cent daily exchange of flow-through sea water. The majority of *H. scabra* larvae were at the pentacula stage by Day 14.

From this first trial we produced over 10,000 juvenile *H. scabra*. From Day 40, juveniles were reared in 4,000-litre concrete tanks. At 60-days-old, the juveniles held at the lowest density averaged 23.8 ± 4.7 mm in total length (n = 50). Settlement and juvenile rearing on fiberglass plates conditioned with diatoms in the 750-litre tanks produced smaller animals 8.4 ± 3.4 mm (n = 50). Reduced growth may have been related to a copepod infestation. The second batch of *H. scabra* larvae are now 14-days-old, and undergoing settlement. The *A. mauritiana* larvae are only a week old and still auricularia.

The results to date have been very encouraging, and we look forward to improving survival and growth in subsequent batches. In addition to the larval rearing experiments we have also been collecting data on the reproduction of *H. scabra, H. fuscogilva* and *A. mauritiana* in the wild, and also plan to start conducting experiments to determine suitable habitats for the release of hatchery-produced juveniles.

Sea cucumbers in Madagascar: difficulties in the fishery and sustainable management

by C. Conand, N. Galet-Lalande, H. Randriamiarana, G. Razafintseheno & M. de San

History of the fishery

The age and scale of various fisheries were estimated from historical export data. In 1921, for example, the *Bulletin économique de Madagascar* refers to exports of 11 metric tonnes (t) of trepang to China and Mauritius in the third quarter of the year, which would probably give an annual total of 40 t.

G. Petit (1930) presents statistics for the 1920 to 1928 period, when exports varied from 50 to 140 t. The subject of this study merits further research through trade statistics, in order to determine whether historically activity in the fishery fluctuated according to resource availability or for other reasons, and whether the fishery was being exploited on a sustainable basis.

In the south-western region (Tulear), this fishery is an active one: various sources (provincial trade and sea fisheries departments) indicate that exports fluctuated between 10 and 56 t from 1979 to 1986.

Export data from 1987 to 1995 are as follows: 1987: 60 t; 1988: 119 t; 1989: 113 t; 1990: 202 t; 1991: 545 t; 1992: 423 t; 1993: 356 t; 1994: 539 t and 1995: 311 t. The 539 t recorded in 1994 placed trepang in 5th place on the list of national exports in terms of value (2% of the total).

Resource management problems and overfishing

There have been various indications in recent years that the fishery is experiencing difficulties. These indications emerge from various parts of the beche-de-mer trade, which is especially complex (Conand & Byrne, 1994), because of the many stages and parties involved between the fishermen and the foreign consumer.

Fishing on foot would appear to be in decline. Studies currently under way at the Tulear Fisheries and Marine Science Institute will provide more precise data on this development.

Scuba divers are complaining that they now need to dive to increasing depths to harvest holothurians, which is leading to accidents, and also that they are being forced to look for new fishing grounds. The size of specimens of the various species concerned would also appear to be diminishing. With regard to processing, which is either done by the fishers themselves or by traders, techniques could apparently be improved. The processed product often fails to meet the required quality criteria, even with high-commercial-value species. Problems can subsequently arise in the export market.

Prospects for sustainable management

This resource has great social and economic importance for the coastal villages of Madagascar where it is often exploited as a family activity. Research carried out—in Tulear for the south-west region and in Nosy Bé for the north-west region, where the main reef areas are found—will make it possible to assess the state of the resource more accurately.

The Indian Ocean Commission—Commission de l'Océan Indien (COI)—is currently conducting a regional programme on integrated coastal zones management. Madagascar has therefore resolved that the sustainable management of its resources, and in par-

ticular sea cucumbers, is an objective to be achieved and that coordination and integration are necessary; meetings have taken place in the regions to better organise the sea cucumber trade by involving the various parties concerned (meetings were held at Ambanja, Mahajunga and Toliara). The Madagascar National Trepang Traders Group (ONET) was set up in Antananarivo on 25 September 1996.

The group's objectives are as follows:

- trepang quality management;
- training of traders and fishers in better resource management; and
- working closely with the administration in the management and exploitation of trepang.

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A new study of asexual reproduction in holothurians: Fission in *Holothuria leucospilota* populations on Reunion Island in the Indian Ocean

by C. Conand [1], C. Morel [1] & R. Mussard [1]

Introduction

Holothuria leucospilota is a large, black sea cucumber species, which is found throughout the tropical Indo-Pacific Region. It most often lives near the back reef, in sandy areas where dead coral accumulates (Massin & Doumenc, 1986; Conand, 1989; Ong Che, 1990). This initial study on Reunion Island proved that asexual reproduction through fission does exist, contrary to some previous observations (Britayev, 1992), and that it is even quite common.

The data collected covered information on the species populations and their densities, and on fission and regeneration rates in the different sites within the La Saline reef complex.

This data also allowed observations on the morphology and anatomy of normal individuals, those in fission and those in regeneration. Finally, the chronology of organ development during fission and regeneration was extrapolated from the data.

Material and methods

All specimens of the species *Holothuria leucospilota* found within the 10 m^2 quadrats set out in the back reef of several sites in the Saint Gilles/La Saline Reef were collected, measured and weighted. The process of asexual reproduction in *H. leucospilota* leads to six distinct categories for specimens. The categories as defined for other species, in particular *Holothuria atra* (Conand & De Ridder, 1990; Conand, 1996), were used here for *H. leucospilota*.

- Normal specimens (N) which show no sign of fission.
- Specimens in the process of fission (F) are characterised by a constriction in the anterior part of the body.
- Complete fission of F specimens leads to two new types of specimen:

  (A) specimens which correspond to the anterior part,

  (P) specimens which correspond to the posterior part.
- A and P specimens will then regenerate into:

  Anterior specimens that are regenerating their posterior part are specimens (Ap).

  Posterior specimens that are regenerating their anterior part are specimens (Pa).

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