

The Aitutaki experience in the development of management strategies for the trochus fishery

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Management of the Aitutaki trochus fishery

Currently the Marine Resources Act 1989 and the Aitutaki Fisheries Protection By-Laws 1990 are the only two statutes which apply to the trochus fishery. From the establishment of the trochus fishery on Aitutaki, a management plan was developed by drawing on examples from trochus fisheries elsewhere and experience from past harvests on Aitutaki (FFA Report No. 93/25).

The aim for the development of an effective management plan was to maintain a catch as large as possible which would be profitable to the community and not biologically jeopardise the renewability of the resource. Table 1 illustrates the development of management strategies for the Aitutaki trochus fishery in chronological order.

The management strategies put into practice for the Aitutaki trochus fishery are briefly summarised below.

Harvest season

The harvesting seasons following the 1981 harvest were very limited in duration, ranging from one day to three months. Initial harvest seasons were declared arbitrarily. However, due to actual yields grossly exceeding the set quota, harvest duration was then determined by the estimated time needed to attain the allocated quota.

This system alone proved ineffective in controlling the allocated catch quotas. In 1987 the harvest durations were allocated as separate 24-hour periods. The harvest season was then closed when yields were fairly close to the allocated total catch quota. The introduction of 24-hour pulse fishing periods appears to have successfully minimised quota overruns.

Catch limits

It has been difficult to determine how the first two catch quotas were achieved, however af-

ter the second harvest season, quotas were calculated as approximately 30 per cent of the assessed biomass of 8–11cm shells. During the 1990/91 and 1992 harvests, the total allowable catch quotas were set at 60 per cent of the assessed standing stock of legal-size shells. Trochus harvest inspectors are required to monitor all landing sites as the harvest progresses. This has proved logistically impossible (Sims, 1988).

Trochus reserve

A breeding reserve was introduced in 1983 which covers a 3 km stretch of the windward reef of Aitutaki. The location of the reserve was designed to promote retention of plankton larvae in the lagoon (Sims, 1988). Pre- and post-harvest surveys suggest that poaching has occurred in the reserve (Sims, 1988).

Size limits

Legal size limits were introduced after the establishment of the fishery and have changed over the years from the experience gained in each harvest. A minimum size limit of 8cm was imposed during the first harvest (Clark, D., pers. comm.).

Experience from other trochus fisheries has indicated that trochus reach reproductive maturity at around 6–7cm basal diameter. A minimum size limit of 8cm allows most young trochus the opportunity to spawn before becoming vulnerable to fishing pressure.

During the first harvest season trochus buyers were reluctant to purchase large, wormy shells. The outcome of this was the introduction of a maximum size limit of 12.5cm (basal diameter) during the 1983 harvest season. In 1984 the maximum size limit was reduced to 11cm (Bour, 1988). This appears to have successfully improved the value of the total catch. The maximum size limit was designed to limit the taking of low-value (wormy) shells and preserve the more fecund animals within the population.

Licensing

Licensing of divers was first introduced in 1983 and is currently a requirement under law.

Trochus kept alive

There is a requirement that all harvested trochus must be kept alive until approved by a harvest inspector. This allows for the illegally harvested shells to be returned to the water.

Individual Transferable Quotas

During the 1990/91 harvest an Individual Transferable Quota (ITQ) system was introduced to control the problems with quota overruns. To determine the ITQ, the allocated

total catch quota is divided evenly between all resident individuals of Aitutaki during the allocated harvest season, regardless of the desire to participate, age or actual ability to harvest trochus (Zoutendyk, 1990).

The ITQ as a management tool appears to be most favoured by the community, as all individuals receive an equal share of the economic benefits. The introduction of ITQs was a success in reducing quota overruns.

It also minimised the risk of stock-piling prior to harvest seasons. ITQs also have the added potential to increase the value of the total catch (fishers are more inclined to fill their quota with high-value shells). ITQs will most certainly be used in future harvests.

Table 1: A chronological history of the development of management strategies for the Aitutaki trochus fishery (tonnes expressed as dry shell weight)

1981/82 harvest season		
Management strategies practised during each harvest	Actual occurrence during each harvest season	Comments
A short harvest season of 3 months was declared.	The actual harvest season was 15 months.	The harvest season was decided arbitrarily.
Harvestable quota was set as 30 t.	Approximately 200 t of trochus shell was collected.	Records do not show how this quota was determined, probably by speculation.
Size limits		A minimum size limit of 8 cm (basal diameter) was imposed.
1983 harvest season		
3 months was declared as the harvest season.	The actual duration of the harvest was 3 months.	The harvest season was determined by estimating the time to attain the set quota.
Harvestable quota set as 20 t.	Total of 35.7 t harvested.	This quota was probably determined by speculation.
Legal size limits	Illegal-sized trochus harvested were confiscated by harvest inspectors prior to processing.	The minimum size of 8 cm was maintained. A maximum size limit of 12.5 cm basal diameter was introduced to remove poor-grade (wormy) shells from the total catch.
Trochus reserve established.	Poaching occurred in the reserve.	Three kilometres of windward reef was designated as a trochus reserve. The size of the reef was decided arbitrarily. Harvesting occurred in the reserve, due to poor enforcement efforts.
Licences issued.	42 licences issued.	Licences cost NZ\$ 1.00.
Trochus must be kept alive prior to inspection.	Illegal-sized shells were confiscated prior to processing.	Confiscated shells were returned to the lagoon.

1984 harvest season

3 months declared as the harvest season.	The actual harvest season was 12 days.	The harvest season was reduced due to the total catch grossly exceeding the set quota.
Harvestable quota set as 20 t.	Total of 45.7 t harvested.	The quota was calculated as 30% of the harvestable stock (8–11 cm size range).
Legal size limits	Inspectors removed undersized and oversized shells prior to processing.	The minimum size limit was maintained. However the upper size limit was reduced to 11 cm (Bour, 1988), probably due to parasitic infestation on large shells. This has successfully improved the total catch value.
Maintained trochus reserve.	Poaching occurred in the reserve.	Harvesting occurred in the reserve due to poor enforcement.
Licences issued.	300 licences issued.	Licences cost NZ\$ 1.00.
Trochus must be kept alive prior to inspection.	Illegal-sized shells were confiscated prior to processing.	Confiscated shells were returned to lagoon.

1985 harvest season

3 days was declared as the harvest season.	The actual harvest season was 3 days.	The harvest season was determined by estimating the time needed to attain the set quota.
Harvestable quota was set at 20 t.	Total of 27 t was harvested.	Quota was set at 30% of the harvestable stock.
Legal size limits	Illegal-sized trochus harvested were confiscated by harvest inspectors.	The legal size for trochus was maintained as animals with a basal diameter of 8–11 cm.
Maintained trochus reserve.	Harvesting occurred in the reserve.	Harvesting occurred in the reserve due to poor enforcement. This was suggested by surveys conducted in the reserve before and after the harvest season.
Licences issued.	250 licences issued.	Licences cost NZ\$ 1.00.
Trochus must be kept alive prior to inspection.	Illegal-sized shells were confiscated prior to processing.	Confiscated shells were returned to the lagoon.

1987 harvest season

2 days declared as the harvest season.	The actual harvest season was 2 days.	The season was divided into 2 separate 24-hour periods till the quota was reached. This was introduced to prevent harvest overruns.
Harvestable quota set at 40 t.	Total of 45.1 t was harvested. Stock-piling took place prior to the opening of the fishing season (O. Terekia, pers. comm.).	Quota set at 30% of the harvestable stock. Stock-piling prior to any harvest allows the fishers to achieve a large catch during the the harvest duration.
Legal size limits	Illegal-sized trochus harvested were confiscated by harvest inspectors prior to processing.	The legal size for trochus was maintained as animals with a basal diameter of 8–11 cm.
Maintained trochus reserve.	There were rumours that poaching occurred in the reserve just before the harvesting (O. Terekia, pers. comm.).	More effort was placed on enforcement.
Licences issued.	190 licences issued (day 1) 233 licences issued (day 2)	Licence issued for the first 24-hour harvest period was valid for the second 24-hour period. The cost of licences remained at NZ\$ 1.00.
Trochus must be kept alive prior to inspection.	Approximately 350 kg of processed shell was confiscated since it was processed without the knowledge of harvest inspectors.	The confiscated shells were later returned to the fishers, as ordered by the Island Council, without any form of prosecution (O. Terekia, pers. comm.).

1988 harvest season

One day declared as the harvest.	The actual harvest season was one day.	
Harvestable quota was set at 20 t.	Total of 18 t harvested.	Quota set at less than 30% of the harvestable stock (8–11 cm) (Zoutendyk & Passfield, 1989).
Legal size limits	Illegal-sized trochus harvested were confiscated by harvest inspectors.	The legal size for trochus was maintained as animals with a basal diameter of 8–11 cm. Confiscated animals were distributed throughout the lagoon.
Maintained trochus reserve.	Poaching occurred in the reserve just before the harvest.	More effort was placed on the enforcement of the reserve during the harvest.

1990/91 harvest season

5 days declared as the harvest season.	The actual harvest season was 5 days.	
Harvestable quota set at 25 t.	Total of 26.2 t harvested.	The quota was set at 60% of the harvestable stock, 8–11 cm size range. The introduction of ITQs seems to have solved the problem of excess quota overruns.
Legal size limits	Inspectors removed undersized and oversized shells from the catch prior to processing.	The minimum size limit was maintained at 8–11 cm basal diameter.
Maintained trochus reserve.	Harvesting occurred in reserve.	More effort was exerted in enforcing the reserve. The total ITQ allocated to fishers who were caught poaching the reserve were confiscated by the inspectors, however they were later returned as ordered by the Island Council without any form of prosecution.
Licences issued.	2,250 licences issued.	The cost of licences remained at NZ\$ 1.00.
Trochus must be kept alive prior to inspection.	Illegal-sized shells were confiscated prior to processing.	
Introduced Individual Transferable Quotas (ITQ).	15 kg allocated to all individuals, regardless of age, actual ability or desire to participate in the harvest.	It was difficult for fishers to reach their allocated quota, therefore a large proportion of wormy shells was collected.

1992 harvest season

Pulse fishing of 24-hour periods.	Actual harvest season was 17 days.	A series of 24-hour pulse fishing periods was declared until the catch approached the allocated quota.
The quota was set at 25 t.	Total of 27 t harvested.	Because of the nature of the harvest, few fishers participated. It therefore became difficult to achieve the allocated quota.
Legal size limits	Inspectors removed undersized and oversized shells prior to processing.	The minimum size limit was maintained at 8 cm, however during the progress of the harvest the maximum size limit was increased from 11 cm to 12 cm to allow for the allocated quota to be attained.
Maintained trochus reserve.	Harvesting occurred in reserve.	Poor reserve enforcement resulted in poaching. This was probably due to the efforts and results of the enforcement officers being overlooked during past harvested seasons.
Trochus must be kept alive prior to inspection.	Illegal-sized shells were confiscated prior to processing.	Confiscated shells were returned to the lagoon.

During 1992 there was a great need for finance to complete an Aitutaki community project. It was decided that the revenue received from the trochus harvest for that year be directed towards the completion of the community project. A series of 24-hour pulse fishing periods was declared till the allocated quota of 25 t was achieved. However, as the harvest progressed it became difficult to obtain the allocated quota with legal-sized shell. The upper size limit was then increased to 12 cm basal diameter.

Stock assessment results after the 1992 harvest indicate that the standing stock of trochus to date has not reached commercially exploitable levels (Figure 1).

Possible reasons and causes for the slow recovery in the population are as follows:

- the assessment of the trochus population *or* interpretation of the assessment result could have been incorrectly performed;
- the use of 60 per cent of the assessed biomass as a guideline by which quotas are cur-

rently set may be an unreasonable figure, as a means of determining the allowable catch,

- from a more cynical point of view, pressure from short-sighted bureaucrats who required a quick source of cash in order to complete a community project could have played a role in the determining of a high quota.

Figure 1 shows that harvests occurred annually between 1983 and 1985 and should have occurred in 1986. This would have allowed for five successive annual harvests. Harvestable quotas for the period were determined as approximately 30 per cent of the standing fishable biomass.

Conclusion

During the development of the trochus fishery, established management tools were improved and others introduced. This has evolved into a management plan for the fishery which has proven to be a very effective mechanism in achieving most of its goals. In the near future there is a need to further investigate a more

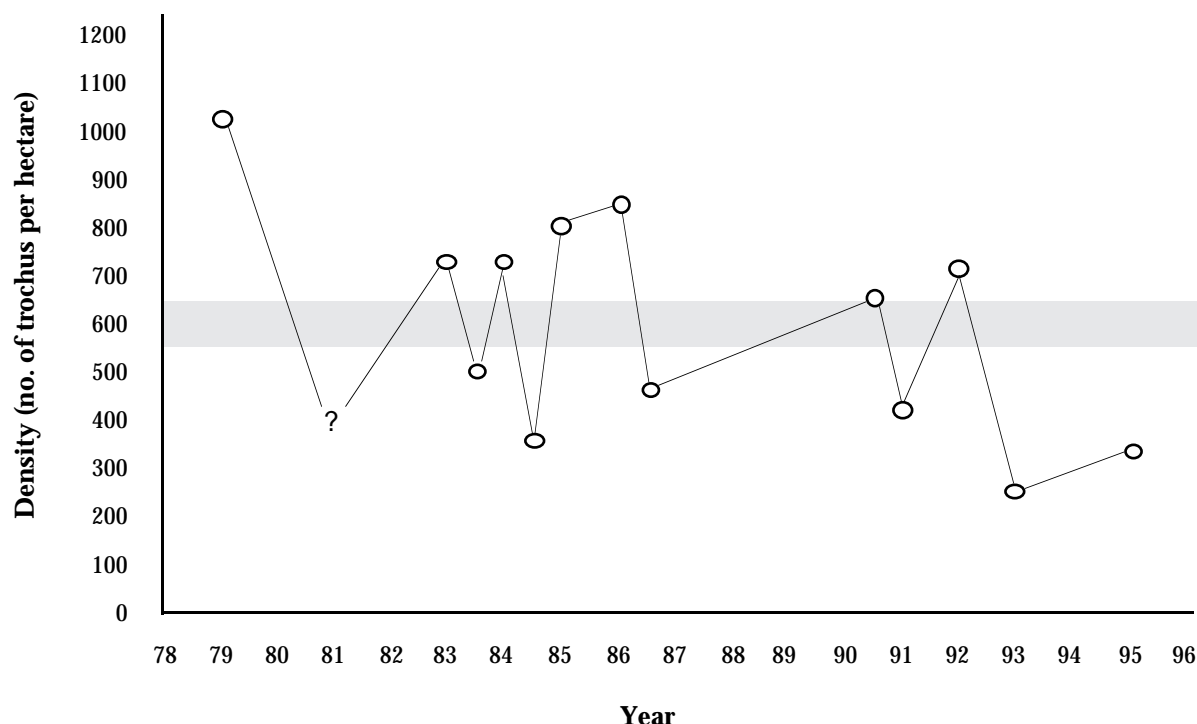


Figure 1. The history of density estimates (individuals/hectare) for the Aitutaki trochus resources. The closed circles represent post-harvest density estimates. The shaded bar indicates the approximate density guideline in which trochus harvest are declared.

applicable figure (between 30 and 60%) from which harvest quotas can be calculated. There is also a need to ensure that the reserve is strictly enforced and poachers prosecuted, in order to reduce future poaching.

Further trends in the future are to produce a simple handbook on how to assess the trochus population and interpret field data on Aitutaki and possibly the development of a computer program in which catch quotas and individual transferable quotas are determined. This would most certainly reduce the risk of errors in stock assessment and analysis. Hopefully this will ensure that it becomes difficult for bureaucrats to tinker with the system.

It is anticipated that these goals will be achieved prior to the exploitation of trochus resources on other islands within the Cook Islands.

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Spatial distribution of trochus population size structure around Aitutaki barrier reef

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One result of the MMR/SPC Aitutaki trochus fishery case study in 1992 (see Nash et al., 1995) was a large set of shell diameter-frequency data from various sites around the reef. This arose both from transect surveys to assess pre-harvest stock abundance (thus covering the whole size range of trochus apart from the first, more cryptic age-class), and from harvest sampling (thus covering only the legally fishable size range between 80 and 110, later 120, mm diameter).

In total, 11,582 shells were measured during the transect surveys and 7,232 shells were measured during the harvest. It was estimated, from a mark-recapture experiment, that the population just prior to the August 1992 harvest was around 315,000 shells (not including

the cohort from the previous summer spawning), and it is known that 49,000 shells (in the 80–120 mm size-range) were collected during the harvest.

One interesting property of these size-frequency data is the great variation in size structure at the different sites around the barrier reef (see Figure 1). This is not haphazard variation, but follows a consistent cline around the reef, with the greatest proportion of juvenile shells on the northeast face of the reef and the greatest proportion of large shells on the southern face.

This is shown clearly by the histograms that were published in Figure 3 of Nash et al. (1995) and is summarised in Figure 2 here.