

The process of matching photographs is time consuming and tedious. If a computer programme existed, similar to a police fingerprint database, photos would be an efficient means of identifying holothurians. However, this study does prove photo-identification can be used as a means of re-identifying holothurians for growth measurements.

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Preliminary notes on the exploitation of holothurians in the new Wakatobi Marine National Park, Sulawesi, Indonesia

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Introduction

The remote Wakatobi or Tukang Besi islands are situated in the south-east of Sulawesi (Indonesia) in the area of greatest tropical marine biodiversity (Tomascik et al., 1997). They are inhabited by two separate ethnic and cultural groups: the Bajo, or sea-gypsies, who live almost exclusively by the exploitation of marine resources at a very low subsistence level; and the land-based islanders, who are mainly farmers and traders. There are also large numbers of vessels from other parts of Indonesia, and even other countries exploiting the area.

Fishery background

Holothurians are mainly exploited by the Bajo, but also collected by anyone, anywhere if seen in the

course of other activities, including by the crews of many vessels just passing through. The area has a long history of beche-de-mer exploitation, but there is no separate 'holothurian fishery' as such.

Holothurians form an important part of a multi-species invertebrate fishery (WWF, 1994), which is often also combined with fin-fish exploitation, as reported in other Indo-Pacific areas (Trinidad-Roa, 1987; Conand, 1997). The product is largely marketed through Chinese traders in Bau-Bau, the nearest town of any size, or to visiting Bugis or Chinese traders en-route to Surabaya.

As one of the few cash-earning commodities in what is still predominantly a barter economy, 'trepane' are more important to the local community than their actual value might suggest.

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Species and uses

The main species exploited are: *Holothuria scabra*, by far the most prized and expensive; *Thelenota ananas* and, to a lesser extent, *T. anax*; *Actinopyga echinites*, *A. lecanora*, *A. mauritiana* and *A. miliaris*; *Boadschia marmorata*; *Stichopus variegatus* and *S. Chloronotus*; *Holothuria nobilis* and *H. fuscopunctata*; *H. atra*, *H. edulis* and *H. leucospilota*.

The last three are a fairly recent addition, due to an increasing demand for low-value species (Richards et al., 1994). It was interesting to note that *H. leucospilota* seems to occur in two varieties: pure black, and black with white fringes to the tentacles and white tips to the podia and papillae. Are these in fact two varieties of one species or two species? The white-tipped ones are twice as valuable.

Holothurians are mostly collected for trade only, and are prepared along substantially similar lines to those described in Conand (1990), though sometimes there is room for improvement. The majority are prepared in the villages, by a few local traders. However, in the calm season, the catch is often cooked and dried on-site in remoter areas. Wood is initially taken along, then collected from as close as possible to the harvest site. The main source of fuel in both cases is mangrove wood—a potential environmental problem.

A few individuals may be eaten raw in times of hunger and low market prices, though never *H. scabra*, which is too valuable, or *H. atra*, used locally for 'obat' (which can mean 'medicine', either in the western sense, or as in 'medicine man', for warding off evil or as a charm).

Those most commonly eaten, and viewed as a 'hard times food', are small holothurians which are not dried or traded, and which I have failed so far to identify. The local name is 'buntulaha'. They are long and thin, about 1 to 1.5 cm diameter, tubular, diameter constant except for conical tips, both extremities looking very similar. Length varies from 7 to 15 cm, but diameter does not seem to vary with length (personal observation and local sources). They all live buried in the sand flats, and are abundant—if you know how to find them. Buntulaha are eaten raw: first the outer spicules are removed by scraping the tegument, like preparing a new carrot, then they are split longitudinally and the insides removed. The tegument is then cleaned in sea-water and cut into pieces. It has the taste and texture of oyster-flavoured chewing-gum!

Fishing methods and timing

Local exploitation occurs year-round on reef-flats close to the villages or sheltered from the prevail-

ing winds. The main collection seasons are October to December and April to May, when the winds are usually light, and trips can be made to the further reefs. There is some tradition as to which of the outlying areas are exploited by which village, though this is not always adhered to, and outsiders in any case do not comply with any such restrictions.

Collection methods include:

- reef-flat gleaning at low tide (mainly women and children), by local people
- collection by free-diving, using home-made goggles, by day or more usually by night (nulu), mainly from small canoes, predominantly by local people
- hookah, including that on boats mainly engaged in lobster or other fisheries; boats and often also crews are frequently from outside the area.

Fishing vessels:

- Most local boats are still dug-out canoes, with sail and paddle, though increasingly motorised with small long-shaft outboards called 'kat-intin', which can cope with the appalling fuel quality (fuel is often mixed with kerosene as well as dirt and water).
- The larger traditional sailing boats, the Sope and Lambo models, are often used to go further away, including to various illegal fishing activities in Northern Australia, and are increasingly motorised.
- There is also a growing fleet of pure motor boats, called 'Johnson', ranging from smallish open skiffs to larger vessels (7 m keel not uncommon) with a cabin, in which whole families can go to the offshore reefs for days or weeks at a time. Inboard diesel engines tend to be Chinese—relatively cheap but very noisy and polluting. As well as local crafts, large numbers of boats of many types (bait-fish, live-fish, chilled fish, lobster etc.) from many areas come and go, often using cyanide, bombs and hookah, for which they are the main culprits, though locals are also sometimes guilty of destructive practices.

Problems in the fishery

There has been a dramatic decline of most nearshore resources in recent years (Majors, 1996), including holothurians. Local collectors and merchants all agree that there are problems. It is get-

ting harder to find 'trepang', and those brought in are smaller.

Specimens I saw awaiting preparation, or already prepared, were much smaller than I would have expected from the literature on the species involved. Many would have been below minimum spawning size (where this is known), and below recommended legal minimums where these exist in other holothurian fisheries (Uthicke, 1996; Conand, 1997). My personal observation is that, even since my first visit to the area in 1995, it is harder to find holothurians.

Closure of the fishery without provision of other options would undoubtedly cause hardship, and in such a remote area would probably be unenforceable. Smuggling is part of the culture anyway!

Mariculture attempt

A small pen was tried here in 1996, but specimens either escaped or failed to grow. A Bajo visitor from an island just to the North said that in his village, juveniles are brought in by local fishermen, but instead of being killed immediately, are placed in a pen and have been successfully reared to adult size. This has reportedly been done with no special feeding, and with a mixture of species. Planks were sunk into the substrate to a depth of about 20 cm to prevent escape, and the pens were big. He said that it took 3 months to 1 year between capture and market readiness.

It seems that pens on sea-grass or on bare sand were equally successful, but that depth was important, as if they dry out or the water is too shallow, they stop feeding and also burrow, tending to escape more. Maybe the pen size is crucial, or the design, or the siting. . . further investigation seems necessary.

Conclusion

There is a general opinion locally that conservation measures are necessary, in particular that the juveniles need to be left to grow. One village has agreed to avoid harvesting juveniles as a community decision. Significantly, this is one of the better-off villages, with more alternative sources of income. With the support of the local communities, local and other NGOs involved in the area, the Marine Park, relevant authorities and local businesses, it should be possible to work out and implement suitable measures, as has been the case in similar situations elsewhere (e.g. McManus et al., 1988).

Because it is not a case of a few people solely dedicated to holothurian fisheries, for whom alternative livelihoods could perhaps be found, but rather

of most members of a community relying on the resource as a small but significant part of their survival kit, solutions are unlikely to be simple.

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