

Sea cucumber fisheries in Northeast Brazil

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For decades, tropical sea cucumber fisheries have centered on the Indo-Pacific region (Shepherd et al. 2004; Tuwo 2004; Uthicke 2004) and have only recently developed in Latin America (Toral-Granda 2008). This expansion is mostly dictated by a sustained demand from Asian markets, especially China (Yang et al. 2015). Despite the fact that this is a fast-growing sector, relatively little is known about the sea cucumber industry in Central and South America. Only a few countries (e.g. Cuba, Peru, Chile, Mexico and Ecuador) have regulated fisheries, and provide production data (Toral-Granda 2008); for example, for *Isostichopus fuscus* in Baja California, Mexico (Aguila-Ibarra and Ramirez-Soberón 2002). To our knowledge, reviews of sea cucumbers in Latin America (e.g. Toral-Granda 2008; Anderson et al. 2011) do not provide any information about the state of sea cucumber resources and harvests in Brazil. This contribution aims to report on the occurrence of sea cucumber fisheries, and describe common practices to collect and process sea cucumbers in northeastern Brazil, thereby adding one new species of sea cucumber (*Holothuria grisea*) to the list of commercial species known around the globe (Purcell et al. 2013; Leite-Castro et al. in press).

Two types of survey were carried out. Ground surveys (8–17 September 2014) were conducted to confirm that the exploited species was, in fact, *Holothuria grisea* (Fig. 1), which is one of the most abundant species along the Brazilian coast, occurring from the northeast to the south of Santa Catarina (Tommasi 1969; Mendes et al. 2006). Ground surveys were restricted to the northeast of Brazil, covering an area of 2,611 km², which is equivalent to 35.3% of the Brazilian coast. Four states were found to harbour populations of sea cucumbers: Bahia, Paraíba, Rio Grande do Norte and Ceará. Among them, Ceará and Rio Grande do Norte (Fig. 2) had the greatest densities of *H. grisea*.

Following the ground surveys, aerial observations were made to identify fishing sites along the coast using a helicopter (EC 130 B4) that flew 100 m over the coastal areas that are believed to have the highest densities of sea cucumber drying areas in Ceará State. Four helicopter surveys were conducted around the full moon of 14–17 October 2014 (period during which the coastline is most exposed), covering 470 km of coastline, corresponding to 87% of the Ceará coast. The flights coincided with low tide and aimed to identify all types of sea cucumber fishing



Figure 1. The sea cucumber *Holothuria grisea* collected in the intertidal zone along the coast of the state of Ceará in northeastern Brazil. This individual is about 15 cm long. (Image: J. Souza Jr).

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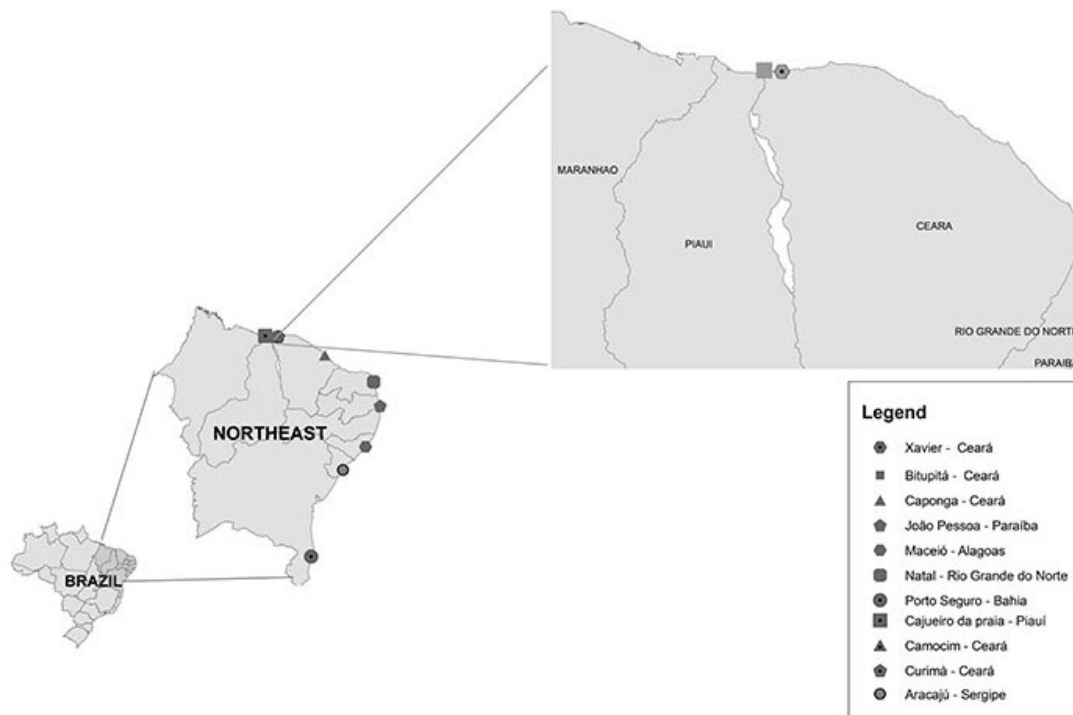


Figure 2. Maps showing the states of northeast Brazil where surveys were conducted and locations where sea cucumber fishing activities have been identified. (Illustration by M. Fernandes).

activities. A sea cucumber drying area was located on Xavier Beach, in Camocim, Ceará (Figs. 2, 3a). This community was then used to exemplify the sea cucumber fishery.

To characterise the types of fishing activities and the methods used by the local population to harvest sea cucumbers, Xavier Beach was monitored between 13 and 18 July 2015 during the lowest tides of the month (which correspond to the harvest period). The studied community is located in a remote area that is difficult to access and has only 26 homes.

The sea cucumber fishery is not a traditional activity in this region; historically, harvests have focused mainly on fish, shrimp and lobster. Sea cucumber collection in this community started 18 years ago, but intensified rapidly over the last 8 years, as a complementary income activity of traditional fisheries. Sea cucumber harvests take place twice a month, at low tide, when the reefs are exposed, and involve 14 fishing families, composed of men, women and children. The daily fishing starts before low tide, with the harvesters using a boat to reach the reefs (Fig. 3b), and ceases when the reefs are no longer exposed. Fishing spots are spread along the shore or near the coast, with distances from land ranging from 10 to 2,000 meters (from the highest high tide mark). Accessibility is facilitating the participation of novice harvesters (Fig. 3c).

Sea cucumbers are collected by hand, and all sea cucumbers are processed shortly thereafter (Fig. 4a). Evisceration is carried out on the beach at low tide by the harvesters themselves, using a small knife; the process takes about 8 seconds per specimen (Figs. 4a-c). Afterwards, all sea cucumbers are stored in large bags (of about 50 L), and every harvester weighs his or her catch in a nearby house belonging to the community representative. During the collection period, which lasts five days (around each appropriate lunar phase), about 506 kg of eviscerated sea cucumbers are collected. According to the data gathered, it is estimated that this community alone collects around 12,144 kg of sea cucumber annually. Many other villages like this one harvest *H. grisea* every month, especially in Ceará State.

Production data are noted by a community representative and then passed on to the middleman. Each harvester gets paid daily for the delivery of fresh eviscerated sea cucumbers. In the absence of competition, the price is determined by the middleman, and is currently set at about USD 0.51 kg⁻¹ of wet weight. Sea cucumber fisheries in the entire village produce an estimated annual income of USD 6,193, which is unequally divided among harvesters, depending on their level of experience and expertise. *H. grisea* is cryptic, living hidden inside crevices, but experienced fishers quickly detect the types of rocks that are used as shelter by the sea



Figure 3. A: Aerial view of sea cucumber drying area on Xavier Beach (Ceará, Brazil); B: Sea cucumber fishers readying their boat; C: Fishers wading on the reef in search of sea cucumbers. (Images B and C: J. Souza Jr)



Figure 4. A to C: Sea cucumbers are eviscerated on the shore immediately after the harvests; D: A boulder that was turned over, exposed sea cucumbers hidden underneath. (Images: J.-F. Hamel)

cucumbers. Unfortunately, the rocks that get turned over to collect sea cucumbers are not returned to their original position (Fig. 4d). This practice exposes hundreds of encrusting marine invertebrates, including sponges, tunicates and worms, many of which presumably die. Hence, this fishery is not only impacting on the sea cucumber population and their closest associates (e.g. predators), but also a myriad of other species that make up this rocky coastal community.

The processing, carried out by one of the fishers, involves boiling the eviscerated sea cucumbers in 100 L cast-iron metal cookware with about 2 kg of salt for two hours (Fig. 5a). The boiled products are laid on a perforated plastic box (36 cm x 55 cm x 31 cm) for approximately 12 hours to remove excess water. The sea cucumbers are subsequently scattered on canvas and left to dry under the sun for six consecutive days (Fig. 5b). Sometimes, in order to speed up the drying process (or during rainy days) a



Figure 5. A: Boiling in salted water is the first step in the preparation of beche-de-mer; B: After boiling, sea cucumbers are typically sun dried; C: On rainy days, sea cucumbers are dried using a wood-burning oven; D: The lengthy shore-based evisceration process and poor training often yield low-quality products that may be over-cooked, brittle, or misshapen. (Images: J. Souza Jr)

home-made oven is used (Fig. 5c). Steel plates set over a wood fire are used as shelves to accommodate approximately 560 kg of wet sea cucumbers. After the drying is completed, the resulting beche-de-mer is stored in Styrofoam boxes and transferred to the middleman. During the present survey, several examples of poor-quality dried products were noted, which were either contaminated by sand and dust, or not properly cut or burned (Fig. 5d). Based on interviews with fishermen, sea cucumbers are the main source of trade and income for their community, whereas other fish are used mostly for subsistence. Sea cucumbers are not consumed in Brazil, and the route used by exporters to ship them out of the country remains unknown.

The status of *H. grisea* populations was not characterised before the onset of the fishery along the coast of Brazil. Therefore, it is not possible to infer about the impact of this activity. However, studies of population densities conducted by the PEP-MAR group in 2009, on a beach close to the village of Bitupitá (Fig. 2), showed natural concentrations of 40 ind. m⁻² (unpublished data). Another study performed by Farias (2012) in the same locality reported a density of 0.54 ind. m⁻², corresponding to a decrease of 98.7%. Such a drastic decline can result from a number of factors, including intensive fishing pressure. However, in-depth and controlled studies should be conducted in order to determine the precise effect of fishing activities on population

densities. While biological investigations of *H. grisea* populations in Brazil have begun (Leite-Castro et al. in press), more research is necessary to understand the patterns of seasonal fluctuations in population density, as well as to characterise the fishery and monitor its productivity. Based on this information, management strategies could be developed to monitor fishing activities for *H. grisea*, which is clearly a major source of income for dozens of small villages scattered along the coast of Brazil.

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