

## Trochus (*Trochus niloticus*) size and abundance in Tongareva Lagoon, Cook Islands

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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 was well 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 to assist local economies. Four hundred and forty 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 should nearly be 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 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 basal diameter of approximately 6 cm. The life span of trochus is around 15 years, when they reach a 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 trochus populations 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 that trochus were present in the western section of Tongareva Lagoon with the highest densities 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 to:

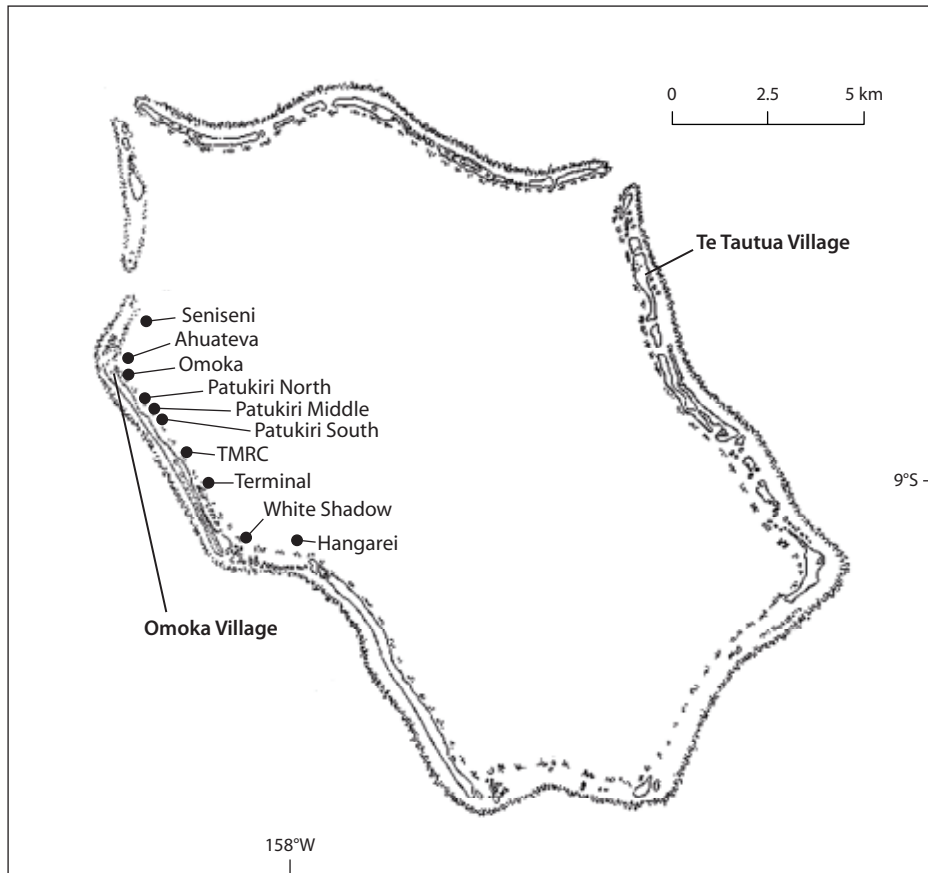
- assess the size distribution of trochus,
- assess trochus abundance and density in the western section of the lagoon, and
- estimate the number of trochus that could be sustainably harvested from the surveyed area of the lagoon.

### Methodology

The survey took place from 3–11 May 2006 with a follow-up survey in Patukiri on 31 May 2006, in conjunction with a survey of *pasua* (*Tridacna maxima*) populations. Fieldwork was conducted by the author, Mataora Marsters and Taimana Manata from the Tongareva Marine Research Centre (TMRC), with additional assistance from Tomas Samuela Jr and Tuku Marsters. Surveying was concentrated in the western section of the lagoon (Fig. 1) as this was where the highest numbers of trochus were discovered in the previous survey. However, 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 transect line were counted and all were measured except those surveyed at TMRC, where approximately every second trochus was measured (i.e. 39% of the 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. The census of trochus abundance in the



**Figure 1.** Survey sites in Tongareva Lagoon showing the two main villages Omoka and Te Tautua.

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<sup>2</sup>. The calculation for the amount of trochus available for sustainable harvest was based around 30% of the population in the 8–12 cm size range as per harvest regulations established in Aitutaki. Ten sites were surveyed (Fig. 1).

## Results

### *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 previous survey conducted 10 years ago by Ponia et al. (1997). Of the 433 trochus measured, 406 individuals or 93.76% were of legal size, that is, above the 8 cm minimum and under the 12 cm maximum (Fig. 2). The minimum size limit is designed to allow young trochus the opportunity to spawn before reaching a harvestable size, while the maximum size limit is 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 trochus, measuring 15.4 cm, was found at the White Shadow site and the smallest one, measuring 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.

### *Population abundance and density*

The highest numbers of trochus were found at Omoka and TMRC sites (Table 1). The corresponding densities were 0.075 ind m<sup>-2</sup> and 0.065 ind m<sup>-2</sup>, respectively. Low numbers were recorded at Patukiri North and at sites in the southwestern end of the lagoon (Terminal, White Shadow and Hangarei), resulting in a combined average density for the entire population of 0.022 ind m<sup>-2</sup>. The low numbers

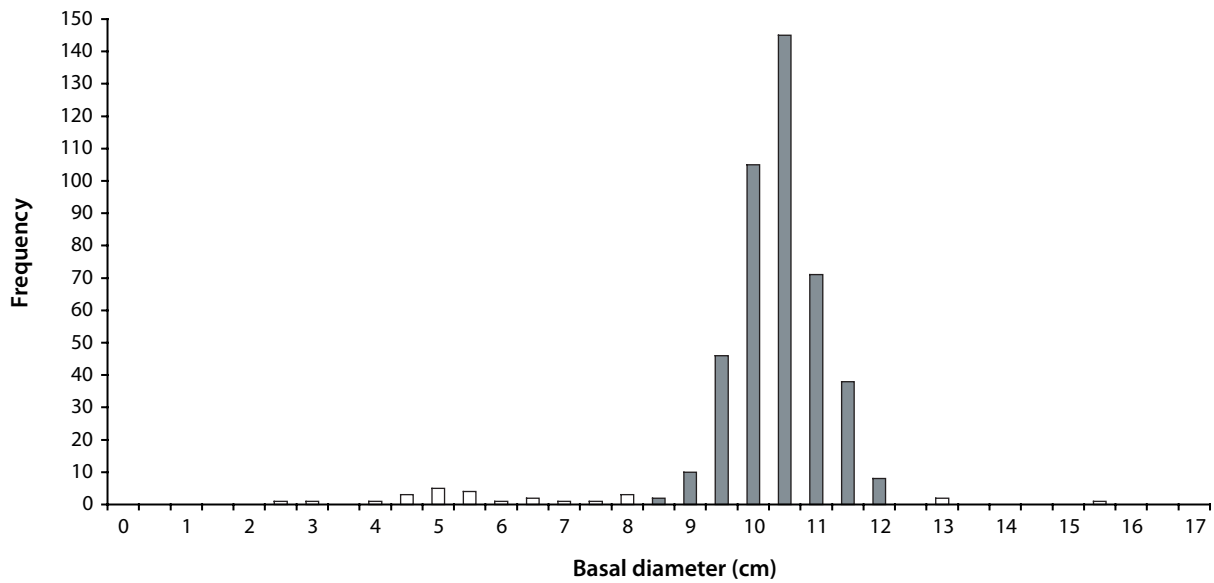


Figure 2. Trochus population size structure indicating shells within the legal size range in grey.

recorded at the Patukiri North site are unusual given the high numbers recorded at neighbouring Omoka and the increasing numbers discovered as the survey moved southward. This discrepancy prompted a resurvey of the area, which found numbers increasing as the survey moved southward.

No other trochus were recorded at any other sites visited in the lagoon during the course of the *pasua* survey although this survey 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.

**Harvest capacity**

As discussed, of the trochus measured, 406 individuals (93.76%) were in the legal size range.

Extrapolating this to the total number of trochus counted (554) suggests that 519 shells would be in the legal size range of the area surveyed. In accordance with the sustainable limits for trochus harvesting 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 apply only to the area surveyed (25,000 m<sup>2</sup>). 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.

The weight of this potential harvest could then be 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).

Table 1. Abundance and density of trochus at different sites surveyed

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

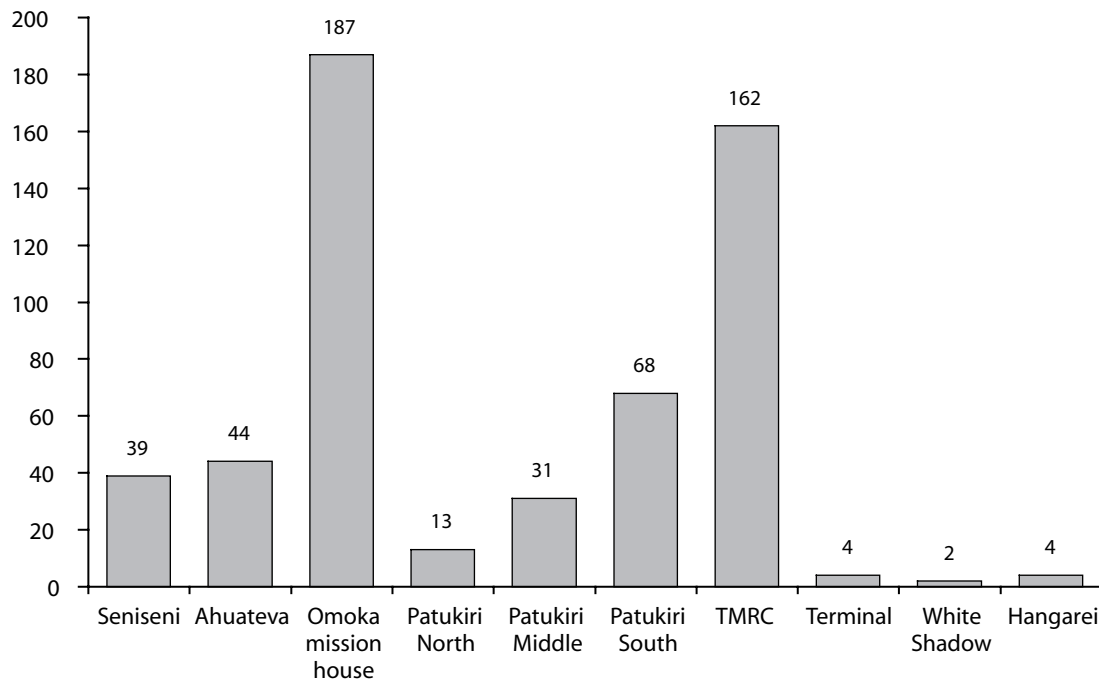


Figure 3. Number of trochus found in each site surveyed.

### Conclusions and recommendations

Bertram's report in 1998 estimated the trochus yield on Tongareva to be around 110 t, to be achieved within 10–15 years (Bertram 1998). Once the results from the present survey are extrapolated according to the total area of suitable trochus habitat, that is, the coastline from Seniseni to Hangarei, this estimate will need to be updated. The majority of trochus measured in this survey are of a 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 coastline around Te Tautua be surveyed to confirm the absence of trochus in this area of the lagoon. Based on size distribution patterns, it is recommended that the existing size limits of 8 to 12 cm be 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 5:18–24.
- Sims N.A. 1988. Trochus resources profile report for Cook Islands. Rarotonga, Cook Islands Ministry of Marine Resources. 12 p.

Appendix 1. Tongareva trochus survey

10 sites:	Totals	Seniseni	Ahuateva	Omoka	Patukiri North	Patukiri Middle	Patukiri South	TMRC	Terminal	White Shadow	Hangarei
Area surveyed (m <sup>2</sup> )	25,000	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
No of shells found	554	39	44	187	13	31	68	162	4	2	4
Density (shells m <sup>-2</sup> )	0.022	0.016	0.018	0.075	0.005	0.012	0.027	0.065	0.002	0.001	0.002
No of shells measured	433	39	44	169	11	31	68	61	4	2	4
% of shells measured	78.16	100.00	100.00	90.37	84.62	100.00	100.00	37.65	100.00	100.00	100.00
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
Max. size (cm)	15.40	11.40	11.00	11.00	11.20	12.50	11.50	10.70	5.40	15.40	11.00
Min. size (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	0	0	1	0	1	0	0	0	1	0
No ≤ 80 mm	24	0	2	2	0	0	1	13	4	1	1
Total no of legal size measured shells	406	39	42	166	11	30	67	48	0	0	3
% legal	93.76	100.00	95.45	98.22	100.00	96.77	98.52	78.68	0	0	75.00
Extrapolated total number of legal size	519	39	42	184	13	30	67	127	0	0	3