

Overview: Aspects of sea cucumber industry research and development in the South Pacific

by Andrew Morgan¹ and Jeff Archer¹

Sea cucumbers are members of the class Holothuroidea (phylum Echinodermata), and are related to sea stars, brittle stars, basket stars and sea urchins. This class is divided further into six orders: the Dendrochirotida, Dactylochirotida, Apodida, Molpadida, Elasipodida and Aspidochirotida. Of the 1200 holothurians that have been described, 49 species (belonging to 36 genera) are present in New Zealand waters (Pawson 1970).

The international beche-de-mer fishery produces approximately 80,000 tonnes of raw sea cucumber each year from sources in the South Pacific and Asia (Conand & Sloan, 1989) for processing into beche-de-mer. During the period 1983–1990, a dramatic increase in the demand for beche-de-mer, coupled with a decline in total landings of sea cucumbers, prompted research into the fishery of the commercial species (Preston, 1993). This redefined the geographical parameters of the beche-de-mer industry and diverted some interest from the traditional species (mainly tropical or ancient northern fisheries), to the exploration of new, previously non-utilised, tropical and temperate species, for example; *Stichopus californicus* and *S. parvimensis* on the Washington coast, and *Cucumaria frondosa* on the East coast of Canada (see reviews by: Mottet, 1976; Sloan, 1984 and 1986; Conand & Sloan, 1989; Bradbury & Conand, 1991; Bradshaw *et al.*, 1991; Conand & Byrne, 1993).

An extensive sea cucumber fishery off the Queensland coast and the Torres Strait region in Australia has a TAC (total allowable catch) of 500 tonnes annually. As one species is targeted and fished out, other species are sought, with the end result being the over exploitation of sea cucumbers. Presently, the main species being targeted is *Holothuria nobilis*, the black teatfish. Interest is growing in harvesting the white teatfish, *Actinopyga echinties*, as the black teatfish becomes fished out. *Holothuria scabra*, the sandfish, is also heavily over-fished. It is a common occurrence for indigenous people from Papua New Guinea (PNG) to poach sea cucumbers situated in Australian waters in the area of Warrior Reef, Torres Strait.

More recently, interest has focused on the fishery potential of the Southern Hemisphere temperate sea cucumber *Stichopus mollis*. The New Zealand sea cucumber *S. mollis* forms a visible, yet relatively unstudied component of sub-tidal north-eastern New Zealand. An aspidochirote holothurian, *S. mollis* is perhaps one of the best known of the New Zealand sea cucumbers. Common in shallow water, it can be found on the rocky shores and sandy mud bottoms of many coastlines around this country and parts of southern and western Australia and Tasmania (Pawson, 1970). Currently, a small fishery exists from Kaikoura to Fiordland with an annual quota of just 15 tonnes. Due to the lack of research on population distribution and abundance, and interest from industry, this fishery has not been developed from its present status.

Regardless of the prevalence of *Stichopus mollis*, information on this species is scarce. Past work on *S. mollis* has been concerned primarily with its taxonomy and distribution (Pawson, 1970), and only a few publications provide information on biology or ecology. Since Dawbin's (1948 a and b) accounts of the aspects of regeneration after auto-evisceration, the only other published report on the biology of this species other than Archer (1996) is the investigation of gonad development and the reproductive cycle by Sewell (1987).

At present there are gaps in the knowledge regarding aspidochirote holothurian ecology, and biology (see review by Bakus, 1973). With interest growing in holothurian fisheries biology and ecology, and the major aquaculture project in the Solomon Islands acting as an epicentre for holothurian research in the South Pacific, there is now a continuous flow of publications appearing in scientific journals and fisheries and aquaculture magazines. Little is known about the timing of spawning, larval development and juvenile ecology of these animals. This has led to problems in understanding the life history of these animals, for the management of natural populations in fishery and conservation terms. The lack of knowledge also forms a barrier to intensive hatchery-based activities.

1. E-mail: photoone@xtra.co.nz

Culture

Efforts to develop hatchery techniques for the mariculture of commercially valuable species (Houkou Production Team, 1976; James *et al.*, 1988; Arakawa, 1990; James *et al.* 1994; Ramofafia *et al.*, 1995; Ito, 1995), and the utilisation of species with a lower market value (Conand & Sloan, 1989) have increased over the past five to ten years.

Over the past several years a hatchery and grow-out project has been undertaken at ICLARM (International Centre for Living Aquatic Resource Management) in the Solomon Islands, with the aim of restocking or enhancing populations of commercially valuable holothurians. The program is in the first five year stage of a fifteen year project and has so far proven successful in obtaining large amounts of seed of the sea cucumber *Holothuria scabra* and production of moderate amounts of both the surf redfish and prickly redfish (Battaglene, pers. comm.).

Researchers in Japan at the Saga and Aichi Prefectural Sea Farming Centres (Ito, 1995) have been culturing the sea cucumber *Stichopus japonicus* for a number of years and currently produce millions of juveniles that are released back into the natural population each year.

However, problems exist in finding these animals again and a number of factors have been implicated in causing this. Researchers in India (James *et al.*, 1994) have been producing small amounts of the sea cucumber *Holothuria scabra* for a number of years and biologists continue to refine seed production and grow-out.

A number of problems still exist with the logistics of culturing holothurians, as evidenced by the aquaculture efforts of Pacific Island nations, in areas such as broodstock management, maturation and conditioning, spawning, larval rearing, settlement, grow-out, harvesting, and fattening.

Currently, there are two proposals being put forward by people involved in the sea cucumber fishery in Queensland, Australia, to set up sea cucumber farms and add value by processing the body wall, gut and gonad, targeting the species *Holothuria scabra*, which has so far proved to be the easiest of the possible commercial holothurians to culture.

Marketing and processing

Known as beche-de-mer (*iriko* in Japanese, *hai-som* in Chinese, or *trepang* in Indonesian), the sea cucumber forms large, valuable and traditional fish-

eries in numerous South Pacific and Asian countries. The term beche-de-mer is given to the processed form of the sea cucumber (Bruce, 1983; Robertson *et al.*, 1987; Parish, 1978) and is consumed in a variety of ways.

In Japan and Korea the gutted body wall of their sea cucumber is consumed raw or pickled, and a specialised range of products are produced from the gonad, respiratory trees and viscera (Mottet, 1976; Conand & Sloan, 1989). *Konowata*, the fermented or pickled guts or intestines and *Kuchiko*, the prepared and dried sea cucumber gonads are considered a delicacy. *Konowata* is used in Japan as a 'nibly' with social drinks and is sold in small glass jars (65 g) for around AU\$ 100. Intestines, which are currently wasted during processing, can account for 40 per cent of the wet weight of a sea cucumber. Both these products can fetch prices upwards of AU\$ 1000 a kilo.

The muscle bands of some species are used as clam substitutes in Asia and the United States (Mottet, 1976), and the body wall has been consumed in dry tablet form. Even an extract of boiled skin is drunk as a tonic in Malaysia (Subasinghe, 1992). Only certain species are valued for beche-de-mer production, and are primarily composed of the aspidochirote sea cucumbers.

Currently, Ocean Quenst Pty. Ltd. and Reef Organics Ltd., Australia, are developing a complementary medicine substance (food supplement) product that has anti-inflammatory properties. Therapeutic products have been identified through analytical and laboratory trials. Market trials, label design and a range of flavours are being developed from several reef species. Some concerns still exist about the development of pharmaceutical products and issues concerning toxicology.

In New Zealand techniques have been developed and refined, at a factory managed by Rex Scaper, for processing the body wall of *Stichopus mollis*. It is difficult to obtain export prices on this animal as it is 'lumped' in with sea urchin export prices, which together appear to reach approximately AU\$ 1 000 000 in export earnings annually.

The expansion of the sea cucumber fishery and development of value-added products would increase substantially the export value of *S. mollis*.

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