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Recent surveys of transplanted green snail (*Turbo marmoratus*) and trochus (*Trochus niloticus*) on Tongatapu, Tonga

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Introduction

The former Japan International Cooperation Agency (JICA)/ Tonga Aquaculture Research and Development Project (a five-year project with two years of follow up) concentrated on developing the techniques of hatchery trochus and green snail seed production. It was done with the aim of releasing the juveniles to accelerate establishment and enhancement of both species in the wild. JICA dispatched a short-term expert to assist the shellfish seed restocking and recovery survey. The expert developed the optimum size for restocking and releasing including a study on predation and its control and established a recapture technique and monitoring method. His expertise and assistance were also needed in the renovation of the seawater intake system under an aid grant from Japan, which started in August 1999.

As a consequence of the many demands placed on the expert JICA dispatched another short-term expert to assist in the resource survey, management of shellfish, and hatchery management during construction of the seawater intake system, and assist in the TCTP.

Present status of the Ministry of Fisheries Sopa Mariculture Center in Tongatapu

Most facilities of the Sopa Mariculture Center (SMC) that had been damaged by Cyclone Isaac in 1982 were rebuilt during the seven-year JICA project. However, the poor seawater supply system remained the main problem for the hatchery. In late 1999 a new pump house and a new awning house were constructed (Figs. 1 and 2). The project was completed in March 2000.

The SMC facilities now consist of 50 rearing tanks in the hatchery, three seawater intake pumps, four blower air pumps, one generator, a control panel and other necessary intake equipment in the newly constructed pump house. An elevated tank has been installed on the top of the pump house (Fig. 1). Outside the pump house there are two filtration units for seawater and a fuel tank for the generator. A seawater intake strainer was set up at the reef margin.

After changing to the new seawater intake system, the growth rate of green snails (*Turbo marmoratus* L.) became faster than previously recorded. It

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is obvious that the better growth rate was due to a good supply of stable, quality seawater (Fig. 3).

The current number of green snails reared in the hatchery is about 12,550 individuals (270 spawners, 780 from 1996 and 1997 spawning, 2900 from 1998 spawning and 8600 from 1999 spawning). The intermediate culture phase 1 for juveniles from the first spawning in the new millennium starts on July. At present, 900 juveniles have been collected from the settlement tank.

Surveys of introduced green snail (*Turbo marmoratus* L.) and trochus (*Trochus niloticus*)

Surveys of green snail at `Euaiki Island

The surveys of released green snail at `Euaiki Island (Fig. 4) were conducted in May 1999 and April 2000.

In May 1999, a total of 11 green snails were recaptured, all of which were animals released in May and June 1998 (Niumeitolu et. al 1999). Most of the recaptured shells were found in holes, caves or under ledges. Only a few individuals were found at the coral reef dents.

In April 2000, we recaptured 35 green snails on the same site we surveyed in May 1999. Once again, most of the recaptured shells were found in holes, caves or under the ledges, and only a few individuals at the coral reef dents. Of these 35 recovered shells, 2 had been released in August 1994, 25 in May and June 1998, 5 in May 1999 and 3 in February 2000.

From this survey, we believe that the first introduced group (August 1994) still survives and contributes to natural recruitment. Also, the groups released in 1998 and 1999 have reached mature sizes. We collected many of them in a quite small area, therefore it is conceivable that those green snails had already established a spawning group.

In this report we will only consider green snails released in 1998, because we need more data for green snails released in 1994, 1999 and 2000.



Figure 1. The new SMC seawater intake pump house.



Figure 2. The new SMC fiberglass tanks and awning house.



Figure 3. Ulunga Fa'anunu proudly presenting green snails born and raised at SMC. The new seawater intake system has allowed better growth rates.

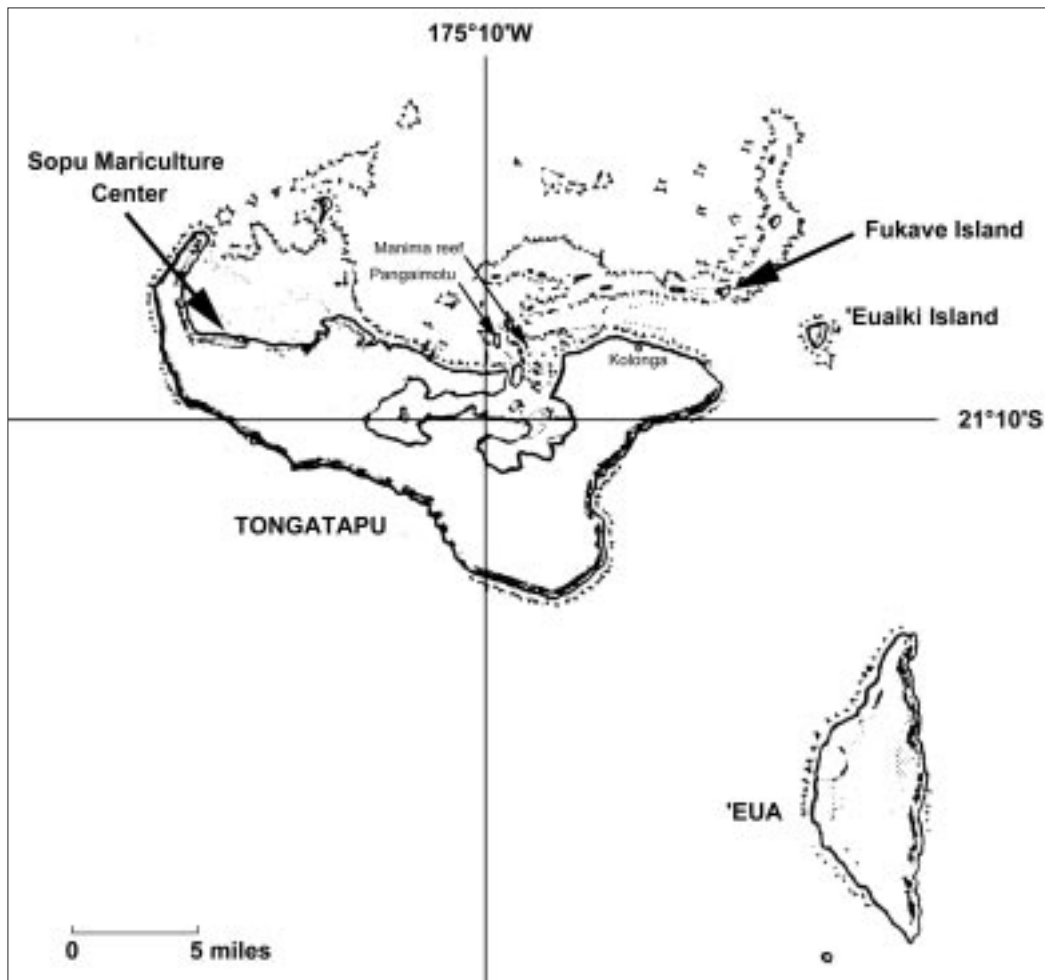


Figure 4. Green snail and trochus survey sites on Tongatapu.

Table 1 shows the increment shell height of each year's group. The average shell height increment for one and two years after release was 54.2 mm and 89.6 mm, respectively. Average shell height for each year was 111.2 mm and 146.6 mm, respectively (Table 1). These results indicate that the growth rate of green snail seeds after release in the wild was considerably faster than when captive. The green snail juveniles had an average shell height of 57 mm when they were released. After two years in the wild, they grew to an average of 146.6 mm and had reached maturity and commercial size.

The number of shells recovered in this year's survey increased by 14 from last year's study. We assume one of the reasons for the increase was the shell growth made them more prominent and easier to find in the field. The increase in shell height from last year was about 40 mm.

Two green snails from the group released in 1994 were found. However, it is difficult to estimate the overall survival number of this group since they probably spread out around 'Euaiki Island.

Survey of released trochus at Fukave Island

Recover surveys of the introduced trochus in Fukave Island have been realised since 1994 (Numeitolu et al. 1999). Table 2 shows the recaptured number and rate of trochus. From the 400 trochus released in 1994, we recaptured 125 individuals during our survey in June 2000. The recovery rate was 31.1% compared to 28.2% last year. The increase may be attributed to the survey team observing seven habitats this year, compared to only six last year. From the results of this year's survey, we could say that the first introduced trochus from 1994, are still an important spawner group.

New recruitment surveys of trochus

Due to some unexpected circumstances experienced in previous years, we were unable to conduct enough surveys. In February 2000 we conducted a survey on the reef around Pangaimotu Island (Fig. 4). Five trochus were recovered in the one-hour survey. The shell diameter sizes of recaptured trochus were 100.5, 96.9, 71.6, 73.7, and 63.7 mm.

In June 2000, we surveyed the Manima reef flats and found two juvenile trochus at 0.5 m depth on the reef flat area. The shell diameter of both shells was 50 mm.

A fisherman found one trochus on the reef adjacent to Kolonga village. Since the specimen looked new to him he took it home and informed the Ministry. We then interviewed him and explained the importance of this species for Tongans in the near future. We also kept the shell, whose diameter was 124.8 mm.

The sizes of recaptured trochus indicate that new recruitment has probably occurred every year since 1994, and new generations of trochus are spreading out.

Status of green snail new recruitment

We were not able to carry out a survey for green snail new recruitment, because there was not enough time to cover this survey. However, we obtained important information from *The Taimi Tonga*, one of the local newspapers. A diver found one large green snail at night around the fore reef slope area on 'Eua Island (Fig. 4). From the newspapers picture, the green snail was estimated to be over 16 cm in shell height and 3 or 4 years old. 'Eua island is about 20 km to the south-southeast of 'Euaiki Island where green snail were introduced.

Seed production of green snail

We conducted seed production using natural spawning of eggs in April 2000. We obtained 100,000 settlement stage larvae from the 900,000 fertilised eggs. The larvae were divided and transferred to two 4-ton settlement tanks. The Intermediate Culture Phase 1 (ICP1) started on 29 June. About 700 juveniles of 2.5 to 3.0 mm in shell width were already transferred for ICP1. The final production number for Phase 1 will be confirmed in three months' time. According to its present

Table 1: Recaptured green snail growth rate at 'Euaiki Island.

No.	Initial shell height (mm)*	Shell height (mm) at time of recapture	Shell height increment (mm)
Recaptured in May 1999			
1	57.0	95.0	38.0
2	57.0	110.0	53.0
3	57.0	116.8	59.8
4	57.0	104.4	47.4
5	57.0	99.8	42.8
6	57.0	104.0	47.0
7	57.0	120.0	63.0
8	57.0	120.0	63.0
9	57.0	128.0	71.0
10	57.0	110.5	53.5
11	57.0	115.0	58.0
Average		111.2	54.2
Recaptured in June 2000			
1	57.0	143.5	86.5
2	57.0	145.5	88.5
3	57.0	147.5	90.5
4	57.0	154.4	97.4
5	57.0	152.5	95.5
6	57.0	150.0	93.0
7	57.0	152.5	95.5
8	57.0	145.0	88.0
9	57.0	132.5	75.5
10	57.0	150.5	93.5
11	57.0	145.8	88.8
12	57.0	157.5	100.5
13	57.0	152.0	95.0
14	57.0	140.2	83.2
15	57.0	131.2	74.2
16	57.0	147.7	90.7
17	57.0	143.2	86.2
18	57.0	149.5	92.5
19	57.0	146.0	89.0
20	57.0	145.0	88.0
21	57.0	153.7	96.7
22	57.0	149.4	92.4
23	57.0	138.6	81.6
24	57.0	144.0	87.0
Average		146.6	89.6

* Average initial shell height when released on May and June 1998

Table 2: Number of recaptured trochus and recapture rate at Fukave Island site.

Year	No. of recaptured trochus	Recapture rate
1994	91	22.8%
1995	57	14.3%
1996	78	19.5%
1998	96	24.0%
1999	113	28.2%
2000	125	31.3%

condition, this year's production should contribute a good stock for future releases.

Other activities

Some public awareness campaigns on trochus and green snail transplantation were aired from Radio Tonga from December 1999 to July 2000. The public was urged to protect these important resources until they reached harvestable size. The program released information on their new recruitment and SMC activities.

Future direction

Future direction for both species, as recommended by Nuimeitolu et al. (1999), was proposed for implementation by the MOF. However, for the time being MOF should concentrate on seed pro-

duction of the green snail, seed release for establishment of spawners' groups, and recruitment surveys. Also the MOF should impose a continuous ban on the harvest of green snails and trochus until their populations are sufficient to support a sustainable commercial fishery.

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Protecting the trochus bounty

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The coral reef flats of the inner islands of King Sound number in the hundreds. These environments present almost idyllic conditions for a much-underestimated species of mollusc commonly known as the trochus or topshell. The trochus (*Trochus niloticus*) once existed in these tidal zones in huge numbers. These zones are in pristine condition with no negative impacts from run-off from settled or industrial areas. However, a combination of overharvesting over the last 20 years and, to a lesser extent, poaching by illegal foreign fishers, has seen trochus populations plummet. From a maximum recorded harvest in the 1980s of 135 tonnes, the current level of harvest is less than 15 tonnes.

Modern fisheries management ensures that sustainable harvesting practices are applied through innovative aquaculture programs and education of local fishers. The impact of illegal foreign fishers collecting the shell is addressed in a more proactive, hands-on approach.

The International Operations Section (IOS) of Fisheries Western Australia is a dedicated and expe-

rienced team of professional compliance officers who undertake a wide variety of demanding tasks on behalf of the Australian Fisheries Management Authority (AFMA), Australia's federal fisheries management agency. They operate in all environments and extremes: from the tropical areas of Cocos and Christmas Islands in the Indian Ocean, to the Antarctic waters of Heard Island in the Southern Ocean, their role in providing monitoring, control and surveillance services is state of the art. For IOS officers based in Broome, Western Australia, keeping an eye on the trochus stocks of King Sound is just one of their various fisheries compliance tasks.

The trochus of King Sound are sought after by Indonesian fishers, who have a small window of opportunity to seek their bounty. The usual practice is to make their way from Indonesia to the north and to enter King Sound under the cover of darkness. The maze of mangroves and tidal ranges of 10 metres allow them to conceal their vessels during the day.

Typically, the vessels used are around 10 to 15 metres with a crew of anywhere from 12 to 30. A

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