

SPC/Inshore Fish. Res./BP. 37
10 March 1988

ORIGINAL: ENGLISH

SOUTH PACIFIC COMMISSION

WORKSHOP ON INSHORE FISHERY RESOURCES
(Noumea, New Caledonia, 14-25 March 1988)

TROCHUS RESEARCH IN THE COOK ISLANDS AND ITS IMPLICATIONS FOR
THE MANAGEMENT

by

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SUMMARY:

The history of introductions of trochus to the Cook Islands, and subsequent harvest seasons on Aitutaki are described. Stock assessment survey data from 1974 (pioneer stock) to 1987 are presented, with estimates of size-class distributions and abundance of trochus. The population has recovered well from earlier periods of heavy fishing (1980-81, and 1984). Size class distributions show a recent shift, with fewer larger trochus (greater than 11 cm) but more trochus in the fishable size-range (8 cm to 11 cm). Although this increased potential yield is encouraging, there is a need for caution, as the decrease in breeding stocks could result in lessened recruitment in future.

The effectiveness of harvest regulations are examined. The current practice of a series of 24 hours harvest seasons is a useful way of constraining quotas overruns, and effectively enforcing other regulations. The reserve appears to be ineffective in maintaining concentrated brood stocks, because of poaching or post-harvest dispersion of trochus.

TROCHUS RESEARCH IN THE COOK ISLANDS **AND ITS IMPLICATIONS FOR MANAGEMENT**

1. INTRODUCTION

1.1 Introduction History

Trochus niloticus was introduced to Aitutaki, in the Cook Islands from Fiji in 1957. This initial introduction, and its obvious success has been described elsewhere (Powell, unp, and 1957; Van Pel, 1957; Sims, 1985).

Since the late 1970's, a series of attempts have been made to introduce trochus to other islands in the Cooks. Initial trochus introductions to the short bench reefs of the 'makatea' islands in the South were largely unsuccessful. A lack of suitable habitat for trochus (on the bare, low-relief reefs), and poor recruitment levels (with heavy larval run-offs) are likely to have prevented stocks establishing themselves.

In the northern group atoll islands, the introductions have reportedly been more successful, with large adult trochus being found on Manihiki over two years after release. There has been, as yet, no evidence of successful reproduction. Specific details of introductions to each island, and their success, or otherwise, are given in Table 1.

1.2 Transshipment Methods

Earlier efforts to transport trochus between islands often resulted in high mortalities because of poor handling techniques and holding systems. Later attempts utilizing air-freight services to the Southern Group islands, and vessels with circulating sea-water tanks on trips to the North were more successful. Finally, development of the "flooded skiff" method sufficiently solved the problem of a suitable transshipment method, and a series of successful transshipments have been subsequently undertaken. (see Gillett, 1986, for a comparison of success rates between methods).

2. STATUS OF STOCKS

2.1 Harvest History

Trochus began to be commercially fished in Aitutaki in 1981, when an estimated 200 tonnes or more were taken over a 15 month period. Later harvests were more effectively

controlled, with quotas usually set at, or below 30% of standing stocks. This estimate of allowable harvest ratio was obtained from a series of pre- and post-harvest surveys, using cross-reef belt-transects to provide measures of stock abundance, harvest impact, and stock recovery between harvest seasons. (see Sims, 1985). This level of exploitation appears to represent a fair approximation of sustainable yield, as stocks have shown slight increases or decreases as actual harvest tonnages have been less than, or greater than this percentage (See Figure 1, and Table 2).

2.2. Stock Abundance

Recently obtained survey reports from earlier years, before the trochus stocks were fished, provide some information on the establishment of the pioneer population on Aitutaki. Estimates of standing stock derived from these surveys show a dramatic increase in trochus abundance over a five year period, from 35,000 trochus in 1974 (Marsters and Wichman, unp) to 470,000 trochus, in 1979 (Dashwood, unp). The 1974 estimate is likely to be a gross underestimation, but no description of the methodology used is provided. The 1979 figure was obtained by standard belt-transects, and may be taken as accurate.

Trochus stocks on Aitutaki appear to have recovered well from the earlier period of overfishing during the 1981, and 1984 harvests as evident from Table 2 and Figure 1. It is evident that the population is currently at around 20% less than the greatest previous recorded abundance (Dashwood, unp). Maximum carrying capacity of the reef may in fact be beyond this level.

In recent harvests, quotas have been set at less than 30% of standing stocks, to both minimise overruns, and to allow an increase in standing stock levels. Although resulting in slightly decreased returns to fishermen for these harvest periods, such conservatism is warranted in light of the almost universal experience of over-fishing of trochus stocks, even when rational management approaches have been attempted (eg; Rao, 1937; McGowan, 1958; Devambez, 1959; Heslinga and Hillman, 1981; Bour et al, 1982; Nash, 1985; and Yen, 1985).

Higher standing stocks may, through increasing the population's reproductive capacity, produce higher sustainable yields. The partitioning of the reef according to size-classes of trochus indeed suggests that juvenile stocks will not be limited by adult abundance. A policy of fostering gradual stock increases may perhaps result in slight detriments, (in terms of lessened returns for a period) but, with the current lack of understanding of

trochus population dynamics, is the only means of testing for the optimum level of standing stocks.

2.3. Population Size Structure

Trochus stock assessment surveys have included recording of sizes of all trochus encountered (generally to the nearest half centimetre). This has allowed monitoring of changes in relative and absolute abundance of trochus size-classes. Figures 2A, 2B, and 3 show the shifts in population structure which have occurred from pioneer and virgin populations, (1974, and 1979), through the period of heavy exploitation, (1984, 1985 and 1986 surveys), up to the current situation (1987).

Absolute abundance of the 12 cm size class has varied by 20,000 trochus, either side of the 1984 and 1985 estimates of around 60,000 individuals, (Figure 2B), and currently stands at a lowest estimate of around 40,000 (Figure 2A). There has been, also, a gradual decrease in absolute abundance estimates for the 11 cm size class (Figure 2B), to a current level of 106,000 trochus, or 28% of the population (Figures 2A and 3, respectively). However, a marked increase in abundance of smaller fishable size classes (9 and 10 cm) was evident in 1987, to levels slightly greater than that of the unfished (1979) population.

Although this increased recruitment into the fishable stock is a positive sign, there is still need for caution, with the dynamics of trochus populations still so poorly understood. The planned increases in stock abundance are a necessary insurance, so that shifts in population structure, such as the decreasing abundance of larger sized trochus, do not produce any dramatic slump in fishable stocks.

3. HARVEST REGULATIONS

3.1. Tonnage Quotas

Quotas were, for initial harvests, declared arbitrarily. From 1984 onwards, with the approximation of allowable harvest ratio to work from, quota estimates were set on a more deterministic basis (see Table 2). The task of enforcing quotas using landed tonnages as the sole criterion was, however, difficult. Trochus Inspectors were required to monitor all landings as the harvest progressed, and this proved logistically impossible.

The highly unpredictable nature of fishing intensity means that using quotas as the principal control over effort will always be problematical. Obviously, if the effort cannot be predicted, or reasonably controlled (by, for example, limiting entry into the fishery; a socio-economically and politically unacceptable option), then harvest duration must be better regulated.

3.2. Harvest Durations

Harvest periods had earlier been limited in duration to three months, but the fishing intensity during the 1984 season demonstrated the ineffectiveness of broad time scales as a means for controlling harvests.

The emphasis was, then, shifted to the use of duration of the harvest season as the principal limitation, with previous maximum daily landings used as a guide to how long a harvest should be permitted given a certain allowable tonnage. This resulted in, for the two most recent harvests (1985, and 1987) tightening of the harvest period to, respectively, three consecutive days and, two separate periods of 24 hours, separated by a one month interim. Progressively better predictions of total harvest returns have thereby been obtained. (See Table 2).

Further, the discrete one day harvests have also allowed an increased level of control over size-regulations, and illegal stock-piling activities. By requiring that all harvested trochus be approved by the Trochus Inspectors before they are killed, cooked, or cleaned, means that illegal sized trochus are returned to the reef alive. Also, with practice, an inspector can fairly easily tell if an animal has been sitting for the last few days in a sack on the beach or in the water. Estimates are also obtained of the weight of shell harvested by each individual licensee which can be later compared with the buyers' records of shell weights purchased. Stockpiling activities can thereby be largely contained.

.3. Size Regulations

Initially, upper and lower size restrictions were imposed on the basis of those regulations employed in, or recommended for trochus fisheries elsewhere in the Pacific (Yen, 1985; Nash, 1985; Bour and Hoffschir, 1985). For the harvests up until 1983, inclusive, size regulations were set between 3 and 5 inches (8 and 12.5 cm). Following the work of Bour, et al, (1982), with their identification of optimum yields per recruit at between 9 cm and 10 cm for differing mortalities

(ibid. p 43 and Figure 16 and 17), the upper size limit was lowered to 11 cm. This also had the added benefit of protecting more of the larger, more fecund animals.

As the legislative package comes into force is planned to shift the onus for size regulations onto the buyers, by requiring certificates of approval before allowing export.

4 Reserves

Breeding reserves or sanctuaries are a practical and fairly easily enforceable management option for commercially exploited reef species such as trochus. Reserves were often used in earlier attempts to manage trochus stocks, although their usefulness was largely assumed. The real value of reserves was only addressed in detail in recent work in Palau (Heslinga, et al., 1985).

On Aitutaki, a reserve was established over a 3 km stretch on windward reef in 1983, and has remained in force since. The size of the reserve was decided arbitrarily. Originally a 1 km length of reef was proposed to the Island Council, but recognising the value of such measure, they expressed a wish that the area be extended. The location of the reserve on the windward reef was designed to promote retention of planktonic larvae in the lagoon.

Pre- and post-harvest surveys of trochus have suggested that the reserve has been heavily fished during harvests (see Figure 4). The correlation of trochus density fluctuations between Station IX (topographically similar to the Reserve), and Station X throughout a series of harvests indicate that either poaching, or dispersion of trochus was maintaining the reserve population at a level close to that of the rest of the stock. No suitably isolated reef area exists where trochus concentrations could be retained. Poaching has been noted on several occasions, however, and stronger enforcement measures are obviously needed if it is to become an effective component of the resource management strategy.

4. FUTURE DIRECTIONS

From the Cook Islands' perspective, the most pressing issues surrounding trochus research, development, and management seem to have been resolved. A stable, productive fishery has been established on one island, and successful introductions undertaken to those other islands likely to be able to support commercially exploitable stocks. A relatively simple means of setting allowable catch levels has been identified, and while still requiring further trialling and development, has proven most adequate. Management and enforcement mechanisms are approaching an acceptably water-tight level, and require now only the supporting legislation.

**TABLE 1 :TROCHUS INTRODUCTIONS TO
THE COOK ISLANDS**

ISLAND			INTRODUCTIONS			
<u>Name</u>	<u>Type</u>	<u>Reef</u>	<u>Year</u>	<u>Number</u>	<u>Status</u>	<u>Success</u>
Southern		Group				
Aitutaki	Almost- -Atoll	Barrier/Fringe/ /Bench	1957	40	Abundant	
Rarotonga	High	Fringe/Bench	1983	200	Rare	
Mangaia	Makatea	Bench	1983	300	Rare/Extinct	
Atiu	Makatea	Bench	1982	300	" / "	
Mauke	Makatea	Bench	1983	300	" / "	
Mitiaro	Makatea	Bench	1982	300	" / "	
Manuae	Atoll	Barrier/Bench	1981 1986	500 600	Present	
Palmerston	Atoll	Barrier	1981 1982	2000 1000	Common	
Northern		Group				
Penrhyn	Atoll	Barrier/Bench	1985	440	Present	
Manihiki	Atoll	Barrier/Bench	1985 1986	400 1040	"	
Rakahanga	Atoll	Bench	1985 1986	690 1050	"	
Pukapuka	Atoll	Barrier/Bench	1986	1220	"	
Suvarrow	Atoll	Barrier	1985 1986	460 1000	"	

TABLE 2 : TROCHUS ABUNDANCE AND HARVESTS

ON AITUTAKI. 1979-1987

YEAR	1980-81	1983	1984	1985	1986	1987
STOCK ESTIMATE ('79 est)	470,000	336,000	339,000	305,000	360,000	385,000
QUOTA (Tonnes)	30	20	20	20 (est TAC)	No harvest	40 (est TAC)
DECLARED DURATION	3 mths	3 mths	3 mths	3 days	"	2 Days
ACTUAL DURATION	15 mths	3 mths	12 days	3 days	"	2 @ of 24 hours
LICENCES (Number)	?	42	300	250	"	Day 1 190, Day 2 233
HARVEST (Tonnes)	? 200 ?	35.7	45.7	27.0	"	Day 1 12.0 Day 2 33.1
HARVEST RATIO		31%	49.8%	26.5%	"	Day 1 11.5% Day 2 36%
C.P.U.E. (kg/man.day)	No accurate harvest data 1980-81	7	13	36	"	Day 1 63, Day 2 141
REMAINING STOCK	?	232,000	170,000	224,000	360,000	217,000

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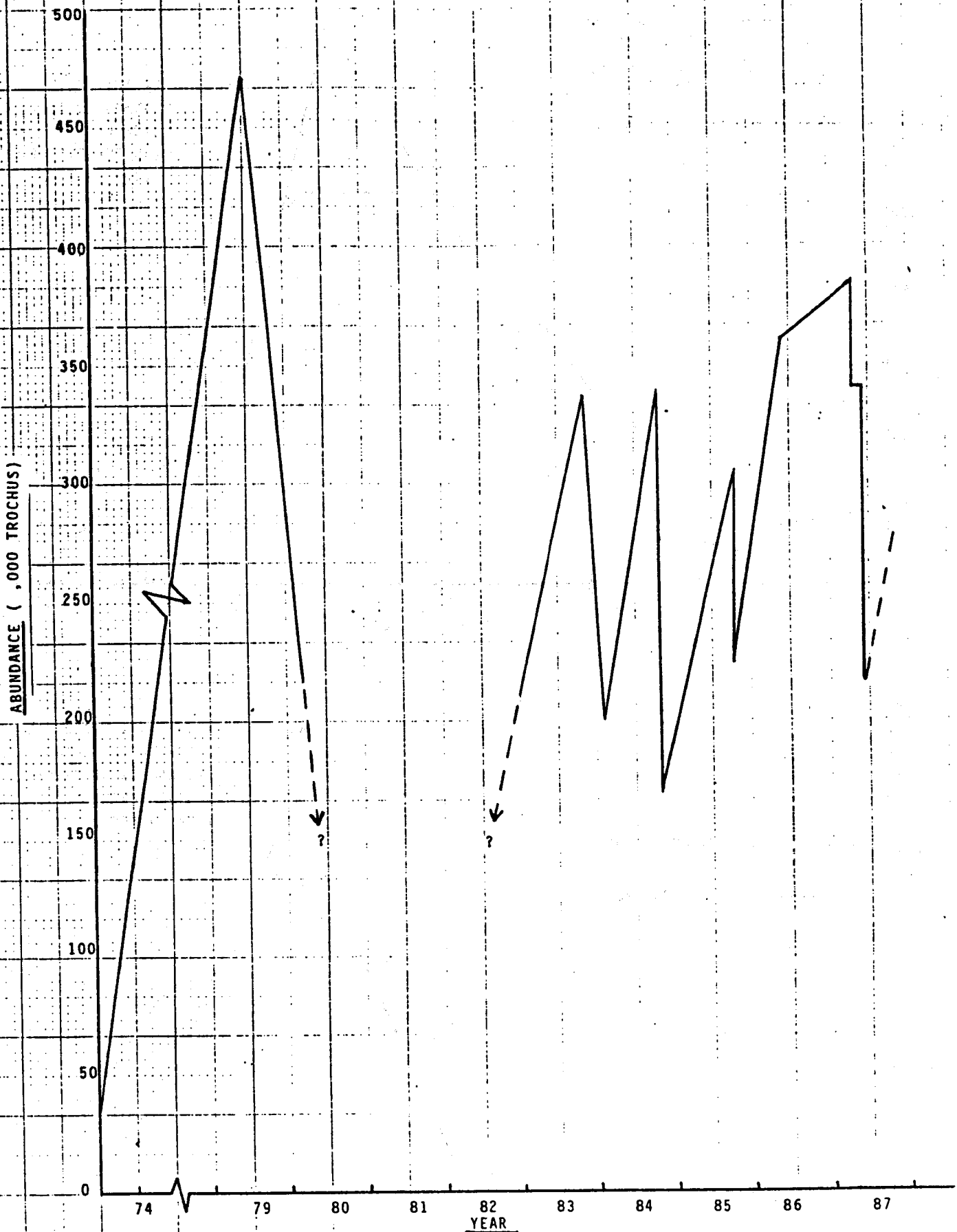
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FIGURE 1: ABUNDANCE OF TROCHUS ON AITUTAKI
OVER TIME



NOTE: DECREASED ABUNDANCE, RESULTING FROM HARVESTS GENERALLY COMPUTED
FROM TONNAGE FIGURES - SEE TABLE 2.

