

Madagascar Holothurie SA: The first trade company based on sea cucumber aquaculture in Madagascar

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Sea cucumber fishing in Madagascar is a widespread activity (Laroche and Ramanarivo 1995; Conand et al. 1997; Rasolofonirina and Conand 1998; McVean et al. 2005) and natural populations are currently overexploited (Conand 1998; Conand et al. 1997). In 1999, a sea cucumber mariculture project was launched in Madagascar (Jangoux et al. 2001). The work was funded by the Belgian University Corporation for Development (CUD) and the Malagasy government. It involved the universities of Brussels and Mons (Belgium) and the Malagasy University of Toliara (Jangoux et al. 2001). Initial work consisted of building a sea cucumber hatchery on the grounds of the Toliara Marine Sciences Institution (IHSM). The hatchery was functional in 2003 and currently produces tens of thousands of juveniles of the valuable sea cucumber *Holothuria scabra*. Its main section consists of a 120 m² air-conditioned building, containing six rooms for growing seaweed, rearing larvae, caring for genitors, and undertaking microscopic and computer analyses. The hatchery's aquaria are connected to a saltwater pumping station, whose reservoir fills up at high tide and whose water pours into a 30 m³ settling pond. Decanted water is then cleaned by repeated filtration before being used in the larval rearing tanks.

The second phase of the project, launched in 2004, consisted of setting up a sea cucumber farm to grow out juveniles until they reached a marketable length. The farm was erected at Belaza, 20 km south of Toliara. This setting, which borders mangroves, fulfils the ecological requirements of *H. scabra*, and possesses a natural freshwater spring that allows an optimal functioning of the laboratory and houses. The farm raises sea cucumber juveniles produced by the hatchery to a marketable size and weight (more than 20 cm and 300 g) in 10–12 months. The method for rearing sea cucumbers includes three successive phases, each requiring specialized infrastructures (internal aquaria, external tanks and sea fences) related to the animal's size. Aquaria in which small juveniles are reared are located in the hatchery. Each aquaria contain 200 L of filtered seawater in which juveniles grow to a length of 2 cm (Fig. 1). Sea cucumbers are then transferred onto sandy-muddy substrates in 25,000 L external tanks (Fig. 2) where they are maintained until they reach a

length of 6–8 cm (Fig. 3). Seawater is changed twice a week and new substrates are added between each run. The optimal density is 20 individuals per square meter. Once individuals reach 6–8 cm, they are placed in sea fences (Figs. 4 and 5), but below this size, they can be attacked by predators such as crabs or fish. Sea fences are of ca 600 m², and are made of wood sticks and plastic nets with a mesh size of 1 cm. Fences are built in intertidal zones where sea cucumbers are immersed even during low tides. The maximum density in fence areas is 3 individuals per square meter. The farm is currently producing thousands of sea cucumbers (Fig. 6).

Funds from the Belgian CUD ended in March 2008. At that time, a tripartite partnership, involving a spin-off from Belgian universities, the IHSM and a private company (Copefrito SA), have formed the first trade company — Madagascar Holothurie SA — based on sea cucumber aquaculture in Madagascar, and involving coastal villagers. The company's expected production in the next five years is 200,000 sea cucumbers per year. Farm productivity is not limited by the number of hatchery-bred juveniles (a single pair of genitors, one male and one female, produce tens of thousands of fecundated eggs), but rather by the surface of the available farming structures (surface of enclosed spaces). The trade company currently supplies various local organizations (groups of fishermen, coastal villages) so that they can be trained in farming operations. Management of farmers is ensured by scientists working in the company and by people from non-governmental organizations (NGOs) based in the Toliara region. If the experience is positive, it could be extended to many villages on Madagascar's west coast and will hopefully be the seed of a new type of aquaculture in this country.

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Figure 1. External tanks where *H. scabra* juveniles are reared until they reach 2–6 cm. Tanks are protected from the sun by umbrellas during the hot season.

Figure 2. Juvenile *H. scabra* (2 cm long) coming from the hatchery. At this size, they begin to hide into the substratum during the day, and are transferred from the hatchery to the farm's external tanks.

Figure 3 Juvenile *H. scabra* (6–8 cm long) after pre-growing in external tanks. Upon reaching this size, they are transferred into natural sea fences.

Figures 4 and 5. Sea fences set up in front of the farm's buildings.

Figure 6. *H. scabra* ready to be sold on the local trade market or to be treated as trepang and exported to Asian countries.