

Sea cucumber fisheries around Phu Quoc Archipelago: A cross-border issue between South Vietnam and Cambodia

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Hai Sam is the common Vietnamese name for dry eviscerated sea cucumbers. Dried sea cucumbers are sold in the fish markets of Ho Chi Minh City and exported to mainland China, Hong Kong, Japan, Taiwan and Singapore. More than 10 different edible species are sold in Ho Chi Minh markets, among them are *Holothuria scabra*, *H. whitmaei*, *Thelenota ananas*, *Bohadschia argus*, and *Stichopus chloronotus* (Fig. 1). Prices vary according to species and time of the year, between 60,000 to 700,000 Vietnam dong (VND) per kilo (2004, 1 USD = 15,000 VND).

The main fishing grounds for sea cucumbers in the south of Vietnam include the provinces of Khan Hoa, Bin Thuan and Kien Giang. Phu Quoc, which is in Kien Giang Province, is the primary source of sea cucumbers.

Actual trade levels from the southern provinces are unknown. In the south, sea cucumbers are also abundant within the waters of the Koh Sdach and Koh Rong group of islands of Cambodia, close to the Phu Quoc waters of Vietnam, where the locals call them "teak".

Phu Quoc Island lies in the Gulf of Thailand, 45 km from mainland Vietnam and 15 km south of the coast of Cambodia. The island covers an area of 585 km² in Vietnam's southwestern waters, and represents the largest island within an archipelago of 14 islands.

Situated on the shallow continental shelf of the tropical monsoon zone and with various geomorphologic and oceanographic conditions, Phu Quoc has a rich variety of marine communities, including some of the most important seagrass areas and coral reefs in the country (Asian Development Bank 1999). Patches of coral communities and sandy-coarse substrate are characteristic habitats of the west coast of the island, especially surrounding small islets and protected bays. Depths may reach 15 m in some of these areas. The east shore of Phu

Quoc is characterized by very shallow waters of less than 6 m that extend 6.4 km offshore. Patches of seagrass, sandy and muddy areas are predominant over this coastline. Off the southern tip of Phu Quoc are the An Thoi Islands, a group of small islets with fringing coral reefs and reef flats. Coral communities are common on the west and unexposed zones of the islets (20–25 m depth), while the east is often under the influence of strong currents in steep slopes that might reach depths of 40–60 m. Due to Phu Quoc's geographic location and the territorial ownership disputes between Vietnam and Cambodia, development has, until recently, been quite restricted in the area. However, the growing human population (mostly dedicated to fishing), the increase in trade, and the boom in tourism development, is starting to threaten the coastal ecosystem. Biological resource surveys have been fairly restricted in the past and present knowledge on the demography and spatial distribution of the marine communities is limited (WWF Vietnam 1994; Kanjana 2002; Latypov 2003).

Many Vietnamese believe that sea cucumbers, as with many other marine resources, are highly abundant in Phu Quoc Island. This general understanding is because Phu Quoc is the primary source of origin for many sea cucumber species at Vietnamese food markets. In 2003 and 2004, we obtained several individuals of *H. scabra* from the island in order to carry out pilot culture studies at the College of Fisheries and Aquaculture at Can Tho University, in South Vietnam. Here, we obtained our first reports on the scarcity of sea cucumbers in the area. During 2004, we conducted some field investigations to examine the population of exploitable sea cucumber species around Phu Quoc Archipelago, the status of the exploitation, capture techniques, areas and past history of the fisheries. More information on the species in the area and the status of their populations was obtained by conducting over 80 underwater surveys in the area's shallow waters (down to 18 m depth).

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Figure 1. Sea cucumbers in Cholom market, Ho Chi Minh City.



Figure 2. Hookah diver from Phu Quoc Island.

Notes on past and present fisheries around Phu Quoc

Sea cucumber fishing activity in Phu Quoc started in the early 1980s. Initially, sea cucumbers were caught using large poles from boats on shallow waters but as the shallow water sea cucumber populations decreased, hookah divers replaced the pole fishing activity. Some sea cucumber species that are rarely seen nowadays, such as *H. scabra*, were commonly found in very shallow waters around the archipelago. The sea cucumber fishery

boomed in the late 1980s with divers from many fishing communities around Phu Quoc dedicated to this type of fishing. By 1992, the average catch per diver was 20 kg (dry weight) per day for some sea cucumber species (e.g. *Holothuria leucospilota*, *Stichopus herrmanni* or *Bohadschia argus*).

Nowadays, most hookah divers (Fig. 2) collect sea cucumbers at night using torches in waters as deep as 30–40 m. The fishery is year round when weather permits, except during nights when clear skies and a full moon coincide. The divers explained that during these nights, and during the monsoon season (months of June and July), sea cucumbers remain buried in the sand or hidden in the crevices of corals and rocks.

The average monthly income for a sea cucumber diver in Vietnam might reach 2–3 million VND, equivalent to USD 130–194 (2004). However, as sea cucumber numbers decline, divers are beginning to target other fauna. Fishermen also occasionally catch sea cucumbers, particularly *H. scabra*, when fishing for swimming crabs with fine nets and on fishing trawlers. Today, sea cucumber fishermen only occasionally dive in South Vietnamese waters due to the sharp decrease in stocks during the last five years. Fishing activity, especially during the dry season, is now concentrated in Cambodian waters. Dive boats (12 m long and 4 m wide) with four or five divers travel for one or two days to harvest sea cucumbers in the far islands of Kaoh Mano, Kaoh Rong, Kaoh Rung and Kaoh Kong. Divers are normally away for 10 to 20 days (depending on the amount of catch), returning home during the days of full moon. Nevertheless, interviews with sea cucumber divers revealed that although Cambodian stocks are still abundant, there has been a decline in the capture rate. The number of dive boats has also increased in these waters. Most Vietnamese fishermen that previously were dedicated to harvesting sea cucumbers have moved to other fishing activities. The main reasons given for this are related to the increasing difficulty in finding sea cucumbers in and outside Phu Quoc Archipelago and the low monetary return received for time spent diving. Moreover, illegal fishing in Cambodian waters is considered a dangerous activity and Cambodian coastguards are increasing both the number and amounts of fines for Vietnamese dive boats.

Local trade in sea cucumbers

The sea cucumber trade in Phu Quoc has decreased considerably over the years as stocks have diminished. Dried sea cucumbers are sold mainly to Ho Chi Minh City. Their trade began in 1978 and mainly focuses on one species, the sandfish, *H. scabra*. By 1994, Phung (1994) reported that five target species, *H. scabra*, *H. leucospilota*, *H. edulis*,

H. atra and *Actinopyga echinites* were commercialized from the south Vietnamese coastal zone. After the boom in their exploitation during the last decade, captures declined and five years ago, most shops in the island stopped trading sea cucumbers. Some sea cucumber buyers also indicated a decline in catches of sea cucumbers after Typhoon Linda in 1997. Table 1 gives some examples of harvests before and after the typhoon.

Those who still trade sea cucumbers chose to broaden the number of targeted species to 8–12 dif-

ferent types. As the divers reported, most sea cucumber fishing nowadays occurs in Cambodia and the farthest islands of the Phu Quoc Archipelago. The target species are mainly *Holothuria atra*, *H. leucospilota*, *H. edulis*, *H. fuscopunctata*, *H. scabra*, *Stichopus naso*, *S. ocellata*, *S. hermanni*, *S. chloronotus*, *Bohadschia marmorata*, *B. argus*, and *Thelenota ananas*.

Table 2 shows the scientific, English and local names of the edible species of sea cucumbers collected around the area.

Table 1. Examples of sea cucumber harvests before and after Typhoon Linda.

Species	Harvests before 1997	Harvests after 1997
<i>Holothuria scabra</i>	200–500 kg year ⁻¹ (dry weight)	Less than 100 kg year ⁻¹ (dry weight)
<i>Holothuria atra</i>	Many tonnes year ⁻¹ (dry weight)	Less than 1 t year ⁻¹ (dry weight)
<i>Holothuria leucospilota</i>	Many tonnes year ⁻¹ (dry weight)	100 kg year ⁻¹ (dry weight)
<i>Stichopus hermanni</i>	1 t day ⁻¹ (fresh weight)	10 kg day ⁻¹ (fresh weight)
Total amount	5 t year ⁻¹ (dry weight)	500 kg year ⁻¹ (dry weight)

Table 2. Scientific, commercial and local names of sea cucumbers in Phu Quoc plus average price in Vietnam dong, 1 USD = 15,000 VND (2005).

Scientific name	English name	Local name	Average value (VND kg ⁻¹ dry weight)
<i>Holothuria scabra</i>	Sandfish	Đột trắng	500,000–700,000
<i>Holothuria atra</i>	Lollyfish	Đĩa đen , đĩa máu	40,000
<i>Holothuria leucospilota</i>		Đĩa mũ	20,000
<i>Holothuria edulis</i>	Pinkfish	Sâu gai	50,000
<i>Holothuria fuscogilva</i>	White teatfish		
<i>Holothuria whitmaei</i>	Black teatfish	Đột đen đá	
<i>Holothuria fuscopunctata</i>	Elephant trunkfish	Đột đá, đột da trần	80,000
<i>Stichopus chloronotus</i>	Greenfish	Sâu biển, đột bê ơ	250,000–300,000
<i>Stichopus hermanni</i>	Curryfish	Đột ngận đá, đột ngận trường	>300,000
<i>Stichopus horrens</i>		Đột ngận	
<i>Thelenota ananas</i>	Prickly redfish	Đột điều	800,000
<i>Thelenota anax</i>	Amberfish	Đột khoai lang	
<i>Bohadschia marmorata</i>	Brown sandfish	Đột mũ	100,000
<i>Bohadschia argus</i>	Tigerfish	Đột da trần, Sâm vàng	300,000
<i>Pentacta anceps</i>		Đột bí đao	
<i>Pentacta quadrangulis</i>		Đột gai đỏ	130,000
<i>Pearsonothuria graeffei</i>	Flowerfish	Đột dãi, đột dãi đá or dẫu đá (small)	

Sea cucumber processing

The divers process the sea cucumbers themselves. If evisceration has not taken place in the boat, the sea cucumbers are squeezed to force the ejection of the guts and water, or a small cut is made. They then are washed with clean seawater and boiled. Special care is taken with *H. scabra*. After boiling they are buried in a bag in sand for some days and then sun dried.

Spatial abundance of exploitable species of sea cucumbers

There have not been previous sea cucumbers surveys in the island and the lack of information on habitat variability restricts the possibility of quantifying the status of these populations at present. Nevertheless, this survey is the first account on the species, general abundance in surveyed areas, and habitat description.

Twenty-five species of sea cucumbers were found in Phu Quoc Archipelago. Eleven of these species are edible and exploited commercially, but *H. scabra* is the most valuable by far. *H. scabra* was never encountered during our dive survey although local fishermen using crab nets occasionally see some live individuals.

Other common species of low commercial value were *H. leucospilota*, *H. atra* and *H. edulis*. These species were found in very low densities and had a

patchy distribution. *H. edulis* was found in habitats with rubble and scattered rocks at the edge of the reef between 8 and 15 m depths, whereas *H. atra* was encountered in shallow waters on sand flats, among rocks or in mixed seagrass beds. As with *H. atra*, the black sea cucumber *H. leucospilota* was present all over the island, although more commonly in intertidal waters.

Stichopus ocellata aggregates in shallow mixed seagrass beds and on coarse sand among coral reefs (Fig. 3). Two colour morphs were distinguished: one is a light uniform brown morph and the other has dark chestnut spots over the dorsal surface. This species is found exclusively among bivalve beds and mixed seagrass-algae beds in the east of the island. A few individuals of other species of the genus *Stichopus* were also found (Fig. 3). *S. chloronotus* was only seen in the farthest Vietnamese islands of the archipelago and *S. herrmanni* and *S. naso* were present on only two occasions during the entire survey period.

Bohadschia species, *B. bivittata* and *B. argus* (according to classification of Clouse et al. 2005), were rare and exclusively sited at the An Thoi islands in depths of more than 12 m. *B. vitiensis* was found buried on sand reef flats at 17 m in the farthest islands. *Pearsonothuria graeffei* was only recorded on the reefs of one island of An Thoi, exposed on natural blocks. It seems that this species was more active (and visible) on days with high ocean currents.

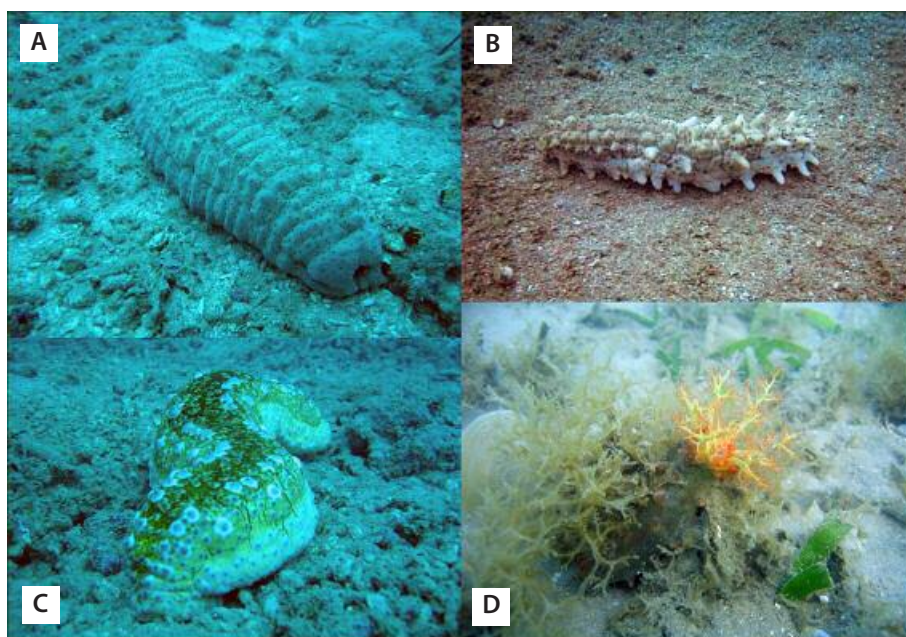


Figure 3. Sea cucumber species from Phu Quoc.
A. *Stichopus herrmanni*; B. *Stichopus ocellatus*,
C. *Stichopus naso*, D. *Pentacta quadrangulis*.

The help of C. Massin and Y Samyn in identification is acknowledged.

Overall, the density of all sea cucumbers in the surveyed area was found to be very low. Taking into account the comments from the divers and traders, it seems that the present situation is probably a consequence of many years of uncontrolled fishing. Other low commercial species showed a very patchy distribution, often concentrated in a single transect line (50 m), hidden under sand or between rocks, coral crevices, or seagrass and not reappearing for kilometres. Species such as *H. scabra* and *S. herrmanni*, once highly abundant, are nowadays rare, a prediction of nearby future local extinctions. As in many other Indo-Pacific countries, fishing effort has also switched from high to low value commercial species, and going to deeper and more remote waters (Uthicke and Conand 2005). Sea cucumber harvesting has now moved to neighbouring Cambodian waters, but the products enter into the Vietnamese market through Phu Quoc and are labelled as a domestic product, rather than imported. Consequently, Vietnamese market stocks still maintain a good supply of products.

Phu Quoc Archipelago serves as an important ecological transition area between the South China Sea and the Gulf of Thailand. The dynamics and status of the sea cucumber populations between the islands and the supply from other areas will need to be provided in order to characterize the natural fluctuations. Further studies concerning the fisheries activities in Phu Quoc Archipelago and neighbouring Cambodian islands are necessary in order to elucidate the interaction between fisheries and the yield of commercial sea cucumber species. Fishing effort needs to be regulated for all commercial species of sea cucumbers. A co-management programme between both countries to regulate sea cucumber fishing in these waters will not work unless it has the full support of local communities. Working and collaborating with fishermen and conducting environmental education campaigns will be most important for making this a success.

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