Table 55. Production of sea cucumbers in some Southeast Asian countries (MT)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brunei Darussalam	…	…	…	…	…	…	…	3	0.90	0.12
Cambodia	…	…	…	3	…	…	…	…	…	…
Indonesia	4,690	3,517	9,116	3,014	6,930	7,178	29,733	4,273	3,623.00	3,750
Philippines	…	965	…	979	1,006	761		851	777.00	934

Sources: *Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2009) and Fishery Statistical Bulletin of Southeast Asia (SEAFDEC 2010)*

Table 56. Destination countries and value (in US$) of sea cucumber products exported from Indonesia, Philippines and Thailand in 2007

Destination Country	Indonesia	Philippines	Thailand
Hong Kong	497,682	2,976,398	2,494,676
Singapore	256,367	642,446	548,122
Taiwan	30,000	10,132	1,627,500
Malaysia	274,872	73,450	-
USA	13,831	87,651	548,122
Vietnam	288,085	-	819,800
China	-	115,171	-
Japan	-	12,025	-
North Korea*	-	-	561,439
South Korea	-	1,015,263	-

Source: *Fishery Statistical Bulletin of Southeast Asia (SEAFDEC, 2011)*

much and collection of sea cucumber is by nature scattered making data collection for statistical purposes difficult to undertake.

As a result therefore, sea cucumbers contributed very small quantity to the total marine capture fishery production of the region. While there could be weaknesses in data collection of sea cucumber production in most of the countries, the situation makes the understanding of the production status and trends of the species difficult to reckon with, particularly from official statistics figures collected by the countries. Other sources of information including research results and data collected through *ad hoc* schemes should therefore be gathered and incorporated in the over-all production in order to obtain a better picture of the status and trends of sea cucumber production from the Southeast Asian region.

In an attempt to address such concern, SEAFDEC in collaboration with eight Southeast Asian countries, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam conducted the Regional Study on Sea Cucumber Fisheries, Utilization and Trade in Southeast Asia in 2007-2008 by collecting secondary data and information available in the respective countries. Results of the study showed that there are approximately 135 species of sea cucumbers found in the region (SEAFDEC, 2009).

Moreover, sea cucumbers are generally harvested by local fishers using simple or traditional methods that vary and range from picking by hand during low tide, snorkeling at the depth of up to 10 meters, punching by a metal spear as well as using trawl nets (Labe *et. al*., 2007). The species are mostly utilized for local consumption while some are exported to Hong Kong markets where fishers are able to obtain high market prices (**Table 56**).

The Regional Study also recognized that there is very limited information on sea cucumbers in terms of statistical records, inadequate information on research works, and insufficient and/or limited biological data and knowledge on species identification. Despite these constraints, consideration is being given to this species group by the Southeast Asian countries especially in view of the declining and diminishing sea cucumber resources, and the emerging global concerns that focused on the conservation and management of sea cucumbers. In fact, such concerns had become one of the most popular issues being discussed in the international community, particularly at the CoP-CITES and several fora of FAO, and it has been anticipated that the listing of sea cucumber species in CITES Appendices could be brought up for discussion during the forthcoming CoP16-CITES in 2013. Therefore, it has become necessary for the Southeast Asian countries to take a serious look into the issues and collect relevant scientific/technical information on economically important sea cucumber species, *e.g.* production, utilization, trade, as well as the conservation and management measures that have been put in place, in order to come up with a common position of the Southeast Asian countries demonstrating that sea cucumber fisheries of the region are being undertaken in sustainable and responsible manner (Labe *et al*., 2007).

1.3.5 Seahorses

Seahorses comprise the genus *Hippocampus* of family Syngnathidae, consisting of 35 genera of pipefishes, pipehorses and seadragons, and falling within the order Gasterosteiformes (Vincent, 1996). Currently, 47 seahorse species have been identified in the world (Lourie *et al*., 1999 and 2004; CITES Species Database, 2011) although species identification still remains challenging with some of the taxonomy unresolved (Koldewey and Martin-Smith, 2010). Seahorses occupy both temperate and tropical coastal waters from about 50° North to 50° South, and are usually found among corals, macro-algae, mangrove roots and sea grasses, with some living in open sandy or muddy bottoms (Lourie *et al*., 2004). Among the 47 species, nine species are confirmed to be distributed in the Southeast Asian region with one species still not confirmed (**Table 57**). Twenty nine and 22 species are traded in the world as live individuals and non-live individuals, respectively. Culture technology has been developed for 18 species where 13 species are being commercially cultured, one species could be cultured but its commercial status is unknown, and four species have been researched on, the results of which have been published in various literatures and journals (Koldewey and Martin-Smith, 2010).

Seahorses have very unique characteristics such as male pregnancy and faithful monogamy as well as lengthy parental care. In addition, the peculiar body-shape and swimming style are also probably ascribed to the high popularity of seahorses not only as aquarium species but also as curio items. Moreover, the demand for sea horses is high especially as ingredients for traditional Chinese medicines (Vincent, 1996). The specialized life history traits of seahorses including male pregnancy, lengthy parental care, small size of brood, strict monogamy in most species, low mobility, small home ranges, and sparse distribution make seahorse populations very susceptible particularly to anthropogenic disturbance (Koldewey and Martin-Smith, 2010).

Utilization and Trade of Seahorses

Direct exploitation, incidental catches by non-selective fishing gear, and habitat loss and degradation have put considerable pressures on seahorse population in many regions of the world (Vincent and Koldewey, 2006). Specifically, seahorses in the Indo-Pacific region may be the most immediately at risk because of their proximity to major markets for the traditional Chinese medicines (Vincent, 1996). All species of the seahorse genus *Hippocampus* are already listed in the Appendix II of CITES in 2002, denoting the potential threats caused by unregulated international trade of these species.

The number of seahorses exported (**Fig. 36**) largely increased in 2003 for non-live commodities and in 2004 for live commodities. However, not all seahorses traded originate from the wild. Captive-bred seahorses accounted for 25-84% (mean 57%) of the total volume traded in 2004-2008 (Koldewey and Martin-Smith, 2010).

Seahorses are exported as live and non-live commodities in the world and from Southeast Asia. From 1997 to 2009, the average percentage of seahorses traded from Southeast Asia was 54% for live seahorses and 82% for non-live seahorses. Since the number of the non-live seahorses is extremely larger than those of the live seahorses, this indicates that majority of seahorses traded in the world could have originated from the Southeast Asian region. During the recent years, Vietnam had been the largest exporter of live seahorses while Thailand leads in the

Table 57. Seahorses *Hippocampus* spp. identified in Southeast Asia

	FAO Common Name	Scientific Name	Type Traded	Culture Techniques	Distribution in Southeast Asia	
					Confirmed	Suspected
1	Barbour's seahorse	*H. barbouri*	L, N	C	ID, MY, PH	
2	Bargiban's seahorse	*H. bargibanti*	N		ID, PH	MY
3	Tiger-tail seahorse	*H. comes*	L, N	C	ID, MY, PH, SG, TH, VN	
4	Denise's pygmy seahorse	*H. denise*	L		ID, MY, PH	
5	Seahorse Spiny seahorse Thorny seahorse	*H. histrix*	L, N		ID, MY, PH, VN	BI, MM, SG, TH
6	Great seahorse Kellog's seahorse Offshore seahorse	*H. kelloggi*	L, N		ID, MY, PH, TH, VN	BI, MM, SG
7	Black seahorse Colored seahorse Oceanic seahorse Spotted seahorse Yellow seahorse	*H. kuda*	L, N	C	KH, ID, MY, PH, SG, TH, VN	BI, MM
8	Japanese seahorse	*H. mahnikei*	L, N	(C)		TH, VN
9	Hedgehog seahorse	*H. spinosissimus*	L, N	C	KH, ID, MY, MM, PH, SG, TH, VN	BI
10	Flat-faced seahorse Long-nose seahorse Low-crowned seahorse Three-spot seahorse	*H. trimaculatus*	L, N	C	KH, ID, MY, MM, PH, SG, TH, VN	BI

Note: *In the column of "Type Traded", 'L' and 'N' denote 'live seahorse' and 'non-live seahorse'; "Cult. Techechniques" distinguished as follows: C=commercial operation, (C)=unknown about the commercial availability, and R=research published only; *: BI=Burunei Darussalam, ID=Indonesia, KH=Cambodia, MM=Myanmar, MY=Malaysia, PH=Philippines, SG=Singapore, TH=Thailand, and VN=Vietnum.*
Source: *Lourie et al. 1999 and 2004; Koldewey and Martin-Smith 2010*

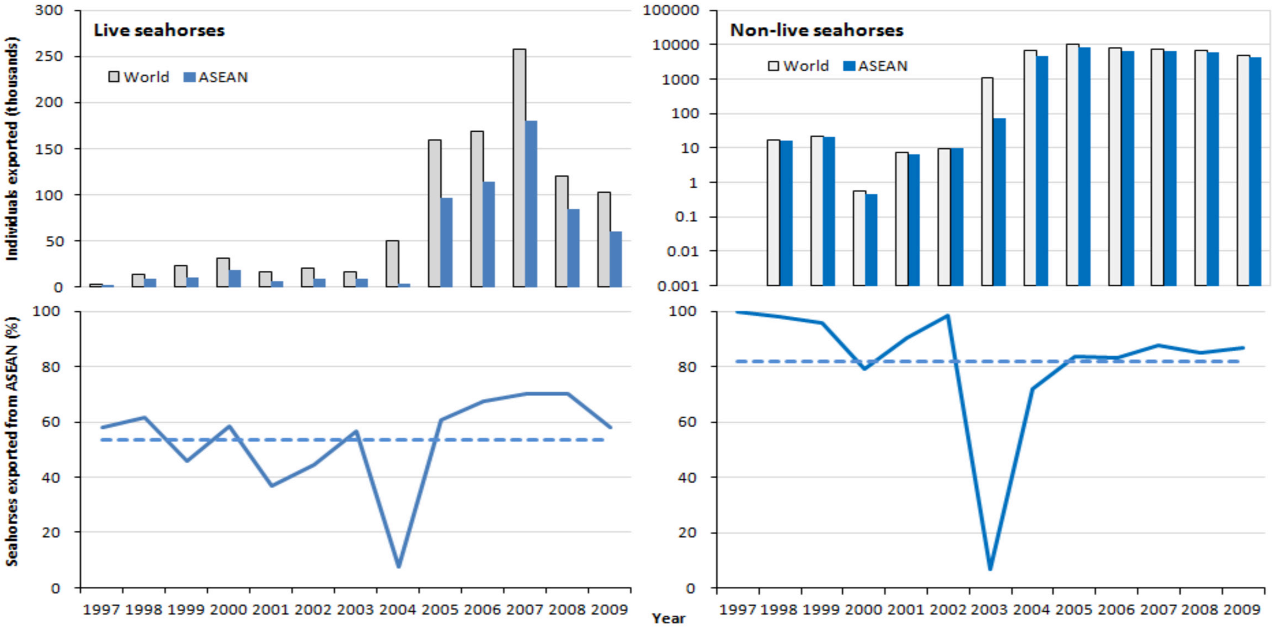

Figure 36. Export of seahorses from the Southeast Asian countries

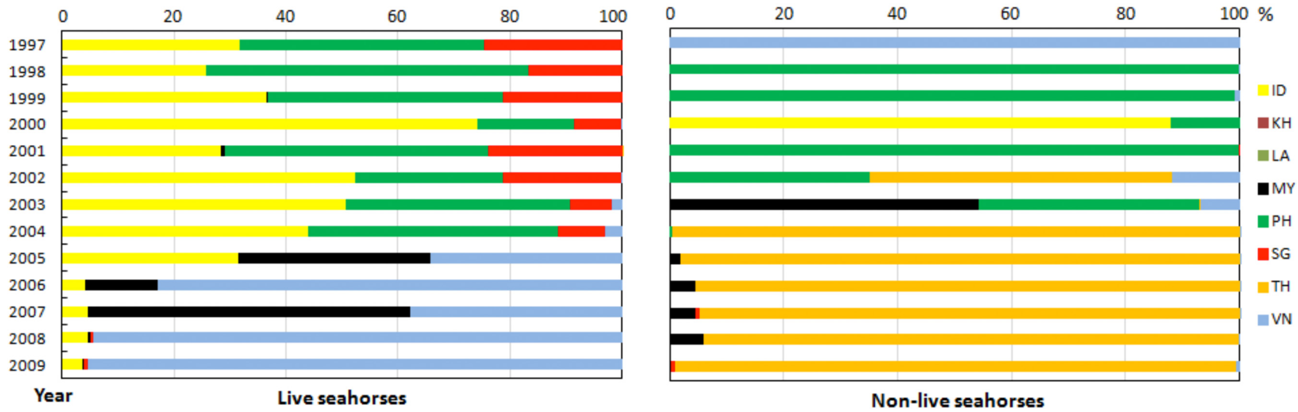

Figure 37. Percentages of seahorses (live and non-live) exported from Southeast Asian region by countries: BI=Brunei Darussalam, ID=Indonesia, KH=Cambodia, MM=Myanmar, MY=Malaysia, PH=Philippines, SG=Singapore, TH=Thailand, and VN=Vietnam

Sources: *CITES trade statistics derived from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, United Kingdom*

export of non-live seahorses (**Fig. 37**). The dotted lines show the average values between 1997 and 2009. The data were obtained from CITES trade statistics derived from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK. To calculate the individual number of live seahorses, the weight data shown in the database were converted to individual numbers using estimated body sizes by species as 80% of the maximum height as established by Lourie *et al*. (2004) and the average condition factor (CF=BW(g)/MH(cm) x102=0.371) obtained for *Hippocampus barbouri*, *H. comes* and *H. kuda* broodstocks kept at the facilities of SEAFDEC Aquaculture Department (AQD) in the Philippines.

Culture Technologies for Seahorses

Commercial aquaculture of seahorses has been repeatedly considered as possible solution to replace the collection of wild-caught animals, provide economic opportunities for fishers in developing countries and supply future increases in global demand (Koldewey and Martin-Smith, 2010). Commercial development and considerable expansion of seahorse aquaculture occurred in the 1990s (Woods, 2000a; Woods 2000b).

Thereafter, a number of studies on culture technologies have been published. SEAFDEC/AQD also initiated seahorse breeding studies in 1996 and obtained certain level of progress especially on the culture techniques including findings such as year-round breeding in mating pairs of *H. kuda*, the relationship of parturition frequency with seawater temperature and daylight period, tolerance to various salinities, and effects of illumination on growth in sea cages (Hilomen-Garcia *et al*., 2003; Okuzawa *et al*., 2008; Garcia and Hilomen-Garcia, 2009). Nevertheless, considerable technical difficulties remain unresolved especially in breeding and rearing of many seahorse species because of difficulties in feeding and outbreak of disease (Vincent and Kodlewey, 2006; Koldewey and Martin-Smith, 2010).

More recently, however, AQD found that survival and growth of newborn seahorses are significantly improved in UV-treated water while mass mortality is effectively prevented by treating food organisms in formalin (Buen-Ursua *et al*., 2011). Such findings indicate that using disease-free copepods collected from the wild as feed through formalin treatment would advance the development of cost-effective aquaculture for the mass production of seahorses in Southeast Asia. The goal is not to promote new trade or increase existing trade in seahorses as this might encourage the exploitation of seahorses from the wild (Buen-Ursua, personal communication cited by Malaya Business Insight, 2011).

Other than the issues of vulnerability to diseases and finding the correct diet in captive breeding, genetic diversity and genetic purity of native species of restocked seahorses, disease transmission to wild populations as well as risk of community disruptions should be considered in carrying out seahorse releasing programs (Vincent and Koldewey, 2006; Buen-Ursua, personal communication cited by Malaya Business Insight, 2011). The genes of seahorses bred in one place might not be compatible with native seahorses, raising the risk that mixing them could compromise the genes of local seahorses. Stocks bred in hatcheries whose genetic composition is incompatible with the native population should not be released.

Thus, the characterization of the genetic makeup of seahorses bred in hatcheries and those found in the wild is very essential (Buen-Ursua, personal communication cited by Malaya Business Insight, 2011). As regards disease issues, thorough screening procedures are also necessary in any program that transfers captive seahorses into the wild (Vincent and Koldewey, 2006) as sudden influx of new individuals into a small area could result in changes in the social structure of the wild population which could result in increased competition for food, shelter, and mates (Vincent and Koldewey, 2006). Appropriate measures are therefore very important to avoid such risks, which could include development of tagging and/or marking techniques to monitor the release animals and to establish the impact of the stocking practices (Vincent and Koldewey, 2006).

Future Perspectives and Recommendations

Global interest in aquaculture of seahorses and other syngnathids has increased dramatically over the past decade (Vincent and Koldewey, 2006). As predicted from the global trade situation, the global resource level of wild seahorses would continue to decrease particularly in Southeast Asia. It is likely that the situation in the future would worsen and wild stocks of seahorses would encounter the risk of extinction unless immediate actions to stop overfishing and appropriately control the volume of trade are implemented by the countries of origin and trading countries. For example, catch of seahorses should be limited to 10 cm or less in body height which is the minimum size prescribed by the Animal Committee of CITES (Foster and Vincent, 2004) while the export/transport of live seahorses should be governed by specific guidelines (Vincent and Koldewey, 2006). Direct exploitation as well as habitat loss and degradation should be avoided by establishing and strengthening domestic legislations in order to protect seahorse populations in many countries from over-exploitation (Vincent and Koldewey, 2006).

Although culture of seahorses does not target the traditional Chinese medicine (TCM) markets and has not achieved commercial viability, production of cultured seahorses through development of sustainable aquaculture technology should be enhanced in order to protect the wild stocks of seahorses. In addition, since the ratio of wild-caught to cultured seahorses in the live aquarium trade is unknown (Vincent and Koldewey 2006), cultured seahorses could replace the wild seahorses to supply TCM and tonic products, live aquarium fishes, and curio items and souvenirs, thus, preventing further demands of wild seahorses. As emphasized by Vincent and Koldewey (2006), culture technologies for seahorses should be in line with the aim of minimizing negative environmental impacts and maximizing local socio-economic benefits, and through the compliance with the precepts of the Convention on Biological Diversity.

2. INLAND FISHERY RESOURCES

In 2009, the total fisheries production of the region was reported to be 28,917,096 MT of which 2,397,273 MT came from the inland fisheries sub-sector accounting for approximately 8% of the total fishery production (SEAFDEC, 2011). Despite the low figures as reported, the importance of inland fisheries could not be neglected due to its contribution to food security and poverty alleviation for peoples, particularly those from the low income group whose livelihood is very much dependent on the availability of natural resources. However, by the nature of inland fisheries being small-scale, multi-species, multi-gears, involving large number of fishers which are mostly part-time fishers, while the major parts of the fishery production are meant for household consumption, all these factors result in difficulties in the collection and accurate reporting of routine inland fishery data and statistics. Thus, the importance of inland fisheries is hence overlooked by planners and policy makers, giving this sub-sector low priority compared to the other development sectors that share the same water resources. The result could be manifold impacts to fishers and other fishery-related activities in the region while the accumulated impacts