First insight into Colombian Caribbean sea cucumbers and sea cucumber fishery

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Abstract

Sea cucumbers are invertebrates that have been marketed legally and illegally for years in Colombia. Little is known of these species, and there is hardly any biological, ecological or market information on the population of the species under commercial exploitation. We present information on the sea cucumbers of the Caribbean coast of Colombia, with data on the fishery, fishermen, trade, species of interest, nutritional contents and reproductive characteristics. We report new species for the Caribbean and conclude with the importance of initiating a management plan for the Colombian fishery resource.

Introduction

As is well known, in many Asian countries sea cucumbers are considered a delicacy. *Trepang* or dried holothurians have been sold for over a thousand years, (a) as a food because of their high-protein content (up to 50%), (b) for pharmaceutical and medical treatment and (c) as an aphrodisiac, as they are considered the *Ginseng* of the sea. Asians believe that the daily consumption of sea cucumbers keeps them healthy. Due to overexploitation, the fishery has expanded to other regions, such as the Galapagos Islands, Chile, Russia and the Caribbean. In the Colombian Caribbean, sea cucumbers have been captured illegally in large numbers on the coasts of La Guajira, Magdalena and Bolivar for about a decade, causing intense pressure on the resource (Fig. 1). This resource is sold by artisanal fishermen at negligible prices (USD 0.5 unit^{-1}, or USD 1–3 kg^{-1}), despite having a high value on the international markets.

Little is known about the sea cucumber species in the Colombian Caribbean, and the dearth of knowledge on species, biology, population dynamics, fisheries management and production in captivity, along with the potential for commercialisation in international markets, indicates the need to begin the development of aquaculture with the aim of: (i) establishing an option of new activities for artisanal fishermen and the regional aquaculture private sector; (ii) diversifying marine aquaculture and possibility re-using abandoned aquaculture facilities; (iii) increasing scientific knowledge; and (iv) establishing programmes for the conservation of endangered and threatened species.

We present recent findings made by the Group for Research and Technological Development in Aquaculture of the University of Magdalena (Santa Marta, Colombia), who have been working on acquiring knowledge of some native species, their fisheries and aquaculture technology. One of the main projects was funded by Colciencias and the University of Magdalena.

Figure 1. Map of Colombia (http://www.worldatlas.com/webimage/countrys/samerica/co.htm).

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Colombian Caribbean sea cucumber fishery

Sea cucumber management in Colombia is inadequate, and in the long term it may threaten the preservation of the species, as has happened in other countries. Currently, there are no studies on population dynamics, ecology, trade or biology of the native species. Since 2005, however, there have been unofficial reports of sea cucumber production. For example, in 2005, 1.646 kg of dry weight sea cucumbers were exported. According to Toral-Granda (2008), in Colombia the fishing of sea cucumber is illegal, is not reported, and is not regulated. In turn, Colombian species are not included in the Convention on the International Trade in Endangered Species (CITES) list or in the Colombian *Red book of invertebrate marine species threatened, vulnerable or endangered*. This does not mean, however, that they are not at risk.

Less than ten years ago, state agencies approved the fishing of species that inhabited shallow water in the Colombian Caribbean and Pacific region. In 2005, commercial exploratory fishing (500 tonnes year^{-1}) of sea cucumbers was allowed by the environment authorities (Ministry of Environment and Sustainable Development) and the fisheries institution (Colombian Institute for Rural Development). At the time, the state agencies had no idea of the targeted species harvested and did not clearly identify criteria for their exploitation (Gutiérrez 2010): they permitted relatively indiscriminate fishing that destroyed much of the fishery resource.

Fishing fleets, mainly Asian, arrived in the Colombian Caribbean. They hired local fishermen and paid them USD 45 per day to collect as many as they could in the working day. There are informal records about the extraction of one tonne of sea cucumbers per day to export to Korea and Japan: In the Guajira, fishermen collected up to one tonne of *Isostichopus* sp. daily, using shovels normally used to extract salt. The fishermen said that on the beaches of the north coast (Guajira Peninsula), sea cucumbers were grouped in columns up to 80 cm in height. One time the Colombian National Navy seized a ship that had 15 tonnes of sea cucumbers, extracted during a short fishing trip that lasted six days.

After the state agencies noticed the problem of the overexploitation of fishery resources, sea cucumber was listed as hydrobiological and the Ministry of Environment confirmed the prohibition on fishing for sea cucumber for commercial and scientific purposes. According to the Code of Renewable Natural Resources and Environmental Protection, a hydrobiological species in Colombia is defined as "the set of plant and animal organisms whose life cycle is fulfilled totally inside the aquatic environment, and their products". Today, only government authorities directly involved in research activities can explore this resource. The commercial harvest of sea cucumbers is totally prohibited.

Sea cucumber fishing model in Taganga (north coast of Colombia)

Taganga is a coastal region that is characterised by the presence of fishermen who have exploited marine resources as a main source of income for centuries (Fig. 2). Its population is estimated at 4200 inhabitants, of whom 19% are active fishermen. Much of the population is made up of women who devote themselves to the commercialisation of the products of the fishing. The quality of life of the population is low; there is a lack of basic human needs, such as water, shelter, infrastructure, access to education, healthcare and employment.

Figure 2. Taganga Bay (Picture by Mendoza Y.).

There are five legal fishermen's organisations in Taganga with a total of 400 members. The other 400 fishermen practise their profession without the support of a formal organisation. Fishing takes place in Taganga (Magdalena) and Cabo de la Vela (La Guajira) (11°16.04′ N, 74°11.24′ W and 12°12.27′ N and 72°10.22′ W, respectively). The fishing fleet consists of 80 vessels, ranging from good quality vessels to primitive, homemade canoes and boats, some with inboard or outboard motors. The main fishing activity involves using *ancones chinchorreros* (a kind of fishing net), but gill nets and longlines are also used for capturing commercial species: fish of the families Carangidae, Scombridae (tuna), Lutjanidae (snappers) and Serranidae (groupers), which have a high commercial value in domestic and international markets.

Sea cucumber fishery is rudimentary: it is performed by free divers. Divers have basic gear consisting of a mask, a snorkel, fins and a marker buoy. They follow the "footprints" of holothurians and easily capture them. They catch between 20 and 80 sea cucumbers in six to eight hours. In one day they can fill seven or eight containers of 20 litres capacity, corresponding to approximately 40 kilos in each one. Currently, fishermen catch only on request as long as the amount they receive from buyers is enough to be "correctly paid" (USD 3 kg^{-1}).

Sea cucumbers are traded in two ways, described below.

(1) On the beach, the fisherman keeps the sea cucumbers in the container until they have expelled all the water from their bodies. He empties the water out of the container until the sea cucumbers remain dry. Once dry, the fisherman weighs the product. It has been established between the fisherman and the buyer (Asians usually), that he discounts a kilo from the total weight and this final weight is the one that the buyer will use to pay to the fisherman.

(2) The fisherman and his wife process the sea cucumbers: the woman washes them in a plastic bowl full of freshwater, then they are cooked on wood stoves placed on the beach and finally they are dried on the roof of their houses. A few days later the buyer weighs and pays for the sea cucumbers and sends them directly to Asians countries.

Fishermen say that Korean and Japanese consumers prefer to buy sea cucumbers from the Magdalena shores, because they taste better than the ones from La Guajira as they remain sheltered on coral surfaces and have different feeding habits.

Commercial species

Official export data are unavailable. In Colombia, studies on sea cucumbers are scarce and refer to the distribution and taxonomic identification. One such is that of Caycedo (1978) who defined the biological classification, habitat and ecology of 14 species of shallow water holothurians on the northern coast of Colombia, including their description and taxonomic keys for identification. The material was collected in Rosario Islands (10° 08.39′ N and 75° 43.21′ W) and Tayrona National Park, northeast of Santa Marta (11° 20′ N and 74° 05′ W). Ten of the species found were new to Colombia – *Isostichopus badionotus*, *Astichopus multifidus*, *Holothuria* (*Thymiosycia*) *impatiens*, *H.* (*Thymiosycia*) *arenicola*, *H.* (*Halodeima*) *grisea*, *H.* (*Halodeima*) *floridana*, *H.* (*Halodeima*) *mexicana*, *H.* (*Selenkothuria*) *glaberrima*, *H.* (*Semperothuria*) *surinamensis*, *H.* (*Platyperona*) *parvula* – and one of these was new to science: *H.* (*Thymiosycia*) *thomasi* sp. *nov.*

Another study is that of Borrero-Pérez et al. (2003), who caught 259 holothurians (Invemar-Macrofauna expedition I), which were distributed in four orders, five families, eight genera and 15 species (with one subspecies). Most of them were recorded for the first time in Colombian Caribbean and ten species are distributed in the Caribbean Sea and in the West Indies. Five species, however, were recorded for the first time in the mainland towns of the Caribbean: *Holothuria* (*Vaneyothuria*) *lentiginosa enodis*, *Amphigymnas bahamensis*, *Mesothuria gargantua*, *Enypniastes eximia* and *Molpadia barbouri*.

Isostichopus badionotus

Our findings confirm the presence of *Isostichopus badionotus* (Selenka, 1867) in the shallow waters of Rodadero beach, Bay of Santa Marta (11°13′22.73″ N – 74°13′32.59″ W), in beaches near the Simón Bolívar Airport (11°09′23.48″ N – 74°13′41.65″ W) and in Taganga bay (11°15′54″ N – 74°12′40″ W). Their habitat is sand or mud. The species presents distinctive taxonomic characteristics: diverse brown colouration, numerous conical warts, twenty peltate tentacles in the buccal area, paired gonads and tubular feet. The presence of spicules prompted us to confirm the species (Fig. 3 and 4). This species is captured in the daily work of the fishermen who sell them to illegal traders. This is the main commercial species because of its abundance, flavour and thickness of the skin.

Figure 3. *Isostichopus badionotus*.

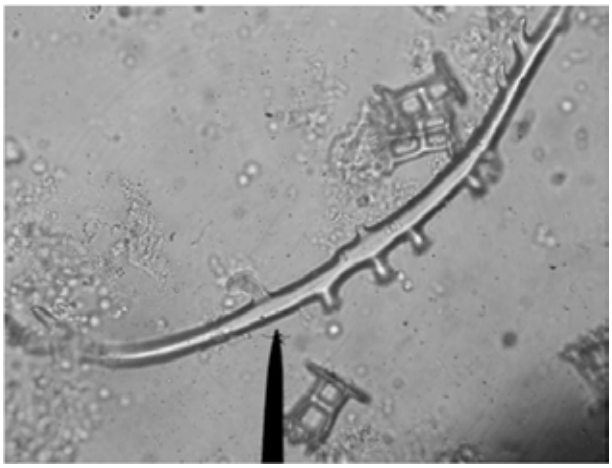

Figure 4. *Isotichospus badionotus* spicules.

During the journeys made to monitor *I. badionotus*, we detected two new species that we registered for the first time in this Caribbean zone – *Stichopus variegatus* and *S. herrmanni* – and also detected the presence of three morphotypes of the genus *Stichopus* (Fig. 5). These species are associated with rocky bottoms. They are easily caught by fishermen because of the traces they leave with their faeces. They are distinctive for their great size (1 kilo per unit), a feature that appreciates their value in the Asian market.

Figure 5. *Isotichospus badionotus* and *Stichopus herrmanni.*

Nutritional composition

Sea cucumbers are classified as commercially important, depending on species, abundance, appearance, smell, colour, thickness of the body wall and also global market demand (Purcell et al. 2012). Processed sea cucumbers are priced according to the dish and the occasion on which they are served (Lo 2004). They are first gutted, then boiled or roasted. They can be preserved by drying, smoking or freezing (Bruckner 2006). In the experience of native fishermen, market buyers prefer small species (*Stichopus* sp.), which has thinner skin, so they are a source of major earnings.

In view of the importance of knowing the nutritional properties of the sea cucumber and the lack of knowledge of these properties in the Colombian sea cucumbers, we are currently undertaking studies to assess the nutritional composition of wild and cultivated sea cucumbers. It is known that the composition of fresh sea cucumbers varies, depending on the species, age and diet. We present a table (Table 1) related to the nutritional content found in *Isostichopus badionotus* compared to the findings of Mehmet et al. (2011).

Reproductive features

Little is known about the reproductive biology of Columbian sea cucumbers. Under controlled laboratory conditions, we obtained natural spawning from *Stichopus* sp. So far we have managed to bring the cycle as far as early auricularia and started methodological adjustments to close the life cycle in captivity. Additionally, we sampled animals monthly in the wild and fixed their gonads for histological examination. We found that *I. badionotus* has a gonad structure similar to other species of the genus.

Conclusions

There is a huge lack of knowledge about Colombian sea cucumbers and therefore great potential for research in various areas related to these invertebrates. There are many species that appear to be suitable for marketing on Asian markets, as is well

Table 1. Nutritional and moisture content (in %) found in *Isostichopus badionotus* compared to the findings of Mehmet et al. (2011).

Species	Humidity	Protein	Lipid	Ash
I. badionotus (from Colombian Caribbean)	87.6	8.9	0.2	2.8
Holothurians (Mehmet et al. 2011)	82–92.6	2.5–13.8	0.9–1.5	1.5–4.3

demonstrated by the large fishing fleets and many buyers who come in search of new products. The work to be done in the near future should include a list of vulnerable species in the *Red book of invertebrate marine species threatened, vulnerable or endangered* as there is no information on the potential danger of extinction. Sustainable aquaculture of sea cucumber should be supported. Environment and fisheries authorities must implement management plans for the species and adjust the legal issues regarding the use of the species for diverse purposes.

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