

The main species targeted for export are the white teatfish, *Holothuria (Microthele) fuscogilva*; and the black teatfish, *Holothuria (Microthele) nobilis*, because they are highly valued in the Asian markets (Anon., 1994). The other species that make up a large proportion of the exports are the prickly redfish, *Thelenota ananas*; and elephant trunkfish, *Holothuria (Microthele) fuscopunctata*. Four other species make up around 3 to 13 per cent by weight of the exports and these are the blackfish, *Actinopyga miliaris*, surf redfish, *Actinopyga mauritiana*, brown sandfish, *Bohadschia marmorata/vitiensis*, and leopard (tiger) fish, *Bohadschia argus* (Table 1).

After processing, the product is stored in synthetic fibre bags (onion bags), until a sufficient volume is accumulated, and then shipped to Fiji on the next available cargo ship, usually once or twice a year. Prior to export, the shipments are inspected by the Principal Fisheries Officer, who verifies the grading, quality and quantity of each shipment, and issues the exporter with a certificate. This service is performed voluntarily by each party, and is done to ensure that seafood products from Tuvalu are of the highest quality possible, and therefore command and receive the

highest possible price in overseas markets. Despite a drop in production of 450 kg from 1994 to 1995, the monetary value of the exports rose by approximately US\$ 5,700. This is attributed to the higher prices received for the products in 1995.

References

- ANON. (1979; 1980; 1981; 1982). Fisheries Annual Report. Tuvalu Fisheries Department, Ministry of Natural Resources, Funafuti, Tuvalu.
- ANON. (1994). Sea cucumbers and beche-de-mer of the tropical Pacific: a handbook for fishers. Handbook no. 18 (Rev. ed.). South Pacific Commission, Noumea, New Caledonia.
- BELHADJALI, K. (1995). Tuvalu country statement: Tuvalu fisheries legislation and management. Country report 5. SPC/FFA Workshop on the Management of South Pacific Inshore Fisheries. Noumea, New Caledonia, 26 June – 7 July 1995. SPC, Noumea, New Caledonia.

Table 1: Tuvalu beche-de-mer production and species composition

Year	Total (kg)	Value (US\$)	Species composition (%) by weight				
			White teatfish	Black teatfish	Prickly redfish	Elephant trunkfish	Other
1993	871	12,461	52.1	10.6	19.0	13.6	4.6
1994	3,678	40,004	67.4	0.6	14.1	5.1	12.8
1995	3,228	45,737	71.7	0.0	19.5	5.9	2.8

Successful production of juvenile sandfish *Holothuria scabra* by ICLARM in the Solomon Islands

The International Centre for Living Aquatic Resource Management (ICLARM) Coastal Aquaculture Centre (CAC) in the Solomon Islands has a five-year project funded by the Australian Centre for International Agricultural Research (ACIAR) to develop methods for mass rearing of tropical sea cucumbers for the purpose of enhancing wild stocks (see *SPC Beche-de-mer Information Bulletin* no. 8, p. 45).

The project started spawning trials in August this year. A total of 107 *Holothuria scabra* and 69 *Actinopyga mauritiana* broodstock have been collected from the wild and transported to the CAC. We have successfully spawned both species by elevating sea water temperature by 3 to 5°C. Spawning was induced in 16

per cent of *H. scabra* and 33 per cent of *A. mauritiana*. We have reared two batches of *H. scabra* larvae and one of *A. mauritiana*.

We initially fed the larvae a mixture of three types of microalgae—*Chaetoceros muelleri (gracilis)*, *Chaetoceros calcitrans* and *Tetraselmis chunii*—up until settlement, and then a combination of fresh microalgae and a new commercially dried microalgal product, 'Algamac 2000'. In our first trial *H. scabra* larvae were reared in 750-litre fibreglass tanks at around 2 larvae/ml, with about 25 per cent of the larvae surviving to settlement. Water was exchanged by sieving out the larvae every second day until the appearance of doliolaria on Day 10. Then we started 200 per

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 sec-

ond 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

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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 par-

ties 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-