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Breeding Season of the Tongan Shellfish 3. Elongated Giant Clam (Kukukuku), *Tridacna maxima*

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Abstract

Monthly samples of *T. maxima* were taken at Vuna Wharf fish market in Tongatapu Island from April 1992 to March 1993. *T. maxima* at 40-59 mm SL were all male. The ratio of hermaphrodite shells gradually increased from 60 mm SL to 140 mm SL at which size all shells become hermaphrodite. The spawning of *T. maxima* seems to occur intermittently throughout the year as indicated by the wide range of gonad indices, from 0 or less than 10 to more than 30, in most of the months.

Introduction

The elongated giant clam, *T. maxima*, out of all the giant clams caught in the Kingdom of Tonga is the dominant species in terms of the amount of landings at the Tongatapu fish market. In spite of their commercial importance, there has been only one study on the biology of this species in Tonga (Mckoy 1980). This study deals with some of the basic biological features such as size at sexual maturity, sexual phases and the spawning season of *T. maxima*.

Materials and Method

Samples of *T. maxima* were taken at Vuna Wharf fish

market once a month from April 1992 to March 1993. Most of *T. maxima*, except for a small number of large individuals, are displayed at the fish market after packaged in coconut leaf baskets which contain from 9 to 38 clams. One basket of giant clams was bought at each sampling time. The total number of sampled giant clams during the study period was 293. Measurements were taken on shell length (SL), total wet weight, wet soft body weight (FW) and wet gonad weight for all giant clams sampled. The gonad weight included weight of a part of the digestive mass since it is difficult to completely separate the digestive mass from the gonad. The weight of an almost empty gonad was recorded as 0 g. The gonad index (GI) was calculated as

$$GI = 100 \cdot \text{wet gonad weight (g)} \ / \ \text{wet soft body weight (g)}$$

Then the gonads were observed on all giant clams either by the naked eye or under a microscope to examine the occurrence of eggs in the gonads. Those clams which had eggs in the gonads were classified as hermaphrodite and those which had only sperms were classified as male.

Results

Table 1 shows the number of clams sampled each month and the fishing grounds where they were obtained. The fishermen of 'Afa village (situated on the northeastern coast of Tongatapu Island) caught all giant clam samples from the northeastern reef batches of Tongatapu Island, namely Tau, 'Ata, Motutapu and Fukave islands. Ha'atafu and Kolovai are both situated on the western most coast of Tongatapu Island (Fig. 1).

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Table 1. Fishing grounds and sample number of monthly samples.

Month	Fishing ground	Number of clams sampled
April	'Ata	9
May	'Ata	22
June	Kolovai	24
July	Motutapu	24
August	Ha'atafu	38
September	'Ata	32
October	Tau	26
November	Motutapu	20
December	Tau	16
January	Tau	25
February	Fukave	41
March	Tau	16

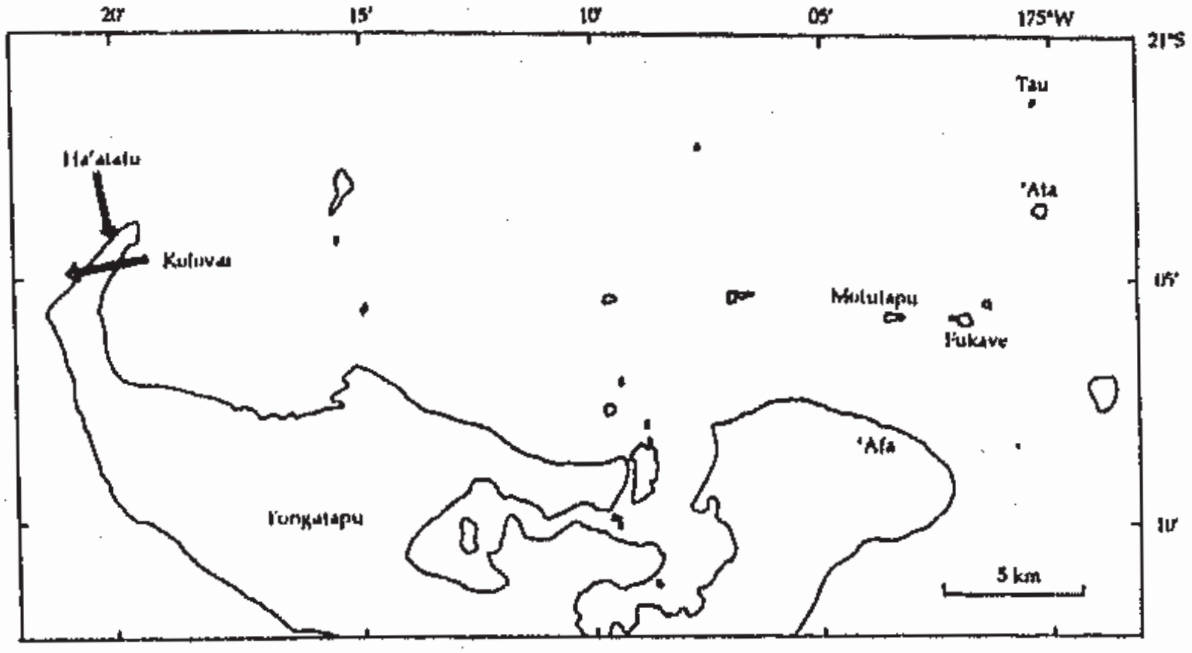

Fig. 1. Map showing fishing grounds of *T. maxima*.

Fig. 2 shows the shell length distribution for all *T. maxima* sampled during a one year period. The range of shell length was 55.9 mm to 194.5 mm (average 113.5 mm). The total weight ranged from 42.6 g to 1,304 g (average 264.2

g) whist the soft body weight ranged from 6.3 g to 177.4 g (average 41.6 g).

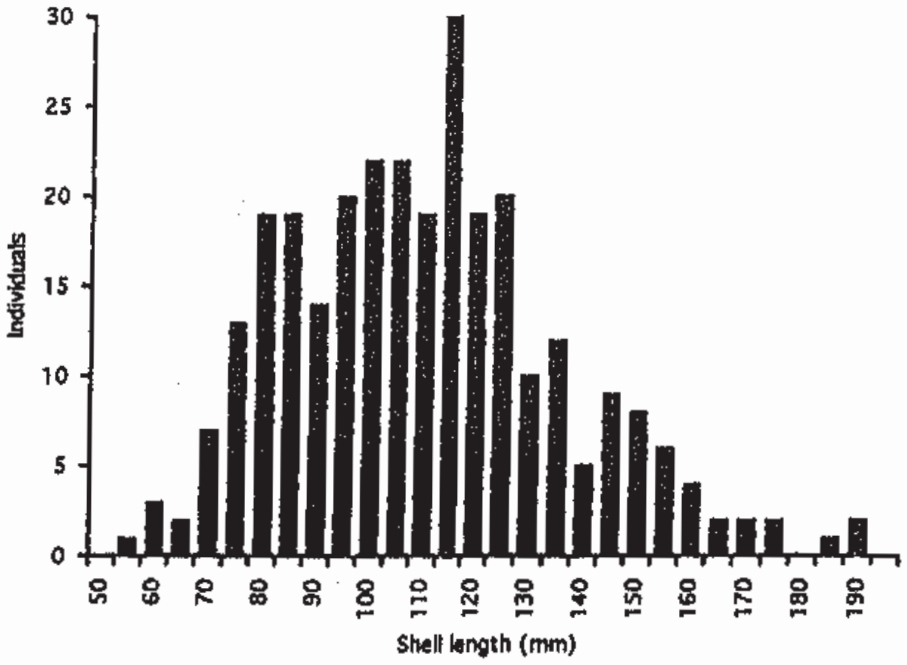

Fig. 2. Shell length distribution of *T. maxima* samples.

The relationship between shell length and soft body weight is shown in Fig. 3. The relationship is well represented by the curve:

$$FW = 0.0001219 \cdot SL^{2.665}$$

Table 2 shows the sexual phase composition of all samples against shell length. The smallest clams in the hermaphrodite phase were 60-70 mm in shell length. All clams larger than 140-150 mm in shell length were in the hermaphrodite phase. Fig. 4 shows the relationship between shell length and gonad index. The figure suggests

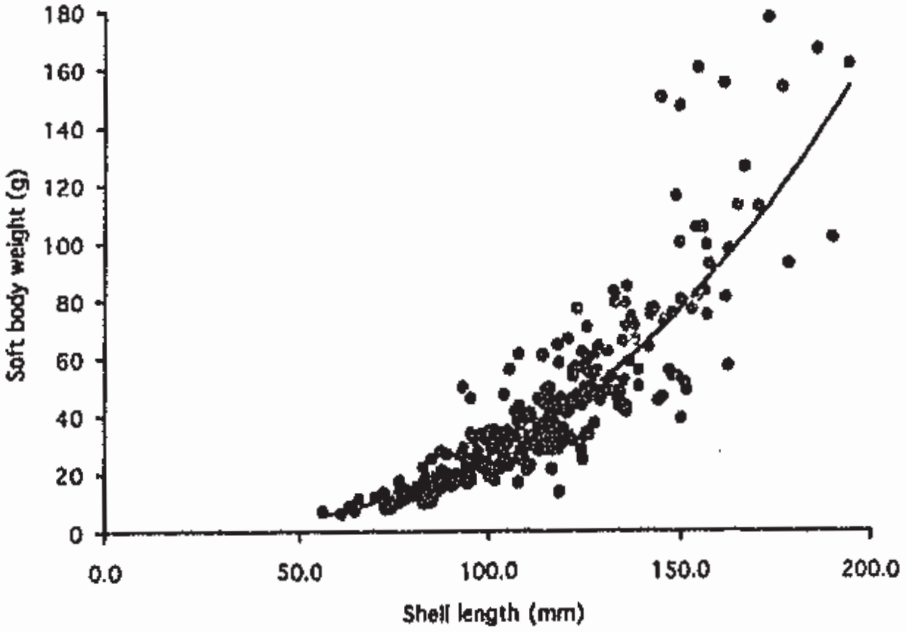

Fig. 3. Weight-length relationship of *T. maxima*.

Table 2. Composition of sexual phases of *T. maxima* by size group.

Size group (mm)	Unidentified	Male	Hermaphrodite Number	(%)
50-60		1		(0.0)
60-70		3	2	(40.0)
70-80	2	7	11	(55.0)
80-90	2	6	30	(78.9)
90-100		3	32	(91.4)
100-110		1	43	(97.7)
110-120		6	42	(87.5)
120-130		1	37	(97.4)
130-140		1	21	(95.5)
140-150			17	(100.0)
150-160			11	(100.0)
160-170			6	(100.0)
170-180			4	(100.0)
180-190			2	(100.0)
190-200			2	(100.0)

that the maximum GI increased as shell length increased until 110-120 mm SL as shown by the broken line. This in turn may mean that the clams smaller than 110-120 mm SL did not attain full maturity.

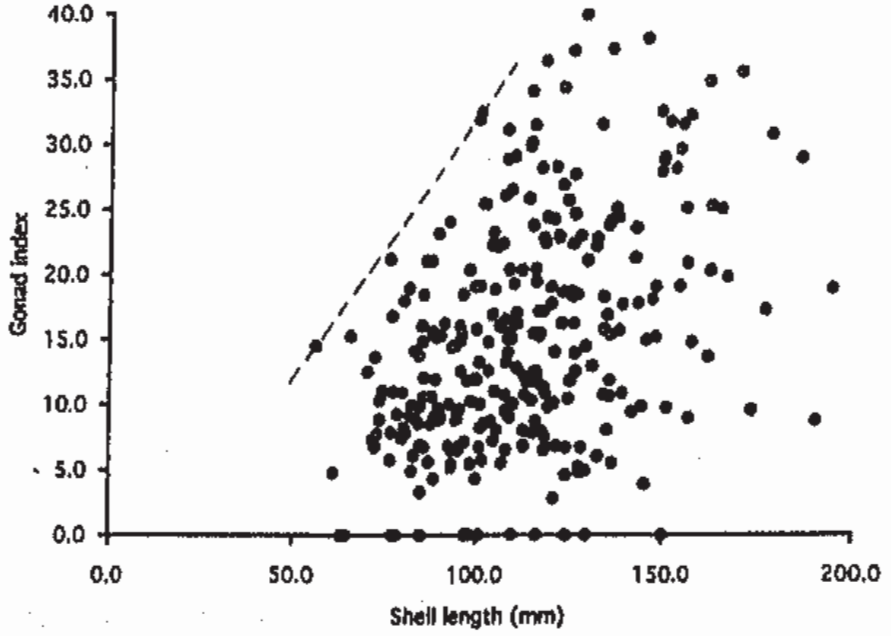

Fig. 4. Gonad index-shell length relationship of *T. maxima*.

Fig. 5 shows the maximum, average and minimum of the gonad index in each month. The monthly maximum gonad index was over 30 throughout the year except for May, December and February when the maximum gonad index was between 20 and 30, and January when the maximum gonad index was below 20. The average gonad index fluctuated around 15 with the highest of 21.1 recorded for October and the lowest of 10.2 recorded for January. The monthly minimum gonad index was 0 for seven sampling months and ranged between 2.8 and 6.7 for the remaining five sampling months. The wide ranges of the gonad index recorded each month, except January, indicate the occurrence of

intermittent spawning events throughout the year. The relatively low gonad index recorded in January may indicate the occurrence of mass spawning just before the sampling date.

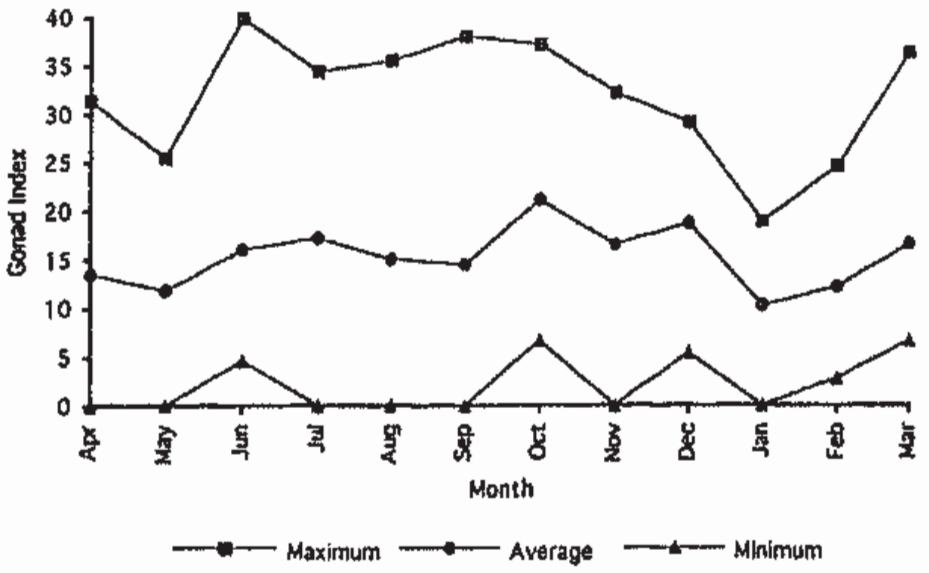

Fig. 5. Monthly maximum, average and minimum of gonad index of *T. maxima*.

Discussion

Mckoy (1979) shows that almost all of the *T. maxima* were male at 50-69 mm SL, 50% were hermaphrodite at between 100 and 109 mm SL and 100 % were hermaphrodite at over 140 mm SL. However, this study showed that the clams were male at below 59 mm SL and more than 50 % of the clams were hermaphrodite at 70-79 mm SL. The sizes that were 100% hermaphrodite were the same as Mckoy's (Fig. 6). This study did not find a reason for the discrepancy between the two results.

A gonad index or gonad weight ratio (=GI/(1-GI)) was

used to examine the reproductive cycle of giant clams, *T. crocea* and *Hippopus hippopus* in Australia (Shelly and Southgate, 1988) and *T. crocea* in Japan (Murakoshi and Kawaguti, 1986). The Australian study showed that spawning events occurred in November for *H. hippopus* and

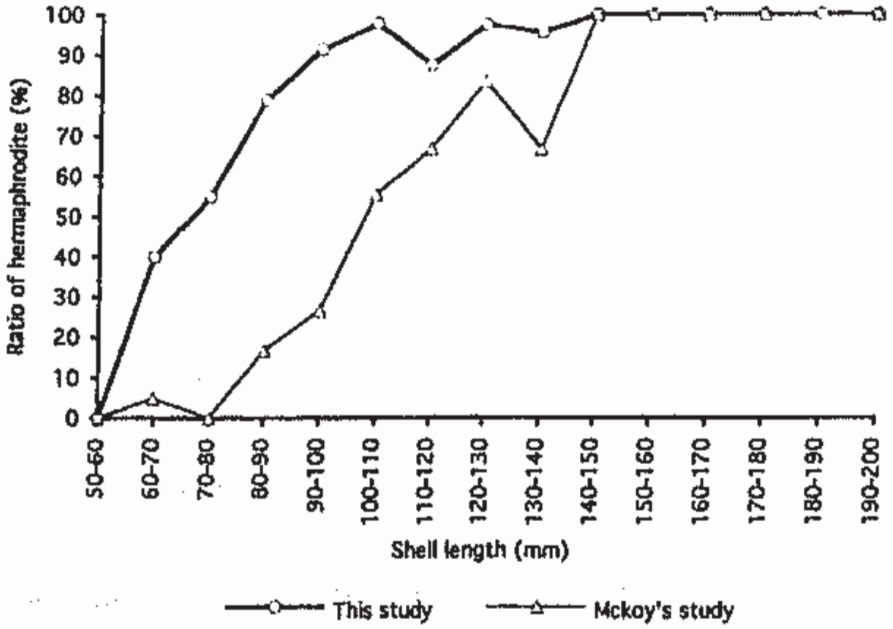

Fig. 6. A comparison of ratios of hermaphrodite of *T.maxima* by shell length range between results of this study and Mckoy's study.

October-November for *T. crocea*. The Japanese study showed that spawning events of *T. crocea* occurred from spring to summer. The Japanese study also showed that a complete release of gametes was ignited by a typhoon at the end of summer and this is indicated by the sudden drop in the gonad index. However, no clear seasonal tendency was observed in the changes of the gonad index for *T. maxima*. This, together with the wide range of gonad index observed in each month, suggests that there is no clear spawning season

for *T. maxima* in Tonga.

References

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