

GIANT CLAMS IN THE ANDAMAN SEA, THAILAND. PART 1: DISTRIBUTION AND ABUNDANCE AT RAWI, BUTANG AND KATA ISLANDS

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ABSTRACT

Three species of giant clam, *Tridacna squamosa*, *T. maxima* and *T. crocea*, were encountered east of Rawi Island. The species *T. crocea* and *T. maxima* were common at all stations but only few *T. squamosa* were encountered. The densities of *T. maxima* and *T. crocea* were higher on the reef flat than on the reef slope. Both species were found from the littoral zone to a depth of 7 m. *T. crocea* was smaller on the reef flat than the reef slope, while *T. maxima* differed only slightly (non-significant) in the same habitats. Shell lengths ranged from 1 to 15 cm in *T. crocea*, from 1 to 34 cm in *T. maxima* and from 9 to 40 cm in *T. squamosa*.

INTRODUCTION

Giant clams are the largest bivalves in the world. They inhabit coral reef areas with clear water. Giant clams occur in many countries in the Indo-Pacific region (Rosewater 1965; Lucas 1988; Lucas 1991). There are eight extant species within two genera namely *Hippopus hippopus*, *H. porcellanus*, *Tridacna crocea*, *T. derasa*, *T. gigas*, *T. maxima*, and *T. squamosa* (Calumpang 1992). Only three species (*T. crocea*, *T. maxima* and *T. squamosa*) are commonly found in Thai waters (Chantrapornsyl *et al.* 1996). In Thailand, most giant clams were previously harvested for ornamental purposes and their adductor muscles were consumed. The high demand led to intensive harvesting of giant clams, which caused overexploitation of the stocks (Adulyanu-

kosol 1997; Chantrapornsyl *et al.* 1996).

Rawi Island is a part of Tarutao Marine National Park, Andaman Sea, located off Satun Province, Thailand. The island is under monsoonal influence: NE monsoon (November-April) with hot and dry weather, and SW monsoon (October-May) with rain and thunderstorms (Upanoi & Banchongmanee 1998).

This study is a part of the survey on coral reef resources under the EU-Department of Fisheries Cooperation: "The Pilot Project for Marine Ecosystem in Protection and Eco-sustainable Development in the Adang Archipelago, Tarutao Marine National Park, the Andaman Sea, Thailand". The aim of this study is to assess giant clam stocks around Rawi Island with a view to provide data for further study and preservation.

MATERIALS AND METHODS

Five reef sites referred to as L-O (Fig.1) were established to study size frequency, distribution, and abundance of giant clams at Rawi, Butang and Kata islands. Two stations (reef flat and reef slope) were surveyed at each site except at site P where only the reef slope was surveyed. No site was established on the north coast of Rawi Island due to limited occurrence of coral reefs. At each station, actual count and measurement (Fig. 2) of giant clams were conducted along five belt transects, each 50 x 4 m. The assessments were made by two Scuba divers, one on each side of the belt. Two-way ANOVA was used to analyse the variations of den-

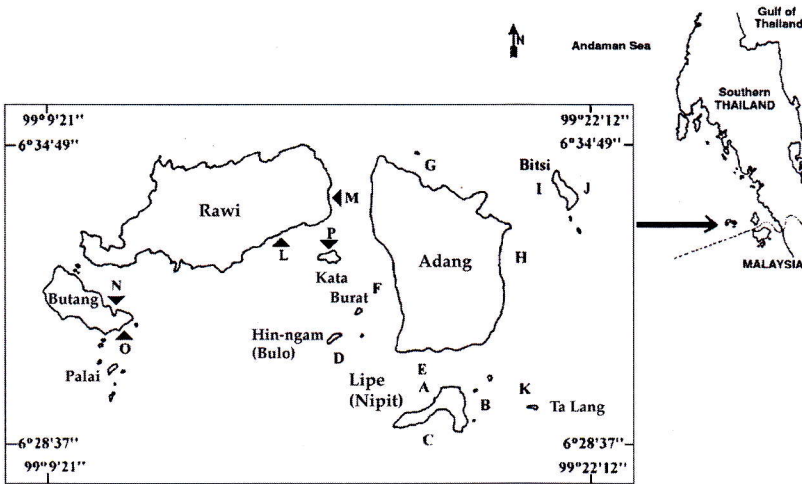


Figure 1. Study sites at Adang-Rawi Island group.

sity and mean shell length of giant clams at each reef zone. The Student-Newman Kuel's test (S-N-K) was used to separate significant differences ($p < 0.05$). S-N-K tests were performed on data transformed to $\log_{10}(x+1)$.

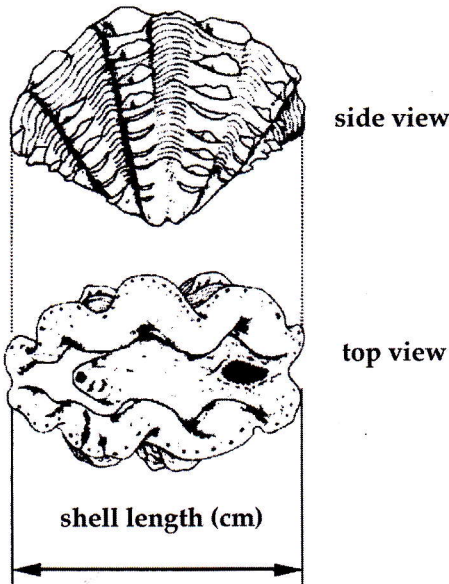


Figure 2. Schematic illustration for size measurement of giant clam.

RESULTS

THE SPECIES

Three species of giant clam, *T. crocea*, *T. maxima*, and *T. squamosa* were found at Rawi, Butang and Kata Islands. The most abundant species was *T. maxima* (Table 3). The numbers of *T. crocea* and *T. maxima* were rather constant at most sites while only a few *T. squamosa* appeared at some stations. The highest abundance the three species occurred to the south of Rawi Island (site M).

ABUNDANCE

Tridacna squamosa. - At a total of 5 sites, there were only 23 individuals of *T. squamosa* with an average density of 0.5 ± 0.7 ind./200 m².

Tridacna maxima. - This species was found at all sites, both on reef flat and the slope. The average density was 25.4 ± 20.9 ind./200 m². It was most abundant on the reef slope on the east side of Rawi Island (site L) with an average density of 65.6 ± 24.7 ind./200 m². There was a significant difference in mean of *T. maxima* per 200 m² at each station (two-way ANOVA, $p < 0.05$). The probabilities of means were grouped (3 groups) for Post Hoc Tests (Student-Newman Kuel's test). In the first group gi-

ant clams occurred at an average density of 1.2 ± 1.6 ind./200 m² (reef slope at site M). In the second group there were only few clams (reef slope of Site N and O). The last group had high density of giant clams (reef flat of sites L, M, N, O and reef slope at site L) (Table 1).

Tridacna crocea. - This clam was generally found on the reef flat at every site, while there were few clams on the reef slope except at site L. The average density was 5.6 ± 3.5 ind./200 m². The species was most abundant on the reef flat east of Rawi Island (Site M) with 90.4 ± 46.0 ind./200 m². There were significant differences (two-way ANOVA, $p < 0.05$) in mean of density of *T. crocea* between each station. Post Hoc Tests showed that there were few clams, 0.0 to 0.6 ± 0.8 ind./200 m² in the first group (the reef slope at sites M, N and O). In the second group there were from 21.2 ± 11.3 to 28 ± 24.2 ind./200 m² on the reef flat at site O

and the reef slope at site L. In the third group there were from 33.6 ± 1.1 to 90.4 ± 46.0 ind./200 m² on the reef flat of sites L, N and M (Table 1).

SHELL LENGTH

Tridacna squamosa. - The shell length *T. squamosa* ranged from 9 to 40 cm, with an average of 19.7 ± 10.5 cm. The smallest clam was found on the reef flat at site O while the biggest clam occurred on the reef slope at site M.

Tridacna maxima. - The shell lengths of *T. maxima* ranged from 2 to 32 cm, with an average of 10.3 ± 6.5 cm. There was a significant difference in average shell lengths of *T. maxima* between each reef zone (two-way ANOVA, $p < 0.05$). The average shell lengths of *T. maxima* were grouped in two groups (Student-Newman Kuel's test). The first group was small clams found on the reef flat of site L, M, and N and on the reef slope

Table 1. Significant differences among sampling stations, based on the S-N-K test, for mean abundance of individual species. Underlined sites/stations indicate homologous group of mean. The 1st letter designates the site and the 2nd letter represents reef stations where F = reef flat, S = reef slope.

<i>T. maxima</i> mean density (ind/200m ²)	1.2	6.6	17.0	37.0	37.2	38.0	39.2	65.6
Station/site	<u>MS</u>							
Station/site		<u>NS</u>	<u>OS</u>					
Station/site				<u>MF</u>	<u>OF</u>	<u>LF</u>	<u>NF</u>	<u>LS</u>
<i>T. crocea</i> mean density (ind/200m ²)	0.0	0.2	0.6	21.2	28.2	33.6	46.6	90.4
Station/site	<u>MS</u>	<u>NS</u>	<u>OS</u>					
Station/site				<u>LS</u>	<u>OF</u>			
Station/site						<u>NF</u>	<u>LF</u>	<u>MF</u>

Table 2. Significant differences among sampling stations based on the S-N-K test, for mean shell length of individual species. Underlined stations/sites indicate homologous group of mean. The 1st letter designates the site and the 2nd letter represents reef stations where F = reef flat, S = reef slope.

<i>T. maxima</i> mean shell length (cm)	8.50	9.07	9.30	10.29	11.43	12.74	14.89	17.83
Station/site	<u>NF</u>	<u>MF</u>	<u>LF</u>	<u>LS</u>	<u>OF</u>	<u>OS</u>		
Station/site							<u>NS</u>	<u>MS</u>
<i>T. crocea</i> mean shell length (cm)	0.00	4.46	5.83	6.53	6.74	7.57	8.00	8.76
Station/site	<u>NF</u>	<u>MF</u>	<u>LF</u>	<u>LS</u>	<u>OF</u>	<u>OS</u>		
Station/site							<u>NS</u>	<u>MS</u>

Table 3. Average shell length (\pm SD) and average density (mean \pm SD) of giant clams at each site. RF = reef flat station, RS = reef slope station, SD = standard deviation, Si = site, St = station, D = mean depth, Ind. = number of individuals at sites, *Tot* = overall averages and total numbers.

Si	St	D (m)	<i>Tridacna squamosa</i>			<i>Tridacna maxima</i>			<i>Tridacna crocea</i>		
			Ind.	shell length (cm)	density (ind/m ²)	Ind.	shell length (cm)	density (ind/m ²)	Ind.	shell length (cm)	density (ind/m ²)
L	RF	1.5	3	14.0 \pm 4.0	0.6 \pm 0.8	186	9.3 \pm 4.8	38.0 \pm 19.9	233	5.8 \pm 3.0	46.0 \pm 14.6
	RS	2.9	3	15.3 \pm 8.3	0.6 \pm 0.5	451	10.2 \pm 6.2	65.6 \pm 24.7	106	7.5 \pm 3.9	21.2 \pm 11.3
M	RF	1	3	20.0 \pm 17.3	0.6 \pm 0.8	185	9.0 \pm 6.0	37.0 \pm 3.7	452	4.4 \pm 2.8	90.4 \pm 46.0
	RS	6.5	1	34.0	0.2 \pm 0.4	6	17.8 \pm 3.6	1.2 \pm 1.6	0	-	0
N	RF	2	0	-	-	196	8.5 \pm 4.7	39.2 \pm 11.0	152	6.5 \pm 3.7	33.6 \pm 1.1
	RS	4.4	1	33.0	0.2 \pm 0.4	36	14.8 \pm 8.7	6.6 \pm 4.2	1	8.0	0.2 \pm 0.4
O	RF	2.3	2	11.5 \pm 2.1	0.4 \pm 0.5	186	11.4 \pm 6.9	37.2 \pm 19.8	143	6.7 \pm 4.1	28.0 \pm 24.2
	RS	5.4	6	22.8 \pm 10.0	1.2 \pm 1.0	85	12.7 \pm 8.5	17.0 \pm 14.0	3	8.6 \pm 6.1	0.6 \pm 0.8
P	RF	-	-	-	-	-	-	-	-	-	-
	RS	4.3	4	13.3 \pm 0.4	0.8 \pm 0.8	46	8.9 \pm 5.7	9.2 \pm 11.1	3	8.3 \pm 3.7	0.6 \pm 0.8
<i>Tot</i>	-	3.77	23	19.7 \pm 10.7	0.5 \pm 0.7	1377	10.3 \pm 6.5	25.4 \pm 20.9	1093	5.6 \pm 3.5	21.4 \pm 38.8

of sites L and O. The second group consisted of the big clams found on the reef slope of sites M and N (Table 2).

Tridacna crocea. - The shell length of *T. crocea* ranged from 1 to 15 cm, with an average of 5.6 ± 3.5 cm. There was significant difference (two-way ANOVA, $p < 0.05$) in average shell length of *T. crocea* between each of the studied reef zones. The average shell lengths of *T. crocea* were grouped in two groups (Student-Newman Kuell's test). The first group did not contain clams from the reef slope of Site M. The second group had clams from the reef flat of sites L, M, N, O and the reef slope at sites L, N and O with lengths from 4.4 ± 2.8 to 8.6 ± 6.1 cm.

The average shell lengths of the giant clams at the stations are summarised in Table 3.

DISCUSSION

Only *T. crocea*, *T. maxima*, and *T. squamosa* were found around Rawi and adjacent islands, although Rosewater, (1965) reported another two species (*T. gigas* and *Hippopus hippopus*) from Thai waters.

T. squamosa was rare around Rawi Island

area, possibly because it attaches onto the substrate by a weak byssus so it is easy for the fishermen to collect it. The shell of *T. squamosa* is utilised for a variety of ornamental purposes (ashtray, washbasin) (Lucas 1988; Pasaribu 1988).

T. maxima was generally found at all sites, both reef flat and reef slope. *T. maxima* was larger on the reef slope than on the reef flat. *T. maxima* was rare at Butang Island and the eastern part of Rawi Island, possibly because it was harvested. However, *T. maxima* is normally embedded in coral rock with strong byssus so it is more protected against harvesting than *T. squamosa*.

T. crocea was common on the reef flat at all sites. It was most abundant on the east side of Rawi Island where the coral reef was very healthy. This location was well sheltered from waves during the strong SW monsoon, and there was a good flow of water (currents). *T. crocea* was rare on the reef slope at all sites, except at site L where the boundary between reef slope and reef flat was not clearly determined. Fishermen do not demand *T. crocea* since it is small and embedded in coral rock.

ACKNOWLEDGEMENTS

The authors wish to thank Ms. Kanjana Adulyanukosol and Mr. Supot Chantrapornsyl for advice, the staff of PMBC for field assistant, and the European Union for financial support. Special thanks to Mr. Ukrit Satapoomin and Mr. Kongkiat Kittiwattanawong for statistic advise and extra thank to Mr. Nippon Phongsuwan and Ms. Vararin Vongpanich for commenting on the first draft of the manuscript.

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