THE TONGAN GIANT CLAM (VASUVA) REVITALISATION PROJECT

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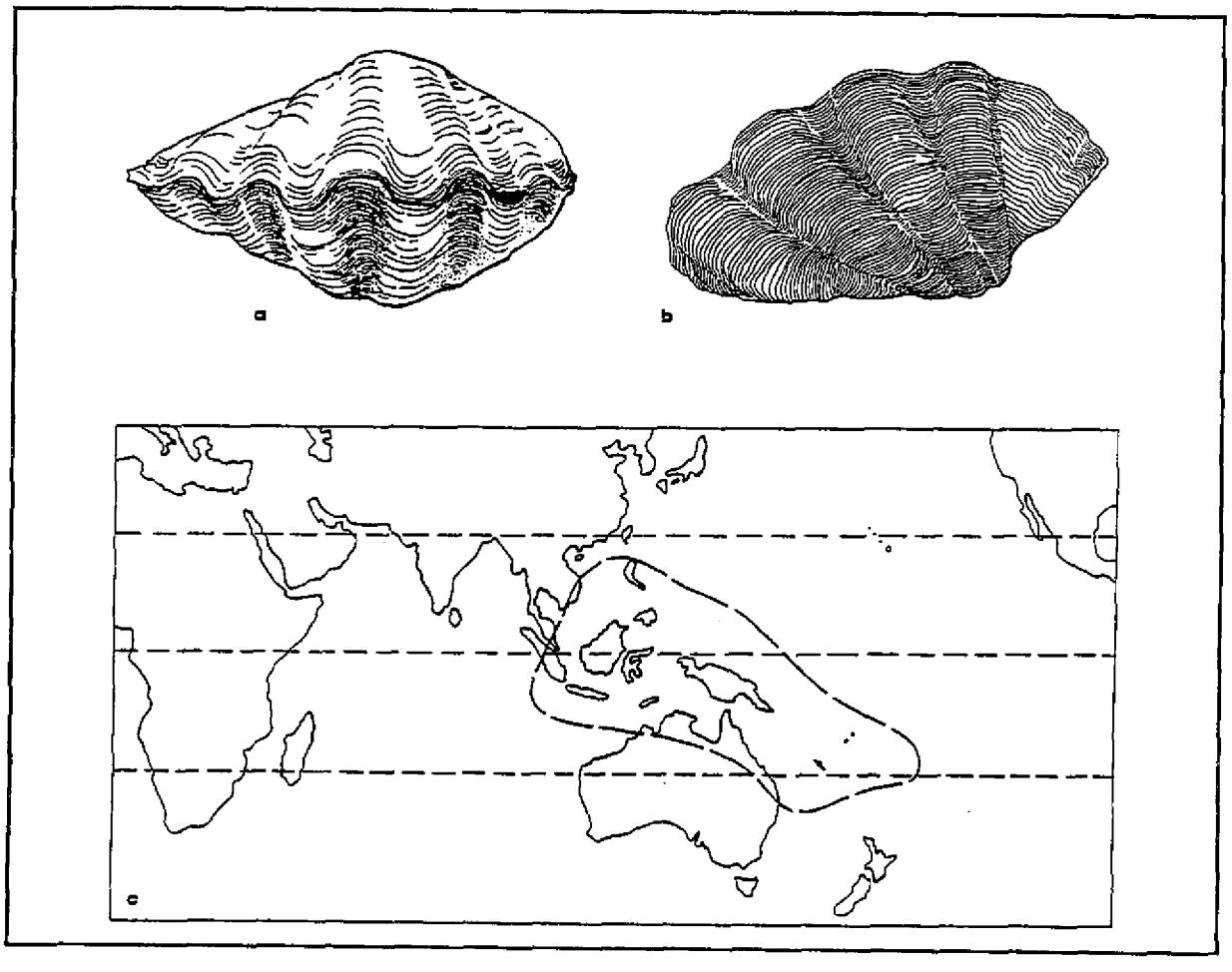
Introduction

During Environment Week in June 1986, the Kingdom of Tonga planted a brood stock of clams (*Tridacna derasa*), or **tokanoa**, on a reef in Nuku'alofa Harbour in an attempt to revitalise the stocks of these animals around the island of Tongatapu (Chesher 1986).

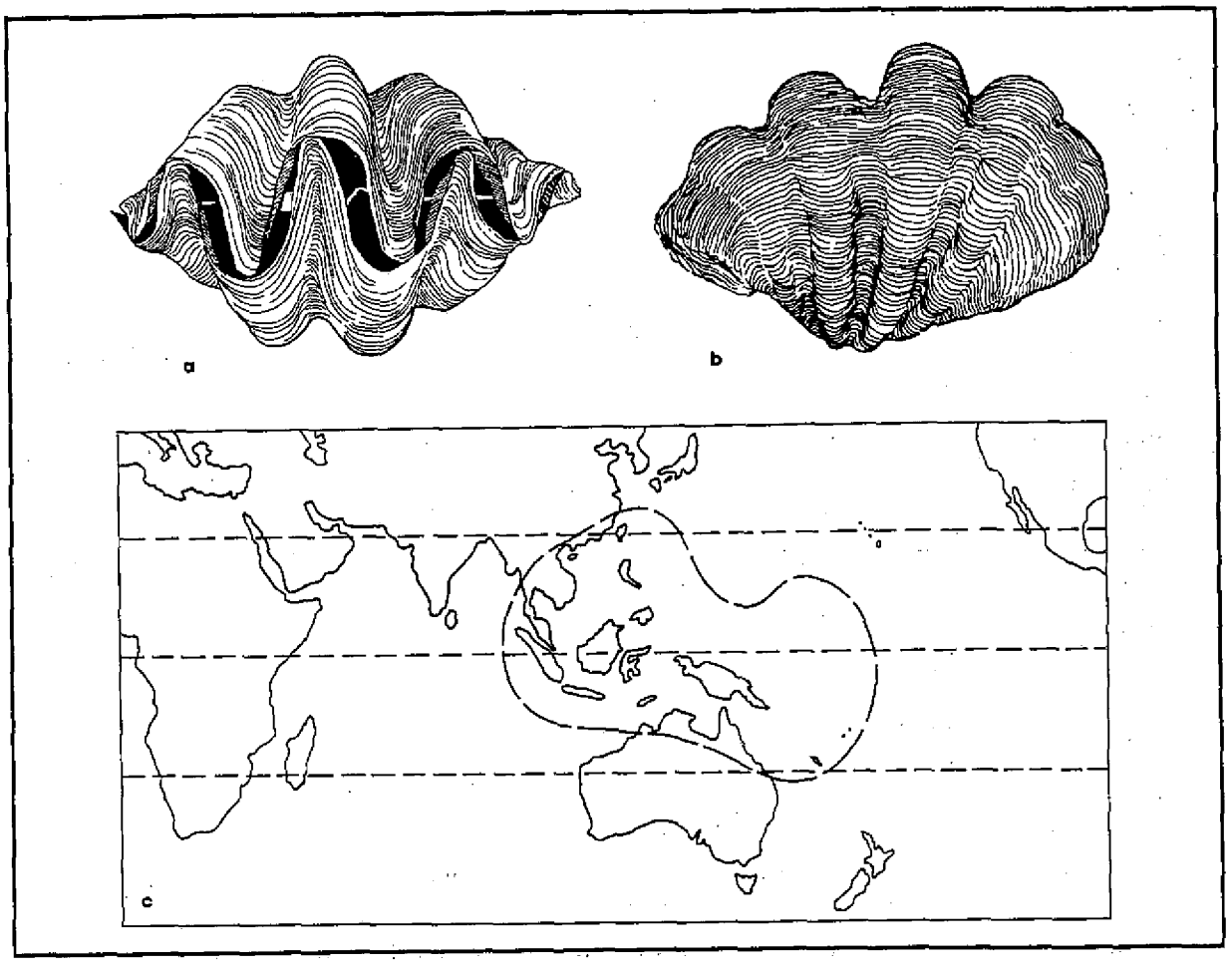
The Project, organised by the Ministry of the Lands, Survey and Natural Resources, with the co-operation of the Fisheries Division of the Ministry of Agriculture, Forestry and Fisheries and the Marine Research Foundation, was the first attempt in the Pacific to increase natural populations of giant clams (**vasuva**) by relocating natural stocks in micro-parks.



***Tridacna derasa*: a. Lateral view of shells. b. Upper view. c. Geographical distribution**

The relocation of natural stocks of giant clams into shallow protected embayments is not a new idea. Johannes (1982) reported that the people of Manus Island in Papua New Guinea collected giant clams and placed them in protected areas on the reef. These clams were left alone until long periods of bad weather prohibited normal fishing activities. Chesher (1980 and unpublished data) observed stocks of relocated and protected giant clams in the Shortlands Islands of the Solomon Islands, and near Tagula in Papua New Guinea. Reports of protected giant clams placed near villages have also come from Savai'i in Western Samoa.

Although a by-product of these cultural practices may have been a local increase in the natural population of giant clams, their purpose was to provide emergency food stocks and not, as in the modern example, a dedicated effort to revitalise the dwindling stocks of *T. derasa*. A second, and major, objective of the Tongan Vasuva Circle Project is to increase public environmental awareness and foster public education on the survival requirements of marine food organisms.



***Tridacna gigas*: a. Lateral view of shells. b. Upper view. c. Geographical distribution**

The larger species of giant clams have become extinct or seriously endangered in many Pacific Island areas through overfishing (Hesler and Jones, 1974; Bryan and McConnel, 1976; Pearson, 1977; Hirschberger, 1980). Although apparently abundant within the recent past, *T. gigas* has not been seen alive in New Caledonia or Fiji for the past two decades (Magnier, Adams, personal communications). McCoy (1980) found stocks of *T. derasa* dangerously low in Tonga and stressed the need for protective measures to avoid overfishing all the giant clam stocks. McCoy also recorded the apparent extinction of *Hippopus hippopus*

in Tonga. The International Union for the Conservation of Nature and Natural Resources (IUCN) has placed both *T. gigas* and *T. derasa* on the endangered species list. As a result of the concern over dwindling stocks of these important food animals, an extensive international research project has been underway for some time to increase knowledge of the biology of the giant clams and methods by which they may be cultured (Munro and Heslinga, 1983). Both *T. gigas* and *T. derasa* have been successfully mass cultured in running sea water systems in Palau (Heslinga *et al.*) and juvenile specimens have been shipped to Guam, Yap, Hawaii, Pohnpei, California, Fiji, the Philippines and Marshall Islands (Heslinga *et al.*, 1983, 1984; Lopez and Heslinga, 1985). However, questions have been raised about environmental problems which might follow transfers of giant clams from one ocean area to another (Munro *et al.*, 1985).

The culture of giant clams has been proven in one location as a research project. A trial commercial-scale hatchery has been started in the Solomon Islands and the researchers involved urge other interested countries to await the results of this facility before attempting further efforts (Pernetta, 1986).

Hatcheries and subsequent transplants of seedling stock to reefs or other countries have many technical, biological and economic hazards. Perron, Heslinga and Fagolimol (1985) report, for example, that an outplanting of seed clams from Palau onto a reef in Yap resulted in an infestation of the gastropod *Cymatium muricinum*. These small gastropods are predators of juvenile giant clams (they do not kill adults) and divers had to clear them from the seed clam trays by hand to prevent serious loss of the stocks. Other, still unknown diseases and predators may seriously hamper clam culture activities in the future. Since the giant clams mature to female size only after five to eight years, and since the new shipment guidelines (Munro *et al.*, 1985) call for the shipment of seedlings, not adults, any new hatchery where adults are not locally available would need to operate for quite a long time before actually producing any product.

In the meantime, while all this is being worked out, the natural stocks need to be protected and, if possible, augmented. The basic reason for the clams becoming rare or extinct needs to be examined and various features of the biology of the tridacnid clams must be researched. Above all, the public needs to be made aware of the need to use marine resources wisely. The Vasuva Circle Project provides a basis for these needs by promoting the creation of protected groups of clams. The clams are collected from wild stocks and then arranged in circles, in areas near villages where they can be cared for and monitored.

Giant clam circles to protect and augment natural stocks

Will giant clam circles protect and augment natural stocks of these animals? The concept is supported by considerable biological evidence:

— Giant clams are males when they are first sexually mature and later become functional hermaphrodites (Wada, 1954). Spawning is induced in nature by the presence of chemicals associated with the eggs. Normally the spawning cycle involves the release of sperm and subsequent release of eggs. 'This results in a chain spawning reaction over a reef but renders the species liable to the non-fertilisation of eggs in depleted population' (Munro and Heslinga, 1982).

— The larger the clam, the more eggs are produced. The increase of eggs is a logarithmic relationship:

$$F = 0.00743L^{4.03}$$

(for *T.maxima* [Jameson, 1976]), which means the larger adults are the main egg producers and are important to the level of population fecundity.

— The larval lifespan is short, from 7 to 10 days depending on conditions (Gwyther and Munro, 1981: Beckvard, 1981) and the juveniles apparently settle out near the adults (Yamaguchi, 1977: Chesher, unpublished data).

— In areas where giant clams are kept in protected embayments for emergency food supplies there is an abundance of clams of all sizes in the same bays and in nearby fringing reef environments (Chesher, unpublished data).

Placement of the clams into circles has several justifications:

— The orderly placement of the clams assures they will not be mistaken for a natural population, but are clearly placed there by someone. Mistaking a clam circle for a natural population is not likely if the circle is put near a village and is done as part of an environmental awareness project. But its symmetry should help identify it as separate from natural stocks to anyone who is not familiar with the project.

— The spacing of the clams is impotant to maximise spawning potential. Braley (1984) has presented evidence that maximum spawning activity can be inhibited by clams which are too far away or too close together. The circle makes the spacing regular and places the clams in a position to ensure that nearby clams detect any spawning activity regardless of the direction of the water currents at the spawning time.

— A broken circle will be obvious at once and the dead or missing clam can be replaced.

— Each member of the circle can be identified by its position and this will assist in growth studies as well as spawning and mortality studies.

To find out if the hypothesis is correct, the Marine Research Foundation and the Center for Field Research have begun studies into the giant clams of Tonga. During the next three years, they will work in association with the Governement of Tonga to:

— Inspect, tag and measure the clams planted in June 1986 and repair the circle as needed;

— Search for juveniles in the vicinity of the clam circle and down-current;

— Conduct hydrographic and bathymetric studies of the embayments of Vava'u to determine the most favorable locations for **vasuva** circles;

— Encourage and assist in the installation of clam circles in the most favourable locations in Vava'u;

— Investigate the existing natural stocks of all species of giant clams in the vicinity of Vava'u and other island groups if time and weather permits;

— Conduct transplanting experiments to determine the best methods of moving the clams from their original habitats to the experimental sites;

— Tag the experimental and selected natural populations for growth and mortality studies;

— Investigate the predators and diseases of the giant clams in Tonga and identify potential hazards for large settlements of clams or for grow-out sites from any future culture activity;

— Study spawning activities in the clam circles to determine optimum spacing of the brood stock and subsequent egg and larval dispersal in the embayments;

— Resurvey the areas in Vava'u and Tongatapu over a period of two or three successive years to determine changes to the clam populations. As a part of this activity, base-line information on subsistence and commercial harvesting of the clam species in question will be gathered.

How to make a giant clam circle

Location

The location of the giant clam circle is perhaps the most important aspects of its future success. Ideally, the circle location should be:

— In clear, unpolluted seawater, with no rivers or swamps close by;

— In a protected lagoon or bay where the clams will not be subjected to strong wave action;

— Where someone can keep an eye on the clam circle (near a village or someone's home);

— There should be live coral near the circle, but the circle should be made on a flat or gently sloping bottom area which is either coarse sand, coral rock or rubble, or a thin layer of medium to coarse sand over a hard bottom. Very fine sand or mud and thick, loose sand are not good for the clams;

— The clam circle should not be too shallow or too deep: 3 - 6 m is about right;

— The larval clams swim for 7-10 days, so there should not be very strong currents in the area or, if there are, there should be an extensive area of reefs and shoals down-current for the young clams to settle on.

Spacing

It is very important that all the clams be of the same species and not placed too close together. When clams are placed right next to each other they create a new microhabitat in which diseases and predators become a problem. Observations on natural populations of giant clams indicates they will do best if they are placed about 2 m apart.

The clams should be arranged neatly in two circles, one inside the other, with 66 clams in the outer circle, 33 in the inner circle, and one very large one in the centre.

The outer circle will have a radius of about 26 m (52 m in diameter). The inner circle will have a radius of 13 m (26 m in diameter). After the general area for the clam circle has been found, locate an area about 50 m in diameter, with the type of bottom specified earlier. There can be live coral heads in the area, but not too many, and there should be open bottom as well. Put a weight at one end of a polypropylene (floating) rope at least 30 m long. Drop the weight in the center of the proposed circle and tie a float onto the line at the surface. The float should be about the size of a 4 l bottle. The bottom weight should be an anchor or something which will not move easily. It could be tied to a piece of coral.

Tie a knot 13 m from the float and another knot at 26 m from the float (or the end of the line).

A swimmer then holds the knot or the end of the line to use line as a guide to swim in a circle with the anchored end at the centre. While one swimmer holds the line and thus marks the circle, two or more divers and a small supply boat move with the swimmer and place the clams one by one along the path described by the line. If the clams are not be put down all at once, the circle can be marked with stones along the bottom, with one stone placed at the

place where a clam will later be put. Each clam should be 2 m from the last one. They should be placed so they are all spaced evenly and neatly.

After the outer circle is put down, the diver holds the knot at 13 m from the float and swims the inner circle, while the other divers follow with the rest of the clams.

Transplanting techniques

The biggest clams are the best, as they produce the most eggs. Collect the clams without harming them. Although they are heavy and their shells are strong, they are soft inside and if they are thrown about they can be hurt and die. Move them slowly and carefully. Do not break the shells.

The clams should be kept moist and in the shade when in the boat. It would be best if they were moved only once, from the collection area to the protected circles. They should be kept out of the water for only a short period of time. If the clams are to be collected in an area far from the placement site, they can be moved to a temporary storage area until ready for the move to the circle area. The storage area should be in about the same depth as the final circle area and the clams should be treated gently and placed correctly in an upright position in the storage area and not just heaped together.

In many cases the most practical idea is to select the circle area and then collect the clams and place them in the circle over a period of weeks, moving new clams into position as fishermen happen to find them and bring them in.

The clams should be carefully lifted from the boat and handed to the divers one at a time and then the divers should carry them to the bottom and place them under the diver on the surface. The surface diver, holding the line, keeps the line pulled gently tight to keep it in position. Once the first clam is placed, the next should be 2.25 m from the centre of the last one. A weighted stick can be used to make the distance exact.

If the clams are too big for a diver to swim with, they should be lowered from the boat on a line. Don't just drop them to the bottom or throw them from the boat as this may damage or kill them.

Care of the circles

If the clams are damaged during collection they will die in the first few weeks. Those that show signs of dying (the shells open and the animal does not move when poked, or white decay is evident on the meat) should be removed from the circle and new clams put in place after a few days. Put the replacement in a slightly different location from the place where the first clam died.

If the clams survive the transplanting they can be expected to live for many years, perhaps more than 30 or 40 years, and thus provide a real contribution to the local clam population. Each big clam provides more eggs than thousands of small clams, so the bigger the clam, the older it gets, the more valuable it is to the production of young.

At least once a year the clam circle should be carefully inspected and any dead or missing clams replaced. People should also remove the large white murex shells (with the pink inside) from the area of the circle as these can eat the clams. If anyone sees some shell or fish eating the clams (even small shells may crawl inside and eat clams), this should be reported and the shells removed from the area of the clams.

The people of one village in Savai'i, Western Samoa, have reportedly kept clams for many generations. The clams have each been given names and the children of the village are sent out to brush the shells clean of growth and to be sure the clams are all right. This may actually be of service to the clams as sponges and other organisms can damage the shell over a long period of time.

It is important for everyone in the community to understand that the clam circle is something which will benefit all the people and that it will provide young clams for many years if it is cared for. If someone kills the clams or takes them from the circle everyone, including the offender, will be poorer in the future.

For this reason, making giant clam circles is a good project for environmental awareness week. It is a time when people can help improve and protect the natural world which in turn provides the food and beauty for everyone. The circles do not have to be built in one day, but they could be started - or finished (or inspected and cared for) during environment week.

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