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Trochus niloticus propagation project in Kosrae, Federated States of Micronesia

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The topshell, *Trochus niloticus* L, is one of the commercially important gastropods in the tropical regions. Its natural range is limited to a region from Ryukyu, through the Philippines, Indonesia, to Fiji, Vanuatu and northern Australia. However, its geographical range has been greatly enlarged by artificial distributions:

Five hundred topshell were introduced successfully from Pohnpei to Kosrae in 1959. Since then, the topshell population has propagated and become a common element of the reefs of Kosrae.

As the commercial value of *T. niloticus* has increased recently, it has become a significant source of supplementary income for the people of Kosrae. This trend is also apparent in the other states of FSM and other Pacific countries.

The resulting increased fishing pressure on the natural population of the topshell has caused numbers to decline (Heslinga & Hilmann, 1981).

Conservation and population management and/ or release of artificially raised seeds appear to be efficient methods of preserving the topshell resources and enabling them to recover.

The *T. niloticus* propagation project, which is jointly administered by the Kosrae State Marine Resources Division (KMRD) and the FSM National Aquaculture Center (NAC), started in March 1992.

The final goal of this project is to allow recruitment and to releasing artificially produced seed to augment the natural increase. The project has three phases as follows:

1. Development of seed production techniques;

2. Development of re-seeding techniques;

3. Seed production, re-seeding and conservation.

During 1992–1994, the project dedicated its attention to the development of seed production techniques suited to Kosrae's economy, environment, culture and customs. Cost-efficient methods were developed to allow the project to function in the present economic situation.

1. Efficient spawning induction in Kosrae

Static-water stimulus was used for all spawning inductions of *T. niloticus*. The animals were kept in a small tank of static sea water filtered through one-micron mesh with strong aeration, for approximately 24 hours. After this spawning stimulus, all the animals were placed in the spawning tank with continuous filtered sea-water flow.

Nineteen spawning experiments were performed, and 66–90 percent of the broodstock were induced to spawn by this method. In Japan, ultraviolet (UV) is used to induce spawning of this species. However, this method is very expensive (Isa, 1991). Additionally, induced rates were almost identical to our result. In Fiji, warm-water stimulus is applied to broodstock. The sea water is warmed by direct heat via sunlight. However, this method is not suitable for Kosrae due to its frequent rainfall. The static-water stimulus is easier, cheaper and the most efficient method of inducing *T. niloticus* to spawn in Kosrae.

2. Hatchery and nursery operations

2.1 Fertilisation and hatchery operation

Each individual was sexed while gametes were being released. Males and females were placed in separate filtered sea-water tanks for collection of gametes. Artificial fertilisation was performed immediately after the eggs had been collected.

The fertilised eggs were placed in 40–50 litre hatchery tanks and reared in 1 micron filtered sea-water.

The stocking rate was 10–15 eggs / ml. Aeration was not used at the hatchery stage, because the water currents it created tended to lump eggs and resulted in the presence of bacteria.

Healthy trochophore larvae hatched and approximately 12 hours after fertilisation swam up near the water surface.

2.2 Nursery operation

Larvae were collected with a siphon at the veliger stage and placed in nursery tanks containing sea water filtered through a one-micron mesh. It would have been inappropriate to collect them at the earlier (trochophore) stage as trochophore larvae have not yet developed a complete larval shell and are therefore extremely fragile.

A stocking rate of 4–8 larvae / ml was used. The water was gently aerated to create an appropriate current. Water was changed at least once a day. The larvae were collected on 51 micron mesh screen during operations. A 70–81 micron mesh screen was also available for pediveliger (two-day-old) larvae.

Larvae were reared in the nursery until they reached the pediveliger stage, when they were transferred to the juvenile rearing tanks.

3. Juvenile rearing techniques

3.1 Algal cultivation

Algal cultivation started one month before the pediveliger larvae were transferred to the juvenile rearing tanks (800–1,000 l). The tanks were cleaned with sea water filtered through one-micron mesh. Plastic panels (40 x 30 cm) were set into the tanks at this time to increase the surface area available for the algae to grow.

Sea water filtered through 10 micron mesh flowed continuously through these tanks. The tanks were covered with 85 percent shade-cloth to promote growth of diatoms.

3.2 Rearing and growth of juveniles

The pediveliger larvae were transferred into the juvenile rearing tanks after algae had grown on the walls and plastic panels. The larvae settled onto this substrate 1–3 days after transfer. The result of survival experiments suggests that the optimum density is 0.2 pediveliger larvae / per cm^2 (e.g. 35,000 pediveliger larvae in a 1,000 l rearing tank with 44 sheets of plastic panels).

High density created high mortality due to lack of algal food.

Juveniles over 5 mm in shell diameter were transferred to the 5,000 l splasher pools, and reared with giant clams. Juveniles over 10 mm in shell diameter were reared in the 10,000 l concrete raceway tanks with giant clams.

The growth of juveniles during the first eight months is shown in the figure on page 13. Although, the growth rate of juveniles in the rearing tank on Kosrae was lower than the result in Palau (Heslinga 1981), it is similar to those of other tropical Pacific regions (Bour 1990; Isa 1991; Nash 1985).

The number and size of *T. niloticus* cultured in 1992–1994 are shown in the table on page 13.

The *T. niloticus* which were spawned at NAC from March to May 1992 grew to approximately 70 mm in shell diameter in two years. They also achieved maturity; gamete release was observed in March 1994.

4. Goal and objectives for next phases

The seed production technique (Phase 1) has been established. Two objectives remain for the completion of this project.

4.1 Development of reseeding techniques (Phase 2)

T. niloticus is very expensive to culture through to maturation in an 'on-land' aquaculture system. Reseeding the smaller juveniles would reduce the rearing cost. It would also allow a larger number of juveniles to be released and increase yearly seed production.

However, reduced survival rates would occur due to predations on small juveniles. To determine the correct propagation methods, it is very important to establish the cost balance between rearing juveniles in land-based systems and survival in the natural habitat.

Size and number of *Trochus niloticus* produced (1992 – Feb. 1994)

Size (mm)	Number	Age
1–5	23,000	< 4 months
5–20	6,000	< 8 months
20–40	5,500	< 1 year
40–70	105	< 2 years

Field observations and basic biological studies must be completed to obtain the required information. It is essential to have information on the predators, feeding habitat, movement and growth of the natural juveniles before starting re-seeding programmes in Kosrae.

4.2 Seed production, reseeding and conservation (Phase 3)

Seed production and re-seeding should be continued to enhance and preserve the topshell resources in Kosrae. The techniques developed in phases one and two of the project will be useful for seed production and re-seeding.

The ultimate aim of this project is to enhance the topshell fishery for all Kosraeans. Impartially, not just those people who own fishing apparatus (for example diving gears or vessels). To conserve the topshell resources and equalise income among the people of Kosrae, regulations governing topshell, including limits on the number and size of trochus to be harvested, location, and harvesting methods should be considered.

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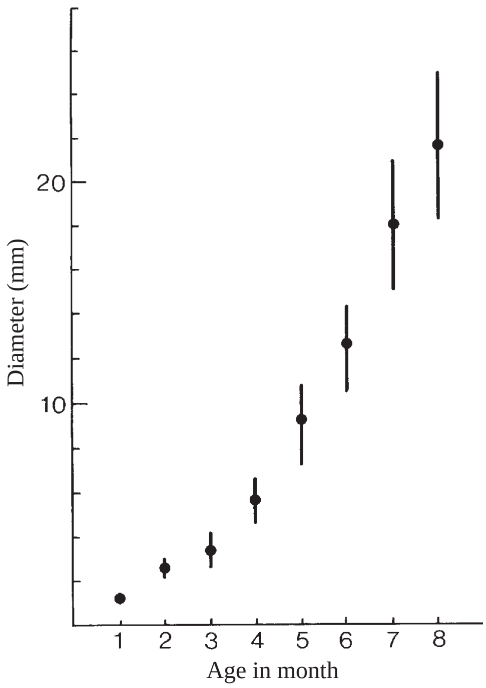

Growth of *Trochus niloticus* juveniles in the rearing tanks at NAC, Kosrae. (Vertical bars indicate standard deviation)

Transplantation of trochus shell, *Trochus niloticus*, to the Kingdom of Tonga

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Introduction

Transplantation of trochus is one of the schemes planned under the Aquaculture Research and Development Project started in October 1991. The aim of the scheme is to establish trochus resources in the unused space (niche) of the inshore reef zone and thus to earn foreign exchange in the future for Tonga.

Preparation for the transplantation began with a preliminary site selection survey (Sone, 1992), which was followed by an intensive release site survey (Kikutani et al., 1993).

Fiji was identified as the most suitable trochus source country because of the frequent flight schedule and the abundant resource. During the enquiry period, we learnt that an FAO–UNDP-funded