)*	
		5-7 (B)		10-12 (B)	
Santa Rosa (Cebu)		1 (sm)		10 (sm Y)	
		5 (med)		15 (med Y)	
				2 (v. sm B)	
				8 (sm B)	
Jandayan Is. (Bohol)	collector got P3 in 1983-1985	5	5.5	10-15 (med B)	
Batasan Is. (Bohol)		7-10		15	

* may get ± P2 according to fluctuations in supply and demand

† trade involves lengthy travel to Puerto Princesa

v. sm = very small; sm = small; med = medium; lg = large.

Source: Author's research

Export prices (FOB) for most seahorses in 1993 were US\$1.00-1.60, but could reach US\$2.00-2.50. One exporter's claim to be paying his fishers US\$2.80 (P70) per seahorse seems improbable.

Economic importance of the seahorse fishery

The seahorse fishery is economically important to thousands of people. Known numbers of seahorse collectors and buyers in 1993 were at least 100 on Palawan, 150 on Busuanga, 35 in just one village on Bohol, 75 on one island near Cebu, and 80 in just three villages in Jolo. To these totals one must add all the other villages on Bohol and in Jolo and the many seahorse fishers in Leyte, Samar, and Mindanao. In addition, there are those people employed in aquarium fish exporters' shops, marine product exporters, and shell craft dealers. Aquarium fishers targeting other animals often gain incidental income from seahorses. Each participant will be likely to contribute to the income of a large family in this practising Catholic country; the seahorse fishing village being studied on Bohol (see **Current Conservation** section) has a mean of four dependents per household.

Most people engaged in targeting seahorses are subsistence fishers; for example, those in Bohol use seahorse income first to buy rice. Collectors and buyers in Busuanga estimated they earned 50-80% of their annual income from seahorses. The fishers and buyers in Palawan and the central Philippines who offered any estimate thought that seahorses contributed about 30-40% of their annual income, with a maximum of 80% annually, and up to 90-100% during seahorse season. Seahorse fishers turned to other activities in the short term when these were more economically rewarding.

The relative importance of trade in live and dead seahorses varied from region to region, and in time. Fishers in Bohol had been totally dependent on the dried seahorse trade when it began (around 1966) but then benefitted from the developing trade in live trade seahorses. By 1995, however, they were again relying more on dried seahorses, because TCM offered higher prices and steadier demand.

Conservation concerns about seahorses with respect to the Philippines

Evaluations of the status of seahorses in the Philippines must be undertaken in the context of serious habitat destruction; one study found that only five per cent of coral reefs in the Philippines remain in good condition. Certainly destructive fishing techniques, including the use of dynamite and cyanide, abound (pers. obs.). Current rehabilitation projects include ambitious mangrove replantings in order to reverse large-scale clearing, often for fish ponds.

All those traders interviewed agreed that supply of seahorses did not meet demand, and that buyers frequently asked fishers for more. Yet fishers and buyers from Palawan, to Cebu, to Zamboanga also reported that seahorse catches were declining. Seahorses in the Roxas area of Palawan had previously been targeted by small boat trawlers, but seahorse numbers had decreased enough by 1993 that trawlers were directing their efforts to crabs and food fish instead. A fisher and buyer in Lapu Lapu near Cebu noted that he could get 100 per night in 1977-78, but only 20 in 1993. An official involved in running an aquaculture project set up in Jolo, in 1988, commented that it was set up to "address the problem of seahorse numbers dwindling through indiscriminate fishing": this is just one example of one of the many testimonies offered to the effect that seahorses were in short supply.

The long-term consequences of catching pregnant seahorses were obvious to many fishers (although most thought these were female) and some acted accordingly. For example, one collector near Bohol started "culturing" seahorses by holding pregnant males in cages in the sea until they had given birth, then releasing the young and killing the male. This idea is being pursued on Bohol where a seahorse conservation project is underway (see **Current conservation** section). Box 1 presents a case study of conservation-related problems.

Box 1

Bohol case study on conservation related issues

Seahorse fishing began in northern Bohol around 1966. Detailed interviews of 25 seahorse fishers in a village on Bohol (Barangay Handumon) were conducted by a Filipino biologist (Vincent et al. in prep). These indicated that the seahorses catch had decreased 69% over the 10 years from 1985, 54% during the five years from 1990, and 38% in the year from 1993. Modal catches were 16-20 seahorses per night during a 1993 pilot visit, but had decreased to 6-10 per night by 1995. The main buyer of dead seahorses on this island confirmed that she could obtain only half as many seahorses as ten years ago; some weeks she obtained less than one kilogramme instead of her previous five kilogrammes. She buys from all fishers, so this indicated that total catch had decreased and not just catch per fisher. Catches are probably a fair reflection of seahorse population size and structure because fishers scan all areas and are expert at spotting and collecting seahorses.

Overfishing and uncontrolled fishing are to blame for declining seahorse populations, in the opinion of Bohol fishers. The number of collectors focusing on seahorses increased from 10-15, in 1985, to 20-30 in 1995. Fishers acknowledged that catching pregnant males has probably contributed to the decline. One collector/buyer said in 1993 that he collected only 20 per night then, instead of his former 100 per night (in 1977-1978) because "the sea is always being harvested". Fishers speculate that fishing pressure may have caused a behavioural shift: seahorses on Bohol are now caught mostly at night, whereas they could be obtained by day 10-15 years ago. They also commented that they must wait longer before returning to a previously-fished area. Although acknowledging mismanagement, fishers also mentioned that three cyclones in the past ten years had seriously damaged local reefs, thus worsening the problem.

Fishers on Bohol noted that they were taking smaller seahorses now. Prior to the onset of an aquarium trade for live seahorses, in the late 1970s, they had left seahorses less than 100mm long but were taking anything longer than 50mm in 1995. Their suspicion is supported by the fact that a kilogramme comprised 250 seahorses in 1993, but 300-450 in 1995.

Captive breeding seahorses in the Philippines

The Department of Agriculture embarked on seahorse culturing in Marunggas Island, just off Jolo, in 1988, but this was not a success (J.-R. Guraili, pers. comm., September 1995). The work was initially funded under its Rainfed Resources Development Program (RRDP) with further support from the US Agency for International Development (AID), but funding ceased in 1992. The project essentially involved capturing pregnant males and rearing the young in floating cages, but only about 12% of young survived even a week. Problems with disease and feeding were exacerbated by algal blooms which caused water quality to deteriorate. This seahorse culturing attempt was subsidiary to other cultures in the same project (for sea cucumbers, seaweeds, abalones, seashells and groupers), which may have diminished its effectiveness. Fishers in Jolo still sometimes use cages as "fattening pens" to hold adults so they may gain weight before sale, and thus be worth more.

New research into seahorse culturing has been proposed by a biologist at Mindanao State University, in May 1995. The Bohol seahorse conservation project (see **Current conservation** section) currently uses cages only to hold captured pregnant males until they release young to the wild, prior to sale, but small-scale culturing is anticipated.

Conclusions for the Philippines

The eight or more species of Philippines seahorses are vulnerable to two trades, dead for TCM and curios, and live as aquarium fishes. The former are exported largely from the central and southern Philippines while the aquarium trade is centred on Palawan and Busuanga. The target fishery for seahorses has become economically important to thousands of fishers. Published statistics and extensive interviews combine to allow export estimates for dried seahorses ranging from a conservative 3.6t (1.5 million seahorses) to a more tentative 11t (4.7 million seahorses).

THE INTERNATIONAL TRADE IN SEAHORSES

Prices vary regionally but are climbing slowly in most areas. Hundreds of thousands of live seahorses may also be sold annually for aquarium fishes. Seahorse populations appear to be suffering as a consequence, with widespread reports of declining number and size. The problems documented with the Bohol fishery (Box 1) are replicated across the Philippines, although the scale of concern varies among regions.

The now-abandoned seahorse culturing project on Jolo was initiated because indiscriminate fishing was depleting local populations (J-R. Guraili, pers. comm., September 1995). It appears that action on behalf of seahorses may be needed all over the Philippines.

SEAHORSE TRADE IN THAILAND

Customs data for Taiwan and China, and anecdotal evidence from Hong Kong suggest that Thailand may export perhaps 15t of dried seahorses *per annum*, more than any other country. Seahorse numbers may now be declining in Thai waters.

Background for Thailand

Information sources in Thailand

The material in this section was gathered by staff at the Bangsaen Institute of Marine Sciences (BIMS, Burapha University) in Thailand. Information was presented to the author in a meeting at BIMS on 6 June 1995, and later clarified with the Director of BIMS. All material should be assumed to come from BIMS if not otherwise stated.

Seahorses in Thailand

The seas around Thailand include a minimum of five seahorse species, of which at least two are extensively fished, one *Hippocampus kuda* type and one *H. histrix* type. Both had generally been considered abundant off the east coast of Thailand.

Use of seahorses in Thailand

Thai seahorses are primarily sold for TCM, most to be exported, but some to be used in local TCM; a display at BIMS mentions the medical functions of seahorses and pipefishes. Two out of five TCM shops visited in Bangkok's Chinatown in October 1995 were exhibiting seahorses (Chen H.K., *in litt.*, 11 January 1996). One was selling a large jar of unbleached seahorses at B250 (US\$10.12) per 35g and another of bleached seahorses at B500 (US\$20.24) per 35g. The second shop offered bleached seahorses at B600 per 35g (US\$24.29).

Large numbers of dried seahorses are also sold as curios in Thailand. Beach resorts feature, for example, heaps of seahorse key chains, with the rings punched through their eyes. Marine aquaria for hobbyists are popular in Thailand but most live seahorses for sale in aquarium shops are reputed to come from the Philippines.

Legislation affecting seahorses in Thailand

Seahorses are not specifically protected in Thailand but any trawling within three kilometres of Thailand's coast is illegal (S. Sirirattanachai, *in litt.*, 10 November 1995).

Seahorse catch in Thailand

A target fishery for seahorses in Thailand dates back to at least the late 1970s. Pairs of fishers go out in small boats (five to six metres in length), equipped with a small mesh (trawl) net intended specifically for seahorses. These seahorses (usually *Hippocampus kuda* type) live in about three to five metres of water. Most seahorses, however,

are caught as a by-product of the shrimp trawl net fishery. Fishers commonly obtain 20-30 seahorses in each trawl (usually a *H. hirtix* type) with maximums of 50-100 seahorses per haul.

Seahorses are generally fished in the Gulf of Thailand during the winter (non-monsoon season), from October to February, which is probably coincident with the breeding season for these seahorse species in Thailand. Fishers say that seahorses move offshore in the summer. Three to four years ago, fishers were already retaining seahorses as small as 75mm (90 days old) even though they do not mature until about 125mm (12 months old). Seahorses are dried in the sun.

In 1989, pairs of fishers caught perhaps three to four kilogrammes (wet weight) of seahorses per day, with about 150 wet seahorses per kilogramme (giving about 300 dried seahorses per kilogramme). Catch volumes may have been influenced by the illegal nature of the fishery: inshore trawling had already been banned. Thai seahorse buyers generally sold them on to ethnic Chinese (Thai) exporters, although fishers sold some seahorses direct to foreign Chinese. Buyers received about B6000-8000 per kilogramme of dried seahorses in 1993 (US\$243-324).

Volumes of dried seahorses exported from Thailand

Taiwan's trade records show that Thailand was its largest single source of seahorses (by volume) for 11 of the 12 years from 1983-1994 (Table Taiwan 3). Volumes increased steadily, in contrast to declining declared value per kilogramme (Table Discussion 6). Taiwan continued to import many seahorses from Thailand in 1995, with 2073kg during the first four months alone.

China's few Customs records for syngnathids indicate that Thailand was also its largest supplier (China Customs Statistics Yearbook). All six TCM importers interviewed by the author in three Chinese provinces (Hainan, Guangdong, and Fujian) commented that Thailand was their primary or sole source of seahorses in April 1995.

Thailand also exports to Hong Kong. The only TCM importer interviewed by the author in Hong Kong reported Thailand as his preferred source for seahorses in 1993. Another source cited Thailand as providing 50% of all Hong Kong seahorses (A Lau, *in litt.*, 18 March 1993). The author found that Thai seahorses are considered good quality by TCM users because they are pale and smooth.

Trade records show that Thailand probably exported about 15t of seahorses (or 4.5 million seahorses at 1989 weights) annually, recently:

- In 1990, it sent 5.967t to China and 4.046t to Taiwan, a total of 10.13t
- In 1991, it sent 4.268t to China and 5.703t to Taiwan, a total of 9.97t
- In 1994, it sent 8.069t to Taiwan and undisclosed amounts as a "major supplier" to China.
- To these amounts must be added annual exports to Hong Kong. These were said to represent half Hong Kong's annual imports of approximately 10t (see Hong Kong section).
- Unrecorded trade will augment these totals, as will recorded exports to other nations.

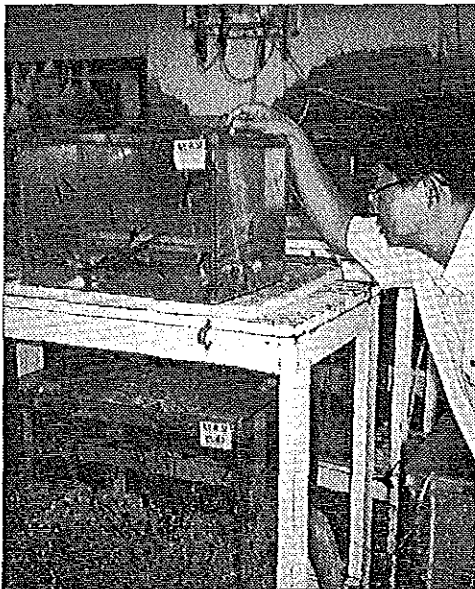
This extrapolation is clearly imprecise, not least because the trade statistics for China may include some seahorses that have come through Hong Kong (although originating in Thailand), and thus could be double counted.

Conservation concerns about seahorses with respect to Thailand

Thai fishers reported to BIMS biologists that seahorse numbers in ChonBuri province had halved from 1993 to 1995 (S. Sirirattanachai, *in litt.* 10 November 1995). They specify that the *Hippocampus histrix* type has diminished more than the *H. kuda* type. Fishers acknowledged overfishing as a root cause but also blamed environmental changes.

In 1993, a TCM wholesaler in Hong Kong told the author that he obtained large numbers of "best quality" seahorses from Thailand. By 1995, the same man told the author that the supply of Thai seahorses had dwindled markedly.

Captive breeding seahorses in Thailand



Breeding seahorses in captivity, Bangsaan Institute of Marine Sciences (BIMS), Burapha University, Thailand

BIMS has been studying seahorse captive breeding for about six years, the only such project in the Gulf of Thailand, with the intention of reducing fishing pressures on wild populations (Chaladkid and Hruangoon, undated; Hormchong, undated). They catch pregnant males and rear the captive-born young, achieving 60% survival at 90 days (about 75mm). Breeding the adults is proving more difficult and they have not yet obtained a second generation. Disease (mostly protozoans) presents the greatest husbandry problems. The programme was moved to southern Thailand two years ago, in search of better quality water, and net culture is now being investigated. Declining seahorse populations are making it difficult for BIMS to obtain enough wild seahorses to run its culturing trials.

Conclusions for Thailand

Thailand is clearly a major exploiter of seahorses, perhaps exporting around 15t each year, but trade dynamics are confusing. It appears that seahorse numbers have declined substantially in Thai waters, yet Taiwanese imports from Thailand approximately doubled since 1990 (Table Taiwan 3). One possible explanation for this is that many of these seahorses were caught by the many Thai vessels in foreign waters, while fishing for other species. Casual inspection of seahorses for sale in importing nations suggests that some of the fishes sold as "Thai" seahorses did not live in Thai waters, but certainty awaits a better understanding of seahorse taxonomy and geographic ranges.

In addition to those seahorses exported, a number are used domestically within Thailand.

SEAHORSE TRADE IN VIETNAM

Vietnam exports at least five tonnes of dried seahorses for the TCM trade, mostly to China. Domestic consumption is probably small relative to exports, despite the large ethnic Chinese population. No live seahorse exports have been reported. Most seahorses in Vietnam are caught off the southern province of Kien Giang or off the six provinces around Nha Trang, on the central coast. The seahorses are primarily a by-catch of trawl fishing but are also target-caught.

Background for Vietnam

Information sources in Vietnam

Trade information in this section was primarily gathered by Dr. Truong Si Ky and other Vietnamese biologists from the Institute of Oceanography in Nha Trang, while working in collaboration with the author on a seahorse conservation project (see *Current Conservation* section). They interviewed more than 100 fishers, traders, and biologists around the country between June and September 1995. Data are theirs unless otherwise acknowledged.

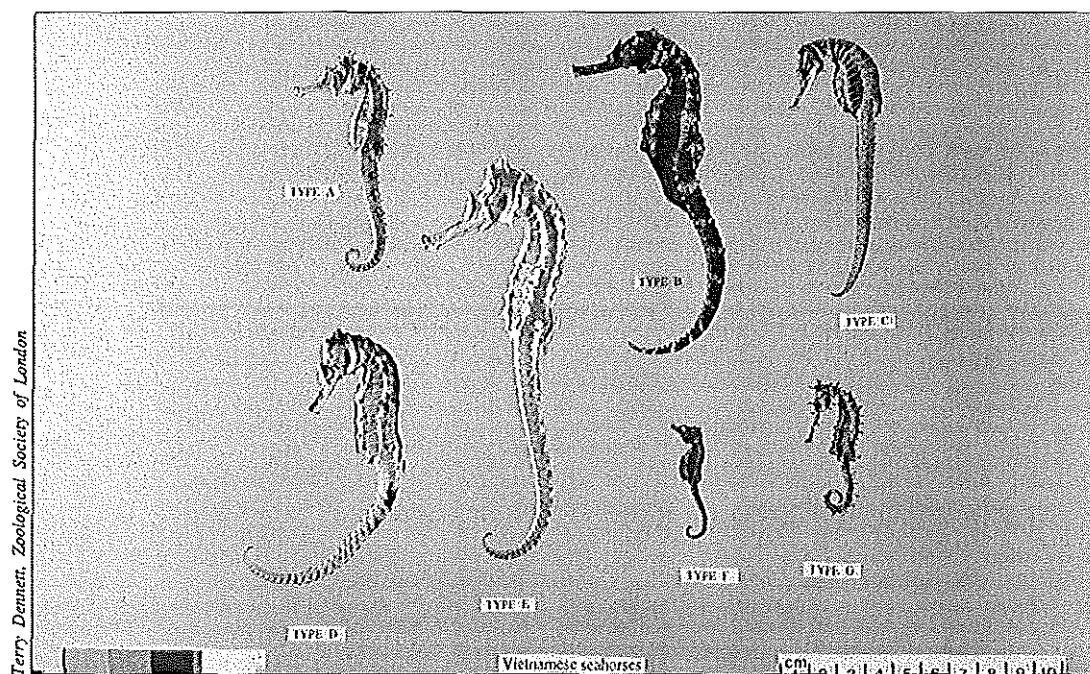
Seahorses in Vietnam

At least seven species of seahorse are found in Vietnamese waters but their taxonomy is confused. One kilogramme usually consists of about 300-400 dried seahorses, but a few larger and heavier individuals are still obtainable (to 250mm length, probably *Hippocampus kelloggi*); these are highly prized in TCM.

Seahorses live among coral reefs and seagrass beds and in estuaries along the coast of Vietnam. They are also found on soft-bottoms, among mollusc shells, and amid algae. They can be trawled from deeper waters offshore. Pregnant males of at least some species breed year round, but the peak of spawning varies among species (Truong Si Ky and Doan Thi Kim Lam, 1994).

Use of seahorses in Vietnam

Most seahorses caught in Vietnam were likely to have been consumed within the country until about 1988, when other trade opportunities appeared (see *Volume of seahorses exported from Vietnam* below). TCM is practised



Types of Vietnamese seahorse

in Vietnam, but sales appear to total only about 50-100kg annually for Hanoi, Ho Chi Minh City and Quang Ninh City, combined. Seahorse-based medicines are thought to cure kidney problems and impotence, and to be an aphrodisiac. They are also valued for tonics, when fermented in strong alcohol with medicinal herbs. Large numbers of dried seahorses can be seen for sale in markets and retail outlets throughout the country.

Seahorses also appear in some patent preparations in TCM. Bottles of seahorse medicine, containing two small seahorses in about 40ml of strong alcohol, are sold in Vietnam under the brand name *Bô Thân Tinh*. This medicine is reputed to improve the sexual potency of older men, and is exported to China.

Status of seahorses in Vietnam

Vietnam's Red Data book, published in 1992 by the Ministry of Science, Technology and Environment, lists four seahorse species as Vulnerable (named as *Hippocampus histrix*, *H. kuda*, *H. kelloggi* and *H. trimaculatus*) and one species as Insufficiently Known (*H. japonicus*) (Anon., 1992). The rationale for the Vulnerable listing is that the number of seahorses for each of these species is unknown but "there cannot be many in the sea."

Seahorse catch in Vietnam

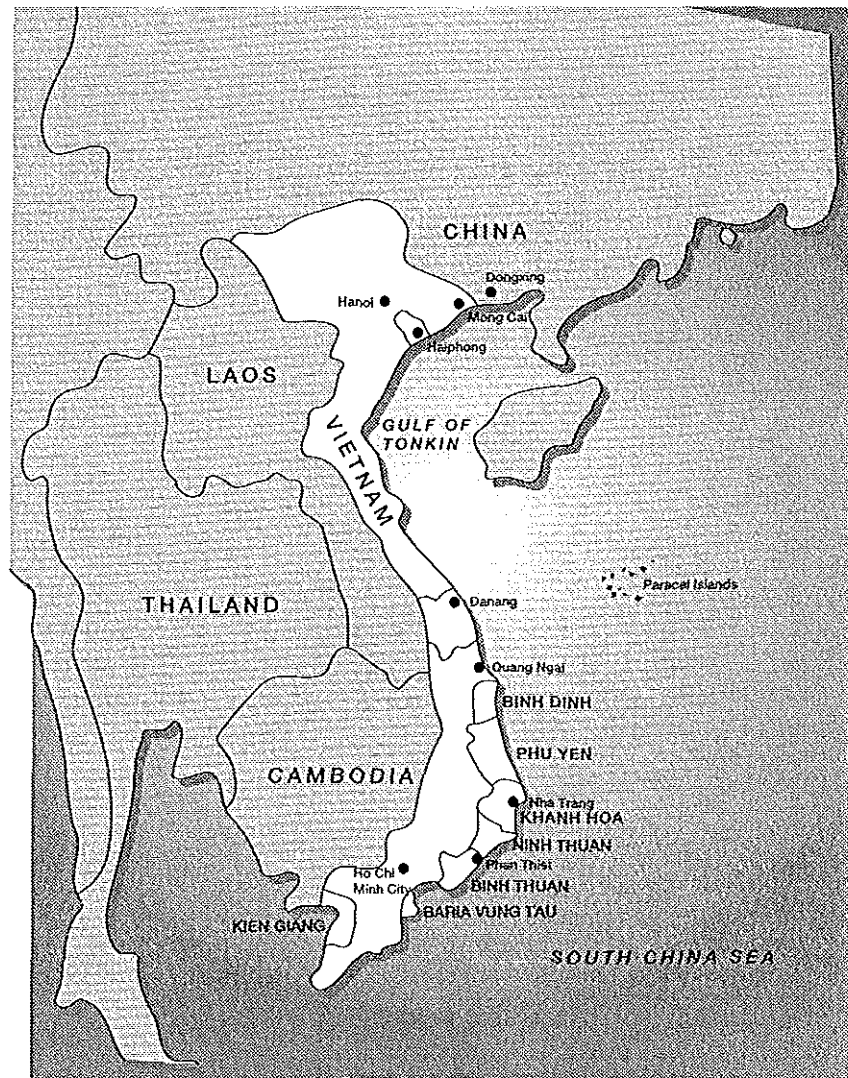
Seahorses in Vietnam are primarily landed as a by-catch of the coastal trawl fisheries, but a few are also hand-collected by divers or swimmers seeking a wide range of animals. Little is known about either mode of capture but seahorse fishing is not an organised activity, even in areas with large output (e.g., Nha Trang, Phan Ri, Phan Thiet, Ham Tan) (Dao Xuan Loc & Hoang Phi, 1991).

Location of seahorse catch in Vietnam

More than half the traded seahorses are caught by fishers from Kien Giang province in the extreme south-west (Figure Vietnam 1). This trade in Kien Giang was only discovered in November 1995 and is still little investigated but it is clear that fishers travel widely and obtain seahorses in many areas, particularly around Phu Quoc Island, Con Dao Islands, and Baria Vung Tau province. One buyer in Kien Giang reported obtaining some seahorses that had been caught off Cambodia.

Figure Vietnam 1

Map of Vietnam seahorse trading areas, as mentioned in the text



The majority of the remaining seahorses are landed in six central/southern provinces around the fishing city of Nha Trang: Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan, and Baria Vung Tau (Figure Vietnam 1). Seahorses are caught all year round, with particularly high numbers in February to July; trawlers operate more frequently then, because seas are calm and clear.

Most dried seahorses from the south-central coast are sent to Khanh Hoa province (Table Vietnam 1). Many provinces (including Khanh Hoa) also send seahorses to the large port of Haiphong in the north, Danang on the central coast, or Ho Chi Minh City in the south (Figure Vietnam 1).

By-catch of seahorses in Vietnam

Many boats obtain seahorses as by-catch, with 640 trawlers operating just in Khanh Hoa province, 623 in Binh Thuan province, and 2799 in Kien Giang province. Each boat only catches a maximum of three to five seahorses per night, but totals are large. Interviews with 13 fishers in Khanh Hoa and nine fishers in Kien Giang indicated that seahorses contribute about one to two per cent of a trawl fisher's income, per trip. Buyers will invest effort in accumulating seahorses, obtaining a few at a time from fishers. About four to five buyers may operate at any one port, and the seven buyers interviewed reported earning about five per cent of their annual income from seahorses.

Relatively few seahorses are trawled in other regions of Vietnam so they may not influence trade patterns. In Haiphong, fourteen fishers reported that boats catch only 5-10 seahorses annually, and these are given away. The claimed low tally in this region is surprising because Chinese fishers working in the same Gulf of Tonkin region obtain many seahorses (see China section).

Seahorses can apparently be landed from most trawls but more are available near coral reefs, and more are landed during the north-east monsoon (October to February).

Seahorse landings comprised an insignificant portion of total fish catch by weight; for example, wet weight of seahorses was two to three tonnes (Dao Xuan Loc & Hoang Phi, 1991) while total fish production in Khanh Hoa province was 38 500t in 1992 (C. Cheung, pers. comm., May 1993).

Volumes of seahorses caught in Vietnam

The southern province of Kien Giang probably landed at least three tonnes of dried seahorses in 1995. Interviews with fishers from 17 boats revealed that the average catch per boat was 2.13 ± 0.627 seahorses per day. There were 2799 registered boats of this size, so total landings were about 5962 seahorses per day. Given that there are 350-400 dried seahorses per kilogramme, Kien Giang province landed about 15.5kg per day. On the basis that the boats fish 20 days per month for ten months, this region will obtain about 3096kg of dried seahorses, all from very small catches by each boat.

The whole central region of Vietnam landed about two tonnes of seahorses (wet weight, probably one tonne dry weight) in 1990, mostly from Khanh Hoa province. Khanh Hoa province also landed between 700-1000kg (dry weight) of seahorses in 1992 (C. Cheung, pers. comm., May 1993); this figure represented 210 000 to 400 000 seahorses by current seahorse weights. By contrast, the total dry weight of seahorses landed in Khanh Hoa in 1995 was only 511-682kg. This reduced figure may not, however, represent a real catch decline since data collection and estimation techniques were different.

Dried seahorse exploitation in Vietnam

Volume of dried seahorses used in Vietnam

TCM dealers in Ho Chi Minh City said that local sales were small, limited to the Chinese community. About 25-30 shops were selling seahorses on Hai Thuong Lan Ong Street in Ho Chi Minh City during September 1995. Each sold about 0.5-1kg annually (a total of 12.5-30kg). Seahorse prices increased from US\$135-140 per kilogramme in June 1993 to US\$180 per kilogramme two years later. Ho Chi Minh City merchants did not indicate the source of their seahorses.

Eleven retailers in Hanoi each estimated annual sales of about 400-500g dried seahorse. Eight TCM shops in the central market of Quang Ninh City (northern Vietnam) reported selling about two kilogrammes each *per annum*. *Hippocampus trimaculatus* was the most common species on sale.

Volume of dried seahorses exported from Vietnam

No live seahorses are known to be exported from Vietnam. All dried seahorse dealers interviewed said that exports had increased greatly since 1988, probably because greatly increased fishing effort has produced more by-catch, and because international demand has increased, particularly from China. Vietnam and China effected a political rapprochement in the mid-1980s, and normalised relations in 1991, although TCM dealers in China reported that smuggling continues (see China section).

Current research indicates that Vietnam probably now exports around five tonnes of dried seahorses annually,

THE INTERNATIONAL TRADE IN SEAHORSES

perhaps 1 750 000 seahorses (Table Vietnam 1). China appears to be the major consumer, probably because of close proximity and easy access. Preliminary findings indicate that Vietnam exports at least 4700-4800kg of dried seahorse annually to China, according to marine product exporters (Table Vietnam 1). This is a very conservative estimate since the Ho Chi Minh City figures include the sales of only one TCM retailer/exporter (120-180 kg) and one marine products exporter (300-400 kg).

Demands from China are often large, with companies requesting one to two tonnes *per annum* each, but most such orders cannot be met (see China section). One TCM importer in southern China claimed in April 1995 that the Vietnam Department of Health had promised to provide him with 500kg of seahorses annually. This, however, was insufficient for China's needs so he was travelling to Hanoi to try to arrange for more seahorses. Vietnam's seahorses are sought after in China for TCM because they are smoother, hence "better quality".

One senior biologist in southern China was confident that Vietnamese seahorses dominated the market in Guangxi province at least (Luo J-Z., pers. comm., 18 April 1995). Another senior Chinese fisheries biologist, in neighbouring Guangdong province, thought the scale smaller, but commented that "Seahorse prices are lower and seahorse harvests are better in Vietnam [than China]" (Wu Q-S., pers. comm., 17 April 1995).

Most seahorses go to China through the cities of Haiphong, Quang Nam-DaNang, and Ho Chi Minh City (Table Vietnam 1). Seahorses are exported through individual enterprises rather than official Government companies. Shipments of Vietnamese seahorses are sent across the border to China at Mong Cai or are transferred to Chinese fishing vessels at sea; all 3100kg exported from Kien Giang province to China apparently go through Mong Cai.

Table Vietnam 1

Dried seahorse trade to China and within Vietnam. Conservative estimates of volume (kilogrammes) are given where available.

Destination Place exporting*	exported to China	Hanoi	Haiphong	Danang	Khanh Hoa	Binh Thuan	HCM City
Haiphong	240-300						
Danang	900	x					
Quang Ngai				x			
Binh Dinh		x		x	x		
Khanh Hoa		x	x	x		300	
Ninh Thuan							
Binh Thuan	x		x	x	x		x
Baria Vung Tau				150-200			
Ho Chi Minh City	420-580						
Kien Giang	3100						

* Provinces are listed from north to south. x signifies trade.

Source: Truong Si Ky, *et al.*

Seahorses are also sent to Taiwan, Hong Kong, and Singapore. Taiwan's official trade figures show small seahorse imports from Vietnam in every year since 1989, apart from 1991 (see Table Taiwan 3), but there may well be a large unrecorded trade also. Vietnam's seahorses ranked among the most valuable imported to Taiwan, on a per kilogramme basis, reaching US\$105 per kilogramme in 1992, if the highly variable declared values can be

believed. Taiwan continues to import seahorses from Vietnam, recording 39kg in April 1995 (valued at about US\$1475).

In 1993, Hong Kong imported a small number of seahorses from Vietnam, and some others were fished from the Paracel Islands in the South China Sea (Amy Lau, *in litt.*, 18 March 1993), which are claimed by Vietnam, among others. One TCM retailer from Ho Chi Minh City said in 1995 that he frequently exported seahorses to Hong Kong, but gave no volume estimates.

A commodities importer from Australia tried to buy 500kg of Vietnamese seahorses from the Nha Trang Institute of Oceanography in May 1995, without success (see Australia section).

Value of dried seahorses in Vietnam

Prices increase steadily with marketing level (Table Vietnam 2). One TCM importer in southern China reported paying RMB1350 per kilogramme (about US\$163) for Vietnamese seahorses in April 1995. This is approximately the same price as that charged by level 3 buyers in Vietnam and suggests this level exports the seahorses to China.

Table Vietnam 2

Prices for dried seahorses (160-170mm long) in Nha Trang, Khanh Hoa province in June 1995

Bought by (level)	Price per s/h (VND 1000)	Price per kg (VND 1000)	Price per kg (US\$)
Buyer (2) pays fisher(1)	3	1050-1200	95-109
Retailer /exporter (3) pays buyer (2)		1300-1400	118-127
Consumer (4) pays retailer (3)	15-20	1700-2300	155-209

Source: Truong Si Ky *et al.*

Bigger seahorses were more expensive, with prices rising from VND1 600 000 (US\$145) (<150mm) to VND3 200 000 (US\$291) (>200mm) per kilogramme to the consumer (Table Vietnam 3). Two large 250mm seahorses purchased in June 1995 cost VND 130 000 in Hue (US\$12 per pair). The author bought a pair of very large Vietnamese seahorses (250mm) in a market in China in April 1995 at a cost of RMB260 (US\$30 per pair or US\$807 per kilogramme). The retailer commented that such large seahorses had become extremely rare.

Seahorses apparently became more expensive farther away from catch areas (Table Vietnam 3). Medium-sized seahorses cost VND8000-10 000 (US\$0.73-0.91) each in Kien Giang and VND15 000-20 000 (US\$1.36-1.82) each in Nha Trang (where many seahorses are caught), VND25 000-30 000 (US\$2.27-2.73) in Quang Ninh (where few seahorses are caught) and VND45 000-50 000 (US\$4.09-4.55) in Hanoi (where no seahorses are caught).



A. Vincent

Two large Vietnamese seahorses for sale in Qingping market, Guangzhou, China (with a pen for scale)

Table Vietnam 3

Prices for dried seahorses across Vietnam in mid-1995

Location*	Net importer (I) or exporter (E) of seahorses within Vietnam	Sold by	Size (cm)	Price per seahorse (US\$)	Price per kg (US\$)
Quang Ninh City	I	TCM shop	16-17	2.27-2.73	209
Quang Ninh City	I	TCM shop	12-18		145
Hai Phong City	I	level 3/4	<15		227
Hanoi	I	TCM shop	16-17	4.09-4.55	291
Hanoi	I	wholesale	12-18		200-209
Danang			<15		145
			15-20		227
			>20		291
Nha Trang	E	TCM shop	16-17	1.36-1.82	155-209
Phau Thiet	E	level 3/4	13-16		136
Ho Chi Minh City	I	TCM shop	>8		182
Barta-Vung Tau	E	wholesale	>8		155
Kien Giang	E	wholesale	>10	0.73-0.91	136

* Listed from north to south geographically.
Source: Truong Si Ky, et al.

Conservation concerns about seahorses with respect to Vietnam

Vietnam's seahorses have become fewer and smaller over the past two to three years, according to all fishers and traders expressing an opinion. The large seahorses (200-250mm) are now very rare. Divers in Cua Be (Khanh Hoa province) report that they could catch three to five seahorses of one species during two hours diving in 1991, but only one to two seahorses in 1995. Biologists from the Institute of Oceanography also found that mean length of seahorses in Cua Be estuary had declined significantly from 113mm in mid-1991 to 96mm in mid-1995.

Eight of the trawl boat fishers interviewed in Kien Giang province, where the majority of Vietnam's seahorses were landed, said that seahorse catch had declined 30-60% over the past three to five years, but none reported any change in seahorse size.

Captive breeding of seahorses in Vietnam

The Institute of Oceanography has been carrying out captive breeding trials for five years, with steady improvement of results. It is hoped eventually to establish small-scale seahorse culturing in net fish cages placed in ponds and estuaries.

Conclusions for Vietnam

Seahorse landings in Vietnam are largely a by-catch from trawling, and are greatest in the southern Kien Giang province and around south-central Khanh Hoa province. Exports escalated in about 1988 and now probably total at least five tonnes of dried seahorses annually, with most going to China. Domestic consumption is slight. Reports of declining seahorse number and size are widespread but largely undocumented.

As they are primarily a by-catch, seahorses are generally subject to the same fishing pressures as other fishes in Vietnam, and these are increasing. Vietnam's current drive for economic growth is encouraging full exploitation of all resources, and the Government's stated objective is to increase marine products exports from US\$550 million in 1995 to US\$1000 million by 2000 (Anon., 1996b). Already, however, fish numbers are declining in Vietnam, as a result both of overfishing and habitat destruction caused by extensive trawling (Luo J-Z., pers. comm., 18 April 1995).

Demand for seahorses *per se* could grow as a result of Vietnam's entry into the trading bloc of Southeast Asian nations (ASEAN) in July 1995 and the re-establishment of full diplomatic relations with the USA in August 1995. All these countries consume seahorses.

Given the current economic climate and their status as a by-catch, it seems unlikely that any general protection for seahorses can be implemented in Vietnam. Some fisheries modifications may be possible but marine reserves and captive culturing may offer the best chance of stabilising wild populations of seahorses.

SEAHORSE TRADE IN CHINA

China's demand for seahorses has accelerated in line with tremendous economic growth, virtually all used for TCM (including patent medicines). The best rough estimate is that China may use about 20t of dried seahorses *per annum*, of which most are imported. Vietnam and Thailand may be the largest suppliers, but seahorses from many other countries probably arrive through Hong Kong. Demand exceeds supply, and traders are keen to find new sources of seahorses.

Background for China

Information sources in China

Material in this section comes from 57 interviews and surveys in southern China in 1993 and 1995, as well as other sources. The largest Government TCM importers were visited in each major coastal town in Guangxi, Hainan, Guangdong, and Fujian provinces (Figure China 1). Six of the eight were willing to discuss the seahorse trade in detail. This section is largely a composite picture of their comments, which were quite consistent, and those of other experts consulted and TCM retailers and users. The author's interests in aquaculture were emphasized in interviews with TCM importers.

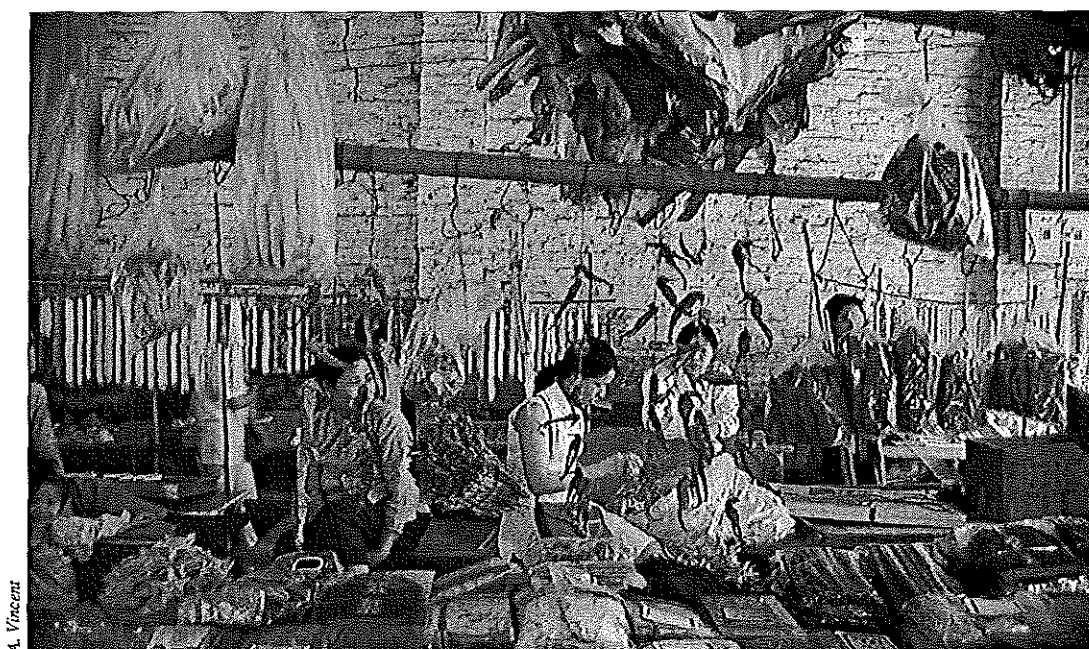
Seahorses in China

Local species in China

Wild seahorses are found along the Chinese coast among seaweed, and in seagrasses, from Vietnam to Korea. The author's informal compilation of seahorse material suggests that the seas adjacent to China may contain about seven species of seahorse, although taxonomy remains confused. One fisheries biologist told the author that four types have commercial value (he named them as *Hippocampus trimaculatus*, *H. kelloggi*, *H. kuda* and *H. histrix*) but that a fifth (possibly *H. coronatus*) had been considered too small (Wu Q-S., pers. comm., 17 April 1995); they may now become acceptable as larger seahorses become more difficult to obtain (see *Declining size of seahorses traded in China* below)

Seahorses for sale in China

Dried seahorses for sale are generally classified by size, colour and smoothness. The preferred large, pale, smooth seahorses apparently come from Vietnam or from within China. The cheaper and "inferior" spiny seahorses were said to come from other Southeast Asian nations or Japan. Imported seahorses used to be bleached and gutted (presumably on their way through Hong Kong - see Hong Kong section) but consumers are switching their preference to the original colouration. Damaged seahorses cannot be sold whole but are now acceptable for manufactured medicines (see *Uses* section and *Declining size of seahorses traded in China* below).



A. Vincent

The market hall at Beihai, Guangxi, China, with dried fish on sale for medicine, including seahorses

TCM dealers generally categorized seahorses roughly by size, measured from coronet to tail tip (Table China 1). They stated that seahorses less than about 70-80mm (about three grams dry weight) were generally used for patent medicines while larger seahorses were sold individually in the traditional way, but the author saw many very small seahorses for sale in TCM outlets. Seahorses in Beihai were measured differently, from coronet to base of the dorsal fin, with categories of small (< 50mm), medium (50-60mm) and large (> 60mm). "Small" seahorses in Beihai roughly corresponded to medium-sized seahorses elsewhere, and were acceptable only for factory use. Many seahorses seen for sale in China were juveniles, even by 1993 and certainly by 1995.

Use of seahorses in China

"The seahorse is a valuable Chinese medicine. There is a saying: 'North is ginseng and south is seahorse'", according to a 1980 video made by the Xiamen Aquaculture Institute (see also You, 1994). This oft-repeated aphorism apparently reflected the prominent status of these products in TCM across the country. Pharmacists in China primarily recommend seahorses to treat problems of the respiratory tract, including asthma and infections. In China, seahorses are widely used as general tonic ingredients and to enhance sexual function. They are also employed in folk remedies, including "sea treasure" which additionally requires pipefish, sea bird, sea snake and sea sparrow. The Uses section provides more detail on all these uses of seahorses.

All TCM merchants interviewed mentioned a significant shift toward proprietary medicines in recent years. Previously, patients chose the raw ingredients for their treatments, which were prepared while they waited. Now, say TCM traders, both disposable income and the pace of life are increasing, and people are choosing to buy boxes of ready-made pills in order to save time.

Perhaps 20-30% of the seahorses and pipefishes in China already go into prepared medicines, according to TCM traders (see Uses section). A TCM dealer in Guangzhou estimated in 1993 that "30-50 medicines include seahorse as an active ingredient" and more were being developed. Seven makes of such medicines incorporating seahorse were available in one pharmacy in Guangzhou in 1993, ranging in price from about RMB10-19 (US\$1.35-2.57). *Hai ma duo bian wan* was particularly popular (price was RMB15:US\$2), perhaps because it was advertised on television and in newspapers. Most clients were men who bought one to three bottles at a time and used the pills every day. The "Seahorse and *Morinda officinalis* pill" was another strengthening tonic, then costing RMB8.53 (US\$1.15).

Seahorses are sold as gifts. A market in Beihai (Guangxi province) specialized in gift displays of dried marine products for medicinal use. Apparently Guangdong residents visiting this holiday area often purchased them as souvenirs or presents. The market hall was festooned with seahorses hanging in pairs down strings. Among the merchandise were gift boxes (selling for RMB15: US\$2.03) of two tiny seahorses, two small pegasid fishes (*Pegasus volitans*), two stick pipefishes, probably *Trachyrhamphus serratus*, a chunk of seasnake and a small starfish.

The few marine aquarium enthusiasts in China apparently will buy live seahorses when available (Wu Q-S., pers. comm., 17 April 1995).

Legislation affecting seahorses in China

One commonly exploited seahorse species, putative *Hippocampus kelloggi*, is listed under category II of the *Law of Wild Animal Protection of the People's Republic of China, 1988*. This classification allows exploitation and trade only with permits granted by the provincial Government, but enforcement may often be relaxed. Only one Chinese interviewed acknowledged being aware of some restriction, a TCM importer who stated that Government permits were mandatory for trading seahorses. *H. kelloggi* is also listed as a Priority Fish Species (Grade B) in China's

Table China 1
Rough categorization of dried seahorses in China in April 1995, with prices in RMB

Grade Length Dry weight Use	extra small <50mm prepared medicine	small 50-100mm 3-4g prepared medicine	medium 100-150mm 5-8g whole or prepared medicine	large 150-200mm 8-15g whole	extra large >200mm >15g whole
Location*					
<i>Prices paid by Government TCM importers (per kilogramme of dry weight)</i>					
Beihai			1350 (smooth) 1150 (spiny)	2000	
Haikou			1300-1500	2000	
Shantou			1500	2000	
Xiamen			1500	2000	
Fuzhou		1000-1100			
<i>Prices charged by retail outlets</i>					
Dongxing pharmacy (Guangxi)		10/10g			
Dongxing market (Guangxi)		18/10g			
Beihai pharmacy (Guangxi)		24/pair			
Beihai market (Guangxi)		19/pair	38/pair	150/pair	460/pair
Guangzhou pharmacies (Guangdong)		22/10g	27-34/10g	40-60/10g	260/pair
Guangzhou market (Guangdong)		44/10g	25/10g		200/pair
Quanzhou pharmacy (Fujian)			26/10g		
Fuzhou pharmacy (Fujian)					

* Locations are organized geographically from west to east along the coast.

Source: Author's research.

Biodiversity Conservation Action Plan (Maxey and Lutz, 1994), although the meaning of this designation is unclear. It is also not obvious why only one seahorse species is designated for protection.

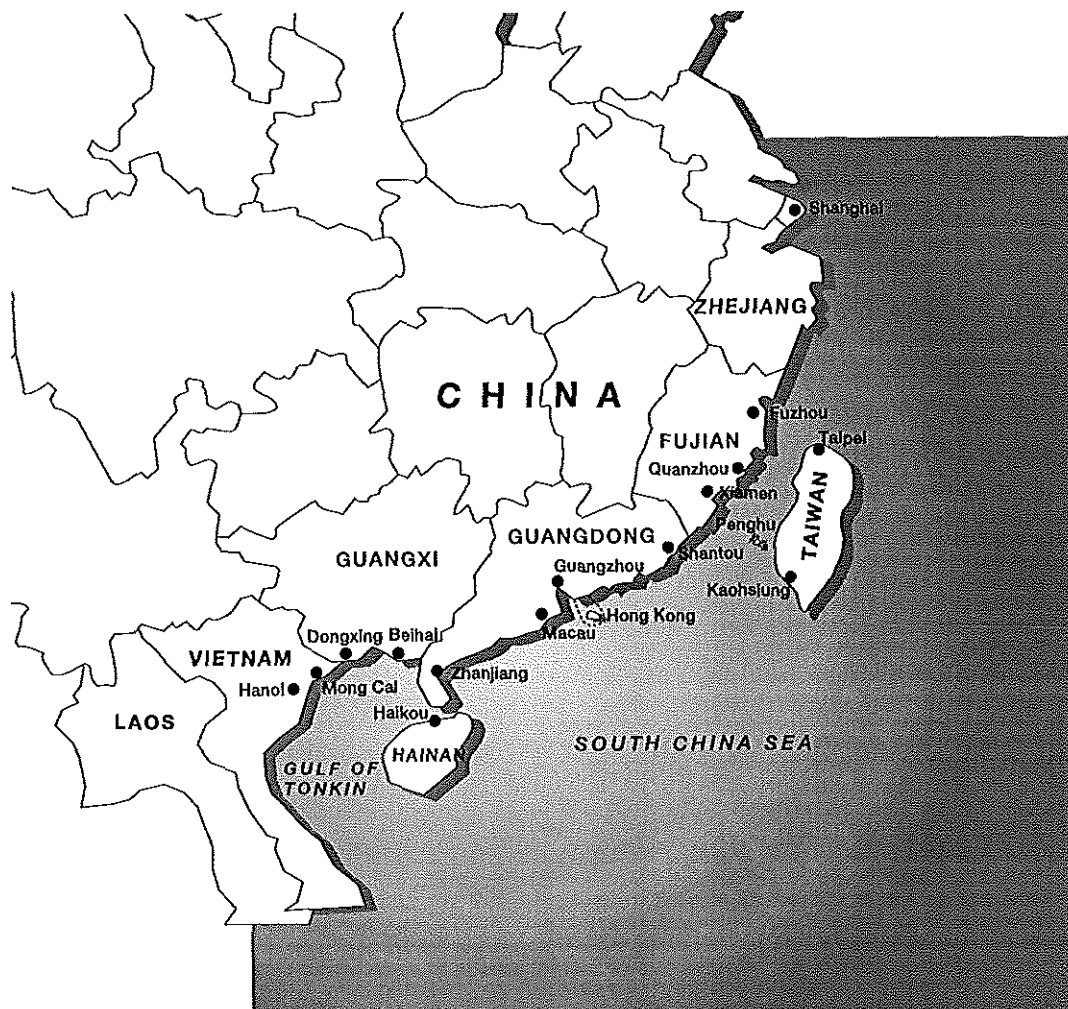
One Government TCM importer commented in 1993 that seahorses attract 60-70% import duties. Another, in 1995, claimed that seahorses destined for tonics attract 75% import taxes whereas those for medicines do not. Government agencies are theoretically obliged to declare seahorses as therapeutic medicines. Apparently, private companies often choose to avoid the issue by trading seahorses as dried fish.

Seahorse catch in China

Seahorses are generally obtained in China as a by-product of trawling for food fishes; there is no known target fishery. They may also be caught in throw nets, or while holding onto the gill nets set in mangroves to catch food fishes. Fishers in southern provinces iterated that the domestic seahorse harvest is very small and production very variable. They noted that total catch per boat was only a few seahorses to a few metric *catties* of total fish haul. It should be noted that such volumes could amount to a substantial number of seahorses, if many boats were active (e.g., see Vietnam section). Some buyers do focus on seahorses, accumulating small numbers from the many fishers, and then drying them in the sun.

Figure China 1

Map of southern China showing trading areas, as mentioned in the text



Most dealers cited the Gulf of Tonkin (*Bei Bu Wan*) and South China Sea as the main domestic sources of seahorses (Figure China 1). The seas around Fujian are also rich in seaweeds, but no longer yield many seahorses, according to a TCM importer. The Gulf of Tonkin is home to at least two species (*Hippocampus trimaculatus* and *H. kelloggi* types) and other species are found around the southern coast of Hainan Island. The Gulf has a mean depth of only about 40m, is rich in seaweeds (particularly brown filamentous types), is edged with mangroves, and is very heavily trawled. There were no reports of seahorse catches in Chinese seagrass areas or estuaries, but this may reflect lack of monitoring rather than lack of fishing (Luo J-Z., pers. comm., 18 April 1995).

Dried seahorse exploitation in China

Trade routes for dried seahorses in China

The TCM trading network in China is extensive and complicated, as a senior Government TCM importer explained in 1993. About 100 provincial and municipal Government agents - and countless new private companies - apparently distribute TCM in Guangdong province. In Guangzhou, TCM was then sold through 1000 outlets (10% of which were Government-owned), 65-75 private shops, and countless stalls, all of which set their own prices.

Nationally, there may be 2000-3000 provincial and municipal Government TCM agents, with at least one in each major town. These outlets previously held a monopoly on trade in medicinal ingredients, but this privilege has disappeared since the mid-1980s as a result of economic reforms. There are now many private TCM traders. Most Government TCM agents felt they now controlled less than half the trade in their region, although they still form a powerful trading bloc, exchanging goods among themselves.

The general consensus of opinion sought was that the ports along the southern and southeastern coast had long been the major trading centres for seahorses, because the native seahorse populations, the medical use of seahorses, and the sources of foreign seahorses are all concentrated there. These ports include Beihai, Haikou, Zhanjiang, Guangzhou and Shantou, and Xiamen and Fuzhou (Figure China 1). Port cities north of Fujian province (e.g., Hangzhou and Shanghai) are also involved in seahorse trading, but apparently to a lesser extent.

Government importers said that they tended not to sell locally, leaving this market to local fishers and small traders (which means that local sales are largely unrecorded here). Instead, these large TCM dealers either sent the seahorses to medicine factories, shipped seahorses to other regions of China, and/or redistributed seahorses around the province. For example, one Guangxi importer re-exported about two tonnes annually to Guangdong province. As well, Beijing agents purchase goods in Guangzhou, according to an importer from Hong Kong in May 1993.

Imports of dried seahorses to China

All those interviewed agreed that local supplies do not meet demands, and that China must import seahorses. One large Government TCM dealer was confident that 80-90% of his annual seahorse supply came from imports. Others agreed that imports constituted an ever-greater proportion of their seahorses sales.

The China Customs Statistics Yearbook lists dried syngnathid imports only for 1990 and 1991, as "Item 291987: Pipefish and hippocampi dried; tariff no. 05146" (Table China 2). The Harmonized System (HS) was adopted in 1992, and syngnathids were subsequently combined with other animal products in Customs tariffs. China imported more syngnathids from Thailand than any other nation in both 1990 and 1991; discussions with dealers suggest that these were all seahorses. Australia was recorded as the other major source, but these syngnathids would probably have been pipehorses, rather than seahorses (see Australia section).

Caution should be exercised in interpreting the official Customs statistics (Table China 2), notably because:

- it seems highly unlikely that 1991 syngnathid imports were only 61% of 1990 imports, given the universal consensus that demand was increasing and domestic supply decreasing;
- Hong Kong is listed only in 1990 but its role would probably have been enhanced in 1991 (see **Hong Kong** section);
- there is a great difference in the source countries supplying China in the two years, and such rapid shifts are not known for other areas.

Vietnam is now an important source of seahorses for China, probably partly because of its geographic proximity - both countries embrace the Gulf of Tonkin and they have land links - and partly because it still has seahorses. Seahorse prices are lower and the quality is better in Vietnam, according to one fisheries biologist (Wu Q-S., pers. comm., 17 April 1995). Very large seahorses (to 250mm) can still occasionally be obtained off Vietnam, although in decreasing numbers (see **Vietnam** section). China and Vietnam normalised relations in 1991 but much of the trade between these two nations continues to be illicit or at least unrecorded, either exchanged between fishing boats at sea or crossing the land border from Mong Cai (Vietnam) to Dongxing (China) (Luo J-Z., pers. comm., 18 April 1995). Vietnamese can cross the border freely, and restrictions on Chinese entries to Vietnam were said to be flexible. TCM dealers from China converge at this border to obtain seahorses for national distribution. Unofficial trade is reputedly tolerated because Guangxi is one of the poorer provinces in China.

Beihai in Guangxi province appears to depend heavily on Vietnamese imports of seahorses for TCM. One TCM agent (who claimed to import more seahorses from Vietnam than any other dealer in China) intended to travel to Hanoi shortly after being interviewed in order to seek more seahorses from the Vietnamese: he had been offered 500kg but needed at least double that volume from Vietnam. The same agent also imported seahorses through Hong Kong, and some from Japan, but none from the Philippines.

Hong Kong sends substantial numbers of seahorses to China. The Government TCM importer on Hainan reported primary sources of seahorses as Thailand and Indonesia (with some from Vietnam and Malaysia) but said these were usually imported *via* Hong Kong. The Government TCM agency in Fuzhou had also imported seahorses from the Philippines, Malaysia and Indonesia, through Hong Kong. Transport from Hong Kong was said to be usually by boat.

Seahorses apparently also arrive in China in the luggage of overseas Chinese, returning to visit ancestral homes in southern China in increasing numbers. A TCM dealer in Shantou commented particularly on the contributions of returning overseas Chinese to the seahorse trade. In this context, it is worth noting that many Chinese from Shantou emigrated to Thailand, a very large seahorse exporter (see **Thailand** section).

All those interviewed agreed that China currently keeps no national statistics on seahorse imports, and warned that any other records are likely to be unreliable because agencies may understate imports in order to avoid taxes (see *Legislation affecting seahorses in China* above).

Exports of dried seahorses from China

Taiwan's Customs data show that China has exported dried seahorses to Taiwan since 1991 (Table Taiwan 3), although these decreased somewhat in volume after 1992. Exports to Taiwan during the first four months of 1995 reportedly amounted to 247kg of dried seahorses. During investigations in Fujian province (closest to Taiwan) in 1995, Government TCM outlets repeatedly emphasized that any contact with Taiwan was illegal, although they admitted that fishers undoubtedly traffic goods across the Taiwan Strait (between Taiwan and Fujian province).

Table China 2

China's records of dried syngnathid imports in 1990 and 1991

Country	1990				1991			
	Volume (kg)	Total value (US\$1000)	Mean declared value (US\$ per kg)	* Rank by volume	Volume (kg)	Total value (US\$1000)	Mean declared value (US\$perkg)	*Rank by volume
Thailand	5967	398	67	1	4268	345	81	1
Australia	64	17	266	5	211	62	294	3
Hong Kong	1189	68	57	2				
Japan	401	25	62	4				
Singapore	424	48	113	3				
Indonesia					84	17	202	5
Mexico					131	18	137	4
Philippines					25	1	40	6
Spain					233	21	90	2
Total	8045	556	69		4952	463	94	

*Ranking of that country (by volume) among the countries from which China imported seahorses in that year.

Source: China Customs Statistics Yearbook

Taiwanese fishers (particularly from Penghu in the Taiwan Strait) similarly acknowledged trading at sea with fishers from mainland China (see *Taiwan* section). *The illicit flow of animal products across the Strait may be substantial* (Anon., 1991).

Japan apparently imports both dried seahorses and pills containing seahorse from China (A. Ishikara, *in litt.* 11 August 1995). TCM shops in Indonesia and the Philippines cited China as the source for their seahorses but in fact their bleached, highly processed seahorses probably came from Hong Kong. A few Hong Kong TCM retailers claimed that their dried syngnathids came from China, though the species seemed not to be of Chinese origin.

Volumes of dried seahorses traded in China

TCM dealers said it was becoming ever more difficult to estimate trade volumes, both because the trade has become very dispersed with the proliferation of new private enterprises and because so much trading passes through unofficial channels. Economic liberalization has diverted much of the medicine trade from Government agencies.

Government channels traded more than 10t annually, according to one of the larger TCM importers interviewed in 1995. This seemed plausible, given that just five of the Government TCM dealers interviewed in 1995 may have traded at least six tonnes according to their own estimates.

If Government outlets sell 10t annually and only control about 50% of the market, then this suggests annual sales of 20t nationally. This is in fact the figure provided by one senior Government TCM official in 1993 when the author asked him for a rough estimate of total trade volume. Twenty metric tonnes would equal five to six million seahorses annually (seahorses on sale in China averaged 3.8g in 1993 but have since decreased in size). That the total trade is large can be inferred from the immediate shortfall of perhaps 2.5t experienced by just four TCM importers (see *Conservation concerns about seahorses with respect to China* below).

In fact, 20t annually may be an underestimate. Vietnam alone is thought to export at least five tonnes annually to China, and just one of the larger TCM importers in Hong Kong estimated in 1993 that he sent seven tonnes of dried seahorses per year to China (see *Hong Kong* section). China might be expected to consume many more seahorses, given that Taiwan, with a population of 21 million, uses at least 11t annually.

Retail sales of dried seahorses in China

A tally of the number of TCM outlets nationally and the volumes each sells indicates that 20t as a figure for annual sales of seahorses in China is no exaggeration. One pharmacy in the small town of Dongxing sells 0.5-1kg monthly (130-260 seahorses or a maximum of 3120 annually). Another pharmacy, in Fuzhou, displayed 100 seahorses but might sell only 20 a week, or an annual total of about 1000 seahorses. One thousand TCM outlets (the estimated number in Guangzhou alone, for example,) each selling 20 seahorses a week (1000 *per annum*) would amount to one million seahorses sold each year.

Outlets can also move larger numbers of seahorses than the 20 estimated above. A total of about 20 large bags of dried seahorses were displayed (more may have been stored away out of view) at Guangzhou's Qingping market, each with a volume of around 15 litres. One stall alone claimed to supply local hospitals with 10-20 metric *catties* per week (at least 650-1300 seahorses, at a generous 3.8g each, gives a total of 33 800 to 67 600 annually). A stallholder in Beihai market said she sold 20-30 pairs of seahorses daily - observations suggested this could have been correct - and there were at least seven other similar stalls, so possibly total market sales could be 320-480 seahorses daily, more than 100 000 annually.

Values of dried seahorses in China

Seahorses are perceived as a “very important, very precious Chinese medicine of high economic value” (You, 1994). Some retailers (e.g., small Fuzhou pharmacies in 1995) considered all seahorses too expensive to stock. The general consensus in China was that cheaper seahorses sold better, but China’s purchasing power is changing. In 1993, Hong Kong merchants said that China always imported the cheapest possible seahorses, and one Hong Kong importer re-exported to China at preferential prices (see Hong Kong section). By 1995, the same Hong Kong importer argued that China was taking all the good quality seahorses, making them unavailable in Hong Kong.

China Customs Statistics Yearbook shows that declared values in 1991 ranged from only US\$40 per kilogramme for Philippines seahorses (usually considered inferior) to US\$294 per kilogramme for Australian syngnathids (presumably pipehorses) (Table China 2). Declared values for Thai syngnathids increased 20% between 1990 and 1991, while Australian syngnathids, presumably pipehorses cost 10% more in 1991.

Government TCM importers reported paying RMB200-300 per kilogramme in the mid-1980s, RMB600 per kilogramme in 1989, and RMB1000-2000 per kilogramme in 1993-1995 (US\$135-241) for dried seahorses. Since inflation has recently consistently run at over 10% (Anon., 1996a), the apparent price increase over at least the years 1989-1995 may simply have kept pace with inflation, without becoming more expensive relative to other products.

Prices varied locally according to supply and demand. Importers in the western part of the country (nearer Vietnam) appeared to pay less for seahorses (Table China 1). Retail outlet pricing also seemed lower in the western part of the country (Table China 1). It was, however, somewhat difficult to compare seahorse prices between dealers because each applied different rules when assessing size, colour and spininess. For example, one Government company considered a seahorse of three grams to be medium-sized, whereas other companies classified this as small. Also, some agents mixed desirable and undesirable seahorses and assigned them all the more expensive price.

Prices for mixed seahorses in one Guangzhou pharmacy rose from RMB20 (US\$2.70) per 10g in 1993 to RMB31 (US\$3.73) per 10g in 1995. This increase, however, was in line with the national retail price index, that climbed 24% in 1994 and 17% in 1995 (Anon., 1996a). One source believed that seahorse prices (among others) had been fixed until the early 1980s when economic reforms freed them to fall to an all time low in 1986, from where they have been recovering (Luo J-Z., pers. comm., 18 April 1995). He reported fixed prices of about RMB50 per pair in 1980. In 1995, the author bought a similar pair of seahorses in the Beihai market for RMB38 (US\$4.59), considerably less in real terms. Pairs of seahorses on sale in the market were matched by size rather than by sex or by species, and cost from from RMB19 (US\$2.29) to RMB460 (US\$55.40) per pair.

Retail prices were usually higher for imported seahorses than for the few local ones available but this apparently varied with the season and with relative demand for different seahorse types. For example, seahorses brought in by local fishers were selling for RMB25-50 (US\$3.38-6.76) per 10g in Guanghai in June 1993, compared with the RMB20 (US\$2.70) per 10g charged for imported seahorses in Guangzhou at the same time.

Conservation concerns about seahorses with respect to China

Increasing demand and decreasing supply in China

Seahorse supply does not meet demand. All those interviewed in 1993 and 1995 agreed that demand for seahorses had expanded dramatically in the previous decade, perhaps ten-fold, and now continues to increase at a rate of about 8-10% per year. According to TCM traders this level of demand has already depleted the domestic supply of

seahorses and will continue to absorb all available seahorses, even should aquaculture become successful.

A senior official in the TCM trade speculated that economic liberalization had to some extent disguised the loss of China's domestic seahorse supply because greater openness had allowed growth in imports to meet increased demand. Yet even imports no longer meet demand in China. The shortfall is such that four Government importers sought to buy nearly 2.5t of seahorses from the author during her 1995 trip (although seahorses are sometimes pooled, thus meeting one such request could reduce others' demands.)

Clearly pressures on wild populations of seahorses are set to increase.

Declining size of seahorses traded in China

It was generally agreed that large seahorses were becoming ever more difficult to obtain, even from relatively newly tapped sources such as Vietnam. Large and "giant" seahorses are now seldom available, and juveniles (lacking brood pouches) are commonly traded. Indeed, TCM agents find that many of the seahorses are too small to be sold in TCM pharmacies.

Declining size may indicate overfishing and should be cause for concern. The problem is set to worsen, as use of prepackaged medicines increases. Consumers do not select the seahorses used in patent medicines, so virtually all seahorses can now be absorbed into TCM, whether small, dark or spiny. TCM dealers apparently feel free to use seahorses that would have been dismissed as unacceptable at the pharmacy counter. Large seahorses are too expensive to be used in pills, so patent medicines are absorbing ever greater numbers of very small seahorses. The net result is that no seahorse is rejected in China, with worrying consequences for wild seahorse populations; both the largest and the smallest seahorses are now vulnerable.

Pressures on previously "unacceptable" seahorses will continue to increase. According to one TCM importer, approximately 30% of seahorses by weight (more by number) now go to medicine factories rather than to more traditional retail outlets. Several agents felt that prepared medicines would soon absorb the majority of the trade, as medicines and factories proliferate. TCM dealers are relieved that this shift to patent medicines may defer greater shortages of dried seahorses, by allowing use of the small and undesirable ones, but it bodes ill for seahorse populations.

Habitat destruction in China

Loss and damage of habitats threaten seahorses in China, as elsewhere. For example, the area of mangroves (seahorse habitat) on the coast of the South China Sea has declined from 50 000ha to 20 000ha since the early 1950s (Maxey and Lutz, 1994). Dynamite fishing is increasing along the south China coast, the state of seagrass meadows is virtually ignored (Luo J-Z., pers. comm., 18 April 1995), and trawl fishing is severely damaging bottom habitats, including in the all-important Gulf of Tonkin. This ecosystem had remained reasonably healthy until recently, because armed conflicts in the region (involving Vietnam, France, USA and China) had deterred fishing, but relative peace in the late 1980s prompted sudden increases in fishing pressure.

Captive breeding of seahorses in China

"Artificial culture of seahorses resolves the conflict of high demand, but small wild populations", pronounced a 1980 video on seahorse culturing by the Xiamen Aquaculture Institute. One senior TCM dealer also suggested culturing as the panacea. Those who had already tried it were less convinced, for culturing has failed thus far.

Seahorses were actively farmed in China from the 1950s to the early 1980s (e.g., Anon., 1990b; Anon., 1982). At the peak of culturing activity, seven large seahorse cultures operated on the South China Sea coast: two in Guangxi

province (Beihai), two in western Guangdong province (near Zhanjiang), and three in eastern Guangdong province (Lufeng, Raoping and Shantou) (Luo J-Z., pers. comm., 18 April 1995). Other cultures were located in Hainan province (e.g., Te Shi and Cheung Hai) and all along the southern coast. During the 1960s, seahorse culturing also involved Zhejiang, Jiangsu, and Shandong provinces, farther north. Despite all this activity, it seems that seahorse farms made little difference to national seahorse supplies.

Aquaculture efforts ceased because of combined biological and economic difficulties. Extensive investigations and on-site visits through four provinces (Guangxi, Hainan, Guangdong, and Fujian) in 1993 and 1995 found no seahorse culturing. The last known farm in the south was an operation at Shanwei (Guangdong province) which was reportedly still selling seahorse young in 1992. Qingdao Ocean University and Qingdao Dongfeng Saltpan apparently mounted a new attempt to culture and overwinter seahorses in 1990 (in Shandong province), but its outcome is unknown.

The seahorse farm at Beihai was representative of larger seahorse culturing attempts and could obtain rearing success of 50-60% when all went well and managed to rear three to four generations in captivity. Nonetheless, the project was abandoned as an economic failure in 1986.

Another seahorse farm run by the Guangzhou Pharmaceutical Corporation persisted until 1987. They cultured "black" seahorses from Shantou and Southeast Asia, and reared the seahorses for six months before harvesting (Ying Xie, *in litt.*, 3 September 1993). Mature seahorses were kept easily but it took considerable effort to achieve 30% survival of young to maturity (140mm). This project was classified as "successful" by the National Medicine and Pharmaceutical Administration, even with its poor yields.

Culturing seahorses poses serious technical problems, although most biologists and TCM dealers felt these could be overcome. All those questioned agreed that breeding seahorses in captivity is relatively simple but rearing the young is highly problematic (see Uses section). The Chinese traders and biologists who were interviewed emphasized that young seahorses in captivity are plagued from birth with nutritional problems and disease. The result is very high mortality rates and low productivity. Familiarity with the technical difficulties made the Chinese sceptical of accounts of seahorse culturing in Thailand, Vietnam or anywhere else.

The common consensus was that seahorse farming just did not pay when compared to other aquaculture efforts such as food fish, shrimps, clams and oysters (for pearls). New economic pressures in the late 1980s exacerbated technical difficulties: industries had to become profitable to survive but seahorse prices fell as a sudden rush of imports arrived through China's newly opened borders. Nowadays, rising prices for seahorses and smaller acceptable sizes may alter the cost/benefit ratio in favour of new culturing attempts (see Recommendations section).

Conclusions for China

Seahorses have been used in TCM for centuries but demand in China has apparently escalated during the past ten years, in response to economic changes. Greatly enhanced disposable income has promoted increased purchases of animal products. China's domestic production of seahorses appears small, and large imports come from Vietnam, Thailand, and other countries around the region (often through Hong Kong). It currently seems, however, that not even large imports can meet demand for seahorses. Sales volumes are difficult to estimate as there is no central registry of seahorse imports is available, and marketing is complicated, but it seems probable that China uses about 20t of dried seahorses annually (five to six million animals). Demand for seahorses apparently continues to rise, and China's collapsed aquaculture initiatives may have to be revived.

SEAHORSE TRADE IN HONG KONG

Hong Kong is a major entrepôt for seahorse trading. A minimum estimate is that Hong Kong consumes seven tonnes of dried seahorse annually, although in excess of 10t is more probable, while many tonnes of seahorses are re-exported to China and Taiwan, among others. The territory buys seahorses primarily for TCM and tonic foods, although some are also imported live as aquarium fishes.

Background for Hong Kong

Information sources in Hong Kong

Most information was collected during interviews and surveys in May 1993, with supplementary data from September 1994 and April 1995. Two Hong Kong Chinese biologists assisted the author on visits to one importer, one wholesaler, and pharmacies in 1993 and 1995, and a European volunteer surveyed four pharmacies briefly in August/September 1994. The Yat Chau health restaurant was also visited in 1993. Casual interviews with staff were conducted in the ten TCM pharmacies visited in 1993, whereas only surveys were conducted in the twelve pharmacies visited in 1995; one of the pharmacies was visited in both years.

Additional information comes from interviews with local officials and academics concerned with TCM. The importer and wholesaler were aware of the author's real identity. The TCM importer interviewed had been in the business for 30 years. He was willing to be informative, but repeat questioning was necessary to clarify volumes and prices. Seahorses and pipefishes comprised about one per cent of his company's trade volume. The wholesaler (visited in both years) was also a pharmacy retailer and had been in the medicine trade for 50 years; he was very co-operative and helpful.

Pharmacies in Hong Kong are often large and bright. Products and prices are clearly displayed, and sale prices are posted in central areas of the territory, although these offer no real savings over pharmacies in outlying areas. TCM merchants and pharmacists were not defensive when questioned and notes could be taken openly when visiting shops. Retail outlet employees did, however, become dismissive when they detected no intention to buy, and one man staffing a pharmacy in Kowloon refused to answer questions unless paid.

Seahorses in Hong Kong

Seahorses were caught locally until the 1970s, mostly as an incidental by-catch, in the South China Sea off Dongsha (Pratas Is.) and Xisha (Paracel Is.). Seahorses caught near Hong Kong and other smooth types of seahorse are considered to be highest grade (A. Lau, *in litt.*, 18 March 1993). Nowadays local production would meet only about 0.5% of current demand, so most seahorses must be imported (A. Lau, *in litt.* 18 March 93). Thai seahorses, with their smooth and shiny body, are second grade. The spiny seahorses from the Philippines are of medium quality while those from Malaysia are dismissed as poor quality, because of both thin spiny bodies and black markings (although there should be other "better" species in Malaysia also).

Many species were for sale in Hong Kong, although some TCM retail outlet staff claimed that all were the same. Pharmacies offered up to six containers full of seahorses, either bleached or unbleached and sorted by size. There was no clear definition of size classes across pharmacies so the labels of "small", "medium" and "large", are somewhat arbitrary, and variable in time and place. Few seahorses longer than 20cm were available.

Seahorses for sale in Hong Kong have generally been bleached white. They are imported in their natural colours, then soaked in "industrial bleach" (probably sodium hypochlorite) by wholesalers. The bleaching process seems to reflect consumer taste, rather than serving to improve intrinsic worth; perhaps it is the natural extension of preference for pale seahorses, which in turn often correlates with greater smoothness. Preference for bleached seahorses may be fading somewhat, because of fears that the process may eliminate important nutrients and leave chemical residue (Chan Cheung, pers. comm., 4 May 1993).

Dealers take advantage of the softening created by the bleach to tie each seahorse's tail in a tight spiral. The tight curling remains even when the seahorse dries and the string is removed. Hong Kong consumers prefer seahorses to have curled tails but not for any obvious medical reason.

Seahorses are often gutted during the bleaching process (so no colour mars the white torso), and hence are about 50-70% of the weight of unbleached seahorses. In 1995, five randomly chosen bleached seahorses weighed a total of 0.4 *liang* (three grams each) whereas five randomly chosen unbleached seahorses weighed a total of 0.6 *liang* (4.5g each). A mean weight of 3.75g each, or a mean of 267 seahorses per kilogramme, is thus used in calculations involving dried seahorses in Hong Kong in this report. This is a conservative figure, since many seahorses (bleached and unbleached) in 1993 surveys weighed only 2.8-3.2g, but it offsets the few larger seahorses.

The lower weight per bleached seahorse is compensated by the higher price per unit weight that such seahorses fetch, ensuring that the merchant does equally well with either type. In 1995, one outlet in Kowloon sold bleached at unbleached seahorses at HK\$80 per tael and bleached at HK\$120 per tael. Thus a 50% higher price more than offsets a 33% reduction in weight with bleaching. Another shop, in Central, sold bleached seahorses for 20% more than unbleached, presumably again compensating for weight loss.

The gutting process probably explains why many bleached seahorses had been sliced opened along the mid-line. Other explanations offered by pharmacy staff included: (a) this was natural; (b) they had burst open; (c) they had been damaged by fish hooks; or (d) they had been gutted to prevent rotting. Unbleached seahorses had also sometimes been opened ventrally by buyers, to check for lead placed inside the animal to increase its weight, and hence price.

Hong Kong syngnathids are sold in units of weight called *taels* (37.8g). One *catty* comprises 16 *taels*, and weighs 0.605kg (more than the metric *catty* weight of 0.500kg often used in China). A common purchase is half a *tael* (18.75g) of seahorse, which would be equivalent to the weight of one large seahorse. TCM outlets display small amounts of syngnathids (Table Hong Kong 1) but may have more in the back room.

Seahorse prices in Hong Kong were usually given per *catty* (605g) or per *tael* (37.8g).

Use of seahorses in Hong Kong

Seahorses are sold in Hong Kong primarily for respiratory ailments, but also for tonics, and for aiding sexual functions. They are included in more expensive alcohol-based tonics, such as those incorporating deer antler which sell at HK\$5 800-HK\$23 800 (US\$773-US\$3173) per four to five litres. Staff in pharmacies reported in 1993 that (a) all age groups and both sexes buy seahorses (four pharmacies); (b) that women buy them primarily for their children's asthma (one pharmacy); (c) that older people buy more than younger people (one pharmacy). Adolescents in Hong Kong are very receptive to TCM, probably because of family influences (Cheung, 1987). There are, however, reports that younger people in Hong Kong, while using TCM, may not understand its principles; this could lessen the strength of their adherence to TCM (Parry-Jones and Mills, in prep.).

The Yat Chau health restaurant in the Central district of HK combines a restaurant and pharmacy, and advisors are on hand to help select dishes. Their menu includes one special dish containing one small pipefish and one small seahorse, that must be ordered in advance, and one dish with chicken garnished with seahorse for one person, costing HK\$60 (US\$8) in May 1993 (Figure Hong Kong 1).

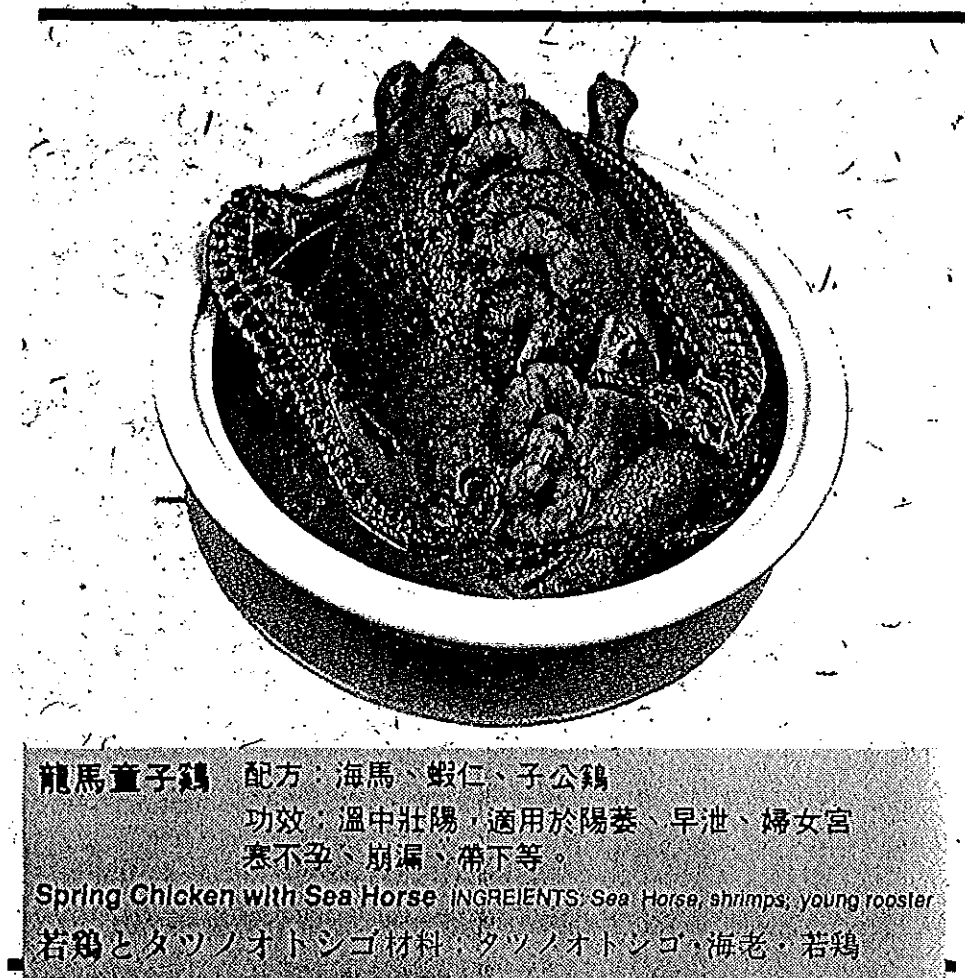
Figure Hong Kong 1

A tonic food of "Spring Chicken with Sea Horse" listed on a promotional pamphlet from the Yat Chau health restaurant in Hong Kong. The Chinese reads as follows:

"Spring Chicken with Seahorse"

Ingredients: Seahorse, shrimps, young rooster

Function: Warms the spleen and strengthens the yang [here denoting sexual function], is suitable for the treatment of impotence, premature ejaculation, female sterility, uterine bleeding, and vaginal discharges."



The son of a Hong Kong fisher remembered that they used to eat seahorse soup in the 1970s. Seahorses would be collected near shore, along with other fishes, often among brown sargassum or other algae, with the aid of a butterfly net. The fresh seahorse was boiled with pork & ginger for four to five hours until the skeleton softened enough to eat it. Roughly one seahorse each was ingested once daily for two weeks in order to treat septic infections and lymph node problems. Such practices have apparently been abandoned because few seahorses are now available.

Legislation affecting seahorses in Hong Kong

Hong Kong legislation protects only those marine organisms listed in CITES Appendix I or II, which seahorses are not.

Dried seahorse exploitation in Hong Kong

Retail sales of dried seahorses in Hong Kong

Nine of 10 pharmacies visited in 1993 stocked seahorses, and the other pharmacy sought to buy seahorses from the investigators. All 12 of the pharmacies visited in 1995 sold seahorses of some type (Table Hong Kong 1). Pharmacies generally displayed more bleached than unbleached seahorses but some pharmacists commented that, in fact, more unbleached seahorses were sold because they were cheaper (Table Hong Kong 1). Supply of the large "top quality" bleached seahorses was apparently very limited.

Imports of dried seahorses to Hong Kong

Thailand is said to have supplied over 50% of the seahorses sold in Hong Kong in 1993 (A. Lau, *in litt.*, 18 March 1993). The importer interviewed in 1993 confirmed that Thailand was his preferred source, but told the author in 1995 that the supply of Thai seahorses had dwindled markedly. The wholesaler, also interviewed in 1993, who obtained some seahorses direct from Thai fishers, warned that country of origin need not mean the fishes were caught in that country (see **Thailand** and **Methods** sections).

TCM dealers at all levels of the trade reported that other seahorses came from the Philippines (see **Tables Philippines 1 and 2**), Malaysia (including Borneo), Australia and Latin America. Exporters in the central Philippines do cite Hong Kong as the major destination for dried seahorses - one said in 1993 that Hong Kong "always takes all the seahorses we can sell" no matter what the size - but Australia and Latin America would be unusual sources of seahorses, more commonly cited as sources for pipehorses ("seadragons").

Some Indonesian exporters of dried marine products and aquarium fishes reported standing orders for dried seahorses from Hong Kong (see **Indonesia** section). Vietnamese sources also report sending seahorses and pipefishes to Hong Kong (see **Vietnam** section), although Hong Kong traders did not mention Vietnam as a source in 1993. One New Zealand fisher reported sending dried seahorses to Hong Kong in the early 1980s (M. McLean, *in litt.*, 4 October 1995). No syngnathids came from Japan, the USA or China, according to the importer and wholesaler, but pharmacy staff cited Japan as sources. Three retail staff insisted that many or most of their seahorses came from China (despite importer's and wholesaler's comments to the contrary), and one shop said their seahorses came from "Africa and Malaysia". The spiny (cheaper) seahorses were said to come from the Philippines while the larger smoother seahorses come from "farther away".

Numbers of syngnathids from all source areas apparently fluctuated seasonally. Seahorses were said to be easiest to obtain in March and April, with numbers declining later in the year. The importer explained this decline as a result of diminished trawling effort, noting that seahorses are a by-catch of shrimp fishing which also diminishes later in the year. The geographic range of source areas for seahorses will make this comment difficult to verify. Although it is true that dried seahorse exports from the target fishery in the central Philippines (much of it destined for Hong Kong) would be high in March and April, this has nothing to do with by-catch (see **Philippines** section).

Exports and re-exports of dried seahorses from Hong Kong

Many syngnathids are re-exported to China, with the TCM importer interviewed in Hong Kong alone sending seven tonnes annually. He said that Chinese TCM dealers often found it easier to buy products through Hong Kong with its established trade routes, than to establish their own networks overseas. So important are re-exports to China that apparently only Hong Kong importers with access to this market will import seahorses.

In 1990, the China Customs Statistics Yearbook reported that syngnathid imports from Hong Kong amounted to 1189kg, at a total value of US\$68 000. The fallibility of these Chinese data is illustrated by the absence of any

recorded imports from Hong Kong in 1991, when TCM traders in both Hong Kong and China confirmed that the trade certainly continued (see China section).

Taiwan acquired many dried seahorses through Hong Kong prior to 1990 (Table Taiwan 3). Thereafter, Hong Kong's sales to Taiwan dwindled, perhaps partly because Hong Kong began to export more to China and partly because China started officially exporting to Taiwan (see Taiwan and China sections). One explanation for these changes was that Taiwan generally imported directly, and bought from Hong Kong only when demand could not be met elsewhere. However, general enquiries in 1993 elicited the information that Taiwanese merchants had a great need for "high grade" large seahorses, and regularly visited Hong Kong to purchase them (A. Lau, *in litt.*, 18 March 1993).

The Hong Kong importer interviewed sent one percent of his syngnathids to Japan, and "a few" to Korea. It seems that Hong Kong merchants also re-export seahorses back to Indonesia and the Philippines, whence they came, for sale in TCM outlets (see Indonesia and Philippines sections). Many of these seahorses have been bleached, which means shipments are probably technically regarded as exports rather than re-exports.

Volume of dried seahorses consumed by Hong Kong

Assessment of trade volumes will be confounded by inadequate knowledge of the large scale re-exports of seahorses to China. For example, Philippines' trade records show exports to Hong Kong of several tonnes annually in the 1980s, although some may have been re-exported to China. A dearth of data means that all calculations in this section are highly speculative, but hopefully illustrative.

Crude calculations from three retail levels in Hong Kong in 1993 produce sales estimates of perhaps 10t of dried seahorses annually by importers (excluding seahorses handled by dealers in other commodities), perhaps seven tonnes by wholesalers (excluding wholesalers in proprietary medicines), and more than 25t by TCM outlets (see Appendix 4 for detailed calculations).

An estimate of 10t would suggest that Hong Kong's consumption is similar to Taiwan's recorded imports of seahorses, but for a much smaller population (about six million people in Hong Kong versus 21 million in Taiwan). The rough estimate for Hong Kong may be wrong, the trade figures for Taiwan may be wrong, or it may be that Hong Kong residents use more seahorses. Hong Kong pharmacies are generally bigger and busier than those in Taipei, and effectively all pharmacies stocked seahorses (*versus* 74% of those in Taipei and fewer elsewhere). Clearly, more detailed analysis is needed, before a surer evaluation of Hong Kong's annual consumption of seahorses can emerge.

Whatever the current sales, they are likely to grow. TCM merchants in Hong Kong agreed that supply did not meet demand. In May 1993, the author enquired after seahorses in a TCM shop that had none (in the New Territories), and was immediately asked to supply as many seahorses as possible.

Values of dried seahorses traded by Hong Kong

Bleached seahorses were substantially more expensive than unbleached types per unit weight (Table Hong Kong 1) but cost about the same per seahorse, because bleached ones weighed less (see *Seahorses in Hong Kong* above). Larger seahorses cost more per unit weight and per individual than smaller animals (Table Hong Kong 1). Prices did not differ in any consistent fashion among the areas of Hong Kong visited. Prices for small seahorses (bleached and unbleached) did not change noticeably from May 1993 to April 1995, at wholesale or retail levels (Table Hong Kong 1); interim prices for small seahorses on Hong Kong Island in September 1994 were HK\$85-88 per *tael* (unbleached) and HK\$120-140 per *tael* (bleached). A typical small bleached seahorse weighing about

THE INTERNATIONAL TRADE IN SEAHORSES

2.8g cost HK\$9 in both 1993 and 1995 (US\$1.20). Since inflation was about 8-10% annually, small seahorses thus became relatively cheaper. Large bleached seahorses cost HK\$250 (US\$33) at one TCM outlet on Hong Kong Island in 1993 and cost HK\$350 (US\$45) at one outlet in Kowloon in 1995, but nothing can be inferred from such sparse data except that they are an expensive commodity.

Table Hong Kong 1

Summary table of dried seahorses for sale in 1993 and 1995 in pharmacies

Type Size	Unbleached			Bleached		
	S	M	L	S	M	L
May 1993						
Weight (g)	3.2		20.8	2.8-3.2	3.8	15.2
Length (mm)	125-150		200-225	100		
No. shops where displayed (n = 10)*	5	0	1	6	1	1
No. on display per shop	40-100		50	40-200	100	12-50
Cost/tael (HK\$)	75-125		200	100-150	130	250
Cost/kg (US\$)	265-441		705	353-529	458	882
April 1995						
No. shops where displayed (n=12)	4	7	0	5	2	1
No. on display per shop	20-150	50-500		100-200	50-150	40
Cost/tael (HK\$)	80-120	75-120		95-150	90-150	350
Cost/kg (US\$)	275-412	265-412		326-515	309-515	1202

* Yat Chau health restaurant not included: 50 large unbleached seahorses for HK\$250/tael and 100 medium-large (>150mm) bleached seahorses for HK\$220/tael.

Source: Author's research

In April 1995, the Hong Kong wholesaler said he bought Thai seahorses for HK\$800 per *catty* and sold them at 10% profit. He classified Thai seahorses as (a) large and smooth and (b) small and spiny, and claimed to sell the former for double what he paid and the latter at cost. He also bought spiny Philippine seahorses (*Hippocampus histrix* type) at HK\$600 (US\$78) per *catty*. These are less liked by consumers but look similar enough to the smooth Thai seahorses when bleached that some retailers blend both sets of seahorses and sell them together for the higher price. If sold on their own in a retail outlet, Philippines spiny seahorses cost HK\$80 (US\$10) per *tael* unbleached and HK\$100 (US\$13) per *tael* bleached.

In May 1993, the importer charged Chinese dealers roughly 10-20% less than dealers from Hong Kong for the same dried syngnathids because "China buys in bulk" (Table Hong Kong 2). The same pattern holds for other

medicinal materials, thus encouraging Hong Kong residents to travel across the border for shopping, according a Hong Kong resident buying dried syngnathids in Guangzhou in May 1993.

Table Hong Kong 2

Prices for syngnathids sold to China or Hong Kong by Hong Kong importer

	Price per kg (US\$)	
	Sold to China	Sold to Hong Kong
Small seahorses	160	200
Pipehorses ("seadragons")	340	400
Pipefish <i>Syngathoides biaculeatus</i>	90	100

Source: Author's research

Live seahorse exploitation in Hong Kong

Indonesian sources reported exporting live seahorses to Hong Kong, but all five aquarium shops visited on the main Tung Tsoi Street in June 1993 were selling seahorses (between two and 13 per shop) that had reputedly come from the Philippines. Many of the displayed seahorses were in poor condition, most were very small (less than 80mm), and some were still juveniles (less than 40mm and lacking brood pouches). Prices ranged from HK\$20 (US\$2.67) for a spiky *Hippocampus histrix* type to HK\$60 (nearly US\$8) for a smooth black *H. kuda* type.

Conservation concerns about seahorses with respect to Hong Kong

Biologists and traders alike report that few seahorses remain in Hong Kong waters, but that they were relatively plentiful in the 1970s. The decline may, however, be attributable to pollution and habitat destruction quite as much as to direct harvesting. About 50% of Hong Kong's marine habitat will have been directly dredged, filled, or otherwise affected by the year 2000 (D. Melville, pers. comm., 4 May 1993).

Little information relating to conservation status of seahorses abroad could be gleaned from interviews held in Hong Kong, but imports from some sources may have declined, including those from Thailand, according to the wholesaler questioned. He also noted that fewer "good" seahorses were available for domestic use in Hong Kong by 1995, a shift which may have arisen partly because China has begun buying quality animals, whereas it had previously sought cheaper seahorses. He had not noticed any change in seahorse sizes by 1995, but reminded the author that he this would probably not be evident to him immediately in any case, because he refused to buy small seahorses.

Conclusions for Hong Kong

Hong Kong imports seahorses for domestic consumption, for processing (bleaching) and export back to source countries, and for re-export to China and other consumer countries. Seahorses arrive from all over Southeast Asia and perhaps from Australia and Latin America. Very crude estimates from minimal data suggest that Hong Kong could be consuming about 10t of dried seahorses annually. There is no evidence that this domestic consumption is increasing but Hong Kong's role as an entrepôt means the territory's merchants will be likely to import (and then re-export) more seahorses to supply China's growing market. Seahorse prices in Hong Kong retail outlets in 1995 reached US\$1200 per kilogramme for large, bleached seahorses. Certain former sources of seahorses may be dwindling (e.g., Thailand) and one TCM dealer in Hong Kong worried that China's growing consumption would reduce syngnathid availability for local use.

SEAHORSE TRADE IN SINGAPORE

Singapore's geographic location, its frequent role as an *entrepôt* for many commodities, and its ethnic Chinese population of 2.2. million people would suggest that it trades large volumes of dried and live seahorses. Certainly large boxes of seahorses are seen for sale in retail outlets. Indian traders reported that Singapore imported more than three tonnes of dried seahorses from India in 1994. The dearth of information on this country's seahorse trade leaves a serious lacuna in the data.

Dried seahorse exploitation in Singapore

Imports of dried seahorses to Singapore



Dried seahorses and geckos, Singapore

One region of India sent most of its annual exports of nearly 3600kg of dried seahorses to Singapore (Marichamy *et al.* 1993 and see **India** section). The largest dried seahorse exporter in southern India observed in 1995 that either demand for seahorses in Singapore had increased or supply had decreased, because importers from Singapore no longer told him to stop sending seahorses because of oversupply, whereas they had occasionally done so prior to 1990.

Philippines' trade records show dried syngnathid exports to Singapore during the 1980s (before records ended), although the exact numbers are unreliable (Table Philippines 1). Exports from Jolo in the southern Philippines to Singapore continued at least until 1992 (Urlanda, 1992). Vietnam also claims to export some seahorses to Singapore (see **Vietnam** section).

Exports of dried seahorses from Singapore

Chinese trade records indicate imports of 424kg dried seahorses from Singapore in 1990, at a total value of US\$48 000 (China Customs Statistics Yearbook). However, the records show no imports for 1991 and only one of six major TCM importers interviewed in southern China in April 1995 mentioned Singapore as a source (see **China** section). Either Singapore exports little to China, or exports to China through another country, perhaps Hong Kong.

Taiwan's trade records show that it also imported dried seahorses from Singapore (Table Taiwan 3). Volumes have fluctuated over the past 12 years. Declared value per kilogramme declined during the 1980s but may now be starting to recover.

Live seahorse exploitation in Singapore

Aquarium fish dealers from Bali commented that most of the aquarium seahorses caught in the rich habitats of western Indonesia go overland to Singapore for sale and further export. One dealer from Bali explained that he exported seahorses *via* Singapore, because of personal contacts. Singapore is one known source of seahorses for North American aquarium hobbyists (e.g., J. Banquero, *in litt.*, 6 August 1993).

SEAHORSE TRADE IN TAIWAN

Seahorses are sold in Taiwan for use in TCM, as aquarium fishes and as curios. Taiwan is the only consumer to publish detailed Customs statistics on the syngnathid trade. These show substantial seahorse imports since at least 1983 and annual imports of more than 11t annually for 1992-1994. TCM dealers in Taiwan stated that both supply and demand were stable and noted that the size of marketed seahorses had not diminished noticeably.

Background for Taiwan

Information sources in Taiwan

Most information presented in this section was gathered during 90 interviews and surveys conducted in April 1993. The author's involvement in conservation was only made explicit to the experts (ecologists, fish biologists, and wildlife conservationists). Taiwanese TCM merchants were particularly wary of criticism at the time of these surveys. In November 1992, a foreign-based environmental group strongly attacked Taiwan's legal domestic trade in rhinoceros horn. The Government responded by immediately banning its sale, thus setting aside plans for a phased reduction that were being developed by conservationists, merchants and TCM practitioners. The TCM community felt itself under siege and became defensive. Other animal products disappeared from open display, and enquiries about animal use were deflected and discouraged.

The following were visited and questions were asked of most, even if only briefly:

Taipei: 18 TCM wholesalers; 23 TCM retailers; 20 aquarium fish dealers and 11 related experts.

Kaohsiung: nine TCM retailers.

Penghu: three TCM retailers, two curio dealers, four fishers.

Interviews and surveys in Taipei were conducted by (a) the author with a Taiwanese interpreter (b) a European assistant who spoke Mandarin or (c) a Taiwanese man. Interviews in Kaohsiung and Penghu were conducted by the author with the European assistant. Note-taking would have aroused concern in TCM outlets but information was recorded immediately after each visit, and verified for accuracy by the assistant.

Reception from TCM pharmacists and wholesalers was usually wary, despite a careful approach. One salesman commented that while it was not illegal to sell seahorses, "the Government suggests we not sell it, so we don't." In a Kaohsiung wholesale outlet, one employee said that seahorses were available, but was immediately contradicted by another employee. In a Kaohsiung pharmacy, seahorses were denied even when they were clearly on display. Another pharmacist chastised a local resident for guiding the author to the pharmacy to buy seahorses, and denied selling them. And a wholesaler selling seahorses in Taipei removed them from the window display within fifteen minutes of the interviewers' visit.

Seahorses in Taiwan

Taxonomy of seahorses in Taiwanese waters is confused, as elsewhere in the IndoPacific region. *Hippocampus erinaceus*, *H. hystrix*, *H. kuda* and *H. trimaculatus* have been cited by one source (Lee, 1983) while another source cites *H. kuda*, *H. kelloggi*, and *H. aterrinus* (Shen S-C., 1993).

At least five seahorse species were for sale in Taiwanese TCM outlets, including two large thickset species and three smaller species. The large species was incorrectly claimed to be *Hippocampus trimaculatus*, and may have been *H. kelloggi*. One shop was offering a single seahorse that was probably *H. coronatus*, found near Japan. Merchants were generally confused about species distinctions, with many dismissing morphological differences as owing to size or different water depths.

Use of seahorses in Taiwan

Seahorses in TCM in Taiwan

Seahorses were found to be widely used in TCM in Taiwan. They were available whole or halved, singly or in gift packages, in alcohol-based tonics (*bu jiu*) or pre-packaged pills. Most pharmacies agreed that, in Taiwan, seahorses were primarily sold for male "strength", as an aphrodisiac and a treatment for impotence. One claim was that male potency was aided by "hormones" released from a seahorse into alcohol.

Pharmacists commented that women bought seahorses too, as a potent general tonic. Large jars labelled "wine" (*bai jiu* or *huang jiu*, both fiery spirits) were filled with vegetable and animal matter, including seahorses, and the contents allowed to ferment for months before the liquid was decanted and drunk. Wholesalers generally thought that older people bought more seahorses. Young people were said to rely more on Western medicine, but were expected to revert to TCM with age.

Seahorses were generally categorised as "large or small", "'black' or 'white'", or "smooth or spiny", and priced accordingly. Thus, for example, all species of small, dark, smooth seahorses were sold at similar prices (NT\$200-250 per *liang*, US\$213-266 per kilogramme). The premium seahorses were large, pale, and smooth *Hippocampus kelloggi* types, considered more efficacious than small species, even though they served the same purpose; these were more common in Taiwan than in Hong Kong. Merchants in Taiwan separated seahorses into fewer size classes than those in Hong Kong. Most of the larger seahorses had been dried oddly, with the head angled up at 120 degrees to the body, and the tail straightened. Apparently Taiwanese customers preferred a seahorse with a straight tail (whereas those in Hong Kong preferred a tightly coiled tail: see **Hong Kong** section). Smaller seahorses were sometimes described by pharmacists as "samples" rather than functionally useful. Treatments generally called for pairs of seahorses, but didn't seem to require one of each sex: few pharmacists knew which was which in any case. Bleached seahorses were not noted in Taiwan in 1993.

Seahorse prices in Taiwan were usually given per *chin* (375g) or per *liang* (37.5g).

Other uses of seahorses in Taiwan

These are popular aquarium fishes (see *Retail sales of live seahorses in Taiwan* below), and sell as curios. The islands of Penghu attract many Taiwanese for short holidays, and correspondingly sell (small) dried seahorses as popular souvenirs. One souvenir shop had about 150 seahorses for sale, each at about NT\$100 (US\$4). The same seahorse would have fetched less than NT\$40 (US\$1.60) in a TCM outlet.

Seahorses also served decorative purposes, including as window dressing in Taipei TCM outlets: one pharmacy displayed a dragon boat constructed of seahorses and another exhibited its seahorses swimming in pearls. Taiwanese interviewees remembered a European who bought every tiny seahorse (< 50mm) available in the wholesale district in the early 1980s, for use in making jewellery.

Sources in Hong Kong claimed that some Taiwanese chop seahorses into small pieces as treats for racing pigeons (A. Lau, *in litt.*, 18 March 1993)

Legislation affecting seahorses in Taiwan

Seahorses are not protected under Taiwanese law, despite repeated comments during 1993 surveys that the Government had banned the seahorse trade. Some local seahorses should benefit from the ban on trawling the ocean bottom within three nautical miles of the Taiwanese coast (Shao K-T., pers. comm., 6 April 1993; M. Phipps *in litt.*, 21 January 1995).

Seahorses (*hai ma*; modified HS code 0510.00.42003) were subject to trade tariff rates of 2.5% on import in 1989 (Anon., 1989).

Dried seahorse exploitation by Taiwan

Sales of dried seahorses in Taiwan

Some wholesalers' premises in Taipei were large and well-lit, but pharmacies in Taiwan were generally smaller, darker and less busy than those in Hong Kong. Sale prices were not displayed on goods, in contrast to Hong Kong.

Wholesalers in Taipei

The main wholesale district in Taipei is Tihwa Street. Wholesalers sold to retailers but also direct to certain customers. Eighteen wholesalers were surveyed. They either displayed seahorses openly (n=9 wholesalers); produced them on request (n=1); said they had no seahorses when asked (n=5) (although one of these five was displaying seahorses); or were not questioned (n=4). Shops openly displayed between 10 and 400 large "white" seahorses and/or between 20 and 100 smaller seahorses. Prices varied considerably. Large, pale seahorses cost NT\$600-800 per *liang* (US\$640-850 per kilogramme) whereas small, mixed, unbleached seahorses cost NT\$200-250 per *liang* (US\$210-270 per kilogramme). Seahorses were reported to come from China (n=3) or Thailand (n=2).

It was difficult to assess seahorse availability or volumes reliably. Many merchants kept seahorses out of sight in the refrigerator to prevent mould and insect damage. One wholesaler, although displaying no seahorses, had thousands in stock. He produced a large bag of at least 1000 small "white" seahorses from a refrigerator in the back room, and said "this is nothing" when the author exclaimed at how many he had. He reported selling about 1000 seahorses to just one client recently, and said that seahorses generally sold briskly.

Retail pharmacies in Taipei

Retail pharmacies in Taipei obtained their seahorses from Tihwa Street. Fourteen of nineteen open TCM outlets visited in Taipei (74%) had seahorses (Table Taiwan 1). They were either on display (n=11); produced on request (n=2); or had recently sold out (n=1). Others had no seahorses because they sold herbal ingredients only (n=1); there was no demand (n=1); seahorses were protected (n=2); or they simply blocked requests for information (n=1).

Table Taiwan 1**Outcome of visits to retail TCM pharmacies in Taipei**

Visit no.*	Approx. no. displayed, and size	Price per liang (NT\$)	Response to request
1	1 (L)		denied it was a seahorse
2	25 (L)	800	
5	3 (M)		decoration only
6	75 in freezer (S, M, L)	100-500 each	not on display but had some when asked
7	50 + 20 halves	50 each	uncooperative
8	100 (M and L)	600	
10	15 (L - deep water)	250 each	outspoken and keen
	15 (S - shallow water)	70 each	
11	15 (S)	200 each	wary
12	10 (L)	1000	willing
14	40 (M, L)		wary
16	(S, L) not on display		uncooperative
19		700 (L)	
		500 (S)	uncooperative
20	None on display but used to sell all sizes	1000 (L)	uncooperative – said “seahorses now banned”
		500 (M)	
		200 (S)	
23	Mixed (S, M, L)	1000	busy: low demand

* A European couple visited outlets 1-12 and a Taiwanese visited shops 13-23. Only those pharmacies having seahorses are shown.

Source: Author's research

Most pharmacy staff questioned dismissed seahorses as being of only minor importance in TCM in Taiwan. Seahorses were said to originate from China (n=6); Taiwan (n=1); Penghu (n=1); or unknown.

Retail prices were quite similar to wholesale prices (Table Taiwan 2).

Table Taiwan 2**Dried seahorse prices in Taipei in April 1993**

	Wholesale price (NT\$)		Retail price (NT\$)	
	Per liang	Each	Per liang	Each
Large, white	600-800	180	700-1000	250-500
Medium, white	500		500	
Medium, spiny	400			
Small, mixed	200-250	80	200-500	70-200
Very small		30	100	40

Source: Author's research

Retail pharmacies in Kaohsiung

Kaohsiung is a busy port and the second largest city in Taiwan. Six of nine shops visited sold seahorses. Four displayed them and two more outlets clearly sold seahorses despite denying it (see **Background for Taiwan section**).

Large seahorses cost NT\$700-1000 (US\$28-40) per *liang* and small seahorses cost NT\$300-400 (US\$12-16) per *liang*. Shops displayed five to 40 large seahorses and two to 60 small seahorses. Three shops said their seahorses came from China. One of these said they could get very small seahorses from Penghu and a fourth shop reported their seahorses came from the Taiwan Strait (thus perhaps Penghu).

At least one point of sale visited would not have been included in usual enumeration of TCM outlets, a small shop in an arcade selling an eclectic mix of clothes and medicines. Possible seahorse purchases there included single seahorses, seahorse-based pills and tonics, and seahorse gift packages, all of which sold well. The manager of a small neighbourhood pharmacy said that she sold about 50-250g of prepared seahorse weekly (or 7.8kg annually, if 150g weekly). Nobody in the latter's area bought a whole seahorse at once, and the preparations sold mainly to older men.

Retail pharmacies in Penghu

Penghu, or the Pescadores Islands, lie in the Taiwan Strait. Fishing is an important economic activity. People in two of the three pharmacies visited were eager to talk, in marked contrast to the wariness of Taipei and Kaohsiung retailers. None of the seahorses sold on Penghu had the straightened tails preferred in Taipei.

The first pharmacy visited reported selling "less than one bag" of 100 seahorses per month (perhaps 600 seahorses annually). At 3.8g per seahorse, this would amount to 2.280kg annually. The shop had two giant seahorses (280-300mm long) which were not for sale, but would have cost more than NT\$10 000 per *chin* (US\$668 per kilogramme).

Another pharmacist produced 50 large seahorses from a cardboard box. One of these, weighing 10g, cost NT\$100 (US\$4), *versus* at least NT\$160 (US\$6.40) in Tihwa Street. He sold about one box of large seahorses (more than 50) per month in the winter but fewer in the summer for a total of perhaps 450 annually (4.5kg).

Both pharmacists obtained their seahorses from Penghu fishers, but suspected they had originated elsewhere - perhaps China - since so few could then be caught locally. Penghu fishers at the harbour commented that seahorses were cheaper in China, and indicated that they traded such commodities at sea (see Anon., 1991).

Imports of dried seahorses to Taiwan

The vast majority of seahorses used in Taiwan, whether dried or live, are almost certainly imported (see **Conservation concerns about seahorses with respect to Taiwan**). Taiwan is alone in providing Customs statistics that document seahorse imports and exports, by country of origin. Records were examined from 1983 (Table Taiwan 3), though see Note at beginning of report.

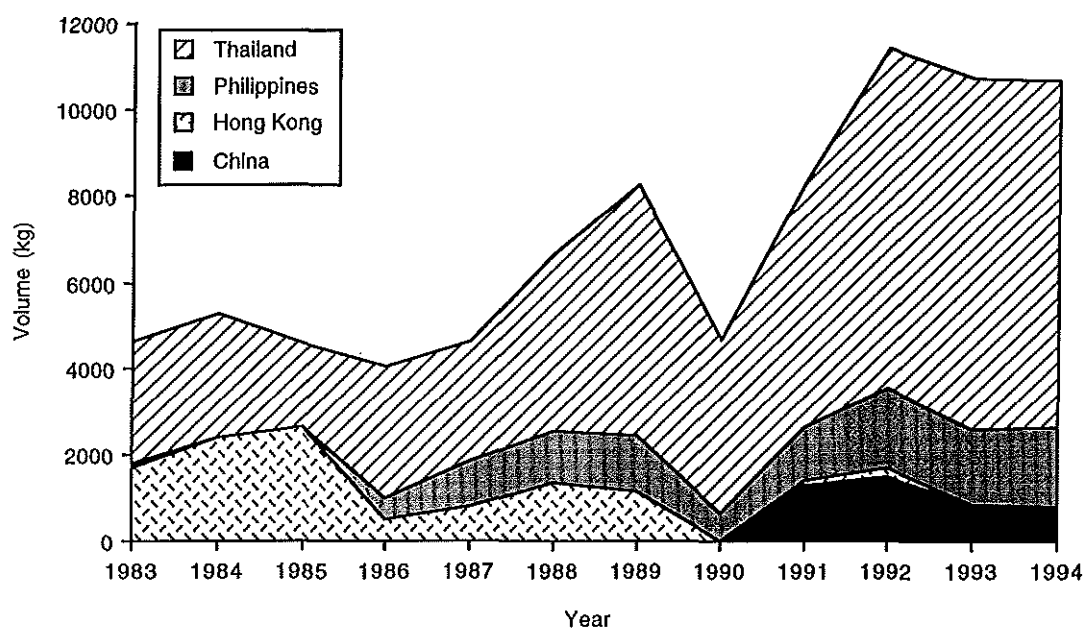
Taiwan's Customs records show that Hong Kong, Malaysia, Singapore, the Philippines, and Thailand all provided seahorses to Taiwan in most years for which records were accessed (Table Taiwan 3). The USA was reported to be a frequent but sporadic source of dried seahorses. The first records of imports from Indonesia were for 1988; this suggests that records for Indonesia may be incomplete because Taiwanese and Hong Kong fishing boats had long been buying local seahorses, according to sea cucumber dealers in north Sulawesi.

Merchants from Taiwan apparently visited Hong Kong to purchase much sought-after large seahorses, which were selling more cheaply in Hong Kong (US\$600-640 per kilogramme) than in Taiwan (US\$640-850 per kilogramme)

in early 1993. Recently, however, imports from China appear to have supplanted imports from Hong Kong (Figure Taiwan 1).

Figure Taiwan 1

Relative contributions to Taiwan's dried seahorse imports from China, Hong Kong, the Philippines and Thailand. The vertical axis shows cumulative total from these countries.



Source: Republic of China [Taiwan] Customs Statistics

Customs data show Thailand to be the main source of dried seahorses, but TCM dealers in 1993 repeatedly claimed that the seahorses came from China, mentioning the central coast and Hainan Island specifically (Table Taiwan 3, Figure Taiwan 1). One merchant in Tihwa Street said he used to obtain seahorses from Southeast Asia but now found it cheaper to import from China. These claims of Chinese origins may be exaggerated and based on special qualities that medicines from China are supposed to possess (as mentioned by Dr. Fang Lu-shing, pers. comm., 8 April 1993), or they may reflect a substantial illicit trade across the Strait. Recorded imports from mainland China began only in 1991, as cross-Straits relations thawed, but there was considerable contact before that; Penghu fishers reported meeting Chinese fishers at sea to trade, even though contact was (and is) illegal for both parties. Such practices would suggest that official Customs figures may underestimate total trade volumes. It should also be noted that some of those "Chinese" seahorses could have originated in other parts of the world and merely passed through China (see *China* section).

Volumes of dried seahorses traded in Taiwan

Taiwan's recorded seahorse imports in the 1990s are well above those in the 1980s. Customs statistics show more than 10t of dried seahorse imported in 1991 and more than 11t in each year from 1992-1994 (Table Taiwan 3, Figure Taiwan 2). Seahorse imports appeared to increase at the end of the 1980s. In 1993, pharmacists in Taipei stated that demand for seahorses had not changed in recent years, but they may only have been reviewing the previous five years. Three other possible explanations are that the TCM dealers were wrong, that record-keeping had improved, or that seahorses were being re-exported. The apparent contradiction cannot be explained by incorrect use of the "walras" [*sic*] data set, because the year 1988 (in the "walras" [*sic*] data) provides

Table Taiwan 3
Taiwan's records of dried seahorse imports, with origins and volumes (kilogrammes) per annum

	1983*	1984*	1985*	1986*	1987*	1988*	1989	1990	1991	1992	1993	1994
China												
Japan	20	15										
Hong Kong	1688	2376	2634	499	788	1346	1121	75	1271	1500	823	806
Indonesia						43	168	3	130	179		
Malaysia	120	213	144	100	41	127	506	597	14		50	39
Singapore	96	297	186	16	140	271	45	36	469	350	129	236
Philippines	115								145	22		136
Thailand	2844	2909	1948	480	1050	1191	1297	640	1258	1858	1770	1830
Vietnam				3043	2796	4120	5854	4046	5703	7903	8150	8069
Other Asian												
Italy		30					10	258				
USA		123	160	76		5	1317	1564	1369	20	384	140
Ecuador												
Other	746							35				
TOTAL	5629	5963	5072	4221	4815	7103	10 318	7272	10 359	11 943	11 306	11 256
Total value (US\$1000)	637.2	742.3	621.1	459.6	449.6	463.9	585.5	355.3	562.3	644.9	831.3	697.7
Mean price (US\$/kg)	113.2	124.5	147.1	108.9	93.4	65.3	56.7	48.9	54.3	54.0	73.5	62.0

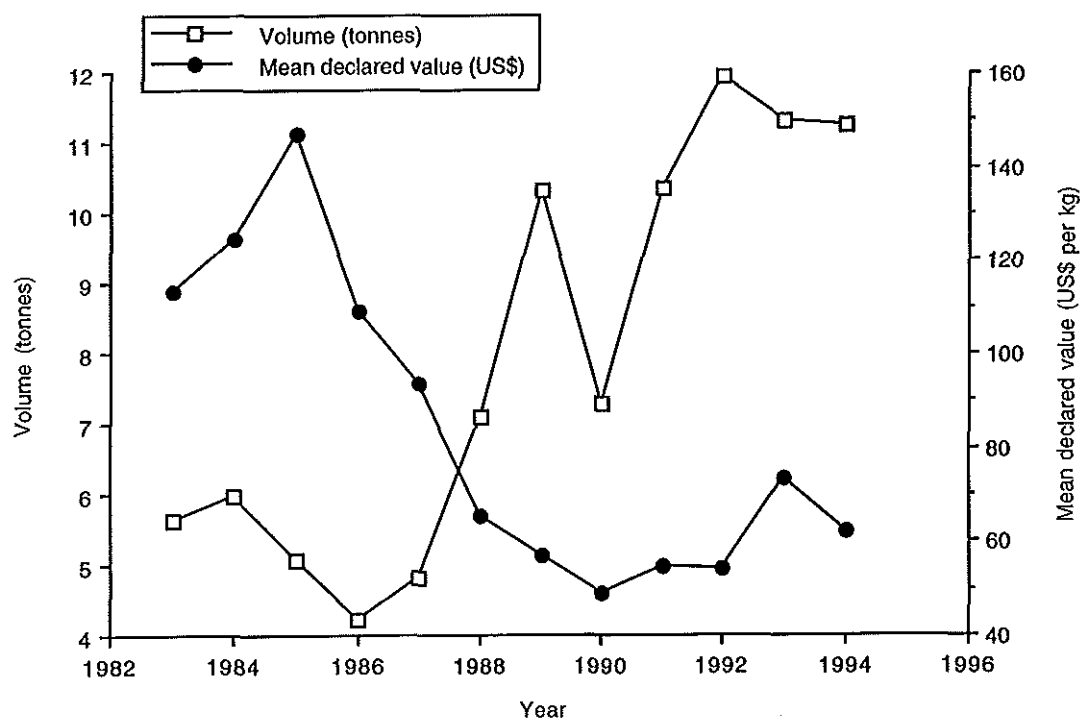
* Imports from 1983 to 1988 are listed as "hai ma" [seahorses] in the Chinese version of the Customs Statistics, but as "walras [sic], live" in the English translation. See **Note** at beginning of report.

Source: Republic of China [Taiwan] Customs Statistics.

a smooth transition to the later set designated *Hippocampus*, thus illustrating their compatability.

Figure Taiwan 2

Total volume and mean declared value of dried seahorse imports to Taiwan, by year.



Source: Republic of China [Taiwan] Customs Statistics

Some imports to Taiwan probably remain undocumented (e.g., the goods exchanged when Penghu fishers met Chinese counterparts at sea or private shipments to Taiwanese from relations overseas). Ecuador apparently started exporting seahorses to Taiwan at the end of 1994 (see *Latin America* section) but these do not appear in the trade records from December 1994-April 1995.

The availability of both Philippines' data for exports to Taiwan, and Taiwanese data for imports from the Philippines, allows cross-examination (Table Taiwan 4). It is likely that all these figures refer to seahorses, as Taiwan has no record of pipefishes ever having been imported from the Philippines. The figures accord on volumes of seahorses traded for 1983, 1985 and 1986, though not for 1984 and 1987.

Table Taiwan 4

Recorded dried syngnathid imports from the Philippines to Taiwan, allowing comparison between Philippine and Taiwanese trade records

	Volume (kg)		Total value (US\$1000)	
	Philippines exports	Taiwan imports ¹	Philippines exports	Taiwan imports
From Philippines ²				
1982	459		5.9	
1983	105	115	10.5	11.9
1984	103	0	1.3	0
1985	0	0		0
1986	480	480	47.5	47.5
1987	890	1050	85.3	105.3
From Cebu only ³				
1990	1050*	640†	36.0	35.3
1991	1250*	1258†	68.8	69.1
1992	1140*	1858†	63.2	108.8
1993	360*	1770†	25.2	124.3
1994	1690*	1830†	118.3	129.0

* Exported from Cebu only

† Imported from all Philippines

Sources: ¹Republic of China [Taiwan] Customs Statistics

²Philippines National Census and Statistics Office

³Port of Cebu Export Customs Statistics

Volume estimates from retail sales in Taiwan

Only three small pharmacies were willing to estimate volumes of seahorse sales. After conversion, these amounted to 7.8kg (Kaohsiung), 2.3kg and 4.5kg (Penghu) annually (see *Retail pharmacies in Kaohsiung* and *Retail pharmacies in Penghu* above, also *Methods* section). The Chinese Medical Commercial Society estimated that in 1993 there were about 5663 licensed TCM outlets in Taiwan (including wholesalers) and a further 8000 unlicensed shops. Licensed pharmacies dispense prescriptions and patent medicines, whereas unlicensed pharmacies are more likely to sell "grey area medicines", such as aphrodisiacs. Seahorses were available in three-quarters of the open Taipei pharmacies that were visited. If 75% of the licensed outlets sold seahorses at the rate of the small provincial pharmacies in Penghu and Kaohsiung, then Taiwan would trade crude estimate of more than 20t, somewhat higher than the import data show, even before incorporating data for volumes traded by unlicensed outlets.

Values of dried seahorses traded in Taiwan

Values of dried seahorses in retail outlets are reported in discussions of retail pharmacies above.

The average declared value of seahorse imports declined abruptly in 1988, as volumes increased: the smooth transition in price (Figure Taiwan 2) again makes it clear that the 1983-1988 "walras" [*sic*] data are not at fault.

There are at least three possible explanations for these trends:

- Perhaps export prices were being systematically undervalued at Customs. This seems most probable; for example, seahorses from Cebu (the Philippines port from which most seahorses probably go to Taiwan) were obtained from the Bohol buyer at about US\$112 per kilogramme in 1994 but listed in Cebu export data as US\$70 per kilogramme and in Taiwan Customs data at US\$71 per kilogramme (see *Philippines* section and Table Discussion 6). This seems nonsensical as exporters clearly will not be selling for only 63% of their buying price. Taiwanese trade tariffs on seahorses of 2.5% (see *Legislation affecting seahorses in Taiwan* above) could perhaps contribute to the undervaluing.
- Perhaps cheaper seahorses were being imported in later years. An increased dependence on small seahorses would mean that seahorses would be worth less per kilogramme, and that there would be more seahorses in each kilogramme. This is possible because TCM retailers commented that the better quality (more effective) seahorses were becoming more difficult to obtain relative to other types or classes.
- Perhaps dried seahorses were abundant enough to diminish the price. This seems unlikely in the face of widespread comment elsewhere that supply of dried seahorses never meets demand.

Live seahorse exploitation by Taiwan

Seahorses are sought as pets in Taiwan. There were apparently 10 major wholesale importers of aquarium fishes in Taiwan in 1993 (Shao k.-T., pers. comm., 6 April 1993). Three of four wholesalers stocking marine fishes in Taiwan, contacted by telephone in early April 1993, could fill seahorse orders. Of fourteen aquarium retailers telephoned or visited in April 1993, eight stocked marine fishes, and three of these had seahorses in stock while the other five sold them sometimes. One retailer reported selling a shipment of "a thousand" seahorses within weeks, apart from two "black" seahorses still on display. The number may have been exaggerated but he clearly sold many. Staff at another shop said they had sold six the previous week and could obtain 50 seahorses within a few days.

"Black" seahorses cost US\$4-8 and "yellow" seahorses cost about US\$8, making them relatively affordable compared to the US\$40 paid for some other marine aquarium fishes in Taiwan. Retailers actively discouraged attempts to keep seahorses, saying they were carnivores and thus "difficult to feed". "Gold" seahorses (US\$20) and "red" seahorses (US\$32) were sometimes for sale.

Aquarium dealers in the Philippines (Manila) and Indonesia (Denpasar) reported regular live seahorse exports to Taiwan. In April 1993, just one Filipino exporter was sending 200 live seahorses per week (10 400 per year) to Taiwan, half of their total seahorse export. Given that there are at least 25 Indonesian and 30 Manila-based aquarium fish exporters, total sales to Taiwan could be very large.

Conservation concerns about seahorses with respect to Taiwan

Seahorses were probably never very common in Taiwanese waters, because of limited suitable seagrass or mangrove habitats, but domestic seahorse populations seem to have dwindled even so (Shao K.-T., pers. comm., 6 April 1993). Penghu fishers reported that large seahorses were no longer caught locally and that the few remaining small ones were not worth selling. One member of a Penghu fishing family remembers that 10 years ago they caught about 30 seahorses on each fishing outing whereas they catch none now. In 1993, several Penghu fishers and pharmacists were exhibiting very large seahorses (up to 300mm long) as curiosities, because these giants are no longer found. The author noted in 1993 that the locally caught seahorses stocked in Penghu pharmacies measured only about 100-170mm, that most were at the smaller end of this range, and that many males were too small to have brood pouches.

Most of those interviewed in Taiwan felt that seahorses were a staple but minor item in TCM, with constant trade volumes. (The reason for increased imports from the late 1980s (Table Taiwan 3) remains mysterious.) Only one wholesaler in Tihwa Street commented that the supply was decreasing, and costs were increasing, but he was unsure of the magnitude of change, although a number of TCM dealers did comment that it was becoming more difficult to obtain large seahorses.

The demand for exotic aquarium species is apparently increasing with economic prosperity but Taiwan was hoping to reduce aquarium fish imports, partly by captive breeding (Shao K-T., pers. comm., 6 April 1993).

Conclusions for Taiwan

Taiwan is seemingly a large consumer of dried seahorses for TCM. Recorded imports appeared to double rapidly, from fewer than five tonnes annually prior to 1988, to more than 10t from 1991. These tend to be larger seahorses than in Hong Kong, and are usually not bleached. About three-quarters of the TCM outlets visited in Taipei sold seahorses, and most dealers classified them as having a small but staple role in TCM. Seahorses came in many different presentation packs and tonic formulations. It was very difficult to obtain volume estimates but three provincial TCM pharmacies may have sold from 2.3kg to 7.8kg annually, and there are thousands of TCM outlets in Taiwan (5663 licensed TCM shops alone). Taiwanese also buy live seahorses for the aquarium trade. Taiwanese seahorse populations appear to have suffered noticeably, particularly around Penghu, where number and sizes of individuals have declined. Few respondents had noticed any great shift in availability of imported seahorses but did comment that size seemed to be diminishing.

SEAHORSE TRADE IN JAPAN

Japanese use seahorses in the local form of TCM (*kanpo*, literally Chinese medicine) and purchase seahorses as aquarium fishes. Japan both imports and exports seahorses, but the only known volumes come from Chinese records which show imports of 401kg from Japan in 1990, and from the Philippines, which exported up to 365kg seahorses to Japan sporadically. This country's use of seahorses remains to be studied.

Background for Japan

Seahorses in Japan

Seahorses are known as *tatsunootoshigo* in Japan, translated as "offspring of the dragon". At least six species probably occupy Japanese waters, ranging in adult size from 60mm to 180mm. *Fishes of the Japanese Archipelago* lists six species, *Hippocampus coronatus*, *H. histrix* (here two species at least), *H. japonicus*, *H. kuda*, *H. sindonis*, and *H. takakurae* (Masuda *et al.*, 1984). None has been studied in detail.

Use of seahorses in Japan

Kanpo in Japan is employed in a manner similar to TCM in China, with similar applications for seahorses (see Uses section). Seahorses are not particularly popular in medicine in Japan, but Japan imports both dried whole seahorses and pre-packaged medicines containing seahorses from China (A. Ishihara, *in litt.*, 14 November 1995). Because seahorses are reputed to contain testosterone, their main role in Japan is to promote male sexual function or desire, but they are also considered a good general tonic.

Seahorses are sometimes served in medical dishes called *yakuzen*, although this dish is by no means universally sought (N. Okuda, *in litt.*, 10 October 1995). Restaurants specialising in *yakuzen* have opened recently, but they tend to use seahorses more for decoration than food (A. Ishihara, *in litt.*, 14 November 1995).

Dried seahorse exploitation in Japan

Imports of dried seahorses to Japan

One Japanese ecologist commented that many seahorses were for sale in late 1995 (N. Okuda, *in litt.*, 10 October 1995). However, a large Japanese importer of Chinese medicines felt that demand for seahorses continued low in Japan and was unlikely to explain any increased trade in Southeast Asian seahorses (cited in N. Okuda, *in litt.*, 10 October 1995). Prices stayed constant, with dried seahorses of seven to eight centimetres length costing ¥1000-1500 (about US\$11.50-17.20) each in 1995.

It seems that Japan may have imported dried seahorses from China, Hong Kong and the Philippines, at least. A senior TCM merchant in China cited Japan as a nation demanding seahorses, and a large TCM importer in Hong Kong reported re-exporting about one per cent of his seahorses to Japan (about 100kg). Indonesia also exported at least small volumes to Japan; a merchant in Ambon (Moluccas) contributed towards a Japanese order for 100kg of seahorses in 1995 (see *Indonesia* section).

Data from the Philippines National Census and Statistics Office show that Japan has been importing seahorses from the Philippines at least since the early 1980s (see *Tables Philippines 1 and 3*). One dealer in Zamboanga reported that he used to export 10 000 seahorses a month to Japan in the late 1970s, but finds Japan a less important market now.

Exports of dried seahorses from Japan

The sole TCM merchant consulted in Japan, a senior official, felt that Japan had no tradition of catching seahorses (cited in N. Okuda, *in litt.*, 10 October 1995). Nonetheless, it appears from foreign records that Japan did export small quantities of dried seahorses to China and Taiwan, and perhaps to Hong Kong. It is not clear whether these seahorses were from Japanese waters, or re-exports.

- China's records show imports of 401kg dried syngnathids from Japan in 1990, at a total value of US\$25 000 (China Customs Statistics Yearbook). In addition, the largest TCM merchant in Guangzhou (China) reported obtaining seahorses from Osaka and Hokkaido in Japan.
- Taiwan's Customs data indicate that the island imported 20kg dried seahorses from Japan in 1983 (worth US\$2600), 15kg in 1984 (US\$1900), and 75kg in 1990 (US\$3000). A single seahorse of a species most common around Japan was seen for sale in Tihwa Street wholesale district in Taiwan in April 1993.
- One TCM retail outlet in Hong Kong claimed to receive Japanese seahorses.

Live seahorse exploitation in Japan

Japan imports live seahorses from the Philippines and Indonesia, according to aquarium fish exporters in these countries. The three large aquarium fish exporters interviewed in Manila all emphasized seahorse sales to Japan. One of them estimated its own live sales to Japan at 20-30 seahorses per week, or 1000-1500 annually. The largest aquarium fish exporter in Bali also sent seahorses to Japan, although the only other exporter interviewed there did not.

A communication from a Japanese aquaculture society to an unknown destination, forwarded to the author, stated that live seahorses were "pricey" but could definitely be sold. An investigator found seahorses for sale in six of 30 shops stocking marine fishes (among other animals) in Japan. Four of the shops implied that they sold a few seahorses just because they were available whilst the two others stocked many seahorses (A. Ishihara, *in litt.*, 14 November 1995). Shop owners said that seahorse-keeping was not popular, and that most seahorses were imported; the investigator inferred that they came from the Philippines. It would be necessary to focus on more specialised outlets before any conclusions can be drawn about their availability for aquaria.

SEAHORSE TRADE IN OTHER ASIAN COUNTRIES

Dried seahorse exploitation in other Asian countries

Asian nations other than those discussed in detail in this report are also involved in trading seahorses. Taiwanese trade statistics included imports from “other Asian” during 1989-1991 (Table Taiwan 3). India could be included among these, because of its large fishery in the southern states, but most Indian seahorses are thought to go to Singapore or Malaysia (see India section). It is hoped that the following brief and fragmented comments relating to Asian countries without their own entries in Taiwanese import data will provoke further research into their trade in seahorses.

Kuwait: This state is reported to exploit seahorses but the scale is unknown (D. Phillips, Acer Environmental consultants, *in litt.*, 20 September 1993).

Korea, Republic of: Large TCM importers in Hong Kong and Guangzhou reported that the Republic of Korea bought seahorses for the local version of TCM (known as *hanyak*, literally Chinese medicine). Philippines’ statistics from the Philippines National Census and Statistics Office indicate that Korea imported 35 014kg of dried syngnathids from the Philippines in 1982, at a total cost of PP 692 736 (about US\$62,350), but this volume sounds most improbable. Seahorses are found in the seas around Korea, but there are no reports that Korean seahorses are sold abroad.

Laos: TCM remedies that include seahorses are sold in Laos (W. Bergmans, *in litt.* 20 October 1995), and must have been imported to this landlocked nation.

Pakistan: No seahorse imports from Pakistan have been reported, but a Hong Kong-based TCM wholesaler claimed in 1993 to have imported pipefishes from there.

Sri Lanka: No trade in dried syngnathids has been reported, despite proximity to the large seahorse fishery in India. One report claims that ethnic Tamils in Sri Lanka use seahorses in traditional medicine (M. Montaña, pers. comm., 2 April 1993). This has not been verified but is believable because Indians in nearby Tamil Nadu occasionally use seahorses medicinally.

Aquarium seahorses are exported from Sri Lanka to Europe and North America (J. Banquero, *in litt.*, 6 August 1993; R. Sankey, *in litt.*, 30 October 1995). In 1989, these were caught in north-west lagoon towns of Kalpitiya, Chilaw and Negombo and off the east coast in Batticaloa lagoon and Trincomalee harbour (N.A.M. Pathirana, *in litt.*, 9 November 1989), but civil unrest may have altered collecting locations since then. Fishing occurred only during non-monsoon months in each region, allowing a recovery period (N.A.M. Pathirana, *in litt.*, 9 November 1989). Seahorses gathered in clusters and were collected soon after the full moon. They were reputedly “easy to find” and were caught in daylight hours by hand, with a fishing net, or with a two person drag net (N.A.M. Pathirana, *in litt.*, 9 November 1989). Densities in 1989 averaged six to eight seahorses per square metre in *Zostera* eelgrass (N.A.M. Pathirana, *in litt.*, 9 November 1989).

United Arab Emirates (Dubai): Seahorse trade is reported, but the scale is unknown (D. Phillips, *in litt.*, 20 September 1993).

SEAHORSE TRADE IN AFRICA

Trade in seahorses has not been investigated in Africa, but a few points of information are available.

South Africa: A South African species, the Knysna Seahorse *Hippocampus capensis*, is the only seahorse listed in the 1994 IUCN Red List of Threatened Animals, as Vulnerable (V) (Groombridge, 1993). Its geographic range is very limited but one important area, the Knysna lagoon, is controlled by the South African National Parks Board, which should afford this population some level of protection.

Tanzania: Seahorses were noted for sale in fish markets in Dar-es-Salaam, Tanzania. No seahorses were observed during casual visits in 1991-1992 but thereafter seahorses and pipefishes were displayed by two to four stalls of the 15-20 in the market (A. Rosser, pers. comm., 9 November 1995). During one visit in April 1995, two of 16 stalls displayed small piles of perhaps 10 dried seahorses, selling for TSh2000-3000 (US\$3.90-5.90) (A. Rosser, pers. comm., 9 November 1995).

Seahorses were apparently incidental catches, collected while diving for shells, or picked off nets where they clung. The seahorses were likely to have come from the Mafia Islands region, perhaps via the boats that travel regularly to Mafia for fishing (A. Rosser, pers. comm., 9 November 1995). Chinese are now buying sea cucumbers in Tanzania, which could make seahorses more vulnerable because the two are often traded together. Shallow waters around Mafia Island have already been denuded of sea cucumbers (A. Rosser, pers. comm., 9 November 1995).

SEAHORSE TRADE IN AUSTRALIA

Australia imports live seahorses, and may import and export dried seahorses. Large numbers of dried pipefishes are exported, primarily from Queensland; this trade is discussed in the section entitled Trade in other syngnathids.

Background for Australia

Information about the Australian trade comes largely from one unpublished source (C. Reynolds, *in litt.*, 1992), but is supplemented by material from other Australian sources.

Seahorses in Australia

Roughly half the world's syngnathid species live in Australian waters, including eleven species of seahorse (Munro, 1958; R. Daley, *in litt.*, 31 October 1995, Yearsley *et al.*, 1995). At least five taxonomically tangled IndoPacific species live around northern Australia, currently named as *Hippocampus histrix*, *H. kuda*, *H. planifrons*, *H. spinosissimus*, and *H. zebra*. In addition, the very small *H. bargibanti* (13mm adult size) was recently found on the Great Barrier Reef on a gorgonian fan at 50m depth, having previously been recorded only from New Caledonia (R. Kuitert, *in litt.*, 3 November 1995).

Five southern species of seahorse are better defined, although little is known about most of them. In ascending order of size, they are:

- *Hippocampus* sp. (to be described as *H. minotaur*) is a tiny seahorse (maximum known length 50mm) only recently discovered in waters off southern New South Wales and eastern Victoria (M. Gomon, *in litt.*, November 1994). This species was not seen for sale in TCM.
- *H. breviceps* is found from New South Wales to Western Australia, reaches a maximum of 80mm and seldom weighs more than 1.5g. Only brief descriptive studies have been conducted (Kuitert, unpublished; Vincent, unpublished). This species was not seen for sale in TCM.

- *H. whitei* is largely restricted to sub-tropical waters, in southern NSW (M. Gomon, pers. comm., 1994), and reaches a maximum length of 210mm. A thorough study of one population in Port Jackson (Sydney Harbour) makes this the best understood Australian species (Vincent and Sadler, 1995; Vincent, in prep.). This species might be difficult to recognize if bleached or mixed into a box of miscellaneous mid-sized dried seahorses.
- *H. angustus* is found only in Western Australia and reaches lengths of 220mm. The first systematic study of these fishes is being conducted at the University of Western Australia, in the wild and the laboratory. This species might be difficult to recognize if bleached or mixed into a box of miscellaneous mid-sized dried seahorses.
- *H. abdominalis* is found from New South Wales to South Australia and in New Zealand and reaches 300mm and 25g. Knowledge of *H. abdominalis* comes from one short underwater study (Vincent and Edmunds, unpublished) and several studies in captivity (e.g., Lovett, 1969). This species was not seen for sale in TCM but is sometimes sold as an aquarium fish.

Legislation affecting seahorses in Australia

No marine fishes are currently protected by the national *Wildlife Protection (Regulation of Imports and Export) Act 1982*. The Australian Nature Conservation Agency is reviewing the issue of removing Syngnathiformes from Schedule 4 (listing native species exempt from export control) of this Act so that they would become subject to controls (F. Antram, pers. comm., 3 March 1995). A proposal by the Commonwealth (national) Department of the Environment to protect all syngnathid species was rejected in December 1993. State and Commonwealth Fisheries Ministries argued it was difficult to justify such protection given the lack of evidence on syngnathid exploitation and depletion (Anon., 1994b).

The *Threatened Species Network* (an Australian conservation ngo) has again (November, 1995) proposed all syngnathids for Schedule 1 or the less rigid Schedule 2 of the *Wildlife Protection Act*. Schedule 1 would grant import/export permits for live syngnathids only for inter-zoo transfer or prescribed scientific research. Only captive-bred animals could be traded when dead. Schedule 2 would further permit import/export permits for live

syngnathids considered household pets under section 16 of the Act. Wild-caught animals could be traded dead or alive. A Schedule 2 listing would mean that a trade in wild seahorses could continue but that "management actions would need to be documented and approved under the Act to demonstrate that harvesting was being managed in a way that allows for the harvest to be controlled and its impact on the species monitored" (F. Antram, pers. comm., 3 March 1995).

The Tasmanian State Government specifically protected all syngnathids in September 1994 under the *Sea Fisheries Regulations 1962: Fisheries Act 1959*. It is now prohibited to take, possess or control any pipehorse, pipefish, seahorse or seadragon (family Syngnathidae) without a permit. This is the most extensive legislative protection afforded syngnathids anywhere. *Hippocampus abdominalis* is the most common seahorse species in Tasmanian waters, but *H. breviceps* is also resident.



Ron Carbutt

Hippocampus whitei in Sydney Harbour

Other states in Australia provide little or no protection for seahorses or pipefishes. In Western Australia, at least, the public may collect any syngnathid for private use with no permit, with a bag limit of 40 per day (G. Moore, *in litt.* 7 November 1995). It is, however, illegal to sell syngnathids obtained as incidental trawl catch in South Australia, as they do not appear on the list of prescribed species that can be kept by the fishery (T. Flaherty, *in litt.*, 1 November 1995). Seahorse habitats (e.g., seagrasses, mangroves, and other marine vegetation) are protected and managed under various state legislations, because of their role as nurseries for fishes and crustaceans of economic value.

Syngnathids receive some protection through controls on the aquarium fishery. No commercial aquarium fish collectors are licensed in New South Wales, Tasmania, or South Australia. Small aquarium fisheries with a limited number of licensees operate in Queensland, Northern Territory and Western Australia.

Dried seahorse exploitation in Australia

Imports of dried seahorses to Australia

No importation of dried seahorses has been documented. However, a Tasmanian commodities company approached a Vietnamese biologist in May 1995 to request immediate delivery of 500kg of dried seahorses; the company contact himself had a Vietnamese name. Such a volume could not be obtained and no deal was completed. The eventual destination of such seahorses was unclear but re-export would have been a possibility.

In November 1994, an Australian travelling by yacht bought six kilogrammes of dried seahorses from a dealer in dead animals in Ambon, Indonesia. He stated that this was for his business and also bought shells and sea urchin spines, with the intention of blending the seahorses and spines into a powder, prior to steeping them in whisky.

Exports of dried seahorses from Australia

No seahorse fishery has been documented in Australia, nor were southern Australian species obviously for sale in TCM outlets in other countries; many northern Australian species have wide distributions through the IndoPacific, making their origins difficult to determine. China, Hong Kong, and Taiwan (at least) absorb Australian syngnathids, but most of these are probably pipefishes rather than seahorses (see relevant country sections and see *Exports of dried pipefish from Australia* in *Trade in other syngnathids* below). TCM retailers in China and Hong Kong, however, thought they sold some Australian seahorses.

It is not easy to trace seahorse exports from the Australian end as these are included merely as "Others" in catch data from the Australian Bureau of Statistics (ABS) and the Australian Department of Primary Industries and Energy (DPIE). Dried seafood exports need only be documented if they weigh more than two kilogrammes, so smaller amounts need not appear (C. Reynolds, *in litt.*, 1992). Most dried syngnathid buyers knew this rule but claimed they never used it to circumvent reporting (C. Reynolds, *in litt.*, 1992).

Advertisements in *Australian Fisheries* and other fishing trade journals offered "top prices" for dried seahorses, seadragons, and pipefishes (Figure Australia 1). Many of the companies appearing had Japanese names and most had addresses in New South Wales or Victoria. There were about ten such buyers nationally in 1992, obtaining syngnathids direct from the fishers (C. Reynolds, *in litt.*, 1992). Apparently most buyers were of Asian origin. One such company advertised for at least four years, from 1988-1992. Other commodities traded by these companies include dried sharks fins, abalone shell, topshells, pearl shell and ambergris. Seahorse requests disappeared from *Australian Fisheries*, now renamed *Professional Fisherman*, during a rush of media attention to the conservation of syngnathids in 1994-1995, for example, in the *Sunday Tasmanian* (26 June 1994) and in the author's own ABC radio broadcasts in September 1994. Attempts to obtain more information (e.g., overseas prices, consumer nations) from these companies have thus far proved fruitless.

Figure Australia 1

Advertisements for dried seahorse in *Australia Fisheries* during 1992. The Journal's name has now been changed to *Professional Fisherman* and the advertisements have disappeared in the wake of media attention on syngnathid conservation

18

111

181

nm

10mm.

11-11

1111



Wanted

**Sea dragons/pip fish
Sea horses**

Top Prices Paid

NSW
Ph: (02)

WANTED

**Dried sea dragons/horses
Shark — fins/skins**

TOP PRICES PAID

International Aust.



Tel: (02)

Fax: (02)

Boat for Sale

Qld east coast trawler & line fishing vessel
GPR constr. L13.72, D4.57
M 31992 NA G M

The newspaper article in the *Sunday Tasmanian* (26 June 1994) claimed that:

- six Tasmanian divers were involved in exporting dead and live seahorses to Asia and the USA. This seems unlikely, since a target catch for seahorses would probably not be economically viable in Australia, given the costs involved, unless carried out as a sideline by recreational divers.
- a Tasmanian buyer tried to sell seahorses to Sydney for export to Taiwan as medicines. Apparently the shipment was rejected as being the "wrong type". (Taiwan's Customs statistics include no record of any seahorse imports from Australia.)
- thousands of [local] seahorses have been sent throughout the world "especially to Asia where they can attract A\$25 (US\$20) to be processed and sold as a rare and expensive aphrodisiac". This price seems exaggerated given that the final sale prices in Hong Kong are less than US\$1200 per kilogramme. Even the largest Australian species (*Hippocampus abdominalis*) would only weigh about 12-15g dried, giving a value of US\$15 per seahorse at point of final sale in Hong Kong.

Tasmanian involvement would probably be a new development. In 1992, the vast majority of dried syngnathids apparently originated in Queensland, with some from New South Wales and Victoria (C. Reynolds, *in litt.*, 1992).

Live seahorse exploitation in Australia

Domestic trade in live seahorses

Seahorses collected live in Australia are largely destined for the domestic aquarium market (C. Reynolds, *in litt.*, 1992). One large aquarium dealer in Perth was selling seahorses at A\$18 (US\$12) each in 1995, according to a biologist who visited the shop. The retailer said that all the seahorses came from Queensland, although at least some were definitely the local West Australian species, *Hippocampus angustus*. The reason for this misinformation is unclear, since *H. angustus* are not protected. Tasmanian aquarium shops continue to stock seahorses even while acknowledging publicly they are difficult to keep in captivity.

Imports of live seahorses to Australia

Retailers usually sell native seahorses, but seahorses are also imported from Indonesia (e.g., one Victorian retailer reported importing about 600 in 1992) and the Philippines.

Exports of live seahorses from Australia

Little is known about the export market for aquarium seahorses. The only seahorse to feature prominently in Queensland aquarium fishery catch returns is listed as *Hippocampus whitei*, even though Queensland is largely outside the geographic range of this species. Seahorses may have little export importance to Queensland fishers, given the export potential for native coral reef fishes. One importer in the UK did obtain a special order of Australian seahorses in 1995 at a cost of US\$12 per seahorse for *H. breviceps* and US\$25 for *H. abdominalis* (FOB) (M. Wilson, pers. comm., 31 October 1995).

Seahorses as food in Australia

One restaurant in Hobart provided a menu listing "Wok-fried seahorses (when available) \$6.90" in February 1993. When the author enquired, three staff said that seahorses were available only a few times a year, and were probably imported. Apparently the chef had spent a long time in Southeast Asia and "liked the idea" of including seahorses on the menu. A customer would get two to three large or six small (50-100mm) seahorses, prepared butterfly-fashion (split ventrally, splayed open and wok-fried). They were said to taste like octopus. A follow-up enquiry in April 1994 (by another questioner) elicited the response that the offer had been a joke. It is difficult to ascertain the truth but the first set of answers were detailed and plausible while the second questioning came after a great deal of publicity in Tasmania highlighting threats to syngnathids.

Captive breeding of seahorses in Australia

Experimental seahorse culturing is said to be underway in Queensland but nothing else is known about this endeavour.

Conclusions for Australia

Australia appears to sell few seahorses. The trade, however, remains largely uninvestigated and a Tasmanian attempt to buy 500kg seahorses from Vietnam hints at a significant level of involvement. It seems likely that the companies seeking dried seahorses through *Australian Fisheries* must have had some success to justify advertising for years. It is highly probable that Australian syngnathids will come under greater pressures as international demand escalates and populations diminish, particularly given Australian proximity to the main consumer nations. Monitoring of any incipient escalation of Australia's seahorse trade is encouraged.

SEAHORSE TRADE IN NEW ZEALAND AND THE PACIFIC

New Zealand may export small volumes of dried seahorses and pipefishes to Hong Kong but is not currently a large dealer.

Background for New Zealand

Seahorses in New Zealand

The only seahorse found in New Zealand waters is the large *Hippocampus abdominalis*, a species that tends to be crepuscular or nocturnal. It is considered "common" and is frequently found in rockpools at low tide (Paulin and Roberts, 1992). This seahorse was not seen for sale in TCM but is sold as an aquarium fish.

In former times, some southern Maoris, particularly children, apparently dried seahorses and wore them as ear-ornaments (Beattie, 1994). The Maori name for seahorses is sea rats (*kiore-moana*), presumably because there were no horses on New Zealand.

Legislation affecting seahorses in New Zealand

Syngnathids are afforded no particular protection in New Zealand. They may be fished "recreationally", except in marine reserves, according to the Ministry of Agriculture and Fisheries of New Zealand. Although prohibited as a target species for commercial fishing, they can be retained in by-catch (M. McLean, pers. comm., 4 October 1995). Syngnathids are not currently on the list of species permitted for land-based marine farming but can be caught for display purposes, with a permit.

Dried seahorse exploitation in New Zealand

Seahorses are probably caught incidentally by trawlers. By-catch of seahorses and pipefishes from Nelson (South Island) used to be dried and sent to Hong Kong in the mid-1980s (cited in M. McLean, pers. comm., 4 October 1995). Apparently fewer were being caught by late 1995. Proffered explanations were the reduction in small fishing operations (larger boats fish further out, away from seahorse habitat), reduced interest in sorting and selling by-catch because fishers now generally work for fixed wages rather than profits, and lack of awareness of marketing possibilities for seahorses.

Foreign boats are unlikely to catch seahorses incidentally off New Zealand because they are excluded from a 12-mile zone around the country, and thus from seahorse habitat (M. McLean, pers. comm., 4 October 1995), although some vessels that operate under joint-venture schemes may be allowed inside that limit.

Captive breeding in New Zealand

An aquaculture company on the North Island started trial seahorse cultures in 1993 (M. McLean, pers. comm., 4 October 1995). It is presumably operating under a research permit since land-based seahorse culture would currently be illegal (see *Legislation affecting seahorses in New Zealand* above). The company held 400 seahorses as broodstock in 1993, and hoped eventually to export seahorses to the USA but were encountering high juvenile mortality. A second company on the South Island was also investigating potential for seahorse culturing in 1995, as were biologists at the University of Auckland and the University of Otago (R. Lau, *in litt.*, 20 July 1995; S. Cook, *in litt.*, March 1995; Mladenov, *in litt.*, August 1995). Another attempt to culture seahorses, near Nelson in the mid-1980s, failed because of husbandry problems.

Some seahorses are incidentally cultured in abalone farming operations, because the fishes help to reduce plankton in the water, but the seahorses are not yet considered a product themselves (M. McLean, pers. comm., 23 August 1995).

Conclusions for New Zealand

New Zealand's proximity to rapidly expanding markets (and declining supplies) in Asia suggest that it would be useful to be aware of the status and potential uptake of seahorses from New Zealand, particularly since the country already exports pipefishes (see Trade in other syngnathids section).

Pacific Islands

Pacific island nations appear not to trade syngnathids (J. Munro, *in litt.*, 6 September 1993).

In Fiji, a few seahorses were seen for sale in curio shops, but the Department of Primary Industries, the Fisheries Division, and marine product exporters all agreed that seahorses were not exported (S. Jennings, *in litt.*, 18 February 1994). There is some potential for a seahorse trade to develop because Fiji exports sea cucumber, often traded with seahorses, to Japan (R. Stiven, *in litt.*, 10 September 1993).

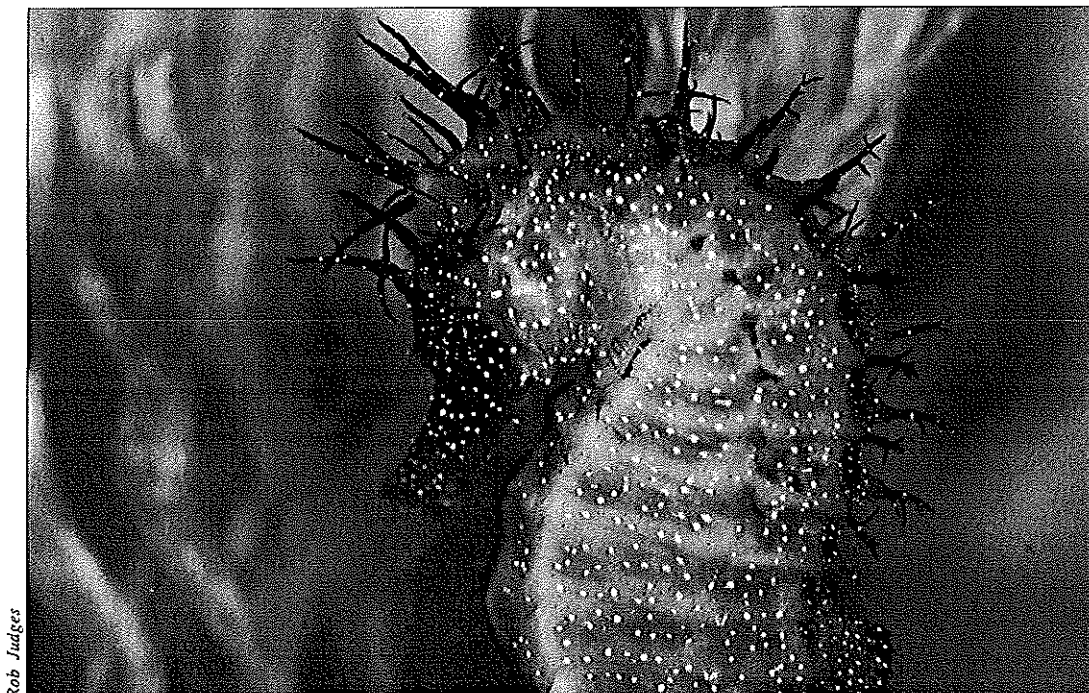
SEAHORSE TRADE IN EUROPE

Europe primarily consumes seahorses as curios and aquarium fishes. Each import shipment is small but total imports amount to hundreds of thousands of seahorses annually. Europe's own seahorses are also being caught and dried for curios.

Background for Europe

Seahorse species in Europe

The two European seahorse species, *Hippocampus ramulosus* and *H. hippocampus* differ primarily in their relative snout length, that of *H. hippocampus* being shorter. Both grow to about 100mm long and have ranges extending from the Bay of Biscay (France) through the Mediterranean to North Africa. *H. ramulosus* may also extend into the Black Sea and Azov Sea (Reina-Hervás, 1989). Both species live in shallow waters with vegetation, occasionally entering estuaries. Their biology is little studied (D'Ancona, 1932; Boisseau, 1967; Reina-Hervás, 1989).



Rob Judges

Hippocampus ramulosus

Legislation and listings affecting seahorses in Europe

Seahorses are not protected under European Community (EU) law. The proposed EU regulation on wildlife trade, *Com (93) 599 final COD 370*, due to come into effect 1 January 1997, lists no syngnathids in its Annexes (Anon., 1995).

France lists *Hippocampus ramulosus* in its Red Data book: "Formerly very common, their capture has become infrequent. Its increasing rarity is in line with that of its preferred habitat, littoral grasses, which is receding everywhere in the littoral region of the Mediterranean with the increase of various forms of pollution and coastal modification... The low fecundity of this species and the fragility of its juveniles makes this a species that is very sensitive to perturbations of its natural environment" (Beaufort, 1987). *H. hippocampus* was not listed, despite its similar biology.

Portugal includes both species in its Red Data book, stating they are of "Undetermined status in continental Portugal and rare in the Azores" (Anon., 1993). There is little information on either abundance or status of these species but seahorses in general are considered very vulnerable to the destruction of biotopes, particularly localised patches of eelgrass and macroalgae. *Hippocampus ramulosus* is thought to be facing serious threats in the Azores.

Neither Red Data book listing has had obvious consequences for seahorses, because no plan has been formulated for their management or conservation.

Seahorse catches in Europe

Seahorses are incidentally caught by Portuguese artisanal fishers, and are also caught intentionally to sell as curios (P. Ré, *in litt.*, 18 October 1995). Dried seahorses are sold in considerable quantities as souvenirs, from central to southwestern Portugal (P. Ré, *in litt.*, 18 October 1995). Prices in 1995 varied but one seahorse commonly cost the equivalent of US\$1-2.

Seahorses are also caught incidentally by French fishers trawling *au gangui* (a local term in the vicinity of Marseille, meaning to trawl with a fine-mesh net), although this method is prohibited in many areas. French fishers appear not to target seahorses (J. Harmelin, *in litt.*, 25 September 1991).

Dried seahorse exploitation in Europe

Imports of dried seahorses to Europe

Italy imports tens of thousands of dried seahorses each year. The manager of one shell enterprise in the Philippines (Zamboanga) ships Italian orders of about 30kg every four months, and now considers Italy his most regular customer for dried seahorses. Each shipment from Zamboanga would include 24 000-30 000 dried seahorses, packed in bags of 100. Despite this regular traffic, only two shipments of dried seahorses from the Philippines to Italy are formally listed (10kg in 1989 and 30kg in 1990) in BFAR records.

Data from the Philippines National Census and Statistics Office and BFAR record that the UK imported three kilogrammes of dried syngnathids in 1984, and in 1986, five kilogrammes in 1991, and one kilogramme in 1992. The same sources of statistics indicate that Norway imported 44kg dried seahorses from the Philippines in 1982, but the reliability of these data is unclear (see **Philippines** section).

Dried seahorse curios are commonly sold in European seaside souvenir shops. For example, a shell shop in St. Ives, Cornwall was selling spiny seahorses from the Philippines (*Hippocampus histrix* type) at £1.25 (US\$2) in September, 1993. The owner reported that he imported them directly from the Philippines, and could sell 20-30 a week. Even with a tourist season of only 16 weeks, this one small shop could sell 320-480 seahorses annually. At least half of the 50 seahorses for sale were juveniles, only 30mm long.

Demand for dried seahorses within Europe could increase as interest in TCM grows: European consumers are experimenting with TCM to treat ailments such as eczema (D. Atherton, *pers. comm.*, 28 November 1995). A Hong Kong wholesaler reported that he exports some TCM ingredients to European nations (e.g., France, UK) but that dried seahorses and pipefishes are not yet among them, "presumably because of their relatively high cost".

Exports of dried seahorses from Europe

Taiwan's Customs statistics show that Italy exported 30kg of dried seahorses to Taiwan in 1984, at a total value of US\$2400. It is possible that these seahorses had originated in the Philippines, and were being re-exported (see *Imports of dried seahorses to Europe*). There are no records of Taiwan receiving shipments of seahorses from any other European nations during 1983-1994 (Table Taiwan 3).

China's Customs Statistics Yearbook documented imports from Spain of 233kg dried syngnathids 1991, at a total value of US\$21 000. This made Spain the second-biggest source of China's recorded seahorse imports in 1991, although records are certainly incomplete. China records no other European imports in 1990-91 (see Table China 2).

Imports of live seahorses to Europe

Exporters in both Manila and Bali reported selling live seahorses to Europe (Germany, the Netherlands and the UK) but noted that the USA and Japan were larger markets.

The UK imports live seahorses from around the world, with prices ranging according to perceived size and attractiveness (Table Europe 1). Relatively few seem to be imported to the UK: Ornamental Fish International, the aquarium industry's self-regulating body in the UK, recorded imports of only 4000 seahorses in 1994 (M. Wilson, *pers. comm.*, 26 October 1995).

Table Europe 1

Sources and free on board (FOB) prices of seahorses sold by one UK importer

Country of origin	Rank by quantity	1995 FOB price range (US\$)* per seahorse
Philippines	1	1.00 - 2.00
Indonesia	2	1.50 - 2.50
Singapore (Malaysia & Indonesia)	3	1.50 - 2.50
Sri Lanka	4	2.00 - 2.50
Florida (<i>H. erectus</i>)	5	3.00 - 4.50
Brasil (<i>H. reidi</i>)	6	2.50 - 4.00
Costa Rica (<i>H. ingens</i>)	very few	6.00
Barbados	very few	6.00

* This is the export price and does not include shipping and handling, so retail prices will be considerably higher.

Rank by quantity means arrangement of the countries from which the UK obtained seahorses in 1995, by order of importance in terms of number of seahorses from each country.

Source: R. Sankey, *in litt.*, 30 October 1995.

Captive breeding of seahorses in Europe

Public aquaria in Berlin and Stuttgart in Germany are unusual in having done well at keeping seahorses. The UK Federation of Zoos Fish and Aquatic Invertebrate Taxon Advisory Group (FAI-TAG) has launched a Seahorse Conservation Group, comprised largely of staff from public aquaria that keep seahorses. The goal is to improve captive breeding so as to reduce demands for wild seahorses for aquaria, and to educate the public about these fishes and threats to their survival. A successful pilot study by the Tropical Marine Centre (a very large aquarium fish trader) offers hope of supplying the UK domestic market from captive breeding, and of transferring culturing expertise to developing countries

SEAHORSE TRADE IN NORTH AMERICA

Trade records and anecdotal evidence from other nations indicate that the USA may import and export substantial numbers of seahorses, both dried and live. Florida records many thousands of seahorse landings each year, and is also reputed to be a major recipient of dried seahorses from the Philippines at least. Canada appears also to import small volumes of dried and live seahorses while Mexico is reputed to export at least some dried seahorses.

Background for North America

The material in this section is far from complete, was largely obtained by chance, and offers only a cursory glimpse of the trade, in the hope of promoting further monitoring and research. No North American country controls the trade in syngnathids or collects appropriate Customs data (A. Gaski, *in litt.*, 2 July 1994).

Seahorses in North America

Four seahorse species occur in the Americas, three on the east coast and one of the west coast (Fritzsche, 1980; Vari, 1982). Only *Hippocampus erectus* reaches Canada.

- *H. ingens* is the sole species found in the eastern Pacific, with a range extending from Baja California, south to Ecuador. It is one of the world's larger species, reaching lengths of 250mm. The first study of these fishes has been proposed for the Galapagos Islands (J. Gomezjurado, pers. comm., 22 August 1995). This species is being exploited for TCM, and is valuable because of its large size and smooth texture (see **Latin America** section). *H. ingens* seahorses have also been sold as aquarium fishes in Europe and North America.
- *H. reidi* is a slender species (approx. 150mm long) living primarily among corals, from Florida throughout the Caribbean and along the Latin American coast, as far south as Uruguay. The minimal understanding of its biology comes from one brief study in the wild (Dauwe and Nijhoff, unpublished) and some laboratory observations (Vincent, 1990). *H. reidi* is popular in the aquarium trade because of its attractive colouration.
- *H. erectus* is a deep-bodied species (approx. 150mm long), usually marked with horizontal lines. Its range extends from Canada throughout the Caribbean, and may continue south to Uruguay. *H. erectus* is often caught off Florida by shrimp trawlers and sold dead and alive. Little of its biology has been studied (Linton and Soloff 1964; Hudson and Hardy, 1975; Vincent, 1990).
- *H. zosterae* is a small seahorse (approx. 25mm long) found in the Gulf of Mexico and around Caribbean islands. Its biology has been investigated by field and laboratory studies (Strawn 1953, 1958; Tipton and Bell, 1983; Masonjones and Lewis, unpublished). Although sometimes taken as an aquarium fish, its small size currently precludes use in TCM.

Use of seahorses in North America

Dried seahorses for TCM in North America

Dried seahorses are sold for TCM in North America, both whole and as pre-packaged medicines. *Chinese Herbal Patent Formulas: A Practical guide* (Fratkin, 1986) lists eight general tonics commonly available in North America that include seahorse. Pills include twenty or more ingredients and are intended to treat organic disorders, including sexual organs, kidney and spleen. The seahorse component ranges from 0.5% to 10%. One example of such preparations is: no. 176 *Seahorse Herb Tea* (Hai Ma Bu Shen Wan "Sea Horse Tonify Kidney Pill") produced by the Tianjin Drug Manufactory; Tianjin. Bottles include 120 pills and the instructions are to take three pills, three times a day. Seahorse is the first listed ingredient of 15, including Tiger bone.

Dried seahorses for curios in North America

Seahorses are seen for sale in curio and shell shops in many areas of North America, from Pier 39 in San Francisco to the Florida Keys, and north into Canada. It appears from their morphology that most seahorses sold as souvenirs have been imported from other countries (P. O'Donnell, *in litt.*, 31 October 1995). Twenty large (100-120mm) and fifty smaller (50-70mm) *Hippocampus histrix* type seahorses were on sale in Vancouver for C\$4 (US\$2.90) and C\$2 (US\$1.45), respectively in May 1992.

Two American buyers were encountered while visiting a shell and curio dealer in Cebu, the Philippines. They blocked all attempts to obtain information from the Filipino owner, but acknowledged that seahorses constituted part of their business, albeit only about 0.5%.

Live seahorses as aquarium fishes

Seahorses are popular aquarium pets in North America, despite the widely recognized difficulties of keeping them alive in captivity.

Seahorse catch in the USA

Seahorses are brought up as a by-catch of shrimp trawling in Florida, and are then sold as aquarium fishes or curios (pers. obs. on fishing boats in 1986). Those seahorses caught by boats trawling for live bait were more likely to be alive when brought to the surface, because nets were raised every 15-30 minutes rather than every few hours, thus subjecting the seahorses to less battering. Fishers noted that they generally caught many more seahorses (up to 50-100 per boat) on full moons. This lunar co-incidence is not understood but may be related to reproductive behaviour because most males were at an advanced stage of pregnancy when caught, and would have released young soon.

The number of seahorses landed has increased steadily since records began in 1990, with more than 112 000 seahorses taken in 1994 (Table USA 1). *Hippocampus erectus* and *H. zosterae* (and possibly *H. reidi*) are combined in these data, and no distinction is made between target catch and by-catch. The data probably include most seahorses that are landed live but may not include seahorses dying in the trawls (P. O'Donnell, pers. comm., 31 October 1995). More seahorses were caught on Florida's west coast than on the east coast. Trawl fishers told the author that they perceived seahorses as a useful income supplement.

Table USA 1

Number of seahorses landed in Florida

	Total no. seahorses landed	East coast, incl. Florida Keys	West coast, incl. Monroe county
1990	6504	1855	4649
1991	16 173	5429	10 744
1992	85 805	15 553	70 252
1993	73 485	18 231	55 254
1994	112 367	17 080	95 287

Source: Florida Department of Environmental Protection's Marine Fisheries Information System.

Seahorses apparently find ready markets, either live as aquarium fishes or dried for medicines and curios (e.g., Figure North America 1). Florida is the largest centre for marine curios in the USA (A. Gaski, *in litt.* 3 January 1996)

Figure North America 1

An advertisement from an American company seeking dried seahorses and other "underutilised" products

Reader enquiry number

**SEA HORSES
SHARK BONES**

We are a large dealer in underutilised products such as the above. If your company, fishing vessel or fishing village is a producer of any of these products, we would like to buy from you. We are interested in quantities both small and large.

Brooklyn
New York
USA
Tel: 718-
Fax: 718

Reader enquiry number

International 6/94

Imports of dried seahorses to North America

USA

Philippines' Customs statistics show intermittent exports of dried syngnathids to the USA since at least 1982, although actual figures are probably unreliable (Tables Philippines 1, 2 and 3). A dried seahorse exporter in

Philippines (Zamboanga) claimed that Florida was the largest market for dried seahorses in the USA. The sole recorded export of 357kg of seahorses from Zamboanga would have totalled about 300 000 animals. Trade records are known to be incomplete so volumes may be larger (see **Philippines** section). Zamboanga traders said the USA importer paid only P0.90 (US\$0.04) per seahorse in 1995, suggesting these were very small animals, more suitable for curios than medicines. In September 1995, one exporter in Zamboanga repeatedly commented that supply did not meet demand from the USA.

Some of the dried seahorses are likely to be used as medicines, particularly within the large Asian community; there were 1.6 million ethnic Chinese and nearly 800 000 ethnic Koreans in the USA in 1990 (0.7% and 0.4% of the population respectively) (Famighetti, 1995).

Canada

The only record of a seahorse export to Canada was one kilogramme of dried seahorses from Zamboanga in the Philippines in 1987 (perhaps 800 seahorses), but the dried seahorses seen by the author at other times (e.g., May 1992 and May 1994) were also apparently from the Philippines. Canada also has large Asian communities.

Exports of dried seahorses from North America

USA

Taiwanese Customs statistics show that the USA exported seahorses to Taiwan (Table Taiwan 3). Volumes were not large but even 100kg represents a minimum of about 26 000 seahorses. The USA is rumoured to export to other nations as well, but no facts could be ascertained.

Mexico

China official Customs statistics record imports of 131kg of dried syngnathids from Mexico in 1990, at a declared value of US\$18 000 (US\$137) per kilogramme. Two American curio and shell dealers working in the Philippines also commented on exploitation of Mexican seahorses.

Imports of live seahorses to North America

The USA reportedly imports substantial numbers of seahorses from the Caribbean, Indonesia, Philippines, Sri Lanka, or through Singapore (J. Banquero, *in litt.*, 6 August 1993). In turn, these nations cite North America, particularly the USA, as one of their biggest markets for live seahorses (see relevant sections). Several Asian exporters of marine aquarium fishes have their own distributors in North America, particularly the USA. Ecuador exported live seahorses to Florida from 1988-1991 at least (J. Gomezjurado, *in litt.* 31 October 1995).

Exporters in Southeast Asia commented that North American demand for seahorses is increasing. This appears to be the result of greater interest in marine aquaria by consumers, greater availability of marine aquarium equipment and expertise, and an improved range of desirable ornamental fishes (A. Gaski, pers. comm., 3 January 1995). One company in New Zealand started attempting to culture *Hippocampus abdominalis* with the USA market in mind (S. Ham, pers. comm., 26 October 1993).

Wholesale prices in the USA increased only slightly between 1989 and 1993 (Table USA 2). Retailers frequently sell seahorses at double these wholesale prices (J. Banquero, *in litt.*, 6 August 1993).

Table USA 2**Wholesale prices (US\$) of three types of seahorse in 1989 and 1993**

Species Size	<i>H. kuda</i> type (Black)			<i>H. kuda</i> type (Yellow)			<i>H. erectus</i> (Brown)		
	S	M	L	S	M	L	S	M	L
1989	3.75	4.50	5.00	5.00	5.50	5.75	3.25	4.50	5.75
1993	5.00	5.65	6.25	5.65	6.25	6.90	5.65	6.90	9.40

Source: J. Banquero, *in litt.*, 6 August 1993.

In 1989, Canadian wholesalers offered "black" seahorses from C\$7.50 (US\$5.40) to C\$8.50 (US\$6.10). In 1993, retailers sold *Hippocampus erectus* at C\$10.00 (US\$7.20), *H. kuda* type at C\$12 (US\$8.60), and *H. coronatus* at C\$35 (US\$25).

Exports of live seahorses from North America

The author saw shipments of live seahorses (*Hippocampus erectus*) leaving Florida for Europe in 1986, and UK aquarium fish importers report that such shipments continued in 1995 (R. Sankey, *in litt.* 30 October 1995).

Conclusions for North America

The USA both imports and exports live and dried seahorses. Untangling American involvement in the seahorse trade will be complicated because the USA serves as a major global entrepôt for fisheries products. Closer examination is needed to understand the fate of Florida's substantial seahorse landings. It currently would seem possible that the USA exports "good quality" seahorses for TCM, and imports cheaper seahorses for sale as curios, primarily in Florida.

Canada has too few seahorses to be a major exporter: even Nova Scotia is the northern edge of the seahorses' range. Its imports for the aquarium and curio trade may well come *via* the USA.

Exporters in the Philippines report that they cannot send enough seahorses to meet demand in the USA. Apart from the curio trade, demand for seahorses in medicines may be expected to grow in the USA; already four percent of Americans have Asian or Pacific Islander heritage, and that proportion is expected to increase many fold over the next 20 years (Famighetti, 1995).

SEAHORSE TRADE IN LATIN AMERICA

Some South and Central American nations have at least a minimal involvement in the seahorse trade, but very little is known about trade volumes, values, or destinations. Even less is known about the the conservation status of exploited populations.

Seahorses in Latin America

The four species of seahorse listed under the North American section (*Hippocampus erectus*, *H. ingens*, *H. reidi*, and *H. zosterae*) also occur in South American waters, while no species are restricted to Latin America.

Dried seahorse exploitation in Latin America

Large-volume TCM importers and wholesalers in Hong Kong and China reported obtaining small quantities of dried seahorses from Latin America.

Belize: A UK-based environmental consultant reported "limited commercial collections [of seahorses in Belize] for dispatch to Chinese end users" when dried (D. Phillips, *in litt.* 20.9.93).

Ecuador: Taiwan's trade records show imports of seven kilogrammes of dried seahorses (presumably *Hippocampus ingens*) from Ecuador in 1986. They had a total declared import value of US\$1000 (\$143 per kilogramme), second in price only to the popular Thai seahorses (US\$158 per kilogramme). Ecuador does not appear in later trade records but seahorses continued to be extracted: they were seen drying on the decks of shrimp trawlers in 1992 (P. Martinez, pers. comm., 1995).

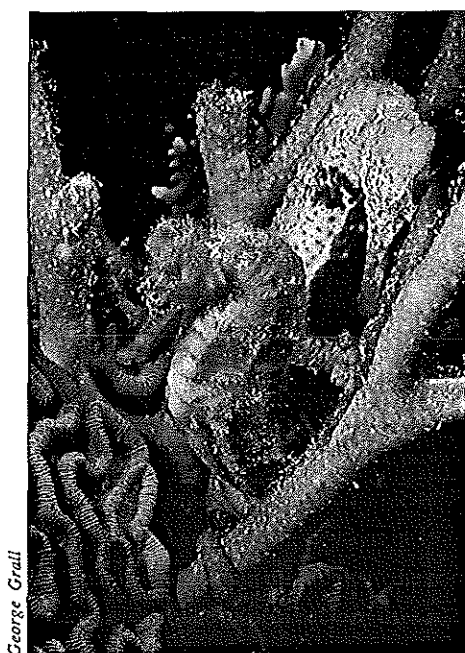
In 1995, seahorse exploitation began in earnest during an Ecuadorean fisheries disputes (J. Barry, *in litt.*, 6 July 1995). The closure of a sea cucumber fishery (because of over-harvesting) led to angry confrontations, and destructive fishing within the proposed Galapagos Islands marine reserve. Clear protective status had not yet been established for marine species within the reserve (J. Barry, *in litt.*, 6 July 1995). Biologists at the Charles Darwin Research Station reported that seahorses were among many species stripped from the sea (J. Gomezjurado, *in litt.* 31.10.95). Many were hand-collected by hookah rig divers seeking sea cucumbers in the waters around the Galapagos Islands (J. Gomezjurado, *in litt.*, 31 October 1995) and others were caught incidentally by shrimp trawlers operating in the Golfo de Guayaquil and around the Peninsula de Santa Elena.

Dealers from Taiwan and mainland Ecuador were reportedly "purchasing all available dried specimens" from Galapagos Island fishers in 1995 (J. Gomezjurado, *in litt.* 31 October 1995), paying fishers up to US\$3 per seahorse in 1995 (with only 60-80 seahorses per kilogramme *versus* 800-1000 seahorses per kilogramme in the southern Philippines). Large areas can probably be depleted of seahorses very quickly, given the low densities of *Hippocampus ingens* recorded on the west side of the archipelago (one to three per square metre) (J. Gomezjurado, *in litt.* 31 October 1995).

Live seahorse exploitation in Latin America

The UK imports seahorses from Belize, Brazil and some Caribbean islands including Barbados (R. Sankey, *in litt.* 30.10.95). Supplies from Brazil, at least, are abundant in certain seasons. A few seahorses from Costa Rica are

also imported to the UK, but more Latin American seahorses go to North America than Europe, probably because of lower transport costs (R. Sankey, *in litt.* 30.10.95). These Latin American countries target seahorses, collecting them by hand or with hand nets. Ecuador definitely exported live seahorses between 1988 and 1991 at least (J. Gomezjurado, *in litt.*, 31 October 1995). These were caught off the Santa Elena peninsula, by people targeting other aquarium fishes (e.g., damselfishes, angelfishes, blennies), and were sent to Florida.



George Grall

Hippocampus reidi, native to Latin American waters

Seahorses in tourism in Latin America

Live seahorses can have *in situ* commercial value in dive resorts, because of their appeal to tourists. The coral reef surrounding the island of Bonaire (Netherlands Antilles) falls entirely within Bonaire Marine Park, and diving is a mainstay of the local economy, so tourism initiatives are important. Dive masters on Bonaire told the author in 1992 that they were earning up to US\$100 in tips for leading American divers to seahorses

(*Hippocampus reidi*). Consequently each dive master monitored “his” seahorses carefully, and there were rumours that some of them relocated seahorses in order to prevent other dive masters from exhibiting them. Results of a brief study in 1992 found these seahorses to be faithful both to one partner and one location (Dauwe and Nijhoff, unpublished; pers. obs.). The Park authorities thereafter adopted a management plan which prohibited disturbance of seahorses caused by displacing or touching them (K. De Meyer, *in litt.*, 2 September 1993).

TRADE IN OTHER SYNGNATHIDS

The pipefishes, pipehorses, and seadragons are the closest relatives to the seahorses (all in the family Syngnathidae) and also have commercial value. Pipehorses and some pipefishes are exploited for TCM and as aquarium fishes, while seadragons are occasionally sold as expensive ornamental fishes (usually for public aquaria in Japan, Europe or North America). This section will present only a brief overview of a few aspects of the pipefish trade and is intended as a spur to further research. These fishes are here referred to collectively as pipefishes unless a distinction is required. The section includes a case study on Australia, because this is the only exporting country for which significant information is available.

The identities of the 200 or so pipefish species (in perhaps 35 genera) are still somewhat tangled, but a reasonable taxonomy is in place for most species, including those of the IndoPacific (Dawson, 1985). Among these genera are the pipehorses (genera *Solegnathus* and *Acentronura*) and the seadragons (two genera with one species each, *Phycodurus eques* and *Phyllopteryx taeniolatus*). Pipefishes have a much wider latitudinal distribution than seahorses, and even penetrate freshwater.

Male pipefishes, like male seahorses, undertake egg brooding, but the male brood pouch differs across pipefish genera, from simple ventral glueing (e.g., *Nerophis*, *Entelurus*) to walls protecting the eggs (e.g., *Syngnathoides*, *Corythoichthys*) to fully enclosed “zipped” pouches (e.g., *Syngnathus*), before culminating in the sealed pouch of the seahorse (*Hippocampus*). Genetic work indicates that this continuum probably reflects an evolutionary gradient (Meyer *et al.* unpublished).

Few species have been studied, and none of the most exploited species are well understood. Pipefishes, like seahorses, are characterised by sparse distributions, relatively low mobility, low fecundity, and lengthy parental care. In their behaviour and ecology, pipefishes fall into two major groupings: some pipefishes are similar to seahorses in forming monogamous pair bonds and are rigidly site faithful (e.g., *Corythoichthys intestinalis*; Gronell 1984; *Filicampus tigris*; Vincent and King, unpublished) while other species are polygamous (even within one brood) and range more widely (e.g., *Nerophis ophidion*, *Syngnathus typhle*; Berglund *et al.* 1988; Vincent *et al.* 1994).

This section presents information on pipefishes discovered in the course of the seahorse investigation. It is neither comprehensive nor detailed, but should provide a general overview and the basis for further study.

Uses of pipefishes in TCM

Pipefishes and/or pipehorses first appeared in *Omissions from the Grand Materia Medica* (720 AD - see *History of seahorse use in TCM*). They are considered to serve virtually the same medical purposes as seahorses (Bensky and Gamble, 1993: see *Uses* section), and are commonly combined with seahorses in medicines. One TCM practitioner reported the fine distinction as seahorses being better for “kidneys” and pipefishes being more effective for removing phlegm.

A modern TCM book from China lists seven pipefish and pipehorse species as medically implicated (Lin and Chen, 1988), labelling them generically as *hai long* ("sea dragons"). Often in TCM, though, "sea dragons" refers specifically to the large solid-looking pipehorses which are generally, but not exclusively, members of the genus *Solegnathus*. Other, cheaper pipefishes are sometimes labelled "false seadragons"; these include the widely sold Double-tailed Pipefish *Syngnathoides biaculeatus*, as well as *Trachyrhamphus serratus*, *Microphis boaja*, and *Halicampus koilomatodon* (Lin and Chen, 1988). Those species called seadragon in English (*Phycodurus eques* and *Phyllopteryx taeniolatus*) have no known role in TCM. *Hai long* ("seadragons") can also mean sea otters in Chinese, but this should not create confusion in a TCM context.

In terms of perceived medical value - and hence cost - large "sea dragons" (pipehorses) rank above seahorses, which rank above "false seadragons". Of the smaller species, only *Syngnathoides biaculeatus* are considered efficacious. Although most commonly sold dried, pipehorse and pipefishes are increasingly incorporated into prepared medicines, for example, comprising 35% of the contents in "Hai long tonic pills" (*hai long bu wan*) (see Uses section). Pipefish are found in several TCM formulations in North America, constituting at least 35% of one set of tonic pills (Fratkin 1986)

Pipefishes are often used in tonics, sometimes together with seahorses. One recipe that includes "seadragons" (pipehorses) is called "Monk jumping over the wall" and is said to help to improve men's sexual function, increase body strength and revitalize the elderly. At least one study of pipefish medical efficacy has been carried out (Shi Rui *et al.*, 1993). The English-language abstract for this study states that extracts of the pipefish *Syngnathoides biaculeatus* "stimulated PBL proliferation and inhibited growth of several tumor cell lines."

Pipefish availability varied among regions, with more bleached pipefishes and fewer large pipehorses ("seadragons") in Hong Kong than Taiwan.

Conservation status of pipefishes

Two pipefish species, *Microphis caudocarinatus* and *M. spinachoides*, appear in the 1994 IUCN Red List of Threatened Animals, listed as having Indeterminate Status (I) (Groombridge, 1993). It is unclear why they are distinguished from other pipefishes in this way, since most other species are also little studied and relatively rare.

The current draft of the proposed EU regulation on wildlife trade, *Com (93) 599 final COD 370*, due to come into effect 1 January 1997, lists no pipefishes in the Annexes (Anon. 1995) but a previous draft had proposed an Annex-B listing of the small Banded Pipefish *Doryrhamphus (Dunckerocampus) dactyliophorus* on the grounds that "live specimens are unlikely to survive long in captivity or in transport." The same could be said of other syngnathids.

Portugal's Red Data book lists two pipefishes, *Entelurus aequoreus* Linnaeus 1758 and *Nerophis lunbriciformes* Jenyns 1835 as Insufficiently Known (Anon., 1993). Both have large geographic ranges, as far north as Sweden. Other national Red Data Books have not been consulted for pipefish status. In Australia, Tasmania has implemented laws protecting pipefishes while four states accord seadragons protection (see *Legislation protecting pipefishes in Australia* below).

Sources of pipefishes and pipehorses

The smaller pipefishes are seldom considered sufficiently valuable to be targeted, even by subsistence fishers, but they can be caught by pushnet (e.g., near Bolinao in the Philippines) and some are taken by hand (e.g., Bohol in the Philippines). Most are probably incidental catches, taken as by-catch in shrimp trawl nets, obtained while emptying nets of other fishes, or collected while diving for shells (e.g., Tanzania). Pipefishes do not always find ready

markets and may be thrown away (e.g., some parts of Indonesia). The larger pipehorses (*Solegnathus* spp.) would be sufficiently valuable to target but most are apparently caught as a by-catch of trawling.

Philippines

Philippines trade statistics for 1982-1987 include pipefishes in the overall syngnathid figures (see Table Philippines 1). These show that the Philippines exported to Hong Kong, Japan, Korea, Malaysia, Norway, Singapore, Taiwan, the UK and the USA. It is impossible to know what proportion were pipefishes, but it seems likely that seahorses dominated the shipments. For example, Taiwanese trade records, which do separate seahorses from pipefishes, show that only seahorses were imported from the Philippines.

China

TCM traders in China in April 1995 reported that they could obtain most small types of pipefishes from Chinese waters, particularly from the Gulf of Tonkin where they are a by-catch of trawling, but that they had to import *Solegnathus* pipehorses (*hai long*). The *China Customs Statistics Yearbook* listings for 1990 and 1991 amalgamate seahorses and pipefishes (see China section: Table China 2), but it is reasonable to infer that much of the import from Australia would be pipehorses (see Australia section and Pipefish exploitation in Australia below). TCM merchants in China also reported obtaining "sea dragons" (pipehorses) from Southeast Asia and Latin America.

Hong Kong

A TCM importer in Hong Kong reported obtaining about 80% of his "seadragons" from Australia and New Zealand in 1993, with an increasing number of "poor quality" animals coming from Latin America as the Australian type becomes less common (Brazil and Belize were specifically mentioned: pers. obs. and A. Lau, *in litt.* 18 March 1993). The same sources noted that the rare local South China Sea "pipehorses" are better quality than the Australian type, because they are thicker and have no black markings. The Latin American pipefish, while used as a replacement for *Solegnathus* species, more closely resembles the cheap *Syngathoides biaculeatus*.

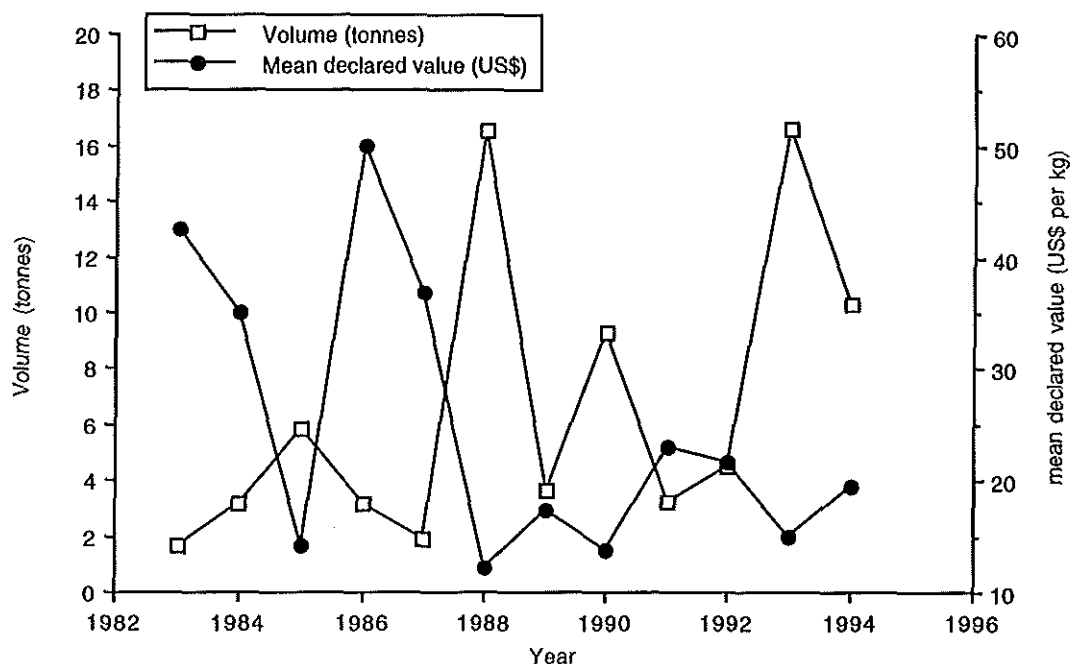
Hong Kong imports *Syngathoides biaculeatus* pipefishes from Malaysia, the Philippines, Latin America and occasionally from Pakistan, according to TCM merchants there in 1993. Merchants and fishers in the Philippines (and in Vietnam) independently noted that they sent small pipefish types to Hong Kong. Taiwan's trade statistics report that Hong Kong imported 741kg pipefishes from Taiwan in 1990 (at a total value of US\$6 500) and 1001kg in 1991 (at a total value of US\$8 800).

Taiwan

Local TCM merchants reported that some "false" pipefishes came from Taiwan's waters, but most pipefishes and all pipehorses will have been imported. Taiwan is the only consumer to publish detailed Customs statistics on the syngnathid trade (Table Pipefish 1: Republic of China [Taiwan] Customs Statistics). Recorded levels of imports varied greatly between 1983 and 1994 (Figure Pipefish 1). The most consistent supplier has apparently been Australia (see Pipefish exploitation in Australia below) but Hong Kong (1983-1990) and Thailand (1984-1994) have been larger sources. More recently, Taiwan's statistics report pipefish imports from Malaysia (since 1987) and China (substantial volumes since 1991). Less significant sources include Singapore, the USA, and Japan.

Figure Pipefish 1

Total volume and mean declared value of dried pipefish imports to Taiwan, by year.



Source: Republic of China [Taiwan] Customs Statistics

Volumes of dried pipefishes and pipehorses traded

TCM dealers in China report selling about 25% as many pipehorses as seahorses by weight. Given that seahorse consumption is roughly estimated at 20t annually (see China section), this would suggest that perhaps five tonnes of pipehorses are sold annually in China. Just one Hong Kong TCM importer estimated that he sent 70% of his pipefish sales (perhaps 700kg) to China annually.

The same importer reported annual sales of 200-300kg of pipefish to domestic Hong Kong outlets in 1993. He was one of two large syngnathid importers and there were also five to six smaller syngnathid importers (see Hong Kong section) so one could guess that Hong Kong importers might sell a total of one tonne of pipefishes domestically.

Taiwan's trade statistics show annual pipefish imports of more than 10t in 1993 and 1994, about the same as the seahorse imports during those years (Table Taiwan 3).

Further investigation is clearly needed to elucidate the trade in pipefishes, which may be large. For example, one level 3/4 buyer in Kilakurai in India thought that pipefish exports may exceed the substantial trade in seahorses (3.6t) (see India section).

Values of pipefishes at origin

Smaller pipefishes do not yield much income for fishers. In India in 1995, the fisher or sorter received Rs0.20 (< US\$0.006) per *Syngnathoides biaculeatus* pipefish, and the level 2 buyer received Rs100 (US\$3.16) per kilogramme, with about 400 pipefishes per kilogramme.

In the Philippines, one dried seahorse buyer reported a price of P120 (US\$4.80) per kilogramme of *Syngnathoides biaculeatus* in May 1993, while a Cebu dried fish exporter mentioned a value of P200 (US\$8.00) per kilogramme

Table Pipefish 1
Taiwan's records of dried pipefish imports, with origins and volumes (kilogrammes) per annum

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
China									1870	2844	7113	2969
Japan											78	
Hong Kong	1254	2493	5427	694	540	5977	285	105				
Malaysia					66	65	6	306	688	991	175	2051
Singapore	6					2111	54	24				
Thailand		300	78	2100	1094	8054	2079	8272	2	60	8552	4285
Other Asian									81			
Australia	240	336	332	367	171	277	94	20	548	530	714	1008
USA		12				18	6					
Other	154									70		
TOTAL	1654	3141	5837	3161	1871	16 502	3615	9322	3189	4495	16 632	10 313
Total value (US\$1000)	70.1	109.8	83.0	158.0	68.9	201.9	62.0	127.7	73.2	97.3	249.2	201.4
Mean price (US\$/kg)	42.4	35.0	14.2	50.0	36.8	12.2	17.2	13.7	23.0	21.6	15.0	19.5

* Some pipefishes may be re-exported. Hong Kong imported about one tonne from Taiwan in 1990 and 1991.

Source: Republic of China [Taiwan] Customs Statistics.

(about eight percent of the value of seahorses from the same exporter). Buyers in Bolinao paid fishers P2 (US\$0.08) for each live *Doryrhamphus dactyliophorus* and could sell them to Manila aquarium fish exporters for P7 each (US\$0.28), who in turn exported them for P10 (US\$0.40). Another exporter paid only P3-4 and then could sell some for P25 (US\$1.00). A buyer in Busuanga had to pay collectors P0.5-1 (US\$0.02-0.04) per Green Pipefish (species unknown) but received only P3 in Manila, making it uneconomic to transport them. Collectors in Bohol received only P0.50 (US\$0.02) for any dried pipefish but could get P15 for live *S. biaculeatus* (US\$0.60) from aquarium exporters.

In Lampung, Indonesia, fishers receive Rp500 (US\$0.23) and Rp1000-2000 (US\$0.45-0.90) per *Doryrhamphus dactyliophorus* pipefish they catch in the push nets (less than for seahorses; see Table Indonesia 3).

Prices for dried pipefishes used in TCM

Declared values will be confusing because the category *hai long* embraces both cheap pipefishes and expensive pipehorses, which may explain why declared values from Singapore were only US\$13 per kilogramme in 1988 but more than US\$100 in 1983, 1989 and 1990; the latter values were probably for pipehorses.



Dried pipefish (*Syngnathoides biaculeatus*) in Singapore

China

Retail prices for pipehorses were about twice as high as those for seahorses (see China section). In 1993, they cost RMB35-42 (US\$4.73-5.68) per 10g in Guangzhou. By 1995, they cost RMB57.4-62.4 (US\$6.92-7.52) per 10g in the same pharmacies. *Syngnathoides biaculeatus* ("sea awls") retailed at RMB9-14 (US\$0.93-1.69) per 10g in Guangzhou pharmacies and RMB25 (US\$3.01) per 10g in Qingping market (Guangzhou). Pipehorses in a Beihai market fetched "several hundred RMB per pair" whereas stick pipefish probably *Trachyrhamphus serratus* were sold at only RMB2-3 (US\$0.24-0.36) for each bundle of about 10 animals. Prices were slightly higher if the pipefishes had been bleached.

Hong Kong

Three classes of pipefish were available in 1993, and four classes in 1995 (Table Pipefish 2). The pipehorses were much more expensive than the pipefishes, and many fewer were displayed. The price of small pipefishes did not change between 1993 and 1995 (Table Pipefish 2). The Yat Chau health restaurant offered 30 unbleached pipehorses at HK\$280 (US\$37.33) per *tael* in 1993.

Table Pipefish 2

Summary table of dried pipefishes for sale in Hong Kong in 1993 and 1995

Type Size	Unbleached			Bleached		
	S	M	L*	S	M	L*
May 1993						
Weight (g)			20.8	3.8		
Length (mm)	125-150		375	175		
No. shops where displayed (n=10) [†]	4	0	2	4	0	0
No. on display per shop	50-200		20	40-200		
Cost/ <i>tael</i> (HK\$)	15-30		250	22-25		
Cost/kg (US\$)	53-106		882	78-88		
May 1995						
No. shops where displayed (n=12)	5	2	0	4	0	2
No. on display per shop	50-100	50-200				10
Cost/ <i>tael</i> (HK\$)	15-30	25-35		30-108		300-350
Cost/kg (US\$)	52-104	86-120		103-371		1031-1202

* All large pipefishes were pipehorses ("sea dragons")

[†] Yat Chau health restaurant not included

Source: Author's research

The TCM importer interviewed in Hong Kong reported selling syngnathids to China at lower prices than to domestic wholesalers (see Table Hong Kong 2).

Taiwan

Taiwan's trade records show considerable fluctuation in declared values for dried pipefishes (Table Pipefish 1; Figure Pipefish 1), in contrast to the clearer trends of seahorse prices (see Figure Taiwan 2). Average pipefish prices may appear to fluctuate oddly because of changes in the relative proportion of very valuable pipehorses ("seadragons") and the very cheap pipefishes (e.g., *Syngnathoides biaculeatus*) in a pipefish shipment. Yet declared values on pipefishes from Australia declined steadily, from US\$164 in 1983 to US\$69 in 1994, even though all these should have been pipehorses. The same pattern of decline was seen in declared value for seahorses (see Table Taiwan 3) and remains to be explained; one possibility is that more, but cheaper animals are being traded.

TCM wholesalers in Tihwa Street in Taipei each displayed up to 50-60 pipehorses, priced at NT\$550-700 per *liang* (US\$590-750 per kilogramme). Two pipehorses purchased in different wholesalers shops cost NT\$360 and NT\$450 (US\$14 and US\$18) each, and *Syngnathoides biaculeatus* pipefish cost NT\$20 (US\$0.80) each.

One small shop in Kaohsiung offered three pipefish species for sale. The large pipehorses cost NT\$1000 per *liang* (US\$1070 per kilogramme) and *Syngnathoides biaculeatus* cost NT\$500 per *liang* (US\$535 per kilogramme). The third species was only seen briefly, could not be identified, and was never otherwise observed for sale in TCM. *Trachyrhampus serratus* pipefishes were available in Penghu but were so cheap that the pharmacist treated them very casually and brushed away broken ones.

Indonesia and the Philippines

A single *Syngnathoides biaculeatus* pipefish cost Rp1000-3000 (US\$0.45-1.36) in a TCM pharmacy in Surabaya, Indonesia in 1995. The same species cost P30 (US\$1.20) per individual in a TCM pharmacy in Manila's Ongpin district in the Philippines in 1993.

Aquarium trade in pipefishes

Countries that deal in seahorses (e.g., Indonesia and the Philippines) also appear to catch and export pipefishes to similar destinations (e.g., North America). The species usually traded is *Doryrhamphus dactyliophorus*, but the "Green Pipefish" (species uncertain) and *Syngnathoides biaculeatus* can also be sold as aquarium fishes, though they are worth little.

In the Philippines, fish collectors from Bolinao could get 200 *Doryrhamphus dactyliophorus* in three days of hard work but rarely committed the effort. Instead, fishers generally collected this species incidentally when seeking other fishes, obtaining a maximum of 50 per two divers in one day. According to a former employee of one major aquarium export wholesaler in Manila, the business would get a total of 1 000-2 000 pipefishes (mostly *D. dactyliophorus*) every three to four weeks, usually mixed with some other shipment.

Pipefishes, like seahorses, do not do well in captivity and mortality is high (see Uses section). Seadragons require particularly careful attention to husbandry.

Pipefish exploitation in Australia: a brief case study

Advertisements in *Australian Fisheries* and other fishing trade journals seek dried "sea dragons" (pipehorses), and pipefishes as well as seahorses (see Figure Australia 1). Australia is home to at least 90 species of pipefishes, including the five heavily exploited *Solegnathus* species. "Seadragons" in English denotes the spectacular Leafy Seadragon *Phycodurus eques* and Weedy Seadragon *Phyllopteryx taeniolatus*, native only to southern Australia, but these are sold only rarely as expensive aquarium fishes.

Legislation protecting pipefishes in Australia

- (a) Syngnathids are protected in Tasmania, although at least one permit has been issued, to allow the capture of 20 Weedy Seadragons (*Phyllopteryx taeniolatus*) purportedly for work on captive breeding.
- (b) Western Australia issued a *Prohibition on taking Leafy Seadragons Notice 1991* under the Fisheries Act of 1905, forbidding the extraction of all *Phycodurus eques* from Southern and Indian Oceans. The basis for this prohibition was a perceived but undocumented decline in *Phycodurus eques* populations, concern about their poor survival in aquaria, and a wish to discourage any trade in dried seadragons (G. Hill, *in litt.*, 9 October 1992). *Underwater World* in Perth has special permission to collect 12 *Phycodurus eques* each year.

- (c) *The South Australian Fisheries Act 1982* was revised in 1991 to ban extraction of *Phycodurus eques* except with a permit, but names the species as *Phyllopteryx taeniolatus*, in error.
- (d) Victorian law protects *Phyllopteryx taeniolatus*, but mirrors the South Australian error by mistakenly calling it *Phycodurus eques*.
- (e) *The New South Wales Fisheries Act* protects *Phyllopteryx taeniolatus*.

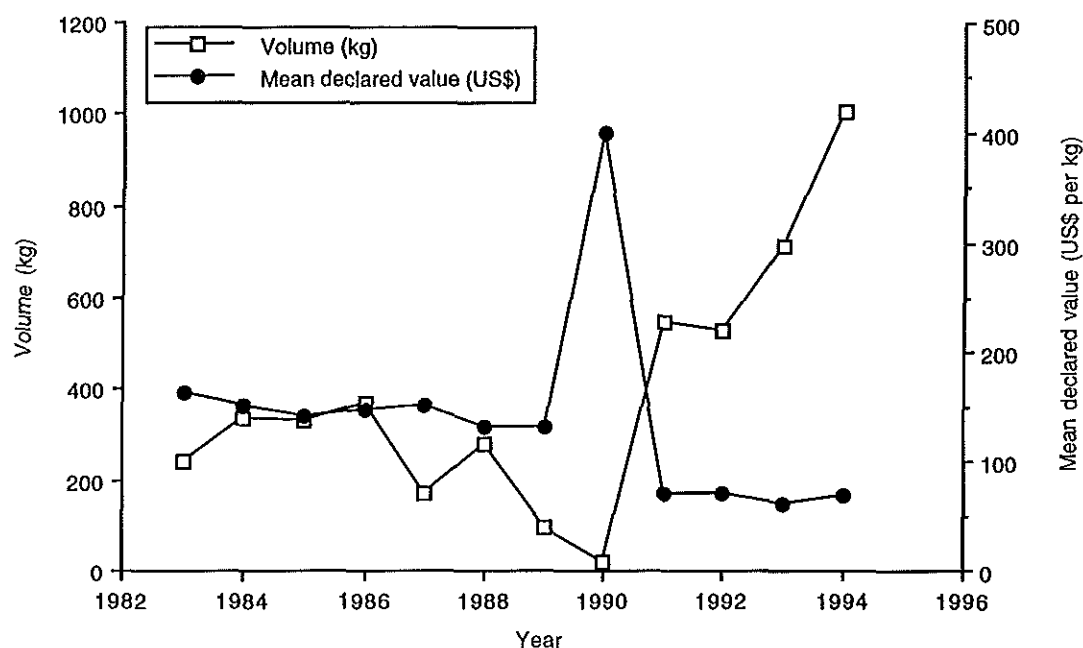
Officially Queensland requires that fishers keep catch records of all species with commercial value and process their fishes at recognized establishments.

Exports of dried pipefishes from Australia

Pipefishes (chiefly the pipehorses *Solegnathus hardwickii* and *S. dunckeri*) are caught off Queensland by shrimp trawlers. Trawlers tend to get only about 5-20 pipehorses during more than 10 days at sea. The fishers claim this is because pipefishes prefer rockier habitats where trawls do not operate and note that catch rates increase near rockier areas. By 1992 fishers' profits from pipefishes began to represent a significant contribution to their income (C. Reynolds, *in litt.*, 1992).

A Queensland DPIE agent estimated that total Australian pipehorse exports were about 1300kg *per annum* in the years up to 1992 (C. Reynolds, *in litt.*, 1992). Six 80-90kg lots of pipefishes were documented as leaving Queensland annually, and the agent thought that as much again would leave without being recorded. Queensland would thus export a total of 960-1080kg pipefish annually. The DPIE official further suggested that all the other states together might export less than 30% of this Queensland volume, or another 300kg *per annum*. A fisheries official in Victoria agreed that pipefish catches in his state were probably of minor importance, caught incidentally during on-shore seining operations (C. Reynolds, *in litt.*, 1992).

The DPIE estimate of pipehorse exports may be plausible, because China and Taiwan together claimed imports of 759kg from Australia in 1991; China registered imports of 64kg syngnathids from Australia in 1990 (total cost US\$17 000) and 211kg in 1991 (US\$62 000) - most of these are inferred to be pipehorses, given the lack of known seahorse exploitation in Australia - and Taiwan recorded pipefish imports of 548kg from Australia in 1991. Taiwan's statistics showed increasing imports of pipefishes from Australia from 1990 (Table Pipefish 1), in the wake of a very high declared value in 1990 (Figure Pipefish 2); this aberration needs explaining. Imports of Australian dried pipehorses to Taiwan totalled 275kg in the first four months of 1995.

Figure Pipefish 2**Volume and mean declared value of Taiwan's dried pipefish imports from Australia, by year.**

Source: Republic of China [Taiwan] Customs Statistics

Hong Kong TCM dealers estimated they began importing pipehorses from Australia about 15 years ago. Australian pipehorses are considered to be good quality, second only to those in local waters. Although slimmer and marked with black, they sell well if the black markings are washed off. Prices for Australian *Solegnathus hardwickii* reached the equivalent of US\$882 per kilogramme in Hong Kong in 1993 and US\$1200 in 1995 (Table Pipefish 2). Some pipehorses are definitely re-exported from Hong Kong to China.

Pipehorse exports from Australia seem to have become substantial during the last 15 years, suggesting either increased fishing pressure, changed fishing methods or greater awareness of the commercial value of this by-catch.

Exports of live pipefishes from Australia

Seadragons *Phycodurus eques* and *Phyllopteryx taeniolatus* are prized as aquarium fishes. *Phycodurus eques* are exported from Western Australia to Japan under special permit. They are also exported to Japan from Sydney (with poor survival rates) and Melbourne (R. Kuiter, *in litt.*, 3 November 1995).

Aquarists in Victoria are attempting to culture seadragons as aquarium fishes. Eggs are collected in the wild just prior to hatching, and reared in captivity. One commercial operation in Melbourne has been relatively successful at raising young, and a few of their captive adults have reached five years of age (R. Kuiter, *in litt.*, 3 November 95). The dealers voluntarily restrict seadragon collecting (under permit) to those less than six months old, as these adapt more easily in captivity (R. Kuiter, *in litt.*, 3 November 95).

Conservation concerns about pipefishes

Too little is known to judge the conservation impact of the trade. However TCM importers in China think that pipefish numbers in Chinese waters are probably declining because intense trawling for other fishes has taken too many as by-catch. Trawling may well also jeopardize pipefishes elsewhere through direct capture and habitat damage. The Australian pipefishes are apparently becoming harder to obtain, although it is not clear whether this reflects declining populations or growing demand.

Conclusions for pipefishes

There is a global trade in pipefishes for medicines and aquarium fishes. Taiwan alone imported more than 16.6t of dried pipefishes in 1993 and 10.3t in 1994. TCM currently absorbs mostly pipehorses (mostly *Solegnathus* spp.) and the pipefish *Syngnathoides biaculeatus*, but other species are becoming involved as substitutes for *Solegnathus*; most good quality pipehorses in TCM ("seadragons") have come from Australia in recent years.

Relatively few pipefishes are sought as aquarium fishes, but the trade could still have serious consequences for species with limited ranges and small numbers, such as *Phycodurus eques* and *Phyllopteryx taeniolatus*. There is a need to study the biology of pipefishes, and to monitor fisheries and trade routes, in order to determine current levels of exploitation and assess consequent impacts on pipefish populations. The Australian Nature Conservation Agency (ANCA) launched a new study in 1996 to study the ecology of *Phycodurus eques*, in order to assess population sizes and threats.

DISCUSSION

Persistent themes appear in this report: (i) seahorse trade volumes are large, amounting to many millions of seahorses annually; (ii) involvement is global, with at least 32 nations trading seahorses; (iii) seahorses can be a valuable commodity, selling at up to US\$1200 per kilogramme in Hong Kong during 1995; (iv) these fish are economically important to many artisanal fishers and medically important to many Chinese consumers; (v) demand for seahorses invariably exceeds supply, with some traders facing a shortfall of many hundreds of kilogrammes; (vi) demand is very likely to continue to grow, particularly as a consequence of China's economic boom; and (vii) most importantly, virtually all the fishers or merchants who were interviewed reported that seahorse numbers are declining, and declining rapidly. Seahorses in many harvests are also becoming smaller, and juveniles are now actively exploited.

Quantifying the nature and impact of the seahorse trade is difficult because (a) fisheries and Customs data are sparse and often unreliable; (b) seahorse taxonomy, geographic distributions and population sizes are unknown; and (c) population responses to exploitation are unstudied. This report has synthesized available published information and gathered a large amount of other evidence (much of it anecdotal and circumstantial) in order to make a first assessment of this hitherto unknown trade, but gaps and discrepancies remain obvious. Nonetheless, no matter how inconclusive the absolute magnitude of the threat to seahorses, the results are sufficiently worrying that they warrant a reaction. An ability to assess the full extent of this conservation problem will largely depend on adopting precautionary measures that permit monitoring, documentation, and research.

This report's focus on direct exploitation should not mask the threat posed by habitat destruction. The accelerating loss and degradation of seagrass, mangrove and coral reef ecosystems can only make seahorse populations more vulnerable to other pressures, including fishing. The status of these vital seahorse habitats needs more investigation and attention.

Seahorse fisheries are individually small, though cumulatively large

Seahorses are caught by artisanal or subsistence fishers, or as a by-catch of trawling. Increasingly, seahorses *per se* have become the goal of fishing trips in many regions, or have become the main source of cash from a trip otherwise dedicated to obtaining food (e.g., India, Indonesia, Philippines). The intensity of effort dedicated to collecting seahorses depends on their availability relative to other fisheries resources, as well as on other income-earning opportunities, but seahorses may now comprise up to 80% of fishers' annual incomes, and up to 100% of the money earned during the peak seahorse catch months (e.g., see Philippines section). Many seahorse collectors

are at a loss to predict how they will replace the dwindling seahorse fishery, given the dearth of other viable resources.

Large-scale mechanised fisheries for seahorses are unknown and are unlikely ever to be viable, because these fishes are patchily distributed, recolonize slowly, and are often found in areas that are difficult to access with fishing gear, such as coral reefs or mangroves. Seahorses are, however, commonly landed as an incidental by-catch from shrimp trawling and other forms of net fishing. These are important contributors to the seahorse trade in some areas (e.g., Thailand) despite the deceptively small yields: each shrimp trawler in India caught only a few seahorses a night, but there were more than 400 such boats operating from just one port.



Palk Bay fishing boat, Tamil Nadu, India

The seahorse trade is complex

The seahorse trade involves many producers and consumers, most of whom handle only a few seahorses. The dispersed nature of the trade presumably explains why it has so far been largely overlooked by conservationists.

Some seahorse exports are sent through recognized channels but many are not, as the author discovered: Indians take them in checked luggage on flights to Singapore; overseas Chinese carry seahorses when they return to visit China; huge volumes cross the border between Vietnam and China in what is often illicit trade; merchants tuck seahorses into shipments of sea cucumber from the Philippines; dead seahorses are sent along with live grouper on fast boats from Palawan to Hong Kong; Taiwanese and Chinese fishers exchange seahorses at sea; Indonesians send them as gifts to relations in Taiwan; and small exported volumes of under two kilogrammes need not be declared in Australia. Frequent gaps and discrepancies in information testify to the difficulties of tracking this trade.

Many countries trade seahorses

A total of 32 countries or territories are already known to sell or buy seahorses. The following can be deduced from Table Discussion 1, despite numerous gaps and deficiencies in the information:

- Five countries (India, Indonesia, Philippines, Thailand and Vietnam) are known net exporters of seahorses, and Malaysia may be. Those Latin American nations that trade seahorses can be inferred to be net exporters since they are unlikely to have a large domestic use.

THE INTERNATIONAL TRADE IN SEAHORSES

Table Discussion 1

Inferred roles of countries in seahorse exploitation

? possible: volume unknown

(✓) minor: tens of kg

✓ significant: hundreds of kg

✓✓ major: thousands of kg

	Catches	Dried		Live		Net importer / exporter?*
		Exports	Imports	Exports	Imports	
Australia	?	?	?	(✓)	✓	
Belize	?	(✓)				
Brasil	✓			✓		
Canada			(✓)		(✓)	(I)
Caribbean	✓			✓		
China	✓	✓✓	✓✓			I
Costa Rica	?			(✓)		
Ecuador	✓	✓		(✓)		(E)
France	(✓)					
Germany					✓	(I)
HK	(✓)	✓✓	✓✓		✓	I
India	✓✓	✓✓				E
Indonesia	✓	✓	(✓)	✓✓		E
Italy	(✓)	(✓)	✓			
Japan	?	✓	✓		✓	
Kuwait	?	?				
Malaysia	✓	✓	✓	✓		
Netherlands					✓	(I)
NZ	✓	?		?		
Norway			(✓)			(I)
Philippines	✓✓	✓✓	(✓)	✓✓		E
Portugal	✓					
Singapore		✓✓	✓✓	✓✓	✓✓	I
Spain	✓	(✓)				
Sri Lanka	✓			✓		
Taiwan	✓	(✓)	✓✓		✓	I
Tanzania	(✓)					
Thailand	✓✓	✓✓				E
UAE	?	?				
UK			(✓)		✓	
USA	✓	✓	✓	✓	✓	
Vietnam	✓✓	✓✓				E

* Bracketed letters signify that this was inferred from size of local market or of local seahorse supply. (Mexico is also known to catch and export dried seahorses)

Source: See relevant country sections in this report.

- Three countries are known large net importers of seahorses: China, Hong Kong and Taiwan. Singapore will probably also belong to this group, as home to 2.2 million ethnic Chinese and very small territorial waters where seahorses could be caught. Countries without native seahorses that sell seahorse curios or consume seahorses for aquarium pets (such as Canada, Germany, the Netherlands, and the UK) will by necessity also be net importers.
- At least 20 countries or territories catch seahorses for export, with volumes from several kilogrammes to several tonnes *per annum*.
- At least 16 nations or territories export dried seahorses and at least 13 import them; some do both. The role of other countries is unclear.
- At least 16 countries also export live seahorses to more than 10 countries or territories. Many aquarium fish go to North America and Europe, but also to Japan and Taiwan.

Trade links are many and varied (Table Discussion 2). References to China, Hong Kong, Philippines and Taiwan appear most often in the table, perhaps because they have been most investigated. Unravelling these connections is made more difficult by the fact that Hong Kong imports seahorses from Indonesia and the Philippines, then re-exports to the same countries after bleaching the animals. Other countries may also re-export seahorses.

In general, Southeast Asian nations which use little TCM export to those Asian regions that use more TCM. Asia sends aquarium and curio seahorses to Europe or North America but there is some return trade as well (from Italy, Spain, USA). It appears possible that the USA may be exporting “good quality” dried seahorses to Taiwan and other Asian countries and then purchasing “poor quality” curio-grade seahorses from the Philippines. South and Central America have primarily exported live seahorses to North America and, to a lesser extent, Europe. Asian business involvement in Latin America is increasing and could promote exploitation of seahorses for export to Asia. Large *Hippocampus ingens* seahorses from Ecuador now go to Taiwan as dried seahorses for TCM.

The uneven distribution of information could severely bias any view of the trade. Taiwan’s detailed Customs statistics make it central to this report, but Taiwan is probably neither the largest dealer, nor the largest consumer.

Consumption is high

The seahorse trade is clearly large. Data compiled in this report, in combination with published statistics, suggest that the annual trade within Asia amounts to at least 45t of dried seahorses (Table Discussion 3). If we assign 350 dried seahorses per kilogramme as a current estimate (Table Discussion 4), then 45t amounts to almost 16 million dried seahorses. Exact quantification is impossible because a dearth of published data forces reliance on anecdotal and descriptive reports, but these were collected carefully and cross-verified both within interviews and among sources. Moreover, although volume estimates depended heavily on inference and extrapolation, these tended to be assessed conservatively. Indeed, the total volume of seahorses exploited, including global trade and domestic consumption, is probably significantly higher than 45t, not only because cautious estimates have been used, but also because the seahorse trade of many countries or parts of countries have not yet been researched. It will be particularly important to obtain realistic estimates of seahorse trade in Japan, Korea, Malaysia and Singapore as well as to evaluate seahorse fisheries and consumption outside Asia. Use within the country of origin must also be added to totals.

Annual imports of seahorses to Asian countries (estimated at roughly 45t) are substantially greater than estimated annual exports (30.8t) (Table Discussion 3). This discrepancy may be resolved when more data are available from the Philippines, Malaysia and Indonesia.

Table Discussion 2

Reported exchanges of dried seahorses since 1983

? possible: volume unknown (✓) minor: tens of kilogrammes ✓ significant: hundreds of kilogrammes ✓✓ major: thousands of kilogrammes																
Australia																
Australia		China														
China	?		Ecuador													
Ecuador				HK												
HK	?	✓✓			India											
India						Indonesia										
Indonesia	(✓)	✓		✓			Italy									
Italy								Japan								
Japan		✓		(✓)		(✓)			Korea							
Korea		?		?						Malaysia						
Malaysia		✓		✓	✓						Mexico					
Mexico		✓										NZ				
NZ				(✓)									Norway			
Norway														Phils		
Philippines		✓		✓✓			✓	✓	(✓)	(✓)			(✓)		Sing	
Singapore		✓			✓✓									✓		Spain
Spain		(✓)														Taiwan
Taiwan		✓✓	✓	✓✓		(✓)	(✓)	(✓)		✓			✓✓	✓		Thailand
Thailand		✓✓		✓✓												UK
UK													(✓)			USA
USA													✓		(✓)	
Vietnam	?	✓✓		✓										(✓)	✓	

HK = Hong Kong; NZ = New Zealand; Phils = Philippines; Sing = Singapore

Sources: See relevant country sections in this report.

Table Discussion 3

Rough estimates of volumes of seahorses traded internationally each year by Asian countries. Domestic consumption is not included.

Area	Live seahorses exported Estimated volume per annum	Dried seahorses exported Estimated volume per annum (t)	Source	Destinations *	Dried seahorses imported Estimated volume per annum (t)	Source	Origins*
China		1.0	1	Taiwan (Japan)	20.0	3	Vietnam, Thailand, Philippines, Malaysia, Indonesia
Hong Kong		10.0 <i>re-exported</i> †	3	China	10.0 consumed	3	Thailand, Philippines, Malaysia (Vietnam)
India		3.6	3	Singapore (Malaysia)			
Indonesia#	>>100 000	0.2	3	(China, HK, Taiwan)			
Japan		0.4	2	China (1990)	0.2	2	Philippines (HK, China)
Malaysia#	??	0.5		Taiwan (HK, China)	0.1	3	India
Other Asian		1.5	1	Taiwan (1989-1991)			
Philippines	500 000	3.5 (11.0 possible)	3	HK, Taiwan (Japan, USA, Singapore)			
Singapore#	?? (many)	0.1	1	Taiwan	3.5	3	India
Taiwan	>10 000				11.2	1	Thailand, Philippines, China (Indonesia, HK, Malaysia, Singapore, Vietnam)
Thailand		15.0	1,2,3	Taiwan, China, HK			
Vietnam		5.0	3	China (HK)			
Total	<1 000 000	30.8			45.0		

* Countries in brackets are minor destinations or origins.

† Excluded from exports total because it is a re-export that should already have been tallied once.

Trade volumes for these countries will be severely underestimated, particularly for Singapore.

Sources: ¹Republic of China [Taiwan] Customs Statistics ²China Customs Statistics Yearbook 1990-1993 ³. See relevant country sections in this report. Figures taken from earlier years are intended to provide guidelines for current trade where no other data are available.

Whatever the gaps and inadequacies of the available information, the seahorse trade appears sufficiently large to justify concern. Adding in trade by Singapore and the non-Asian nations, and incorporating domestic consumption for all nations, may mean the annual global tally would exceed 20 million seahorses: Italy alone imports perhaps 90 000 dried seahorses from just one Philippines exporter each year, just as curios. One large TCM trader in Singapore thought this estimate of 20 million dried seahorses *per annum* ridiculously small, noting that more seahorses would be consumed if just two percent of mainland Chinese consumed one seahorse per year. More precise calculations would clearly need to include a weighted assessment of seahorse numbers per kilogramme in each country times the volume traded by that country, but current data are too incomplete to justify such detailed analyses.

Calculations from Indonesian and Philippines' exports indicate that many hundreds of thousands of live animals may be taken for aquarium pets each year, particularly once live seahorse exports from North, Central and South America are included. This tally, gathered anecdotally from a sample of aquarium exporters, sounds extremely high and there is an urgent need to corroborate it.

Seahorses can be valuable

Fishers targeting seahorses received as little as US\$0.02 (India) or as much as US\$3.00 (Ecuador) per dried seahorse, a 150-fold difference (Table Discussion 4). The Ecuadorian seahorses are probably particularly valued in TCM because they are large and smooth; similar quality seahorses (of other species) are becoming rare elsewhere. Fishers selling live seahorses made slightly more money than those selling dried seahorses in the key aquarium trade areas (Palawan in the Philippines, Bali in Indonesia) (see *Philippines and Indonesia* sections).

Mean declared prices for dried seahorses in Taiwan's Customs records (between exporter and importer) dropped markedly between 1987 and 1988, from US\$116 to US\$66 per kilogramme (Table Discussion 6). A drop in cost sounds rather unlikely given the reported price increases in export trading networks. This needs investigation, to check whether, for example, this drop in declared value can be explained by changes arising from China's economic liberalisation.

The preferred large bleached seahorses were selling at US\$882 per kilogramme in one Hong Kong outlet in 1993 and at US\$1202 in another outlet in 1995 (see Table Hong Kong 1). The less desirable smaller, mixed-species, unbleached seahorses were selling for US\$265-441 per kilogramme in 1993 and US\$275-412 in 1995. Japanese consumers appeared to pay more than any other country, for a much smaller seahorse; dried seahorses of similar size would have cost about US\$2.80 in Taiwan or at least US\$11.49 in Japan (Table Discussion 4).

At least some fisheries are increasing rapidly in both volume and value. The total export value of the Tamil Nadu seahorse fishery in India is thought to have doubled from 1992 (US\$300 000 *per annum*) to 1995 (A.P. Lipton, pers. comm., 14 June 1995).

Seahorse supply is not meeting demand

Seahorse traders generally concurred that demand far exceeds supply, particularly for larger seahorses (see below). All dried seahorse buyers and exporters were confident that they could sell as many seahorses as they could obtain. Thus, pressures on seahorse populations are likely to increase. The increased global consumption of seahorses appears to be driven primarily by China's economic growth, both through direct imports and through imports *via* Hong Kong. During the author's 1995 visits to six large TCM importers in China, in which an interest in seahorse culturing was emphasized, she was asked to supply an immediate shortfall of roughly 2.5t of dried seahorses (in excess of 600 000 medium-sized animals). No stockpiles of seahorses were found during investigations.

Table Discussion 4**A comparison of dried seahorse prices across the world***

Origin of seahorses	No. dried seahorses/kg	Fisher (each)	Buyer (per kg)	Price (US\$) for dried seahorses received by:			
				Exporter (per kg)	Importer (per kg)	Wholesaler (per kg)	Retailer (each)
<i>Philippines</i>							
Manila (1993)							1.20-1.60
Bohol	300-450	0.28-0.56	100-120				
Jolo	800-1000	0.02-0.14	112-120				
Palawan (1993)	600-800	0.04	48-64				
Busuanga (1993)	800-1000		40-80				
<i>Others</i>							
Canada (1992)							1.46-2.92
China (Guangzhou)	260†				120-180		1.00-1.56
Ecuador		3.00					
Hong Kong	267				133-173	147-191	1.07-1.60
India (by-catch)	800-1000	0.03-0.06	62-109				
India (target catch)	350-500	0.17-0.37	62-156				
Indonesia	500	0.68-1.36	1.36 each OR				0.91-6.82
(Bali & E. Java)			2.27-4.55 per kg				
Japan (only 70-80mm)							11.49-17.24
Taiwan (1993)						267-534	2.80-12.00
Tanzania							3.90-5.90
Thailand (1989)	300	1.21-1.62	243-324				
UK (1993)							1.96
Vietnam	300-400	0.27	118-127	227-291			1.36-4.54

* Data are from 1995 unless otherwise stated. These data should be considered tentative at best, as they come from uneven sampling, and are not rigorous enough to allow detailed comparison among countries. Prices for very small seahorses were excluded as these greatly extend price ranges and are not yet retained in all countries.

† This figure is for 1993.

Sources: See relevant country sections of this report.

Table Discussion 5
A comparison of live seahorse prices across the world*

Origin of seahorses	Fisher	Prices (US\$) per live seahorse received by:				Wholesaler	Retailer
		Buyer level 2	Buyer level 3	Exporter (FOB)	Importer		
<i>Philippines</i>							
Bohol	0.24	0.28	0.40-0.60	1.00-2.50			
Palawan (1993)	0.10-0.26	0.20-0.36					
Busuanga (1993)	0.20-0.32	0.40-0.72					
<i>Others</i>							
Australia				12.00-25.00			13.00
Barbados				6.00			
Brasil (<i>H. reidi</i>)				2.50-4.00			8.75
Canada (1993; <i>H. kuda</i> type)				6.00			
Costa Rica (<i>H. ingens</i>)							2.67-8.00
Hong Kong							1.36-2.72
Indonesia (Bali & E. Java)	0.23-1.36	0.91-2.27		1.50-3.00			
Sri Lanka				2.00-2.50			
Taiwan (Taipei)				3.00-4.50		5.00-6.25 ("black" <i>H. kuda</i> type)	4.00-8.00
USA (1993)						5.65-6.90 ("yellow" <i>H. kuda</i> type)	

* Data are from 1995 unless otherwise stated. These data should be considered tentative at best, as they come from uneven sampling, and are not rigorous enough to allow detailed comparison among countries. Prices for very small seahorses were excluded as these greatly extend price ranges and are not yet retained in all countries.

Source: See relevant country sections in this report.

Table Discussion 6

Mean declared values per kg (US\$) of dried seahorses imported to Taiwan

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
China												
Japan	130	127						40	53	42	54	62
Hong Kong	103	130	128	127	110	62	60		60	61		
Indonesia						65	71	33	114			
Malaysia	124	126	124	132	90	52	36	39	44	47	52	51
Singapore	129	126	117	88	94	89	56	78	41	55	51	61
Philippines	104			99	100	74	57	55	55	59	70	103
Thailand	121	120	115	106	86	63	59	50	55	55	78	71
Vietnam							50	94		105	53	60
Other Asian							50	40	56			6
Italy		80										
USA		129	123	134		60		33		66		
Ecuador				143								
Other	104							40				
Mean	113	120	123	118	116	66	55	50	60	61	60	59

Source: Republic of China [Taiwan] Customs Statistics

China's demand for seahorses is known to have climbed steeply in the past 10-12 years, presumably in response to the increased consumer income created by economic changes; one 1993 estimate by a TCM importer put the increase as 10-fold in 10 years. People can buy seahorses now who could not hitherto afford to do so. Moreover, TCM dealers reported that the changing pace of life in modern China is promoting a new market for tonic products, in which seahorses are a prominent ingredient. TCM importers in China seek seahorses from any and all sources, and assured the author that there would be a market for every available seahorse. Even those animals previously rejected as being too small, too spiny, too dark, or too damaged now find a ready market in the manufacture of patent medicines, with seahorses as small as 25mm becoming acceptable.

Seahorses are declining in number and size

Declining seahorse numbers in the wild are the stated reasons for attempts to culture seahorses in China, the Philippines, Thailand, Indonesia, and Vietnam. Fishers and traders all over Asia noted that seahorse numbers are decreasing and that seahorses in the trade are getting smaller (see Table Discussion 7). Good descriptive evidence suggests that the most closely watched populations in each of the five "exporting" countries visited manifest serious declines in numbers, some of more than 50% over five years. This magnitude of decline was also anecdotally reported in other areas (e.g., Busuanga, Philippines). New field research projects in the Philippines and Vietnam are beginning to endorse fishers' views as socioeconomic and biological studies find evidence of decline (see Current conservation section). Declining seahorse populations are making it difficult for the Bangsaen Institute of Marine Science in Thailand to obtain enough wild seahorses to run culturing trials.

Seahorse quality or size was also thought to be declining, where any opinion on this was expressed. Assertions of decreased size were tentatively confirmed through changes in number of seahorses per kilogramme (see Table Discussion 7). Assertions of changes in quality were more difficult to evaluate, but the respondent generally meant that the preferred larger or smoother or paler seahorses were now less available.

Half the 25 seahorse collectors interviewed in Bohol (central Philippines) thought the locally important seahorse fishery was doomed to disappear (Vincent *et al.*, in prep.). One fisher who disagreed said he had to be optimistic that seahorses would remain available because they were his main source of livelihood and thus determined his survival, and that of his family.

A case for precautionary measures

Seahorses clearly face high levels of exploitation. The usual economic argument to address such situations is that exploitation will cease when a resource becomes too depleted to be viable. This is unlikely to be the case with seahorses. If a subsistence fisher must, in any case, seek food for the family, then he will also take the seahorses he finds. Similarly, trawlers will bring up seahorses so long as they fish in seahorse habitats. It is difficult to imagine a point at which it will not be worth retaining seahorses, given the ease with which they can be dried and stored and the ready markets. Thus seahorses are likely to continue to be exploited even if populations become very depleted.

It is impossible at this time to predict the long-term impact of the seahorse trade because information on the taxonomy, geographic distribution, densities, or reproductive biology of most species is still inadequate. There is, however, considerable evidence that virtually all seahorses are marketable and will be fished, and that fished populations are being depleted. Too little is known about their genetic diversity or dispersal to predict the consequences of population losses for species persistence but populations themselves are important conservation units.

Exploitation is global, and Europe and North America consume vast numbers of seahorses as aquarium fishes and

Table Discussion 7

Changes in demand and supply of seahorses in countries visited by the author in 1993-1995, according to those in the trade

	Change in demand	Change in no. caught	Change in no. wild seahorses	Decline in sample seahorse populations	Change in size/quality	Change in no. seahorses per kg	Culture attempts
<i>Net exporters</i>							
India ^{1,2}	+	+	-	Palk Bay 1992-1995: ≤75%	-	250 (1993) 350-500 (1995)	
Indonesia ²	+	-	-	Bali & E. Java 1990-1994: 15-50% 1993-1994: 25%			✓
Philippines ²	+	-	-	Bohol 1985-1994: 69% 1990-1994: 54% 1993-1994: 38%	-	250 (1993) 300-450 (1995)	✓
Thailand ³		-	-	ChonBuri 1993-1995: 50%			✓
Vietnam ⁴	+	-	-	Cua Be (Khanh Hoa) 1991-1995: 33-80%	-	1991-1995: 17% reduction in length	✓
<i>Net importers</i>							
China ²	+	-			-		✓
Hong Kong ²	+				(-)		
	(re-export)						
Taiwan ²	0	-			(-)		

+ = increasing; 0 = no change, - = decreasing; (-) = possible decrease

Sources: ¹Marichamy *et al.* 1993 ²Author's research ³Dr. S. Sirirattanchai, in litt., 10 November 1995 ⁴Truong Si Ky, pers. comm. 3 August 1995

curios. TCM may be the biggest user of seahorses, but taking seahorses as pets or curios has as final an impact on wild populations as taking them as medicine. Further, in those regions where TCM has not yet begun accepting small seahorses, it is the aquarium trade that extracts juveniles, while the curio trade (primarily for Western markets) consumes many seahorses for souvenirs and ornaments.

Seahorses may be affected as much by the general plight of the world's fisheries as they are by their own popularity. For example, as economic pressures increase and fish stocks decline, trawl fishers may work more intensely, thus bringing up more seahorses as by-catch (e.g., China and Vietnam). As inshore fisheries decline, artisanal fishers target seahorses to recover income lost from other sources (e.g., India's depleted sea cucumber fishery). As bans and controls preclude other options, fishers will have to turn to unprotected resources, including seahorses (e.g., Filipino fishers' response to the ban on trading live coral reef fishes near Palawan). Conservation planning can only work if it recognizes the reality that subsistence fishers will be forced to circumvent measures that further deprive them of resources without compensation.

Seahorses, sea cucumbers, and shark's fins are often traded together to the same markets. Seahorse exploitation is therefore likely to increase when a sea cucumber fishery declines (e.g., India) or when a sea cucumber fishery expands near seahorse resources (e.g., Tanzania). It was a dispute over sea cucumber extraction that led to the tremendous increase in seahorse exploitation around the Galapagos Islands in 1995 (see **Latin America** section).

Seahorses depend on their habitats to survive so attempts to diminish the impact of the trade on seahorse populations may be ineffectual unless protection and management are also sought for their vital seagrass, mangrove and coral reef habitats; these highly productive ecosystems are being degraded and lost through dredging, dumping and polluting, silting, clearing, felling, dynamiting and cyanide fishing. The corollary is that the seahorse fishery can damage their environments as well (e.g., sponge holdfasts are collected with the seahorses in India: Marichamy *et al.* 1993).

The data in this report are far from perfect but the overall message is clear: seahorses are being harvested in ever greater numbers, and seahorse numbers are declining. The implications of these findings could be grave indeed, and a precautionary approach argues that pro-active measures should be implemented to ensure the long-term viability of seahorse populations.

CURRENT CONSERVATION

The first seahorse conservation initiatives have been launched: a community-based conservation and management programme in a village in the Philippines, and a project in Vietnam that integrates biological study with pilot work in seahorse culturing. Both these conservation projects will include development of small-scale cage culture techniques, currently unfeasible.

Philippines

In the Philippines, seahorses are often a target catch of considerable economic importance to subsistence fishers. A project was established in the fishing village of Handumon, off Bohol in the central Philippines in October 1994. Seahorse collecting developed in the area in the late 1960s but catches have recently declined markedly (see **Philippines** section), alarming the 40% of village fishers who depend on seahorses for income.

The project is run by two Filipino biologists and a Filipino community organiser, under the direction of the author. They are employed through the indigenous Haribon Foundation for the Conservation of Natural Resources. The people of the village (*barangay*) have been directly involved in the project since its inception. Buyers and exporters

co-operate with the work, and local authorities have been supportive. One core assumption is that conservation initiatives will only succeed in the long term if local people support the work. Project staff and the local fishers both seek the persistence of healthy seahorse populations, albeit for different motives.

The first year of project saw encouraging levels of community commitment to the goals of a sustainable seahorse fishery: the *barangay* implemented a no-exploitation reserve for seahorses and all other marine species (and patrols it effectively despite being subject to threats and dynamite blasts by fishers from elsewhere who wish to exploit the reserve); pregnant male seahorses began to be caged in the sea until they gave birth, thus returning young to the wild before the male was sold; and seahorse collectors donated catch to re-seed depleted areas. Intensive interviews with fishers, buyers and exporters have defined the socio-economic factors driving the trade, and confirmed community willingness to undertake restructuring. Data show that seahorses provide nearly 100% of some fishers' incomes during the three month season when they concentrate on catching seahorses, and substantial income during other months.

Understanding the biology of exploited seahorses is vital to management, yet most species have never been studied, or even identified (see *Biology* section). The project now tracks individually tagged seahorses, monitoring their behaviour and ecology. Findings are checked against the fishers' own knowledge, the data from daily catch records of seahorses, and the fishing effort calendars kept by collectors; all these sources are dependent on the co-operation of the fishers. Associated genetic work in England (Casey, unpublished) is determining taxonomy and investigating species and population relationships.

Community initiatives are considered a key to success. The project also embraces educational programmes on issues as diverse as managing fresh water resources on the island, to fish behaviour, to establishing co-operatives. A high school scholarship is offered in exchange for weekly participation in the project's marine conservation research. Occasional activities such as planting donated mahogany seedlings for World Environment Day emphasize the holistic nature of the project.

The next few years will see the growth of conservation initiatives as research findings are integrated into management plans. An expansion of the caging of pregnant seahorses, community decisions on catch restrictions, and corralling seahorses in the sea are seen as primary objectives. Fishers have indicated they are willing to give time and money for conservation-related activities including patrolling the reserve, lobbying officials, helping to find seahorses for research and assessment, building cages and corrals, and re-seeding depleted areas with seahorses. These Handumon fishers are renowned in the central Philippines for being innovative, not least because they largely launched the seahorse fishery in the region. Initiatives in Handumon are being carefully tracked in nearby areas and their success or failure could exert a strong influence on other seahorse fishers. For the moment, fishers from nearby islands have begun leaving pregnant males in the sea.

Vietnam

The Vietnamese project (also under the author's direction) takes a different approach. The project was launched in May 1995 and is carried out by three biologists at the Institute of Oceanography in Nha Trang. Their investigations into the seahorse trade have revealed that seahorse fishing in Vietnam is primarily a by-catch of intensive trawling, although a small target fishery exists. Thus the decline in seahorse numbers probably reflects a general decline in fisheries, and is proving difficult to influence independently. Consequently, this project concentrates on developing techniques for low technology seahorse aquaculture, which can be introduced to those fishers that do target seahorses, both in Vietnam and abroad. Field and laboratory studies are also underway, in order to learn more about the reproductive ecology of seahorses, partly to improve the captive breeding programme. Community education initiatives are gradually evolving - a recent visit by the leader of this project to the Philippines' project has

prompted the Vietnamese biologists to develop public education posters and visit schools - and it is hoped to begin involving fishers in project planning.

RECOMMENDATIONS

Conserving seahorse populations would best be achieved through an integrated programme of biological research, national and international conservation measures and trade monitoring, assessment and adjustment of demand for seahorses, modification of seahorse supply (through fisheries management, aquaculture, and education), habitat protection and eco-tourism. The long-term conservation goal must be to ensure that healthy seahorse populations persist. This need not preclude their use as both a valuable fisheries resource and an important medical commodity, as long as seahorse catches are at sustainable levels. At present this seems not to be the case.

Planning for the future will require an understanding of relative supply and demand, in order that sustainable levels of consumption can be assessed, and managed. Such an assessment should be undertaken at once, but the anticipated delay in obtaining results must not be used as an excuse to defer action. The apparent rates of decline in some seahorse populations (and the expected continued growth in demand) argue that precautionary measures should be implemented quickly, even with incomplete knowledge, in order to avert crisis management later. A multi-faceted approach is likely to offer the best chance of success. Some of the options with greatest long-term benefit could be difficult or time consuming to implement, but should still be attempted. It will be important to inform and consult participants at all levels of the trade as precautionary measures are adopted.

Seahorse trading will probably respond to subtle shifts in supply and demand rather rapidly, both because there are no known seahorse stockpiles and because supply lines are direct. *Aquarium fish exporters already rapidly communicate changes in international orders for seahorses to buyers, who transmit them to fishers.* Similar direct relay of information should facilitate conservation measures.

The apparent acceptability of most seahorses in trade, the difficulty in distinguishing seahorse species, the increasing trade volumes and the apparent vulnerability of seahorse populations to fishing pressures (because of *their biological characteristics*) indicate that all seahorses should be considered at risk and conservation measures should be broadly applied even to less-exploited species.

A. Biological research

The current lack of biological knowledge handicaps attempts to conserve and manage seahorses. Research is required on virtually all aspects of all species but the pace of progress will be restricted by the dearth of researchers on these animals. Currently only one detailed field study of seahorse biology, with observations of known animals, has been undertaken (Vincent and Sadler, 1995).

- The work on seahorse taxonomy must be significantly advanced and geographic distributions must be determined. Such information is vital to document distribution changes, to ascertain trade routes, to collate catch figures from different regions, to ensure that biological information in the literature is applied to appropriate species, and to propose species for legislative protection.
- An easy key to seahorse species should be prepared, and size at maturity indicated for each, such that juvenile seahorses can be easily recognized at all levels of the trade, and their exploitation avoided.
- Research on the biology of all seahorse species is urgently needed, beginning with the most heavily exploited Indo-Pacific species. Management will be severely hampered until more is known about densities, sex ratios, size distributions, mobility, migration, growth, longevity, mortality, breeding seasons, mating patterns,

fecundity, and young dispersal (to name but a few important parameters). Available information should be logged on Fishbase, a database run by the International Centre for Living Aquatic Resources Management (ICLARM) in Manila.

B. National conservation recognition

- National bodies responsible for compiling Red Data books or other threatened species records should consider including seahorses on precautionary lists that reflect the limited knowledge and increasing exploitation of these never-abundant animals. Most nations with seahorse populations can expect to discover a seahorse fishery sooner or later.

C. National measures to monitor and control trade

- Documentation of imports and exports would greatly facilitate conservation initiatives, and should be undertaken wherever possible. The international Harmonized System (HS) of the World Customs Organization prescribes the six digit codes under which commodities are recorded, but extra digits can be added by different Customs authorities to code commodities in greater detail. In most jurisdictions, seahorses currently appear to be absorbed under Custom Co-operation Council Harmonized Commodity Description and Coding System item 05.10: *Ambergris, castoreum, civet and musk; cantharides; bile, whether or not dried; glands and other animal products used in the preparation of pharmaceutical products, fresh, chilled, frozen or otherwise provisionally preserved.*
- It would be helpful if other authorities followed Taiwan's lead in keeping detailed records on the seahorse trade; Taiwan allocates a modified HS code to seahorses. China should be urged to revive and improve listings of syngnathid (seahorse, pipefish, and pipehorse) imports and exports, currently only available for 1990 and 1991. The Philippines should also be encouraged to resume record keeping on syngnathids (abandoned in 1987), collating national records from current regional records (such as those in Cebu and Zamboanga), and improving their reliability. Other key seahorse trading regions, such as Thailand and Hong Kong, should also be urged to consider keeping records.
- Fisheries agencies in relevant nations should recognize seahorse collecting as a valuable fishery, and monitor catches and populations. The UN Food and Agriculture Organization (FAO) could then be encouraged to collate national data on seahorse fishing into world capture fisheries data. Information on catch volumes (and how these relate to effort) is clearly vital for wise conservation management and sustainable fishing practices. Changes in population size and structure reflect the effect of current management practices (or lack thereof), and indicate conservation status. Indian fisheries biologists investigate volumes and values of some seahorse catches and Florida fisheries statistics include seahorse landings (see USA section), but neither yet assesses the status of wild populations.
- Individual countries should be encouraged to enact internal fisheries or wildlife regulations, as appropriate, to ensure that seahorses are not over-exploited, but only where such regulations are likely to be effective in conserving seahorses. Countries where subsistence fishers rely heavily on income from seahorses (e.g., many Southeast Asian nations) would need to consider seriously the effects of such regulations on dependent fishers and the potential consequences of driving the trade underground where it cannot be monitored.
- Nations where the seahorse catch is of minor economic importance and where solid legal and legislative frameworks for conservation exist, could lead the way in precautionary legislation for seahorses. Particular recommendations for two such countries are as follows:

- a) The growing gap between demand and supply in nearby Asian nations makes it inevitable that Australian seahorses (and pipefishes) will come under increasing pressure. Australia, with at least 11 species of seahorse (five or more believed to be endemic), could lead the way in monitoring and controlling syngnathid exploitation. Seahorses are currently listed as "Native species exempt from export control" on Schedule 4 of the *Wildlife Protection (Regulation of Imports and Export) Act 1982*, but new proposals under consideration suggest placing them under export control on Schedule 1 or 2 (M. Forbes, *in litt.*, 13 November 1995). At the State level, Queensland could be asked to enforce the rule that fishers keep catch records of all species with commercial value. Western Australia's daily bag allowance of 40 seahorses for "private" use should be reduced or eliminated.
- b) The role of the USA in trading seahorses may be significant and warrants further investigation. In particular, Florida recorded landings of more than 112 000 seahorses in 1994, and should consider implementing a research programme to assess the impact of such removals on seahorse populations (see North America section).

D. International conservation recognition

- Consideration should be given to listing IndoPacific seahorse species in the next IUCN Red List as Vulnerable (VU). The Knysna Seahorse, *Hippocampus capensis*, has already been accorded such status (Anon., 1994). Direct observation by fishers and circumstantial evidence obtained by biologists suggest that some heavily fished populations have declined markedly (even more than 50%) over the past five years. Seahorse consumption in China has grown approximately 10-fold in 10 years, and is projected to continue increasing, making it probable that seahorse populations will experience further declines; population changes are now being documented quantitatively where possible. When the ongoing revisions of seahorse taxonomy are complete, it should become possible to judge threat categories for particular species. For the moment, however, listing all IndoPacific species as Vulnerable would avoid the difficulties created by taxonomic disorder, and reflect the fact that all IndoPacific species appear to be exploited, albeit to varying degrees. Species outside this region could also be listed as a precautionary measure; support data are still sparse, but it is known that seahorses worldwide are coming under fishing pressure (e.g., considerable numbers are now being fished off the Galapagos Islands of Ecuador: see Latin America section).

E. Internationally agreed measures to monitor and control trade

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) came into force in 1975. Most seahorse trading countries and territories have joined CITES (either directly or through association with a signatory, i.e. Hong Kong), with the notable exception of Taiwan, which for political reasons is precluded from doing so. CITES Appendix I lists species for which international trade is effectively banned with certain exceptions, such as for approved scientific research. CITES Appendix II lists potentially threatened species for which international trade is permissible under a system of regulation and monitoring.

No Appendix I listing is here proposed for seahorses. The reported rates of decline in some populations (some more than 50% over five years: e.g. see **Philippines** and **Discussion** sections) refer to different species in different regions, and are still tentative, based largely on circumstantial evidence.

It would probably be best to defer an Appendix II listing for seahorses until its justification and its anticipated effectiveness in maintaining viable populations become clearer. While there is considerable evidence that "harvesting specimens from the wild for international trade has, or may have, detrimental impact on the species by exceeding, over an extended period, the level that can be continued in perpetuity" (Appendix II listing criteria: CITES Resolution Conf. 9.24), seahorse population data are still patchy, tentative and circumstantial.

Documenting the seahorse trade is difficult because few seahorses are caught by any one person, many people are involved in the trade, seahorses are easily dried and shipped, trade routes are often unofficial or unorthodox (e.g. in airline passengers' baggage, see India section), and retail outlets are numerous. Any eventual CITES listing could further restrict the flow of information.

The next few years could serve as a trial period for co-operative management between fishers, consumers and conservationists. The option of CITES Appendix II listing could be evaluated on an ongoing basis, in response to changing circumstances and to improved data collection. Should an Appendix II listing become necessary, it would have to be incorporated into the pantheon of conservation measures. In particular, the approach of working with fishing communities would need to be retained, as would the participation of the TCM community and other user groups in planning. In the meantime, ongoing educational work (such as that undertaken by TRAFFIC) on the meaning and purpose of CITES needs to be maintained and expanded.

- The European Union (EU) imports many live seahorses for the aquarium trade and dried seahorses for curios. It would be appropriate to place seahorses on Annex D of the new EU Wildlife Trade regulations to be implemented in 1997, thus imposing a trade monitoring requirement.
- The current inadequate knowledge of international trade routes and trade volumes needs to be rectified. Networks of local contacts should be established to facilitate such enquiries. The TCM community is in a position to supply vital information about sources and availability of seahorses, and might be willing to co-operate with conservationists who seek a conciliatory approach.

F. Influencing demand for seahorses

In the light of population and trade trends identified to date, it would be prudent to identify means to reduce consumption levels. Virtually all seahorses come from the wild and removing them for medicines, aquarium fishes, or curios is equally problematic in conservation terms.

Influencing demand for TCM and Jamu medicine

The World Health Organization has long supported the development of traditional medicine, and recognizes TCM as a viable health care option, one employed by a large portion of the world's population (Anon., 1994a). There is growing interest internationally in the use of TCM, including acupuncture, and health care professionals from different medical traditions are increasingly trading expertise. Seahorses are an important part of the TCM pharmacopeia, and driving them to extinction would be a loss to TCM as well as to the rest of the world.

Conservation will best be achieved through dialogue and collaboration, rather than the confrontational approach that conservationists and the TCM community have tended to adopt with one another. A new, more productive, paradigm must be sought. Conservationists have a responsibility to inform and promote action on the issues of concern, while TCM practitioners and users should accept a compatible responsibility to ensure that use of a TCM product does not deplete its wild populations; natural resources are neither available *ad libitum*, nor *ad infinitum*.

- TCM is the largest consumer of seahorses. It would be extremely valuable if the TCM community could be enlisted to help assess current annual levels of seahorse consumption, project its needs into the future (categorizing seahorses by size, species, and/or origin), provide regular updates, and indicate how demand could be adjusted to meet supplies. This would facilitate discussion of possible alternatives for ensuring that consumption does not exceed levels that seahorse populations can sustain. Biological data will be equally vital for such analyses of harvest sustainability, but may take more time to obtain.
- Current shortfalls in seahorse supply and declines in seahorse populations indicate that precautionary measures are necessary. TCM researchers should be encouraged, as a matter of urgency, to explore

alternative treatments (to seahorse-based remedies) within TCM that are both medically and socially acceptable and ecologically sustainable. TCM traders and practitioners in both China and Taiwan report that seahorses, though very useful, are not vital ingredients. Substitution should be possible but the decentralised nature of TCM will make such changes slow.

- TCM traders and doctors should be advised that seahorse numbers and sizes are declining, and asked to moderate their use where medically possible. Their use as tonic foods may be more amenable to change than prescription use.
- It may be appropriate for conservationists to collaborate with senior members of the TCM community to prepare educational posters encouraging alternative treatments to those using seahorses. These posters could include a simple explanation of seahorse biology and a conservation message, and be distributed to TCM retail outlets as well as to schools and universities. Such an enterprise may not be readily accepted but should be considered.
- Proprietary medicine manufacturers in China should be requested to record seahorse consumption, to diminish the amount of seahorse in the medicines, and to eschew juvenile seahorses (see Research above). Because TCM consumers refuse to buy small seahorses in pharmacies, a manufacturing company enforcing a minimum size limit for seahorses may be able to attract customers by advertising this policy.
- The extent of seahorse use in Indonesia's Jamu medicine should be assessed, and conservation impacts considered. Liaison with the Jamu community would facilitate collaborative approaches to ensuring sustainable use of seahorses.
- Any attempt to modify seahorse consumption must take account of the many commercial dealers in TCM and Jamu whose main motive is profit rather than medicine. Their support will depend heavily on the availability of equally profitable replacements, or on the benefits accrued from pleasing public opinion.

Influencing demand for aquarium fishes

- Traders in marine aquarium fishes should work with aquarists' magazines to inform hobby aquarists of the difficulties and conservation impacts of keeping seahorses, and caution against the non-expert keeping them in captivity.
- The aquarium fish industry should also be requested to track volumes, and sources of live seahorse imports, and to examine ways of reducing demand. For at least some countries, this could be done through the industry's self-regulatory bodies.
- Seahorses could be considered for inclusion on precautionary lists of fishes that are inappropriate for hobby aquaria (e.g., Wood, 1992).
- Efforts should be made to reduce loss of live animals during trade. Exporters should try to influence their suppliers to ensure that seahorse mortality rate is minimized. They should ensure that seahorses are fed between capture and export, and should work to reduce stresses en route. Improved trade practices could enhance survival in captivity and thus pay dividends for wild seahorse populations by reducing re-sales.

Influencing demand for curios

- Significant numbers of seahorses are sold as curios and souvenirs. Education campaigns should inform buyers of the conservation concerns relating to seahorses in an attempt to reduce demand for seahorses.

G. Modifying supply of seahorses

Fisheries management and community involvement

Seahorse fishers often have few other resources available, so proposals for conservation must take into account the real role of seahorses in supplying daily necessities. The reliance on seahorses is often matched by an awareness of declining populations and fishers are usually receptive to management proposals.

- Fishers should be involved at all stages of efforts to manage and conserve seahorse populations. The current seahorse conservation initiatives in the Philippines have shown that at least some subsistence fishers are willing to contribute time, knowledge, skills, materials and money. Fishers should be encouraged to donate part of their catch to re-seed depleted areas and reserves, in order to establish a personal commitment.
- Simple community-based management techniques must be developed. Potential recommendations would be (a) limits on sex, reproductive state, and size of seahorse caught (e.g., no pregnant males, no females with ripe eggs, no juveniles) (b) rotate harvest areas on fixed schedules (c) limit timing to avoid peak reproductive periods.
- Educational material must be developed for seahorse fishers, with their collaboration and in local languages. Community-based resource management initiatives have found that information is often best presented in comic strips and large simple posters. These should include notes on seahorse biology and conservation and simple guidelines on management (see above).
- Fishers should be encouraged to ensure that no pregnant males are traded. This can be done either by prohibiting the capture of pregnant males (preferable) or by placing captured pregnant males in cages in appropriate habitat until they have given birth, allowing the young to be released into the wild before the male is sold.
- Buyers and exporters should be advised of conservation concerns surrounding seahorses, and informed that long-term sustainability is sought. Many buyers exert a considerable influence on fishers' decisions and activities, so their co-operation is vital.
- Fisheries management courses, particularly in the IndoPacific region, could be encouraged to adopt seahorses as a case study of a new genre of fisheries, those destined primarily for medicines. An educational package could be developed by the seahorse conservation projects, to highlight issues and encourage discussion.

Habitat protection and reserves

- Seagrasses, mangroves and coral reefs must be protected and managed wherever possible. It would be appropriate to seek compilation of a world atlas of seagrass habitats — seagrass distribution maps still need to be developed for most countries — and an assessment of their status. These are the prime habitats for many seahorse species, so loss and degradation will affect the fishes.
- Marine reserves should be set up wherever possible, to protect both seahorses and their habitats. The corollary is that seahorses should be specifically targetted when setting up marine reserves. Their home ranges are so small that reserves can be quite effective at protecting the seahorses within them. Seahorses tend to be found along the edges of suitable habitats, such as seagrass meadows, so these areas should be included in reserves. Reserves will need the support of local communities if they are to be effective.

Culturing seahorses

"The demand for seahorses cannot be met by harvesting wild stock... As a result, it is important to establish seahorse farms" (Anon., 1982). Increased prices for seahorses and the growing acceptance of even very small

seahorses for proprietary medicines (see China section) could make seahorse culturing economically viable in a way hitherto impossible. But though captive breeding and sea ranching represent real options to reduce pressure on wild seahorses, they should not be considered panaceas.

- An initial study is required to consider the pros and cons of captive supply of seahorses. Issues of pricing and constancy of supply will be important factors in such an assessment. It seems likely that captive bred seahorses must be cheaper than wild seahorses in order to displace demand for the latter. Even so, a market for wild seahorses is likely to persist, as wealth increases in China. Care must be taken not to promote new demand for seahorses (through very low prices, for example) unless this can be reliably met by culturing; otherwise if captive production suddenly diminished, then wild seahorses might well be taken to fill the demand.
- It would be valuable to develop a protocol for low-technology seahorse aquaculture, which can be employed in fishing villages in developing countries. A pilot study underway in Vietnam suggests that this may become feasible. Funding would be needed to run trials on a larger scale and then to train fishers in culturing, and for them to train other fishers.
- The feasibility of sea ranching seahorses should be explored. Under such a scheme, wild-caught pregnant males would give birth in captivity, and the young would then be reared for a limited period of time before release to the sea. Studies would be needed to determine the critical period required to enhance juvenile survival on release, and to improve early rearing techniques. Such an approach could probably involve local fishers in both the growing out process and final collection of adults, thereby encouraging their support.
- An international workshop on seahorse culturing is urgently needed to bring together the low-budget efforts currently underway in developing countries, to introduce aquaculture experts to the problems, and to harness expertise from public aquaria around the world. This proposal has met with widespread support from biologists attempting to culture seahorses in both Asia and the West, from Asian fisheries officials, from TCM traders, and from public aquaria, and from those working to improve opportunities for subsistence fishers.
- A central register of information on seahorse captive breeding and culturing should be established, in order to improve the many *ad hoc* attempts at culturing. There may be some potential to culture seahorses in conjunction with other species as, for example, with abalone in New Zealand, or shrimps in Vietnam (see New Zealand and Vietnam sections).

H. Encouraging non-consumptive use

- Seahorse watching as an eco-tourism activity should be viable, although promotion would have to consider the needs of both the animals and the local human community. Morning greeting dances between paired seahorses, in the species where they occur, are both active and predictable. Moreover, casual discussions indicate that many tourists would be pleased even to see a seahorse in the wild; this view is supported by the large tips that dive leaders on Bonaire (see Latin America section) receive for showing divers a seahorse. Simple observation need not affect seahorses but these fishes should not be handled or displaced by divers: handling them will increase vulnerability to disease while displacing them may well disrupt mating patterns and other social relationships.
- Any eco-tourism should employ or recompense fishers who would otherwise collect seahorses, if it is to reduce pressure on wild populations.

Pipefishes

- Our understanding of the exploited species is so slight and the information on their trade so minimal that the primary recommendations are to monitor extraction and to establish research into the biology of these exploited species (see above). Many of other recommendations in this section may also be appropriate for pipefishes, should further investigation reveal areas of conservation concern. Particular attention should be paid to *Solegnathus* pipehorses as all accounts suggest they are becoming more difficult to obtain.

Beyond seahorses into general recommendations

Detection of the seahorse trade and implementation of conservation measures, could both have been expedited had consultative structures been in place, such as the two proposed initiatives that follow.

- A central register of animals and plants used in TCM should be developed, and circulated to biologists so that they may comments on the status of those they study. This could facilitate early assessment of conservation problems and reduce the need for crisis management. A very incomplete list - for example, it includes only one seahorse species - shows a further 70 species of marine fishes used in TCM (Tang, 1987).
- There is a need for standing council comprised of representatives from the conservation and the TCM communities, to meet regularly to discuss conservation concerns arising from TCM use. This would facilitate on-going interactions on problems instead of the current *ad hoc* issue by issue approach which so often risks becoming confrontational. Such a council would follow logically from the successful 1995 *International Symposium on Traditional Chinese Medicine and Wildlife Conservation*, organized by TRAFFIC.

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Appendix 1

List of seahorse species in Australia, North and Latin America, and Europe.

Australia

- Hippocampus abdominalis* Lesson, 1827
- H. angustus* Günther, 1870
- H. bargibanti*
- H. breviceps* Peters, 1869
- H. histrix* Kaup, 1856
- H. kuda* Bleeker, 1852
- H. planifrons* Peters, 1877
- H. spinosissimus* Weber, 1913
- H. whitei* Bleeker, 1855
- H. zebra* Whitley, 1964
- Hippocampus* sp. (to be *H. minotaur*)

North America and Latin America

- H. erectus* Perry, 1810 = *H. brunneus*, *H. fascicularis*, *H. hudsonius*, *H. kincaidi*, *H. laevicaudatus*, *H. marginalis*, *H. punctulatus*, *H. stylifer*, *H. tetragonurus*, *H. villosus*
- H. ingens* Girard, 1859 = *H. ecuadorensis*, *H. gracilis*, *H. hildebrandi*, *H. vogens*
- H. reidi* Ginsburg, 1933 = *H. obtusus*, *H. poeyi*
- H. zosterae* Jordan & Gilbert 1882 = *H. regulus*, *H. rosamundae*

Europe

- H. hippocampus* L. 1758 = *H. antiquorum*, *H. antiquus*, *H. brevirostris*, *H. europeus*, *H. heptagonus*, *H. pentagonus*, *H. vulgaris*
- H. ramulosus* Leach in Shaw and Nodder, 1814 = *H. longirostris*, *H. antiquorum*, *H. guttulatus*, *H. rosaceus*, *H. atrichus*, *H. microcoronatus*

Appendix 2**Seahorse names found in the literature purporting to be species from the IndoPacific**

The following list is not comprehensive, and certainly includes many synonyms. Whitley and Allan (1958), in particular, are responsible for several species that appear to be misspellings.

<i>Hippocampus aimei</i> (Roule, 1916)	<i>H. kuda multiannularis</i> (Raj, 1941)
<i>H. arnei</i> (Roule, 1916)	<i>H. kudua</i> (Whitley & Allan, 1958)
<i>H. aterrimus</i> (Jordan & Snyder, 1902)	<i>H. lenis</i> (Ogilby, 1908)
<i>H. barbouri</i> (Jordan & Richardson, 1908)	<i>H. lichensteinii</i> (Kaup, 1856)
<i>H. bargibanti</i>	<i>H. manadensis</i> (Bleeker, 1856)
<i>H. bicuspis</i> (Kaup, 1856)	<i>H. mannulus</i> (Cantor, 1850)
<i>H. borboniensis</i> (Dumeril, 1870)	<i>H. melanospiros</i> (Bleeker, 1854)
<i>H. brachyrhynchus</i> (Duncker, 1914)	<i>H. mohnikei</i> (Bleeker, 1854)
<i>H. camelopardalis</i> (Bianconi, 1853)	<i>H. moluccensis</i> (Bleeker, 1852)
<i>H. capensis</i> (Boulenger, 1900)	<i>H. monckei</i> (Whitley & Allan, 1958)
<i>H. chinensis</i> (Basilewsky, 1855)	<i>H. monickei</i> (Whitley & Allan, 1958)
<i>H. comes</i> (Cantor, 1850)	<i>H. monikei</i> (Whitley & Allan, 1958)
<i>H. coronatus</i> (Temminck & Schlegel, 1847)	<i>H. natalensis</i> (Vom Bonde, 1924)
<i>H. cudua</i> (Whitley & Allan, 1958)	<i>H. novaeheburum</i> (Fowler, 1944)
<i>H. dahlia</i> (Ogilby, 1908)	<i>H. obscurus</i> (Hemrich & Ehrenburg, in Kaup, 1856)
<i>H. erinaceus</i> (Günther, 1870)	<i>H. planifrons</i> (Peters, 1877)
<i>H. fasciatus</i> (Kaup, 1855)	<i>H. polytaenia</i> (Bleeker, 1854)
<i>H. fisheri</i> (Jordan & Evermann, 1903)	<i>H. raji</i> (Whitley, 1955)
<i>H. foliatus</i> (Perry)	<i>H. rhynchomacer</i> (Dumeril, 1870)
<i>H. fuscus</i> (Rüppell, 1838)	<i>H. sexmaculatus</i> (Schlegel, in Kaup, 1856)
<i>H. hilonis</i> (Jordan & Evermann, 1903)	<i>H. sindonis</i> (Jordan & Snyder, 1902)
<i>H. hystrix</i> (Kaup, 1853)	<i>H. spinosissimus</i> (Weber, 1913)
<i>H. horae</i> (Whitley & Allan, 1958)	<i>H. subcoronatus</i> (Günther, in Günther & Playfair, 1866)
<i>H. horai</i> (Duncker, 1926)	<i>H. suezensis</i> (Duncker, 1940)
<i>H. hystrix</i> (Day, 1878)	<i>H. taeniops</i> (Fowler, 1904)
<i>H. japonicus</i> (Kaup, 1856)	<i>H. taeniopterus</i> (Bleeker, 1852)
<i>H. jayakari</i> (Boulenger, 1900)	<i>H. takakurae</i> (Tanaka, 1916)
<i>H. kampylotrachelos</i> (Bleeker, 1854)	<i>H. trimaculatus</i> (Leach, 1814)
<i>H. kaupii</i> (Dumeril, 1870)	<i>H. valentyni</i> (Bleeker, 1859)
<i>H. kelloggi</i> (Jordan & Snyder, 1902)	
<i>H. kuda</i> (Bleeker, 1852)	

Appendix 3

Assessment of live seahorses traded within one aquarium exporter's network in Indonesia

One Bali exporter estimated he sold 50 seahorses weekly during the rainy season, which is also the best season. This seems a severe underestimate, according to all other estimates within his network:

1. Collectors estimate catches of up to 50 seahorses per week. Several fishers on Pulau Serangan reported collecting 10-15 seahorses weekly in three to four hours fishing daily. Some fishers find it possible under good conditions (no wind or rain) to get seven to 10 seahorses per searching day, or 50 per week. Mortality is less than 10% en route to the exporter.
 - a) A level 2 buyer on Pulau Serangan who supplies this same exporter directly (and only this exporter) claims to provide 100-200 seahorses weekly from his 35 fishers. A second buyer on the island supplies the same exporter with a further 15-30 seahorses weekly from his 10 fishers.
 - b) Another level 2 buyer - who considers himself average — says he sends hundreds of seahorses weekly to the Ketapang branch office. His 10 suppliers can provide him with thousands of seahorses weekly for two to three months during the rainy season, though this number is reduced by mortality of up to 60%.
2. Level 2 buyers bought from many collectors and gave estimates of up to 250-500 seahorses obtained per week, each.
3. The branch office of this exporter in Ketapang (eastern Java) reported intakes of 500 seahorses per day (up to 2500 seahorses per five-day week) in the rainy season, although sometimes none during the dry season. The exporter has another branch office, as well as many direct suppliers so would probably receive at least 5000 seahorses weekly.
4. Buyers' figures for this company are compatible with those of another buyer in eastern Java, related through business, who receives up to 50 seahorses a day (250 seahorses per five-day week) from 12 suppliers during the wet season.
5. Similar cross-verification is provided by another Bali exporter who, although much smaller, with only about 15 resident employees, reports selling "hundreds of seahorses weekly" during the season, although only about 20 per week out of season. Seahorses reportedly amount to only 1% of its business, but they still have seven regular seahorse suppliers in Buleleng alone.

The focal exporter and its branch office both rated seahorses an important commodity, amounting to perhaps 5% of branch office business, so should sell more than the second, smaller, Bali exporter. Sending some share of 50 seahorses a week to the main office is unlikely to provide 5% of a large branch office's business.

Appendix 4

Calculations of dried seahorse sales in Hong Kong using figures supplied by traders in 1993

Rough estimates of dried seahorse sales in Hong Kong range from 7-25t annually.

Import level: The TCM importer interviewed estimated that he sold ten tonnes of seahorses annually, of which three tonnes went to TCM dealers in Hong Kong and seven tonnes went to China. He noted that Hong Kong had two large TCM importers of seahorses (of which he was one) and five to six small TCM importers of seahorses. The author inferred from the conversation that the latter imported much less than one half as many seahorses as the former. If two TCM importers each sell about three tonnes in the territory and five or six sell about 750kg each (one-quarter), then the annual total sales in Hong Kong would be about 10t annually. Implicit in these crude calculations is that each importer sells about 30% of their seahorses to Hong Kong, as the interviewed importer did.

These crude calculations are clearly far from satisfactory, but are unlikely to exaggerate scale of the trade. For one thing, they do not include the commodities companies for which TCM products are just part of their imports: for example, one dealer in Cebu exported several tonnes of dried seahorse each year to a broker in Hong Kong. This latter was unknown to the interviewed TCM importer and wholesaler.

Wholesale level: The wholesaler reported in 1993 that (1) his total sales (wholesale and retail) were about 10 *catties* (6.05kg) of seahorses per month; (2) he was one of approximately 100 wholesalers of medical ingredients; (3) he was a medium-sized wholesaler. Thus, according to him, Hong Kong could be consuming about 605kg seahorses per month or 7.26t annually.

When interviewed again in 1995, the importer repeated his estimate of selling 10 *catties* per month. He further commented that there were about 10 TCM importers each selling about 1000-2000 *catties* per month. This would give total sales of 7.2-14.4t *per annum*, straddling the importer and wholesaler estimates for 1993.

The wholesaler's estimate of 100 TCM wholesalers dealing in medicinal materials was the same as that in the Hong Kong Government's *Report on the Working Party of Chinese Medicine* (1994). The same report noted that there are also 200-300 wholesalers of proprietary Chinese medicines. These are not included in the tentative calculation of 7.26t (above) and could add to the consumption of seahorses.

Retail level: Staff in four of the ten TCM pharmacies visited in 1993 gave sales estimates, as follows:

- one small shop in the New Territories sold 7.86kg *per annum* (mean of 4.27 seahorses per day);
- a larger New Territories shop sold 1.68kg *per annum* (1.64 seahorses per day);
- a busy pharmacy on Hong Kong Island sold 29.04kg *per annum* (26.56 seahorses per day);
- another shop on Hong Kong Island sold 12.56kg *per annum* (6.57 seahorses per day).

Observed sales traffic in these shops suggests that these estimates are plausible. These four shops thus are likely to have sold a mean of 39.04 seahorses per day, or 14 250 *per annum*, in 1993. The annual sales from these four varied Hong Kong outlets would have totaled 51.1kg in 1993.

Various professional associations had estimated that there were between 4000 and 10 000 TCM practitioners in Hong Kong, but a Hong Kong Government report considered a figure of 1600 retail herbal shops to be more accurate (Anon., 1994a). The Agriculture and Fisheries Department of the Hong Kong Government estimates 1900 retail TCM pharmacies and 300 wholesalers, some of who also retail (Cheung, C.S. *in litt.*, 22 December 1995).

A figure of 2000 outlets is used here, although this ignores non-pharmacy outlets. All of the TCM pharmacies visited by the author sold or wanted to sell seahorses. If four pharmacies sell a total of 51.1kg annually, and there are 2000 pharmacies, then Hong Kong would consume 25.55t of dried seahorses each year, excluding seahorses in the growing proprietary medicines trade.

Appendix 5:

List of some seahorse names around the world

Afrikaans – seepferd
Chinese – hai ma, shui ma
Danish – søe hest, hav-boever
Dutch – zeepaardje
English – seahorse
French – le cheval marin, cheval, chevalet, l'hippocampe
German – das seepferdchen
Hebrew – jamsus
Indonesian – ikan kuda
Italian – cavaletto marino, cavalluccio di mari
Japanese – tatsu no otoshigo
Korean – haema
Malay – ikan kudu
Maori – kiore
Mindanao – undok undok
Norwegian – seebiber, søe hest
Portuguese – caulinho
Spanish – caballito de mar
Swedish – sjöhest
Tamil – kadal kudara
Thai – ม้าน้ำ
Visayan – cabayo cabayo, seahorse