Trochus (*Trochus niloticus*) size and abundance in Tongareva lagoon, May 2006

Report prepared for the Cook Islands Ministry of Marine Resources and the Tongareva Island Council

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Introduction

Trochus (*Trochus niloticus*) were first introduced to the Cook Islands in 1957 from Fiji. Once the original population of 280 shells established in Aitutaki, *Trochus* were introduced to the rest of the Cook Islands in the 1980s. The main purpose of the introduction was to develop commercially harvestable stocks so as to assist local economies. 440 *Trochus* were introduced to Tongareva (also known as Penrhyn) over 20 years ago in 1985 from the Aitutaki population (Sims 1988). Introduced populations usually reach commercially exploitable levels within 20 to 25 years therefore the *Trochus* population on Tongareva at present should be almost ready for harvest (Bertram 1998).

Trochus tend to be distributed according to age with juveniles found in shallow areas among coral rubble and adults found in increasing densities towards the reef edge. The optimum depth for *Trochus* is up to 10 metres (m) although they can be found as deep as 25 m (Bertram 1998). *Trochus* feed by grazing coral and rocks for microscopic algae and diatoms. They reach reproductive maturity at around two years of age when the animal has a corresponding basal diameter of approximately 6 centimetres (cm). The life span of *Trochus* is around 15 years, when they reach basal diameter of around 15 cm. According to Sims (1988), *Trochus* spawn approximately three to five times a year. Fertilisation occurs externally with a short larval phase of three to five days. This short larval phase does not allow for large natural dispersal hence populations of *Trochus* are considered isolated and are not likely to spread to other reefs (Bertram 1998).

A 1996 survey conducted in Tongareva by the Cook Islands Ministry of Marine Resources (MMR) found *Trochus* present in the western section of Tongareva lagoon with highest densities of *Trochus* found at two sites; *Patukiri* and *Seniseni* (Ponia *et al.* 1997). The survey detailed in this report was designed to re-assess the density of *Trochus* in Tongareva lagoon, 10 years after the last survey and 20 years after the original introduction.

The specific aims of the survey were as follows:

1) To assess the size distribution of *Trochus*
2) To assess *Trochus* abundance and density in the western section of the lagoon
3) To estimate how many *Trochus* can be sustainably harvested from the area of the lagoon surveyed

Methodology

The survey took place from 3 May to 11 May 2006 with a follow-up survey in *Patukiri* on the 31 May 2006, in conjunction with surveying pasua (*Tricdacna maxima*) population abundance. Field work was conducted by the author, Mataora Marsters and Taimana Matara from the Tongareva Marine Research Centre (TMRC) with additional assistance from Tomas Samuela Jnr. and Tuku Marsters. Surveying was concentrated in the western section of the lagoon (see figure 1) as this is where the highest numbers of *Trochus* were discovered in the

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previous survey, but any *Trochus* encountered in other sections of the lagoon during the course of the Pasua survey were also to be recorded although none were found.

From preliminary observations and also based on previous surveys of *Trochus* numbers, it was observed that *Trochus* were distributed with increasing density towards the edge of the inner lagoon reef (kauniho). Transect lines were accordingly placed at the edge of the kauniho extending towards the shoreline. The survey was conducted using a 50 m transect line laid parallel to the edge of the kauniho with five transect lines running perpendicular at 10 m intervals. All *Trochus* found within 5 m on both side of the line were counted and all were measured except at *TMRC* where approximately every second *Trochus* was measured (39 percent (%) of population) and *Patukiri North* where 85 % of the population were measured.

The size distribution of *Trochus* was evaluated by recording the basal diameter of *Trochus* using callipers measured in centimetres (cm). The census of *Trochus* abundance in the lagoon was calculated by counting the number of *Trochus* at each site; density was calculated as the total number of individuals divided by the area sampled, which at each site was 2500 m^2. The calculation for the amount of *Trochus* available for sustainable harvest was based around 30 % of the population in the 8 to 12 cm size range as per harvest regulations established in Aitutaki. The weight of this potential harvest was calculated according to the following relationship between basal diameter (L) and weight (W) where $W=(3.4 \times 10^{-4}) L^{2.943}$ as used by Ponia *et al.* (1997). A total of 10 sites were surveyed (see figure 1).

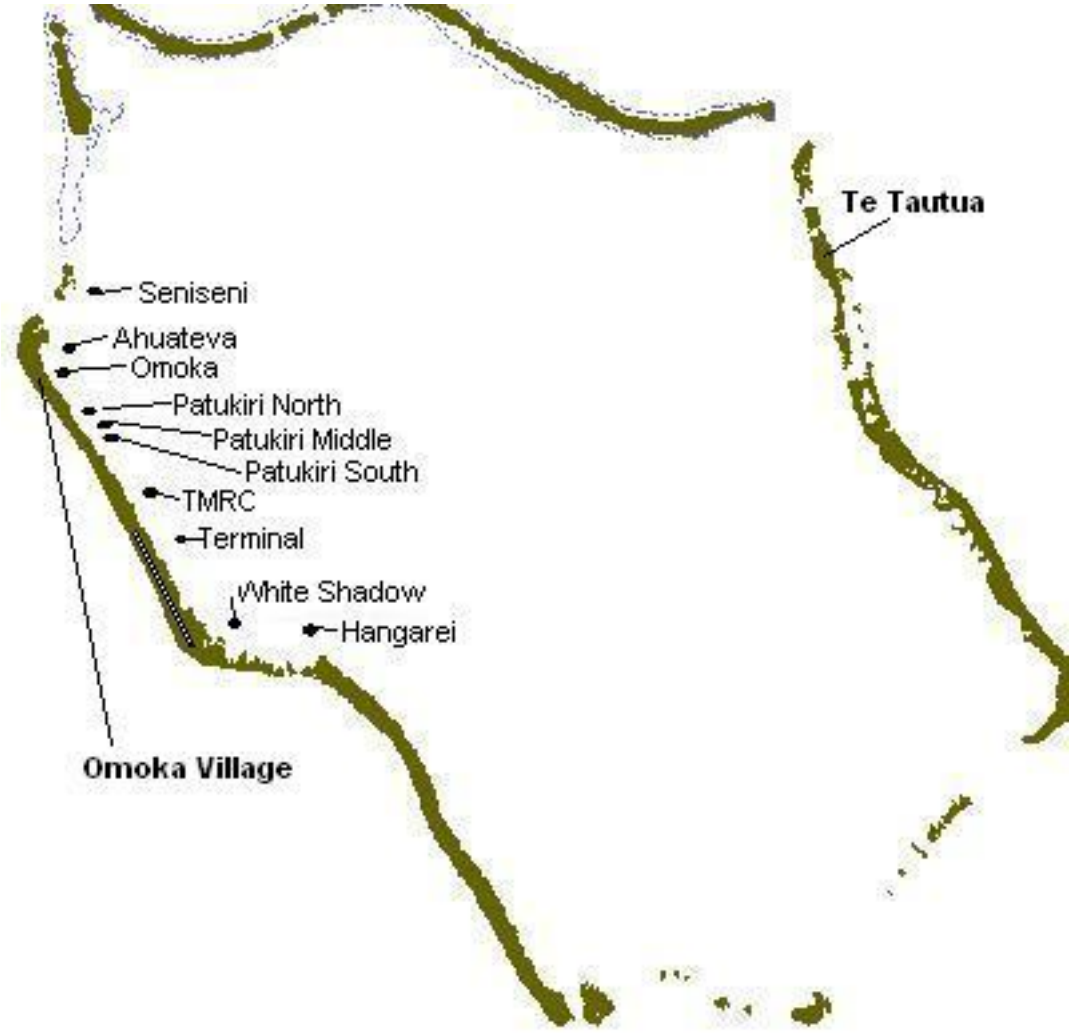

Figure 1: Map of sites surveyed Tongareva lagoon showing the two main villages; Omoka and Te Tautua.

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Results

1) Size distribution

The mean basal diameter of the *Trochus* shells sampled was 9.17 cm (n=451) which was an increase of 0.77 cm from the last survey conducted ten years ago by Ponia *et al.* (1997). Of the 433 measured, 406 individuals or 93.76 % were of legal size, that is, above the 8 cm minimum and under the 12 cm maximum (see figure 2). These size limits used at Aitutaki are designed so as to allow young *Trochus* the opportunity to spawn before reaching a harvestable size. Similarly, the maximum size limits are set to retain large individuals as a breeding stock for future *Trochus* populations and also to accommodate the fact that as *Trochus* age, the value of the shell decreases due to the presence of organisms on the shell surface such as algae and tubeworms (Bertram 1998). Three of the *Trochus* measured were found to exceed 12 cm compared to just one in the previous surveys, whereas 24 were under the 8 cm minimum size bracket. The largest sized *Trochus* measured 15.4 cm, found at the *White Shadow* site and the smallest size measured 2.5 cm at *TMRC*. The largest sized *Trochus* on average were found at the *Patukiri north* site (n=13) with a mean of 10.43 cm. The smallest sized *Trochus* on average were found at the *Terminal* site (n=4) with a mean of 4.7 cm.

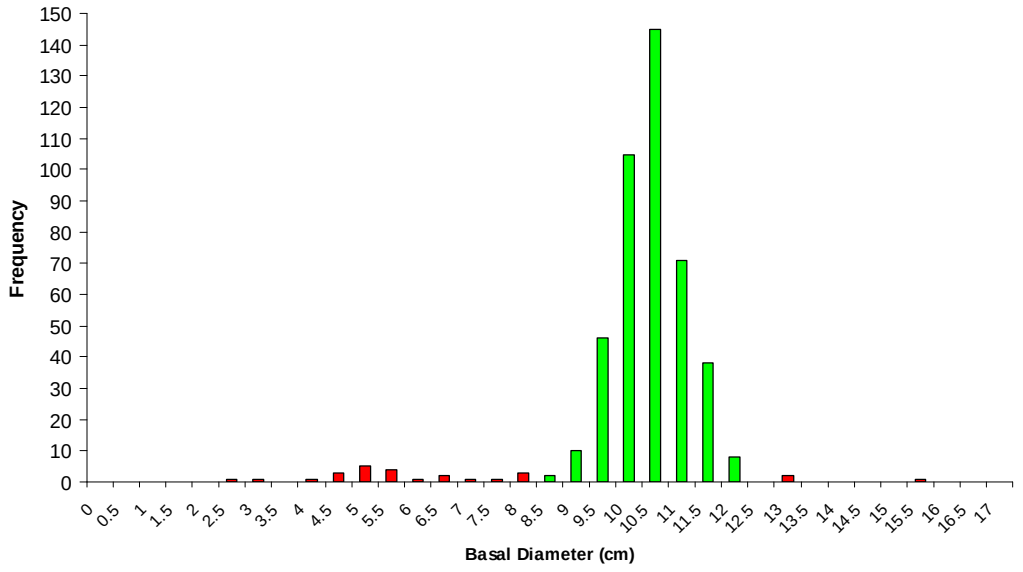

Figure 2: Trochus population size structure indicating shells within the legal size range in green.

2) Population abundance and density

The highest numbers of *Trochus* were found at *Omoka* and *TMRC* sites (see Table 1). The corresponding densities were 0.075 individuals per square metre (ind m^2) and 0.065 ind m^2 respectively. Low numbers were recorded at *Patukiri north* and at sites in the south western end of the lagoon (*Terminal, White Shadow* and *Hangarei*) resulting in a combined average density for the entire population of 0.022 ind m^2. The low numbers recorded at the *Patukiri north* site are unusual given the high numbers recorded at neighbouring *Omoka* site and the increasing numbers discovered as the survey moved southwards. This discrepancy prompted a resurvey of the area which found numbers increasing as the survey moved southwards. No

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other *Trochus* were recorded at any other sites visited in the lagoon during the course of the Pasua survey although this largely focussed on coral heads throughout the lagoon instead of kauniho. The one survey conducted in possible *Trochus* habitat on the eastern side of the lagoon (site *Matinono*) did not find any *Trochus*. A further survey on the eastern side of the lagoon, near Te Tautua, is recommended for confirmation of *Trochus* absence in this region.

Table 1: Abundance and Density of Trochus at Different Sites Surveyed

Site name	Seniseni	Ahuatera	Omoka	P North	P middle	P South	TMRC	Terminal	White Shadow	Hangarei
Count (n)	39	44	187	13	31	68	162	4	2	4
Density (ind m^2)	0.016	0.018	0.075	0.005	0.012	0.027	0.065	0.002	0.001	0.002

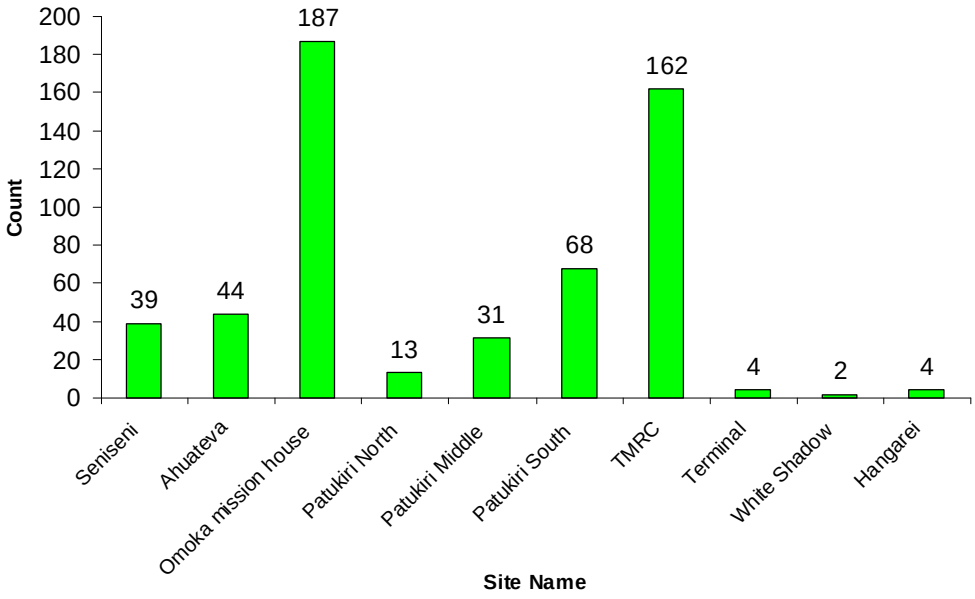

Figure 3: Total Trochus population by site surveyed

3) Harvest capacity

As discussed, of the *Trochus* measured, 406 individuals or 93.76 % were in the legal size range. Extrapolating this to the total number of *Trochus* counted (554) suggests 519 shells would be in the legal size range of the area surveyed. In accordance with the sustainable limits for *Trochus* harvest set on Aitutaki which allows 30 % of the population in the legal size range to be taken, the number of individuals available for harvest is 121 of the total shells measured, or 155 individuals when extrapolated according to total number of shells counted. It is important to note that these calculations are only for the area surveyed (2500 m^2). In order to attain a better estimate of the total number of *Trochus* potentially harvestable from Tongareva lagoon, these calculations need to be extended according to the area of suitable *Trochus* habitat in Tongareva lagoon.

Based on the above calculations, however, the weight of the *Trochus* such a harvest can be calculated as follows: $W=(3.4 \times 10^{-4}) L^{2.9}$. As calculated in this survey, the average shell length is 9.17 cm, the average weight of a *Trochus* will be 452 grams (g). Thus assuming a

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harvestable population size of 121, the total weight would be 54.69 kilograms (kg) or, for a harvestable population size of 155, the total weight would be 70.06 kg.

Conclusions and Recommendations:

Ian Bertram's report written in 1998 estimated *Trochus* yield on Tongareva at around 110 tonnes (t), to be achieved within 10 to 15 years (Bertram 1998 p7). Once the results from this survey are extrapolated according to the total area of suitable *Trochus* habitat, that is, the coast line from *Seniseni* to *Hangarei*, this estimate will need to be updated. The majority of *Trochus* measured in this survey are of harvestable size so it appears that a harvest on Tongareva would be a timely event and one beneficial for the local economy. It is recommended that the coast line around Te Tautua be surveyed to confirm the absence of *Trochus* in this area of the lagoon. Based on the size distribution patterns, it is recommended that the existing size limits of 8 to 12 cm are retained although there is scope to extend the harvest quota to 40 % to make the harvest a financially viable exercise for the Tongarevan community.

References:

Bertram, I. 1998. *Trochus* Commercial Prospects for the Cook Islands, Information Paper No. 1. Rarotonga, Commercial Development Assistance, Cook Islands Ministry of Marine Resources. 15 p.

Ponia, B., Terekia, O. and Taime, T. 1997. Study of *Trochus* Introduced to Penrhyn, Cook Islands: 10 Years Later. SPC Trochus Information Bulletin 5(October): 18-24.

Sims, N. A. 1988. *Trochus* Resources Profile Report for Cook Islands. Rarotonga, Cook Islands Ministry of Marine Resources. 12 p.

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Appendix:

Tongareva *Trochus* survey
Basal Diameter (cm), Person-transect 2500m2 (50m ropes in a square)

10 sites	Totals	Seniseni	Ahuateva	Omoka	Patukiri North	Patukiri Middle	Patukiri South	TMRC	Terminal	White Shadow	Hangarei
TOTAL area sq m	25000.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
Av shell size cm	9.17	9.97	9.80	9.87	10.43	10.32	10.09	6.72	4.70	9.85	9.98
Transect area sqm	25000.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
total population	554.00	39	44	187	13	31	68	162	4	2	4
Shells measured	433.00	39	44	169	11	31	68	61	4	2	4
% Shells measured	78.16	100.00	100.00	90.37	84.62	100.00	100.00	37.65	100.00	100.00	100.00
Density (shells/m2)	0.022	0.016	0.018	0.075	0.005	0.012	0.027	0.065	0.002	0.001	0.002
Max cm	15.40	11.40	11.00	11.00	11.20	12.50	11.50	10.70	5.40	15.40	11.00
Min cm	2.40	9.20	4.30	5.70	8.40	9.00	5.00	2.40	4.00	4.30	7.80
No >120 mm	3.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
No <=80 mm	24.00	0.00	2.00	2.00	0.00	0.00	1.00	13.00	4.00	1.00	1.00
% legal	93.76	100.00	98.00	96.68	100.00	99.00	99.00	65.48	96.00	98.00	99.00
Total no legal	406.00	100.00	98.00	87.37	84.62	99.00	99.00	24.65	96.00	98.00	99.00
30% of legal number	121.80	30.00	29.40	26.21	25.38	29.70	29.70	7.40	28.80	29.40	29.70
30% quota tonnes	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cash 30%	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
40% of legal number	162.40	40.00	39.20	34.95	33.85	39.60	39.60	9.86	38.40	39.20	39.60
40% quota tonnes	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cash 40%	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01

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