

DISTRIBUTION AND ABUNDANCE OF GIANT CLAM AROUND LEE-PAE ISLAND, THE ANDAMAN SEA, THAILAND

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ABSTRACT

Three species of giant clam were found: *Tridacna squamosa*, *T. maxima* and *T. crocea*. Giant clam was most abundant on the southwest side of Lee-Pae Island, which otherwise is dominated by *T. crocea*, the smallest of the giant clams. The shell length of *T. crocea* varied from 2 to 14 cm. *T. maxima* ranged from 2 to 31 cm. Both species were found from the littoral zone to 13 m depth, while *T. squamosa* lived in deeper water. The small clams dominated in shallow water, and the big clams in deeper water. *T. squamosa* has been heavily exploited. Thus the clams are endangered species today. An area was identified for the establishment of a clam's sanctuary in the near future. The utilization of giant clam by local fishermen was examined.

INTRODUCTION

The biggest bivalves in the world are found among the species of giant clams distributed in the tropical zone. Rosewater (1965) stated a length of 1.37 m for *Tridacna gigas*. Rosewater (1965, 1982) and Lewis & Ledua (1988) recognized 7 species in 2 genera: *Tridacna derasa*, *T. squamosa*, *T. maxima*, *T. crocea*, *Hippopus hippopus* and *H. porcellanus*. Only three species are commonly found in Thai waters: *T. squamosa*, *T. maxima* and *T. crocea*. The small *T. squamosa* attaches to the substratum by byssus, but the byssus will disappear when they grow very big. *T. maxima* buries part of its shell into the substratum. This species is also attached by strong byssus. *T. crocea* has most of the shell buried in massive coral but byssus is also secreted (Shokita *et al.* 1991).

Although people of the Pacific and South East Asia have traditionally harvested giant clam for consumption of the meat, only local Thai people living along the coast would do so. In Thailand, most giant clams were harvested for ornamental shells. The adductor muscles were mostly exported. The demand for giant clam shells led to intensive harvesting of giant clams, causing overex-

ploitation of the stocks. In addition, harvesting of giant clam causes deteriorating of coral reef. Therefore, giant clam resources are protected by law which has been enforced through the CITES since 1992.

Lee-Pae Island is located in the Andaman Sea, the south-west coast of Thailand, Satun Province. The area is 2.4×10^6 m². Approximately 660 people live on the island in 52 families. They earn a living as fishermen. A Fisheries Department substation is located on the northern beach (Fig. 1). The purpose of the substation is to help the local fishermen, and to prevent illegal fishing activities.

This study is a project under the Marine Endangered Species division of the Phuket Marine Biological Center. The aims were to estimate giant clam stocks around the island, and to identify a suitable area for the establishment of a clam's sanctuary in the future.

MATERIALS AND METHODS

The Manta tow survey method, based on English *et al.* (1994), was used to evaluate the distribution of giant clams along the

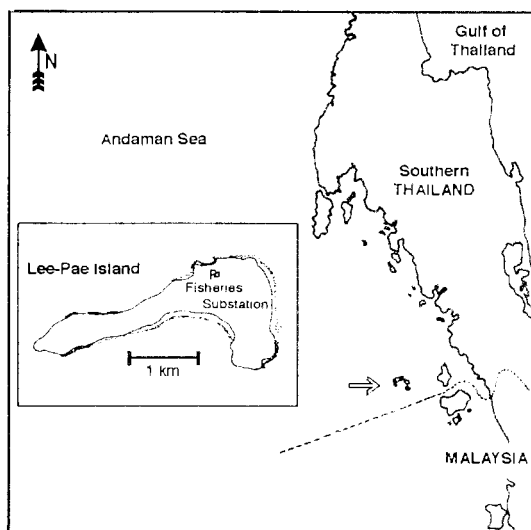


Figure 1. Map of Lee-Pae Island.

coast of Lee-Pae Island. Each tow survey lasted 10 minutes. Two observers were towed; one observer counted the number of giant clam, while the other observer checked the percentage of live corals. The percentage of live coral was roughly divided into 3 categories: "good", "fair" and "damaged". "Good" had more than 60 % of live coral, "fair" between 30-60 %, and "damaged" less than 30 % of live coral. Based on the relative density of giant clam, the locations for line transects were selected.

Four stations were selected for a comparative study on size frequency, abundance and distribution of giant clam as a function of water depth. Station 1 and 2 at the southern part of the island which is exposed to the SW monsoon; Station 3 and 4 at the northern part which is exposed to the NE monsoon. Characteristics of coral reefs in each set of stations differ as a result of the direction of monsoons (Pongsuwan *et al.* 1993). Five transect lines were made at each station: one vertical transect and four horizontal transects to the shore line (Fig. 2). A rope with vertical lines was stretched to the end of the reef slope, perpendicular to the shore line. Vertical lines were used to evaluate the shore profile and to estimate the distribution of giant clams as a function of wa-

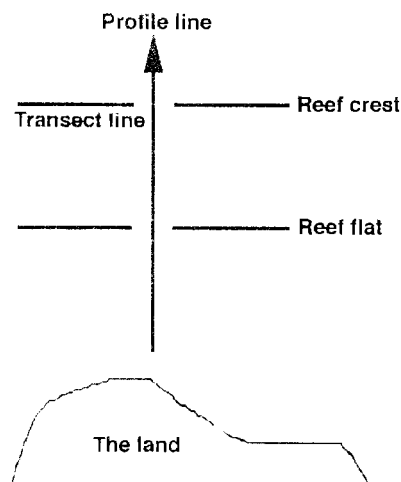


Figure 2. Transect line pattern at each stations.

ter depth. Two SCUBA divers observed tracks spanning two meters on each side of the transect lines. Species, size, distance from shore and water depth where giant clam was seen, were recorded together with the percentage live cover, and characteristics of the reef. Depth profile of the transect was measured during the dive, and calculated in relation to mean high sea level using time and tide data for the Andaman Sea.

Comparison of abundance and size frequency of giant clams was carried out along 4 parallel transect lines at each station: two transect lines on the reef flat and two lines on the reef crest. Each line transect was 100 m long. Scuba diving equipment was used during observation. Two observers recorded number, size and species of *Tridacna* seen within two meters of each sides of the line. Thus, the whole observation area was 400 m² per line. The density of giant clam was calculated to average of individuals per 100 m². Duncan's New Multiple Rank Test based on Winner (1962) was performed to test significant between stations and *t*-test was used to compare between groups; reef flat and reef crest.

Shell traders on Lee-Pae Island, and shell shops owners in Phuket Province were in-

interviewed in order to evaluate the status and utilization of giant clams. Giant clams were measured to estimate the marketing size of stocks.

RESULTS

Manta Tow Observation

A total of 11 tows were conducted around Lee-Pae Island's reef area. The number of giant clam observed and the percentage of live coral reef are presented in Fig. 3. Giant clam was found nearly in every tow except in tows No. 2 and 6 in a highly exposed area where very few corals were observed. The most abundance area of the *Tridacna* was found in tow No. 3 which situated on the south-west of the island. The less abundance were found in tows No. 1 and 7-11. The number of giant clam tended to have inversely relation to the percentage of live coral: the higher relative number of giant clam on the southern coast is more than the one on the northern coast, in contrast with the percentage of live coral which was found lower in the southern part of the island. The SW monsoon trends to damage coral reef more than the northern one.

Shore profile and distribution

The characteristic of reef profiles and dis-

tribution of giant clam in the four selected stations were summarized in Figure 4.

Station 1: The area composed of approximately 80 % dead coral which dominated by *Porites* sp. and *Synaraea* sp. The reef flat is narrow, only 100 m from shore to the ended of coral reef slope where water depth of 13 m and the slope still go down to sandy bottom. Only two species of giant clam; *T. crocea* and *T. maxima* were found in the area of 5 m from shore and water depth of 2-13 m.

Station 2: The nearly 600 m wide of reef flat composed mainly of sand and approximately 30 % of living corals which was dominated by *Porites* sp. The reef slope ended at 10 m water depth. No depth profile have been done.

Station 3: The profile was 350 m long. The area of well situated coral especially at reef slope *Porites* sp. and *Acropora florida* were abundant in this area. The end of reef slope was at 6 m. *T. crocea* and *T. maxima* were observed between 260-350 meters from shore and at a water depth of 1.5-2 m. A *T. squamosa* was found at the water depth of nearly 2 m.

Station 4: Two hundred and eighty meters transect line was laid to the end of reef area.

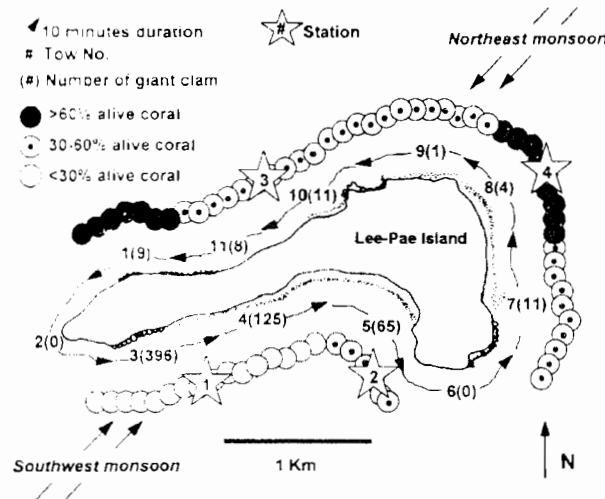


Figure 3. Tow observation.

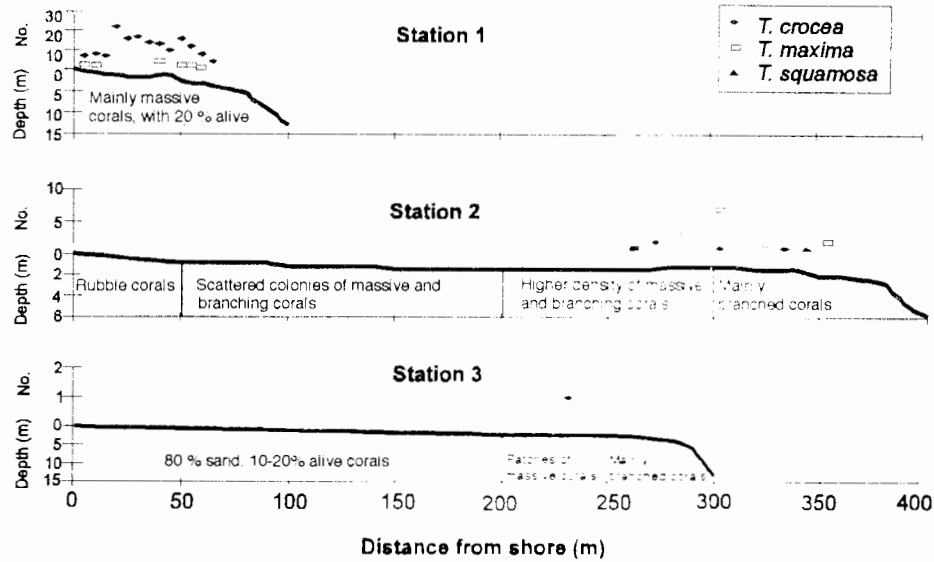


Figure 4. Depth profiles and distribution of giant clams.

Coral reef which mainly composed of 60-80 % live *Acropora* spp. started at nearly 200 m away from shore. The edge of coral reef reached about 12 m water depth. *T. crocea* and *T. maxima* were found between 210-270 m or at the water depth of 7-10 m.

Species and abundance

Three species of giant clam were found around Lee-Pae Island, namely *Tridacna crocea*, *T. maxima* and *T. squamosa*. The most abundant species was *T. crocea* with average density of 24.41 individuals per 100 m² around the island (Table 1). *T. crocea* and *T. maxima* are common in all studied stations, while only one of *T. squamosa* was observed at station 3 (about 3 *T. squamosa* were seen outside the transect area). The density of giant clam at each stations were

presented in Table 1. The area with highest abundance is station 1, while it was lowest in station 4. There is no significant difference in densities between station 2 and 3. Both species were grouped into reef flat and reef crest in order to compare the density between these two groups, the result shows

Table 1. Density per 100 m² of two species of giant clam at Lee-Pae Island. Note: a, b, and c are significant groups within column (p<0.05).

Station	<i>T. crocea</i>	<i>T. maxima</i>	t-test (p<0.05)
1	76.69 ^a	14.56 ^a	*
2	12.06 ^b	5.06 ^b	ns
3	7.25 ^b	4.00 ^b	*
4	1.62 ^c	1.56 ^c	ns
All	24.41	6.30	*

Table 2. Comparison of density per 100 m² of giant clam observed on the reef flat and the reef crest.

Station	<i>T. crocea</i>			<i>T. maxima</i>		
	Reef flat	Reef crest	t-test (p<0.05)	Reef flat	Reef crest	t-test (p<0.05)
1	183.50	69.88	ns	13.62	15.5	ns
2	26.75	17.38	ns	4.00	6.12	ns
3	36.38	8.12	ns	3.62	4.38	ns
4	2.13	1.12	ns	1.38	1.75	ns

that there are no significant difference of density between groups of both species (Table 2).

Length frequency

Length frequency distribution of *T. maxima* and *T. crocea* from each stations of Lee-Pae Island and Phuket shell market are presented in Figure 5. The means shell length, standard deviations and statistical values are summarized as Table 3. The shell length of *T. crocea* ranged from 2 to 14 cm, with the mean shell length of 7.93 cm, while *T. maxima* ranged from 2 to 31 cm with a mean shell length of 11.67 cm. The mean shell lengths of *T. crocea* were greater at station 1 and 2 than station 3 and 4. No significant differences in mean length of *T. maxima* of each station were observed. Mean lengths of both species from Lee-Pae Island were smaller than those from Phuket shell market. It was found that the giant clam in reef crest was bigger than those in reef flat group in both *T. maxima* and *T. crocea*.

Giant clam utilization

Harvesting methods of giant clam by local fishermen is very simple. Search and collecting were usually done during low tide or the fishermen may dive with only a pair of goggles during high tide. Adductor muscles and shells of the clams were extracted and sold to a local trader in the island, other parts of meats were consumed by the fishermen. A local trader bought fresh adductor muscles for 70-120 baht/kg and sold mainly to Tai-

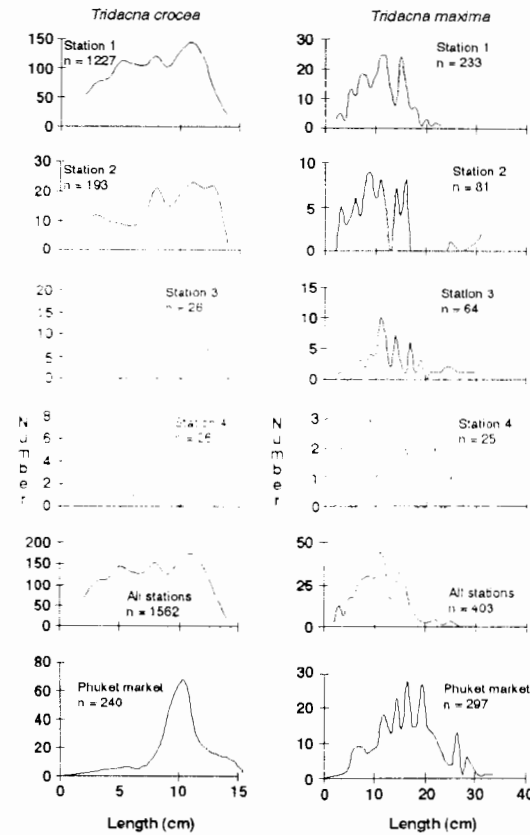


Figure 5. Size frequency distribution of *T. maxima* and *T. crocea*.

wanese trader as dried muscles with price of more than 400 baht/kg. Shells are usually sold to shell traders in Phuket, and then sold to tourists as specimen/ornamental shells or various shell crafts (e.g., ashtrays, soap trays, lamps). The prices of shells vary depending on sizes and species. *T. squamosa*

Table 3. Mean length of two species of giant clam. The reef crest is compared with the reef flat. Note: a and b are significant groups within column (p<0.05).

	<i>T. crocea</i>				<i>T. maxima</i>			
	All	Reef crest	Reef flat	t-test (p<0.05)	All	Reef crest	Reef flat	t-test (p<0.05)
Station 1	8.00 ^a	8.28	7.67	*	11.08 ^a	12.05	10.23	*
Station 2	8.64 ^a	9.26	8.45	ns	10.70 ^a	12.44	9.57	*
Station 3	6.46 ^b	7.22	5.88	*	14.05 ^a	14.66	13.54	ns
Station 4	6.08 ^b	6.88	4.56	*	13.29 ^a	17.82	11.43	*
All stations	7.93	8.23	7.62	*	11.67	12.89	11.00	*
Phuket market	10.32	-	-	-	13.68	-	-	-

is the most expensive clam. The big shells being sold for more than 250 baht/kg and less than 200 baht/kg for smaller ones. *T. maxima* and *T. crocea* have about the same price, 200 baht/kg for the big ones and about 60 baht/kg for the smaller ones. However, the price highly varies upon their beauty. The most popular and high demand is *T. squamosa* because of its big size and beautiful shell. *T. crocea* is the last choice for fishermen because of its small size and it usually burrows into the massive coral which is difficult to collect.

DISCUSSION

Of the three occurring species of giant clam, *T. squamosa* was rarely found at Lee-Pae Island especially in the shallow water. The small *T. squamosa* has never been found, however some big *T. squamosa* were found in deeper water. Most of them were found outside the surveying areas at the reef slope. This may be because the shell is beautiful, easy collected, and has a high price, which lead to a heavier exploitation of this species, than the other two species. Thus in the whole area, *T. crocea* and *T. maxima* are dominant species. Surveying of shell markets shows that *T. crocea* is the lowest demanded of all species.

The number of giant clam tends to inversely relate to the percentage of live coral. This may be because of some competition between the organisms. The giant clam's larvae may not be able to settle successfully in an area covered with live coral.

Table 3 shows that the mean lengths of clams at Lee-Pae Island are significantly smaller than at Phuket shell market. This is caused by heavy exploitation of shells at Lee-Pae Island. In addition, the size of clams at the shallow water or at reef flats was smaller than at reef crest, because of easier collection in shallow water.

Nowadays, collecting of giant clam is illegal and exporting of clams are completely prohibited, but Lee-Pae Island is located far away from main land and a lot of fishermen live on the island. Thus marine resources especially giant clam are important food sources and harvesting of the clams for consumption still exists. Therefore, declaration of protection of the island should be considered in order to preserve it as a clam sanctuary area in the near future. From this study, the most suitable place on the island is at the station 3, which is located close to the Fisheries Substation, where it can be totally protected from illegal fishing activities.

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