

Studies on juvenile *Trochus niloticus* (L.) with a view to using reared juveniles to repopulate reef areas

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Natural stocks of *Trochus niloticus* have been seriously depleted in most countries where *Trochus* has been commercially harvested (Heslinga, 1981; Heslinga and Hillmann, 1981; Nash, 1985; Isa, 1991). Strict fishing regulations have been implemented to allow natural stocks to recover. As well as imposition of a size limit, restricted fishing seasons and the creation of sanctuary areas, management strategies have included translocation of adults.

More recently, effort has been directed to the use of reared juveniles. Because of the relative simplicity of rearing techniques, thousands of individuals can be produced. Survival rates in reseeded experiments have been generally low and have shown great variability among localities (Nash, 1985; Hoffschir, 1990; Amos, 1991; Isa, 1991). This implies a need for further research to understand the process that occur when hatchery-reared juveniles are liberated on a reef.

The overall objectives of my study are to investigate further the possibility of reseeded areas with reared juveniles and to develop a better understanding of the ecological processes involved with juveniles in natural habitats. I will examine the following:

—Comparison of rearing techniques. Rearing in tanks, in hanging baskets and in baskets fixed in the intertidal zone will be compared on the basis of juvenile growth, mortality, survival rates and behaviour;

—Aspects of larval development:

1. Effects of temperature;
2. Importance of parental energy reserves and potential to use external source of nutrients to complete development;

—Laboratory studies of predation on reared juveniles;

—Experimental reseeded with reared juveniles of various sizes under a variety of conditions;

—Ecology of juveniles in natural populations.

Literature cited

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Study of the Aitutaki trochus fishery

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Background

Exports of trochus shell from Pacific Island countries were worth an estimated US\$ 26 million in 1989. Most of this revenue is returned directly to rural communities where the harvesting takes place. *Trochus* fisheries make an important contribution to rural economies in many countries, thereby

helping to mitigate against urban drift and other undesirable effects of centralised economic development. Pacific Island governments recognise the importance of trochus and other marine invertebrate fisheries in maintaining economic and social stability in rural areas, and are keen to ensure that these resources are managed wisely and sustainably.

Aitutaki trochus fishery

Trochus is one of the most valuable marine resources presently exploited in the Cook Islands, mainly on the island of Aitutaki. The most recent harvest of trochus at Aitutaki, in late 1990, was 35 tonnes, which sold for a total of about NZ\$245,000. This income makes an extremely valuable contribution to the islands economy.

Trochus is not native to Aitutaki: 300 mature adults were introduced in 1957 and the present-day fishery has developed from this initial breeding stock. Following the establishment of the Aitutaki population, the Cook Islands Ministry of Marine Resources (MMR) has attempted to introduce trochus to other islands in the Cooks, and these efforts are continuing.

The growth of the Aitutaki population following introduction has been subject to research by MMR and there exists a body of historical data on the population. Since the commencement of exploitation, good records have been kept of harvests and exports. In addition, there exist several SPOT satellite images of the Aitutaki reef, taken before and after periods of extreme environmental damage (cyclone), and at times that coincided with field trochus research.

The Aitutaki trochus fishery is now tightly managed by the island council, following advice from MMR based on the research carried out so far. Harvests presently take place over a period of only one or two days, with each animal being landed live for size verification before shucking. Large numbers of people participate in the harvest, which means that exploitation occurs very intensively and the instantaneous effects of fishing can be assessed. A system of individual transferable quotas permits every individual on the island to participate in the harvest, or to trade his quota.

The unique situation of the Aitutaki fishery presents opportunities for research that could provide answers to several key questions relating to trochus abundance estimation, a critical element in the development of any management plan. Through a well-designed study, timed to take place around the period of the harvest, field survey methods could be calibrated against actual takes, depletion experiments to estimate absolute abundance could be carried out in conjunction with actual fishing, and the subsequent population response to intensive harvesting, in terms of growth and recruitment, could be monitored. In addition, the correlation of intensive field survey data with the existing body of historical information would allow an exceptional

understanding of the evolution of the population and its response to disturbance.

Workshop on Trochus Resource Assessment, Development and Management

The Twenty-second South Pacific Commission (SPC) Regional Technical Meeting on Fisheries, held in August 1991, discussed biological, economic and social issues relating to the development and management of trochus resources in the region. The topic was originally raised by the Cook Islands delegation. The session concluded with a recommendation that SPC organise a Workshop on Trochus Resource Assessment, Development and Management. The workshop was conducted in Port Vila, Vanuatu in May 1991 (see separate article this issue) and made four recommendations to SPC for further action in helping Pacific Island countries develop appropriate management plans tailored to local conditions. One recommendation was that the Commission encourage the detailed study of the Aitutaki fishery as a case study, in order to provide management-related information that will be applicable to the developing fisheries in other atolls of the region.

This recommendation was made because of the unique nature of the Aitutaki fishery. The workshop recognised the value of this research opportunity in providing trochus fishery management information to countries of the region. The data from a study carried out at Aitutaki would be of direct relevance to all areas where trochus populations exist, especially atolls and other environmentally similar areas. In all cases, data gathered could be used as a basis for predicting trochus population response to harvesting, and mitigating against overfishing.

All four recommendations were endorsed by the Twenty-third SPC Regional Technical Meeting on Fisheries (August 1991), and subsequently by the thirtieth South Pacific Conference (October 1991), thus mandating the Commission to commence their implementation. Action is being taken in regard to each recommendation.

Implementation

Following the formalisation of the workshop recommendation, MMR and SPC have jointly developed an approach to enable the study to be carried out on behalf of countries of the region. The project is considered a regional activity by both the two major implementing organisations. Funding support is being provided by the Australian Centre for International Agricultural research, by the British Government through the UK-sponsored SPC

Inshore Fisheries Research Project, and by the South Pacific Regional Aquaculture Development Programme.

The survey will be carried out by an eight-member field survey team, comprising six scientists from Pacific Island countries (preferably selected from trochus workshop participants), including at least two from the Cook Islands, one scientist from SPC, and one Australian scientist. The team will spend three weeks undertaking field work on the island at the time of the next harvest, with a further week being allocated to data analysis and reporting before the team disperses. The timing of the harvest is at the discretion of the Island Council and has been set for 17 August 1992.

The team will undertake: transect surveys to estimate relative trochus abundance; depletion experiments in conjunction with local fishermen, to estimate absolute abundance; and gathering of length-frequency data to provide demographic information on the population. All activities will be carried out intensively before during and after harvest, so as to assess the response of the population to exploitation.

Monitoring of population recovery at three-month intervals will be assured by MMR. An Australian AVA volunteer will be posted to the MMR giant clam hatchery in Aitutaki in January 1992. The possibility of this person also being involved in monitoring the trochus resource is presently under consideration by the Ministry.

SPC will undertake to arrange appropriate broad classification of SPOT images of Aitutaki to assist in field survey planning. Preliminary image classifications are kindly being provided by the French Polynesian Remote Sensing Station (Station Polynésienne de Télédétection). After the survey, more detailed processing will be carried out to relate field observations to detectable features on the satellite images that indicate habitat variation. Through this work, it is intended to verify and

improve the reliability of estimates of the extent of the trochus resource through the use of remotely sensed data.

Outputs

Data analysis and interpretation will include estimates of relative and absolute abundance, catchability and population size structure, and changes in these in response to harvesting. Virtual population analysis based on length-frequency data will permit estimation of recruitment patterns, and these can be verified by subsequent monitoring. Verification of a promising new stock assessment technique being developed for abalone in Tasmania, based on changing ratios of pre- and post-recruits in samples taken immediately before and immediately after intensive harvests, will also be attempted.

The SPC and Australian scientists will be responsible for co-ordinating the production of a detailed preliminary report on the field study within a month of its completion, with inputs from all members of the field team. A final report of the study will be produced by SPC following an estimated 18 months of monitoring. This will include results of the follow-up monitoring and of the satellite data interpretation as well as a recapitulation of the original field survey results.

A key output of the project will be in human resource development. The Pacific Island scientists participating in the survey will be selected from the best participants at the trochus workshop. The field survey will comprise an important extension of the training they received during the workshop, and will greatly reinforce their ability to carry out similar work on their own behalf effectively after returning home. Promoting the ability of Pacific Island countries to develop fishery management approaches using their own human resources is a mandate of the SPC fisheries programme. Experience has shown that participation of national fishery scientists in field activities such as this is an effective means of contributing to this end.

Information on trochus fisheries in the South Pacific

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Introduction

This paper, which is based on information presented at the SPC/SPRADP Workshop on Trochus Assessment, Development and Management, was presented at a meeting ("Comité consultatif des pêches") held in Kone, Northern Province, New Caledonia in May 1992.

Trochus niloticus, commonly known as trochus or top shell, a gastropod found on coral reefs, is extensively harvested for its shell, used in the manufacturing of mother-of-pearl buttons and other items, such as jewellery. It is a significant source of income for rural and island populations of the region.