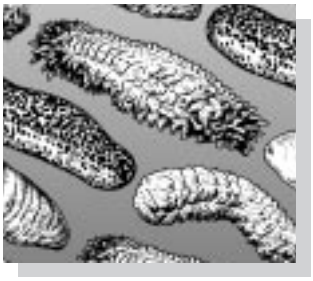

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A sea cucumber hatchery and mariculture project in Tulear, Madagascar

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This project arose from recent and very alarming reports of widespread overexploitation that may, in the short term, lead to the disappearance of echinoderm resources (particularly sea cucumbers) along the entire west coast of Madagascar (Conand 1998; Conand et al 1997).

Collecting sea cucumbers at low tide or by free diving is a traditional activity in Madagascar (Rasolofonirina and Conand 1998). Trepang production has been ongoing in Madagascar since the beginning of the century and was destined exclusively for export to Indochina.

Beginning in 1990, the market underwent rapid expansion and in 1994 catches reached a peak of some 650 mt of trepang exported to Singapore and Hong Kong. At a price of USD 4000 per tonne ("official" rate), this corresponded to overall earnings of more than USD 2.6 million. In more concrete terms, this means that every 10 kg of good quality sea cucumbers harvested provide between one and two euros directly to fishermen [1 euro ≈ 0.94 USD, 03/01/01].

During the period when the resource was abundant, a fisherman could collect several hundred kilos in a single day, thereby earning between 25 and 50 euros, in a country where the current monthly salary of a labourer is about 40 euros! Since 1995, while demand on the international market has remained high, and has even increased, there has been a significant drop in the quality of Malagasy trepang. This is due to the increasing scarceness of those species with a high commercial value, the growing harvest of lower commercial value species, and a decrease in the sizes of the specimens collected (Conand 1999). Trepang exports went from 650 mt in 1994 to 320 mt in 1996, which shows a significant decrease in available resources. Since 1996, harvest zones have clearly expanded through the illegal use of diving tanks to collect specimens (Maillaud 1999). This technique not only accelerates the resource's disappearance but is also responsible for a large number of fatal or severely debilitating accidents due to the lack of preparation and training on the part of those involved.

The situation is such that if no action is taken, the region is headed for disaster in both human and ecological terms. On the human level, the increasing scarcity of a high-value export product can only lead to increased poverty and instability in the village communities on the west coast of Madagascar, which have gradually concentrated their activities around the exploitation of trepang. On the ecological level, sea cucumbers are a vital element for sustaining coastal ecosystems in tropical areas as they are macro-detritivores that consume various organic detritus (e.g. excrement, cadavers, moultings).

In the long term, the project in Tulear should ensure that instruction in sea cucumber resource control and production is provided to specialised staff members. Also, practical training, first by project participants and later by the newly trained staff members, in on-site methods in rearing species of

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commercial interest should be given to those village communities that depend on sea cucumbers.

Meeting this training objective will come about through acquiring skills to routinely produce – through use of simple, reproducible and sufficiently rapid methods – marketable-sized high value sea cucumbers from juveniles produced in hatcheries. Initially, this involves building a hatchery and learning to master the pre-juvenile events of the life cycle of exploited species (i.e. fertilisation, embryonic development, larval growth, metamorphosis and immediately post-metamorphic organogenesis). The next step is to set up a pilot farm at an appropriate site to describe, control and optimise the processes involved in rearing specimens in a natural setting.

The project's two phases (hatchery and grow-out) will be guided by 30 years of research experience in sea cucumber biology acquired by marine biologists at the Universities of Brussels and Mons (Belgium) (Jangoux and Lawrence 1982; Coulon and Jangoux 1993; Gosselin and Jangoux 1996; Grosjean et al. 1998) and the University of La Réunion (France). They have produced a wide range of works on larva farming and biology and on the life cycles, reproductive cycles and eating patterns of adult echinoderms, in particular sea cucumbers.

The work underway is funded by Belgium's University Corporation for Development (Coopération Universitaire pour le Développement – CID) and revolves around a triple partnership involving the Universities of Brussels and Mons and the Madagascar University of Tulear, with the assistance (consultancy) of the University of La Reunion. It began in spring 1999 and is programmed to run four years (1999 – 2003). The project consists of first putting into place and then ensuring the scientific management of a hatchery that is designed to mass produce juvenile *Holothuria scabra* (sea cucumbers) and *Tripneustes gratilla* (sea urchins) using genitors taken from the wild. Once this type of production has been mastered, the project will begin rearing juveniles of commercially exploitable specimens. Successful completion of the hatchery phase – planned for some time in 2002 – should make it possible to launch a second phase, which will consist of setting up a pilot farm to grow-out juveniles.

The situation is simple. The resource will become scarcer and eventually disappear if the current level of exploitation continues. Only a mariculture activity can save the situation by "doubling" the process of forming wild populations through the production of commercially exploitable specimens on farms (optimising juvenile grow-out). Because these juveniles would be produced in hatcheries, this should bring about a decrease in the pressure on wild populations. Once a simple and easy standard rearing method has been applied, it will be possible to do the same at a variety of coastal sites (aquacultural farms) using specimens supplied by the hatchery, which would maintain a minimum level of pressure on wild populations (whose ecological importance is well known). After these populations have recovered, rearing techniques could be transferred to juveniles collected directly on site (this would obviously imply that the skills to ensure stock management did exist).

The Tulear hatchery (Aqua-Lab) began in April 2000 and is currently operational. Its main section consists of a 120 m^2 air-conditioned building (Fig. 1) containing six rooms for growing seaweed (Fig. 2), rearing larvae (Fig. 3), growing out juveniles (Fig. 4A), caring for genitors (Fig. 4B), microscopic analysis, computer processing (Fig. 5) and servicing aquarium equipment.

Initial fertilisation of the sea cucumbers, which began in May 2000, has led to the production of a limited number of 1-2 cm juveniles. The larvae are fed planktonic algae imported from Europe (species from the genera *Phaeodactylum* and *Chaetoceros*) while the juveniles are fed finely chopped macro-algae from the reef (Fig. 6).

The hatchery has been set up at the site of the University of Tulear's Fisheries and Marine Sciences Laboratory. A saltwater pumping station,

Figure 1. Aqua-Lab Hatchery

Figure 2. Planktonic algae cultivation area

Figure 3. Larvae rearing area

Figure 4a.
Juvenile grow-out area

whose reservoir fills up at high tide and whose water pours into a 30 m^3 settling basin (underground basin), was installed. The water stored in this basin is tapped on demand. It is then filtered (filters with decreasing mesh size down to 1mm) and sterilised by repeated applications of UV before being used in the larvae rearing tanks. This facility has proven satisfactory for rearing sea cucumber larvae but has not yet reached its full potential with regards to sea urchin larvae.

If hatchery production meets expectations, the partners plan to use additional funding from the Belgian Corporation to set up a pilot sea cucumber grow-out farm about 20 km south of the hatchery, at a site which the University of Tulear leases from the Madagascar Ministry of Fisheries. This site, which borders a mangrove, is very satisfactory and corresponds to the ecological requirements of the study species, *H. scabra*. It also possess a natural upwelling of fresh water which would obviously facilitate installation of the permanent research and housing buildings.

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Figure 4b. Genitor care area

Figure 5.
Microscopic analysis and computer processing room

Figure 6.
Preparing seaweed to serve as feed for *Holothuria scabra*

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