Abstract

Creation of a stock of trochus (*Trochus niloticus*) on the reefs of Lifou, where the species does not currently occur, was attempted by means of seeding with pond-bred trochus spat. A total of 5,709 juveniles, measuring 19 mm and 14 months old on average at the time of the introduction, were released in 20 different sites so as to create a breeding stock. Five years later, exploration of the reefs at low tide, both through dives and on foot, and enquiries with local residents resulted in the recapture of only a single specimen.

Background

IFREMER (French Institute of Research for Ocean Development) and ORSTOM (French Institute of Scientific Research for Cooperative Development), with funding support from CORDET (Coordination of Research in French Overseas Departments and Territories), carried out trochus (*Trochus niloticus*) production trials with the goal of seeding exploited reefs or areas where the species did not normally exist (Bour & Guelorget, 1986). During the breeding season, which occurs during the hot season (Bour, 1988) from October to May, spawners were collected and put into breeding ponds where spawning occurred on a regular basis. Several attempts were necessary to ensure production of juveniles, given the very high level of mortality in the larval stages to first settlement stages. Despite these difficulties, 5,709 specimens were pre-grown to an average size of 19 mm (range: 14–25 mm).

At the request of the Loyalty Islands Region (which has become the Loyalty Islands Province since the Matignon Accords), introduction was carried out in March 1989 on the island of Lifou where trochus have never existed (Hoffschir et al., 1989a). The juveniles, packed in aerated water, were placed in refrigerated coolers for the trip from the rearing ponds to Lifou. Twenty introduction sites were selected (see Figure 1 on next page), using criteria which were favourable to growth and which would also allow subsequent monitoring of the juveniles’ establishment (Hoffschir et al., 1989b).

Six subsequent visits allowed monitoring of changes in the numbers of specimens and their sizes. A strong cyclone which occurred some two weeks after initial introduction hindered this work by scattering the juveniles.

Growth rate and numbers of surviving specimens

From 26 to 30 March 1990 (Hoffschir et al., 1990), i.e. one year after transplantation, 19 trochus averaging 64 mm (range: 49–74 mm) in size were found. During this year in a natural environment, the growth increment was 45 mm, which is considerable in comparison to the growth increment of 33 mm obtained in rearing ponds (Fig. 2), i.e. a relative growth factor of 2.3 as compared to 1.7.

Abundance indexes fell drastically during this period, with a 20 per cent recapture rate after 2 weeks, 10 per cent after 2 months and 8.4 per cent after 3 months.

Sexual maturity and reproduction

The average size of trochus at sexual maturity in New Caledonia is 54 mm. Reproduction is 100
per cent effective for specimens at least 57 mm in length (Bour, 1988). Thus, of the 19 trochus found, 16 probably were adults. It is possible then that these trochus, transplanted into a natural setting, spawned at the beginning of 1990, i.e. approximately 12 months after the transplantation and 23 months after their birth.

Assessment of the introduction

At the request of the Loyalty Islands Province, a visit to observe trochus stocks was made by UFP and ORSTOM from 26 July to 4 August 1994, i.e. a little more than five years after transplantation.

Sampling methods

Dives were made at the 20 introduction sites. Sampling in 100 m transects along 2 m corridors was planned, but this method had to be abandoned as no trochus were found on the reefs.

The goal of the mission was then changed. It was no longer a question of knowing how many trochus there were in Lifou, but rather if any trochus at all had survived from the introduced population.

Research was then carried out by 30-minute dives by two divers around the 20 introduction sites (Fig. 1). These dives were supplemented by two dives outside the sites (one hour on the Djoj Reef at Cap des Pins between Sites 6 and 7 and 30 minutes at the Dozip Reef in front of the Lifou Plaisance Hotel), as well as two hours of on-foot prospecting of the reefs at low tide (one hour near the port and one hour in front of the headquarters of the Loyalty Islands Province).

Results

1. In all the introduction sites and in spite of the fact that a large surface area was covered, only a single trochus of 126 mm was captured in a

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**Figure 1**

Map of Lifou showing the 4 zones where trochus were transplanted
2 m dive about 30 m from Site 7 (Fig. 1). This specimen was marked with pencil on the inside of its shell so that the mark would be covered by a fine layer of nacre during growth. It was marked with the number 1 as well as the date of its recapture and then released at the site.

2. No trochus were found on the Djoj Reef. A sole specimen may have been caught in 1993 but its shell was broken open in order to get at the meat.

3. No trochus were found at the Dozip Reef. Two specimens may have been caught by tourists in February 1994. A single shell 130 mm in size was kept by the hotel owner.

**Conclusion**

A total of 27 hours of prospecting was carried out. This resulted in the recapture of only a single live trochus. Based on the abundance indexes in the first few months after introduction, which it might be recalled, fell drastically: i.e. 20 per cent recapture after 2 weeks, 10 per cent after 2 months and 8.4 per cent after three months, these disappointing results fit in well with the hypothesis that the introduced stock did not reproduce.

In fact, the virtual weekly mortality rates calculated with the recapture rates are for the following periods:

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**Figure 2**
Comparative growth curves of *Trochus niloticus*
1st period 0.302 i.e. annual rate of 15.71
(after 2 weeks)

2nd period 0.056 i.e. annual rate of 2.91
(after 2 months)

3rd period 0.015 i.e. annual rate of 0.78
(after 3 months)

Overall average: 0.076

If a reasonable mortality rate of 0.50 per cent was applied to the entire surviving population after the third period, models show that there should have been about 30 specimens of the introduced population left after five years. It is not surprising then, that only a single specimen was found and this demonstrates that the population evolved normally but did not reproduce.

Two theories can be considered to account for this lack of reproduction: oligospermy in the population due to the low number of specimens reaching sexual maturity, or dispersal of larvae into the deep ocean due to the absence of a lagoon.

Oligospermy theory

Oligospermy is over-dilution of the sperm, which prevents fertilisation. This occurs when the distances between males and females are too great.

This theory emphasises the possible causes of mortality:

(a) The strong cyclone Lili which occurred two weeks after transplantation of the juveniles may have destroyed a significant number of the introduced specimens;
(b) Intensive fishing of most of the juveniles and breeding animals for food may have destroyed potential stock. It does in fact seem that fishing began as early as 1990;
(c) The size of the juveniles at the time of transplantation (average 19 mm) was not large enough to allow survival on a reef where there may be heavy predation.

These theoretical causes of mortality were most likely cumulative. In fact, one year after transplantation, about 20 trochus, with an average size of 64 mm, were recaptured, so a small number had, in fact, escaped destruction by the cyclone and heavy natural predation. Only a few specimens would have survived but numbers were too limited for reproduction to take place.

Larvae scattering theory

Fertilisation may have taken place, but the pelagic larvae were scattered into the deep ocean by the currents. The absence of a barrier reef would have kept the larvae from settling on the fringing reef.

This theory seems most likely, because if it is not true, it is hard to understand why trochus do not exist naturally on the Loyalty Islands.

It is obviously pointless to release juveniles in an area where normally they do not develop or where they develop very poorly. As the juveniles were obtained at a great cost, as the most difficult stages, i.e. the periods of heavy mortality, had passed, from an economic point of view it would be better to keep those juveniles in a protected environment rather than release them into a known hostile environment.

In the case in question, the best way to proceed would be to hope that the first theory was the cause of failure and repeat the experiment by introducing sexually-mature adult specimens from the main island to various sites. This group of breeding animals would have to be kept in a closed area and protected until it was sure that they had spawned.

If, after this, it was proven that the trochus did not reproduce, or more generally, that the development stages could not be carried out on Lifou, it would be reasonable to halt the introductions.

References


