Distribution and Abundance of the Giant Clams *Tridacna gigas* and *T. derasa* on the Great Barrier Reef.

R. D. Braley

Giant Clam Project, Zoology, James Cook University, Townsville, QLD 4811 AUSTRALIA

Abstract—Fifty-seven reefs were surveyed over 817 km of the Great Barrier Reef. *Tridacna gigas* abundance decreased southwards: it is rare south of 19°S while *T. derasa* was bimodal with peaks in the northernmost and southernmost areas. Distributions of *T. gigas* suggest that limiting factors may be temperature and seasonal currents, while salinity or turbidity may be factors which limit *T. derasa*.

Introduction

Previous clam density estimates include: *Tridacna maxima* (McMichael, 1972; Ricard, 1978), *T. crocea* (Hamner, 1978), *T. gigas* and *T. derasa* (Hardy and Hardy, 1969; Hester and Jones, 1974; Bryan and McConnell, 1976; Pearson, 1977; Hirschberger, 1980). These cover individual coral reefs or lagoons, but broad-scale estimates of giant clam densities are lacking. The Great Barrier Reef (GBR) is the last large area having relatively undisturbed clam populations where basic demographic information can be gathered, particularly for the largest species *Tridacna gigas* (Linnaeus) and *T. derasa* (Roeding).

The critical densities of giant clams required to assure success in fertilisation, as suggested by Beckvar (1981) and Gwyther and Munro (1981), are not yet known. Seventy percent of *T. gigas* neighbors which released gametes naturally occurred within 9-m of one another, yet many adjacent clams were unresponsive to the presence of gametes in the water (Braley, 1984). The density of these clams on a given coral reef may depend on availability of optimum substrata for settlement and a critical density of broodstock on the same or adjacent reefs. Knowledge of a broad-scale distribution of clam densities on many reefs within the GBR System is necessary to understand their overall reproductive strategy.

Materials and Methods

Fifty-seven reefs (over 817 km of the GBR; between 20°11′S–14°27′S) surveyed from late January to late March 1983 and during two weeks of May 1983 are shown (Fig. 1) in the chronological order in which they were examined (except for reef no. 00, Escape Reef) and listed in Table 1. This survey was carried out in concert with a survey of coral trout (*Plectropomus* spp.) by the Great Barrier Reef Marine Park Authority on 7 transects across the continental shelf. Two types of sites were examined: "random" sites and "chosen" sites. Survey sites on the leeward sides of the 57 reefs selected randomly for the (coral trout) survey were adopted as "random" sites for the clam survey. Surveys of all

Table 1. Reefs or Islands (Is.) visited for the survey. Numbers and names are given with an indication of inner (i), middle (m), or outer (o) reef. Mean no. clams/ha listed as (*T. gigas*/ha, *T. derasa*/ha).

Transect	Reef No.	Reef name	Reef position	Mean no. clams per ha at *random* sites (Tg, Td)
Innisfail	1	Feather	m	(0.89, 0.0)
	2	Peart	m	(1.3, 0.67)
	3	Gilbey	o	(0, 0)
	4	Wardle	o	(9.0, 5.5)
	5	So. Barnard Is.	i	(0, 0)
	6	No. Barnard Is.	i	(4.0, 0)
Cairns	7	Fitzroy Is.	i	(12.0, 0)
	8	Green Is.	m	(5.3, 3.6)
	9	Upolu	m	(14.2, 0.9)
	10	High Is.	i	(12.0, 0)
	11	Russell Is.	i	(12.0, 0)
	12	Maori	m	(0, 0)
	13	Channel	o	(4.0, 0)
	14	Northwest	o	(4.0, 0)
	15	Flynn	o	(1.8, 2.7)
	16	Milln	o	(0, 0.7)
	17	Arlington	m	(4.0, 0)
	18	Michaelmas	m	(1.8, 0)
	19	Hastings	m	(0, 0)
Port Douglas	20	Batt	m	(8.0, 0)
	21	Low Is.	i	(0, 0)
	22	Snapper Is.	i	(0, 0)
	23	Opal	o	(1.3, 0)
	24	Tongue	m	(2.0, 0)
	25	St. Crispin	o	(0.6, 1.1)
Cooktown	26	Hope Is.	i	(12.0, 0)
	27	Cowlishaw	i	(18.0, 0)
	28	Egret	m	(52.0, 0)
	29	Boulder	m	(56.0, 0)

sites required the use of SCUBA. At 19 reefs, additional sites were "chosen" for their high clam densities.

At the "random" sites, several 1-ha areas of reef crest and slope (or patch reefs) were surveyed by setting a 150-m rope parallel to the reef front; and a 67-m tape was placed perpendicular to, and bisected by, one end of the 150-m rope to designate the area. At all inshore reefs (<15 km from the coast), and some middle (25–35 km from the coast) and outer (35–70 km from the coast) continental shelf reefs, five 50-m × 20-m quadrats were placed lengthwise from the reef crest down the slope and surveyed. Since I was the only one of 2 or 3 divers collecting the clam density data I was able to survey the following

Table 1.
(*continued*)

Transect	Reef No.	Reef name	Reef position	Mean no. clams per ha at *random* sites (Tg, Td)
Cooktown	30	no. 15043	m	(2.7, 0.9)
	31	Ribbon no. 5	o	(3.5, 1.2)
	32	Ribbon no. 6	o	(0.7, 4.7)
	33	Ribbon no. 4	o	(0, 8.0)
	34	Williamson	m	(24.0, 2.0)
	35	Forrester	m	(4.0, 0)
	36	Low Wooded Is.	i	(36.0, 0)
Flattery-Lizard	37	Linnet	m	(0, 0)
	38	Martin	m	(2.7, 0)
	39	Eagle Is.	m	(0, 0)
	40	Lizard Is.	m	(5.3, 6.0)
	41	Macgillivray	m	(6.2, 5.3)
	42	Carter	o	(1.3, 18.0)
	43	Day	o	(3.3, 12.7)
	44	Hicks	o	(0, 36.0)
	45	Two Is.	i	(4.0, 8.0)
Whitsunday	46	Line	m	(0, 2.0)
	47	Hook	m	(0, 1.3)
	48	Stucco	o	(0, 8.5)
	49	Plaster	o	(0, 26.0)
	50	Border Is.	i	(0, 0)
	51	Hook Is.	i	(0, 0)
Townsville	52	Dip	o	(2.0, 7.5)
	53	Myrmidon	o	(4.5, 9.0)
	54	John Brewer	m	(0.5, 8.7)
	55	Lodestone	m	(0.7, 10.0)
	56	Pandora	i	(0, 0)
	57	Havana Is.	i	(0, 0)

areas: for each 1-ha plot, 0.3-ha was surveyed at mid-shelf reefs and 0.5-ha at outer-shelf reefs; for each 50-m $\times$ 20-m quadrat, 500 m^2 was surveyed. The "chosen" sites were initially selected by a viewer from the surface, followed by an observer being towed underwater. Counts began after the first group of clams was observed. Areas were determined with a measuring tape or estimated by speed of towing over a known distance.

Instances of probable clam poaching were encountered on outer-shelf reefs where empty shells were concentrated rather than scattered amongst living clams. Although such areas of disturbance were rare, these data were excluded from mortality counts in the present study.

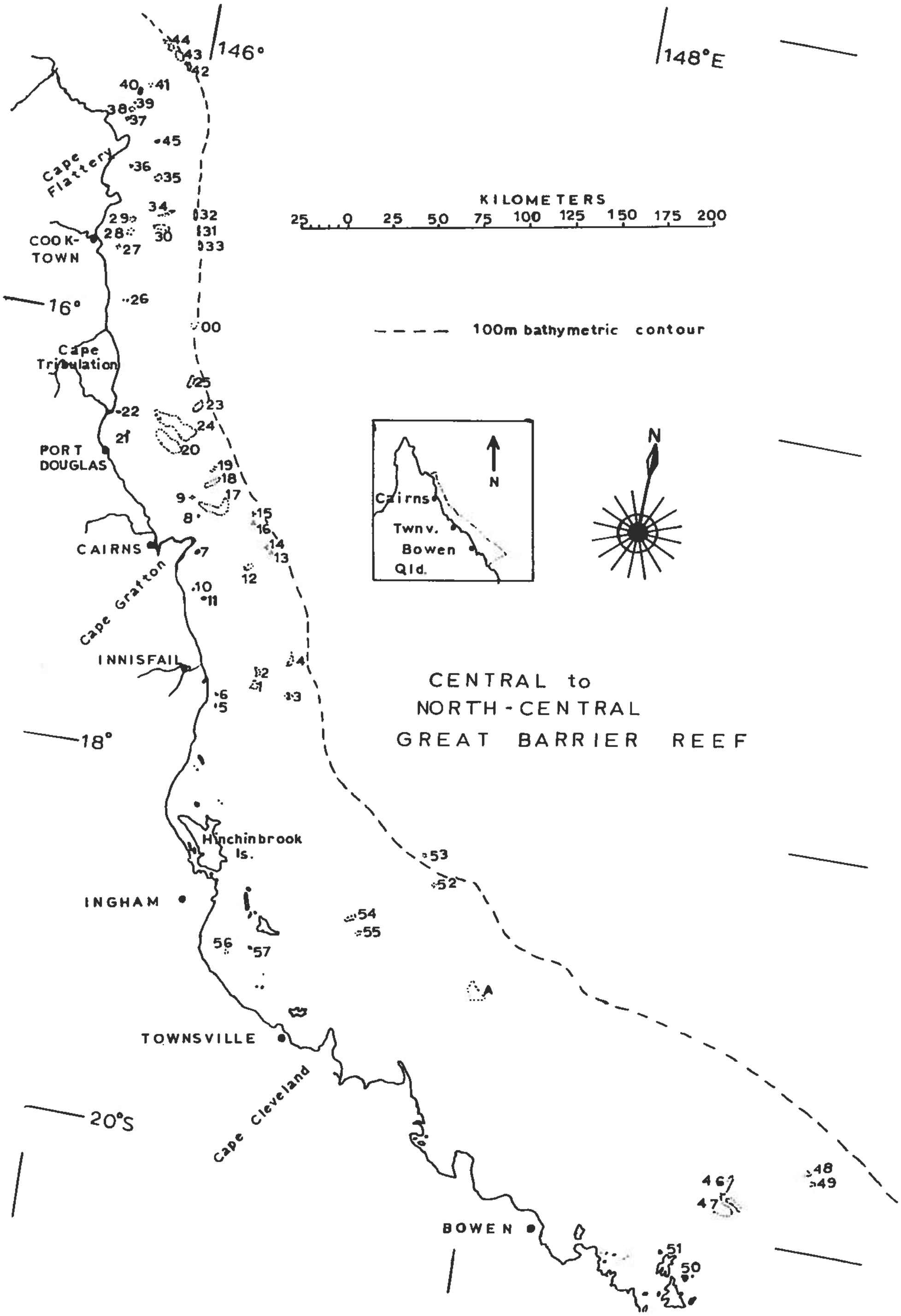


Fig. 1. *Tridacna gigas* and *T. derasa* sampling sites along the central to north-central GBR. Numbered reefs are named in legend of Table 1. This figure is modified after the Great Barrier Reef Marine Park Authority's companion map of the GBR, November 1982.

Results

Figures 1 and 2 show clam densities at "random" sites at 57 reefs: for "chosen" sites see Figure 3.

1. Four hundred and six live *T. gigas* and 261 live *T. derasa* were noted.

2. *Tridacna gigas* was present on 36 (of 57) "random" sites and 17 (of 19) "chosen" reef sites.

3. No living *T. gigas* were found in the Whitsunday transect, south of 19°S latitude. High densities at "random" sites occurred in the Cairns and Cooktown transects. At "chosen" sites high densities were found in all five northern transects (Table 2). Escape reef (no. 00, Fig. 3) densities of *T. gigas* were significantly higher (134/ha) than "random" sites ($t_{(46)}=9.998$, $p<0.001$).

4. *Tridacna derasa* was present at 25 "random" and 9 "chosen" sites. At "random" sites the highest densities of *T. derasa* occurred on outer-shelf reefs in the northernmost and southernmost transects. The only inshore reef on which *T. derasa* was present was in the Flattery-Lizard transect on an island reef (Two Is., no. 45) that may be considered borderline as a mid-shelf reef. Although there was no significant difference between densities of *T. derasa* at "chosen" and "random" sites ($t_{(51)}=0.952$ ns), *T. derasa* was significantly more abundant at Escape Reef than either combined "chosen" sites ($t_{(11)}=4.249$, $p<0.01$) or combined "random" sites ($t_{(46)}=9.907$, $p<0.001$).

5. There were 47 dead *T. gigas* and 38 dead *T. derasa* from the 57-reef survey. These data exclude obvious mortalities from clam poaching at outer-shelf reefs no. 4 and 31. The mean percentages of dead clams from the observed populations of *T. gigas* and *T. derasa* were 10.4% and 12.7%, respectively.

Discussion

Tridacna gigas is rare south of 19°S, but although no live *T. gigas* were found at outer-shelf reefs south of 19°33′S, one long-dead *T. gigas* was found. A second coral trout survey (GBRMPA) in late 1984 found a single individual of *T. gigas* at Hook Is. (reef no. 51)

Table 2. Mean and standard deviation of clam densities at 57 *random* sites and 9 *chosen* sites. Number of clams per hectare ± s.d. are shown.

	T. gigas	T. derasa	T. gigas + T. derasa
Random 5 northern transects (45 reefs)	7.8 ± 12.6	2.9 ± 7.3	10.7 ± 13.6
Random 2 southern transects (12 reefs)	0.6 ± 1.4	5.9 ± 7.4	6.5 ± 7.8
Chosen sites (9 reefs)	236.6 ± 196.7	5.5 ± 8.3	239.4 ± 184

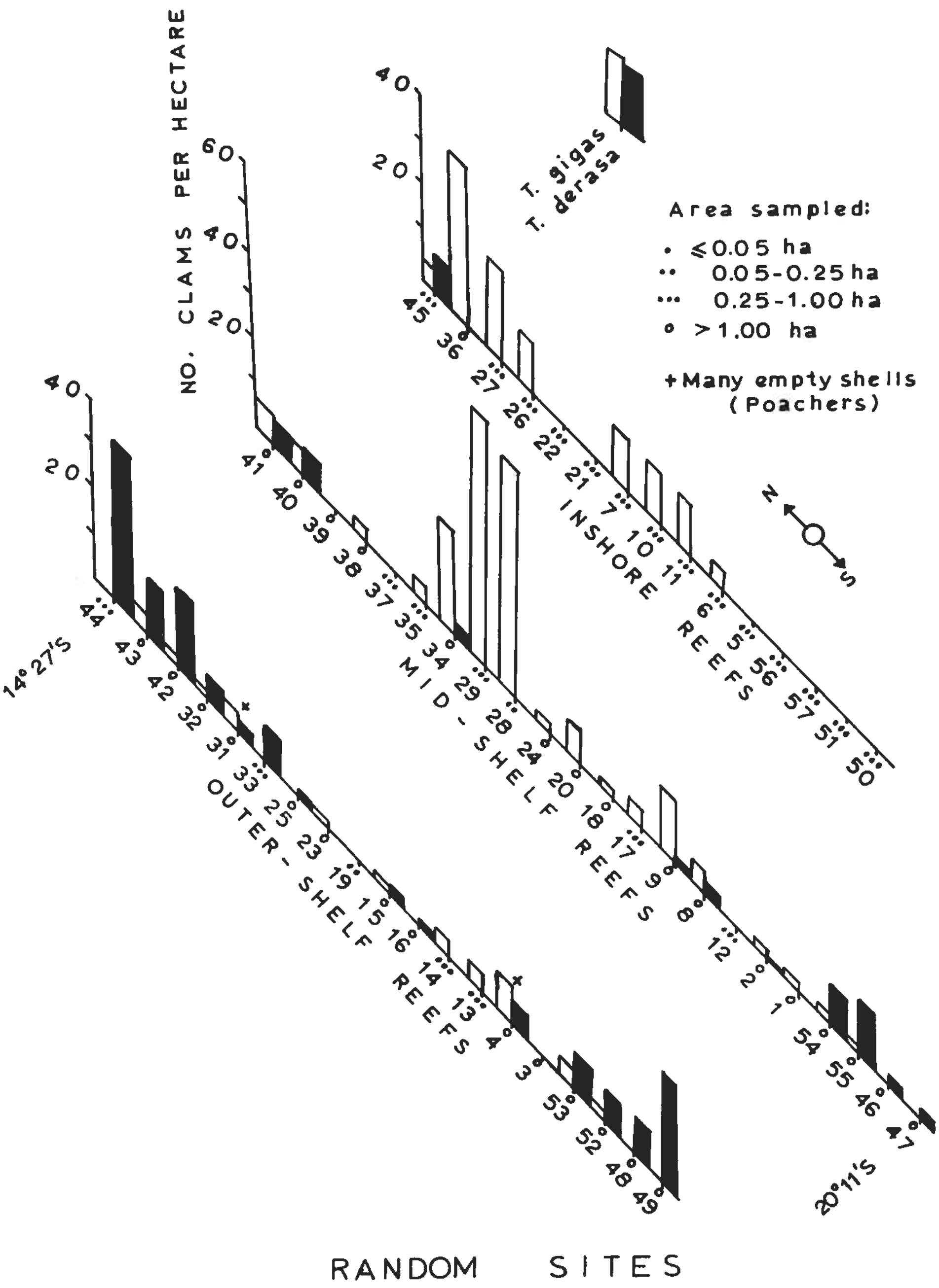
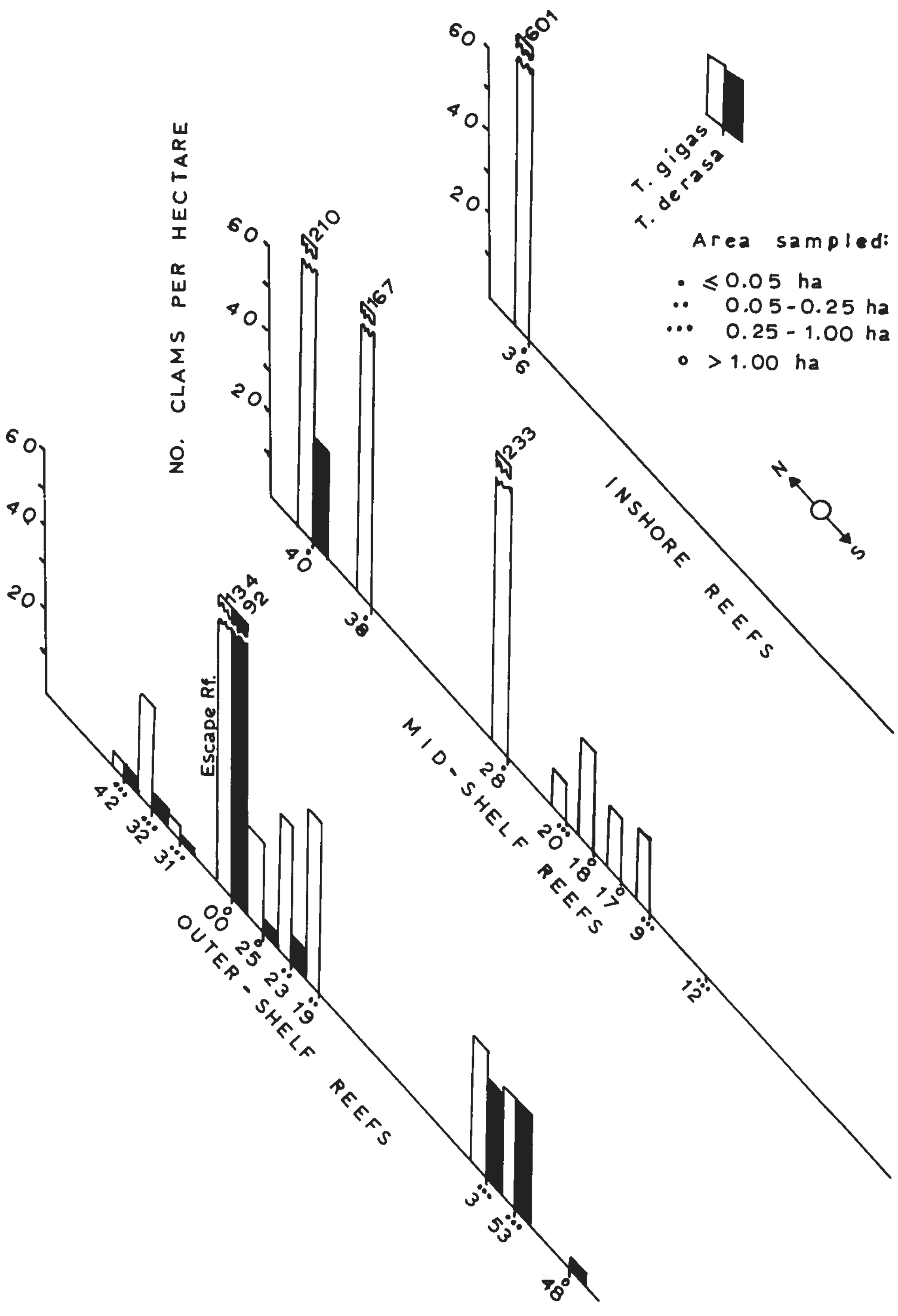


Fig. 2. Abundance of the giant clams *Tridacna gigas* and *T. derasa* (no. clams/ha) at 57 reefs ("random" sites) on the GBR between 20°11'S and 14°27'E. Reefs are displayed from north to south and for outer-shelf, mid-shelf, and inshore portions of the cross-shelf transects (see also Fig. 1 and Table 1).

Fig. 3. Abundance of the *Tridacna gigas* and *T. derasa* (no. clams/ha) at 19 reefs ("chosen" sites) on the GBR (refer to Fig 2). Reef no. 00, Escape Reef, is included for comparison with other reefs. Numbered reefs are named in Table 1.



CHOSEN SITES

and another at a small outer-shelf reef in the Whitsunday transect (Ayling and Ayling, 1985). They also found several scattered *T. gigas* individuals on the extreme outer reefs of the Swains group (21–22°S), where the Coral Sea water mass is predominant (A. Ayling, pers. comm., 1986). Conversely, *T. derasa* is common at 19°S and as far south as the Swains Reefs (Pearson, 1977), though it was not found in surveys in the Capricorn-Bunker group (A. Ayling, pers. comm., 1986).

Population densities of these species are higher further north (from Cairns to Lizard Is.). *Tridacna derasa* is restricted primarily to oceanic environments (Munro and Heslinga, 1983), whereas *T. gigas* is common on inshore reefs potentially affected by seasonal fluctuations in salinity and turbidity. These distributions suggest that temperature may limit survival of young *T. gigas* while salinity and/or turbidity may limit *T. derasa*.

Currents in the GBR lagoon at 19°S, 147°50′E (near Townsville) set from west to north from January to June and from south to east from July to December (Pickard *et al.*, 1977). At 16°23′S, 145°34′E (near Batt Reef and Low Isles) the current flows north from February-October and south (but less intensely) from October-February (Orr, 1933; Cresswell and Greig, 1978). Since gamete release in *T. gigas* occurs in spring to mid-summer (Braley, 1984; Braley, PhD Thesis, 1987) these current patterns and larval drift could be a factor accounting for the observed distribution of this species on the GBR. The apparent fade-out of *T. gigas* at higher latitudes may be ultimately due to temperature, but the minor recruitment in the southern part of the GBR may have resulted from the seasonal spawning and southerly drift of the larvae.

A GBRMPA coral trout survey of the Far-North section (Lizard Is.-Torres Strait) in 1984 also recorded numbers of live/dead *T. gigas* per hectare at 5 outer-shelf reef transects. Densities of combined live/dead varied from 14-24/ha, while densities of live only clams varied from 0-17/ha. Larger numbers of dead clams were found in the northernmost areas presumably due to poaching. These densities for *T. gigas* indicate a steady increase from my southernmost transects toward the Far Northern areas (Ayling and Ayling, 1985).

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