

MOLLUSCAN DISTRIBUTION PATTERNS AT CANTON ATOLL

by

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ABSTRACT

Micromollusks in sediment samples from Canton Atoll are described in terms of three assemblages: seaward reef; outer, clear water lagoon; and inner, turbid water lagoon. The seaward reef and outer lagoon assemblages are characterized by low standing crops, high species diversity, and a preponderance of microherbivores, in contrast to the inner lagoon, where there are higher standing crops, lower species diversity, and a strong tendency toward suspension feeding. The dominant gastropods in the lagoon are members of the family Diastomidae, including *Diala flammea* and species of *Obtortio* and *Scaliola*. The dominant bivalves are cardiids. The assemblages at Canton resemble those from Fanning Atoll in general aspects, such as standing crops, species diversity, and trophic structure, but differ noticeably in species composition. Differences in species composition are suggested to be associated with differences in water chemistry.

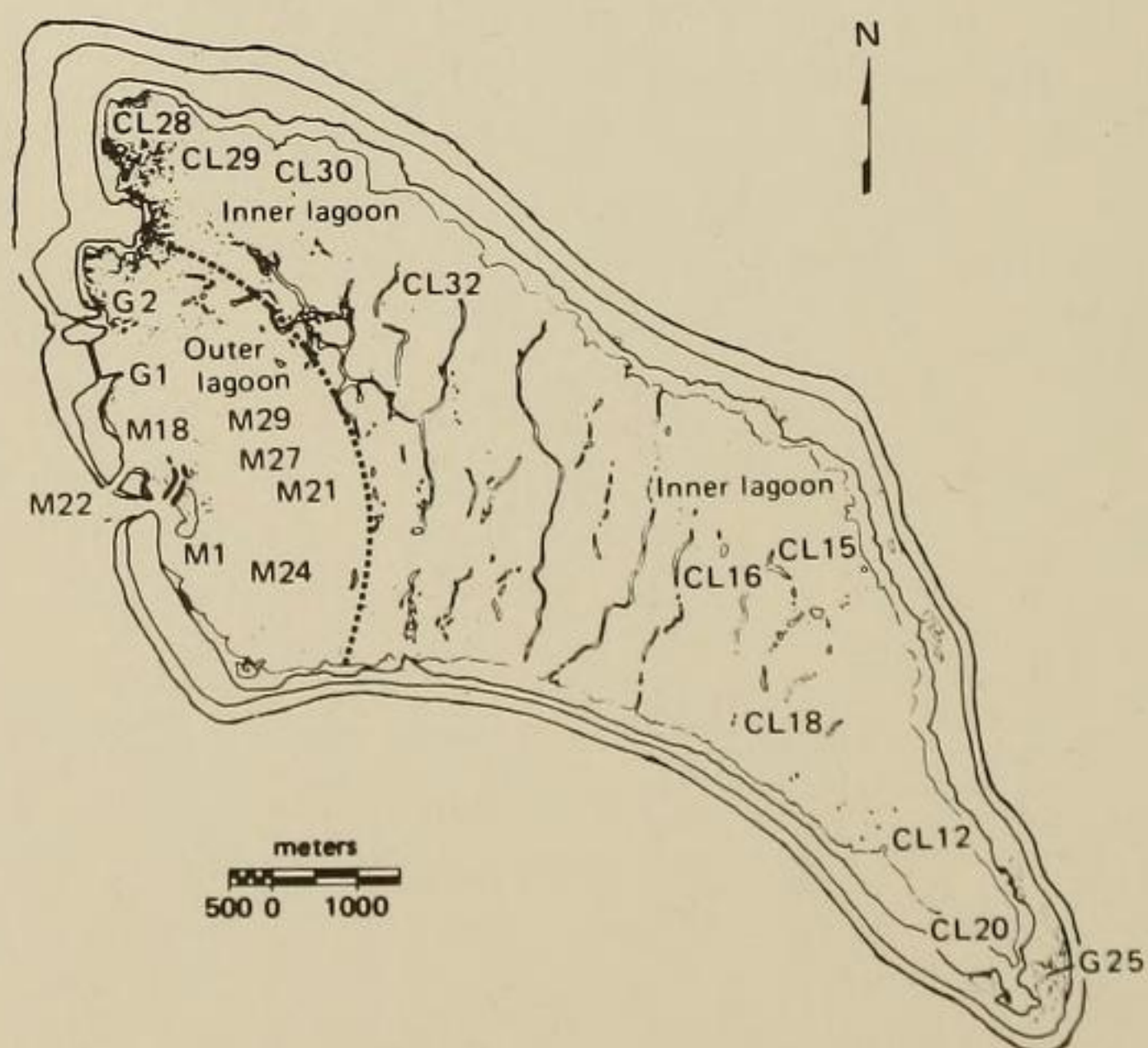
INTRODUCTION

Analysis of molluscan distribution patterns at Fanning Atoll showed a clear distinction in species composition, species diversity, and standing crops between the seaward reefs and the lagoon (Kay, 1971; Kay and Switzer, 1974). Within the lagoon, differences among the mollusks of the lagoon reef flat, patch reefs, and lagoon floor were also detected, associated with substratum types, water chemistry, and turbidity (Kay and Switzer, 1974). Such patterns are of interest because they provide documentation for present and past ecological parameters of atoll reefs and because they are a source of data for both biogeographical and faunistic studies. In this report, patterns of distribution at Canton Atoll are described and are compared with observations from Fanning Atoll.

METHODS

Mollusks from Canton Atoll were obtained from three series of sediment samples. One sample from the slopes of the seaward reef on the lee of the atoll and six samples from the outer lagoon were obtained by hand retrieval from depths between 6 and 35 m by Dr. J. E. Maragos in September 1973 (M stations, Fig. 41). Nine samples from the inner lagoon were collected by Dr. S. V. Smith from dredge hauls at depths of less than 10 m (CL stations, Fig. 41) in December 1973. Two samples from the outer lagoon and one from a "pond" were provided by Mr. E. B. Guinther (G stations, Fig. 41) in December 1973.

Figure 41. Biotic provinces and micromollusk sample sites.



Mollusks from the sediment samples were obtained by picking shells from standard 25 cm³ volumes under a binocular dissecting microscope. Most of the mollusks retrieved were small, less than 10 mm in greatest diameter, but cardiid bivalves larger than 10 mm also formed a conspicuous component of the assemblages. Species diversity (H), calculated from the function $H = -\sum p_i \log_2 p_i$, and standing crops were obtained for all samples by the methods described in Kay and Switzer (1974). Relative abundance (p_i) values refer to percentage composition of the assemblages.

RESULTS

Ninety species of mollusks were recorded from the samples from Canton Atoll. The samples were divisible into three assemblages, one characteristic of the outer slope of the seaward reef, and two characteristic of the lagoon. One of these was representative of the outer lagoon, the other of the inner lagoon (Fig. 41).

Twenty species were found in the single sample from the slope of the seaward reef at a depth of 35 m. Compared with the samples from the lagoon, this assemblage is characterized by low standing crop and high species diversity (Table 22). Microherbivores predominate, but there is also a high proportion of faunal grazers. Gastropods constitute 93% of the assemblage. The families Cerithiidae, Rissoidae, and Triphoridae are the most abundant, forming 11 to 21% of the assemblage. The bivalves are represented by epifaunal species.

The lagoon is divisible into two sectors on the basis of species composition, standing crop, species diversity, and trophic structure. The outer lagoon stations (M stations and G 1 and 2, Fig. 41) are characterized by lower standing crop, higher species diversity, and a proportionately greater number of faunal grazers than occur in the inner lagoon (Tables 22 and 23). Standing crop averages 9.9 shells per cm³, and the species diversity index ranges from 1.2 to 3.8. Trophic structure is predominantly microherbivore, with a faunal grazer component comparable to that of the outer reef sample.

Forty-nine species were recorded from the stations in the outer lagoon, of which 24 were restricted to this sector of the lagoon. Gastropods constitute 90% to 99% of the assemblages, and bivalves average about 5% of the assemblages. Species composition and relative abundance of the various groups are shown in Table 22 and Fig. 42 and 43. The dominant gastropods are the Diastomidae, represented by four species and comprising an average of 56% of the gastropods in each sample. *Diala flammea*, the most abundant diastomid, is found in all the samples and averages 93% of the diastomids. *Obtortio*

Table 22. Standing crop, species diversity, and relative abundance of the most common micromollusks at Canton Atoll.

Station	M22	G1	G2	M18	M24	M29	M1	M21	M27	CL28	CL29	CL30	CL32	CL16	CL15	CL18	CL12	CL20	G25
No./cm ³	3.9	23.8	17.6	5.4	14	11.2	5.3	15	8	3.2	4.4	21.6	23.3	26.6	1.4	39	2.2	15.4	8.4
Species diversity	3.8	2.3	1.2	3.8	3.1	2.5	3.7	2.8	2.4	3.0	1.4	2.5	2.7	2.4	2.3	2.1	2.3	2.2	3.1
% Gastropods	93	94	99	93	90	95	99	95	95	63	48	56	59	76	69	41	44	97	75
<i>Tricolia</i>	10	-	-	3	-	-	3	1	+	-	-	-	-	-	-	-	12	+	-
<i>Leptothyra</i> spp.	2	5	2	9	5	4	4	3	2	16	7	6	6	1	-	1	-	-	14
<i>Rissoidae</i>	20	9	7	15	10	10	11	7	5	+	-	+	3	2	-	1	-	-	4
<i>Bittium glareosum</i>	21	-	-	15	8	2	28	7	8	-	-	3	+	+	-	1	8	-	3
Diatomidae	1	72	86	27	44	67	17	66	68	41	70	78	82	69	96	87	50	88	72
<i>Diala</i> *	+	95	95	94	93	86	100	87	95	38	35	58	36	21	21	28	50	34	63
<i>Obtortio</i> sp.*	-	2	3	3	3	6	-	3	1	14	8	1	13	4	-	18	-	13	24
<i>Obtortio pupoides</i> *	-	2	3	-	2	2	-	6	2	48	49	39	1	9	12	40	33	39	3
<i>Obtortio sulcifera</i> *	-	+	1	3	2	7	-	4	1	-	8	1	26	-	12	-	-	2	9
<i>Scaliola</i> spp.*	-	-	-	-	-	-	-	-	-	-	-	+	23	64	54	13	17	12	-
Triphoridae	11	-	-	-	+	+	5	+	+	-	-	-	+	+	-	-	-	-	-
Cerithiopsidae	2	-	-	+	+	-	+	+	+	-	-	-	-	-	-	-	-	-	-
Marginellidae	1	+	-	+	+	+	4	+	1	-	-	-	-	-	-	-	-	-	-
Pyramidellidae	-	6	3	5	3	7	8	3	3	6	7	5	5	2	4	3	8	-	2
<i>Acteocina</i>	-	5	-	11	14	4	2	6	4	27	1	4	-	2	-	5	17	-	+
% Bivalves	7	6	1	7	10	5	1	5	5	37	52	44	41	24	31	59	56	3	25
<i>Fragum</i> †	-	9	17	44	39	60	-	78	36	93	93	95	99	99	99	99	100	100	2
Tellinidae†	-	89	-	28	50	33	25	-	27	-	5	2	-	-	1	-	-	-	8

*As percent of Diastomidae.
†As percent of bivalves
Note: Species composition is given as percentage composition. + signifies less than 1% of the assemblage.

Table 23. Trophic structure representing averages (in percent) from each area.

Trophic structure*	Seaward reef	Outer lagoon	Inner lagoon
Herbivores	65	66	54
Faunal grazers	25	23	+
Predators/scavengers	—	1	3
Parasites	—	+	2
Suspension feeders	10	10	40

Note: + signifies less than 1% of the assemblages.

*Herbivores include archaeogastropods (*Tricolia*, *Leptothyra*), rissoids, cerithids, diastomids, etc.; faunal grazers include triphorids, cerithiopsids, and marginellids that feed on sponges, etc.; predators/scavengers are columbellids, turrids, and others of the neogastropods, and some opisthobranchs; the pyramidellids are considered parasitic; and suspension or deposit feeders are represented by bivalves.

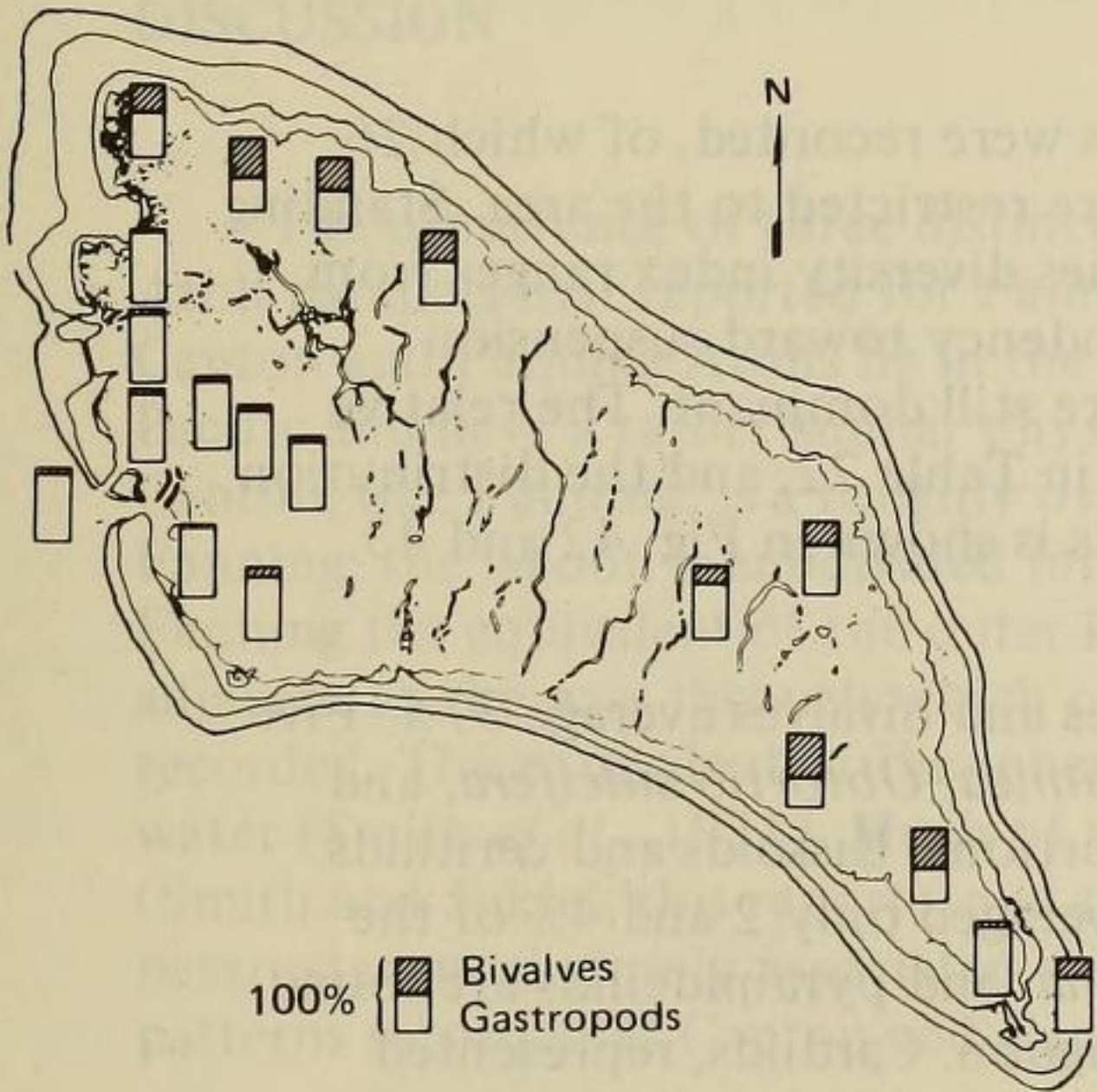


Figure 42. Relative abundance of bivalves and gastropods.

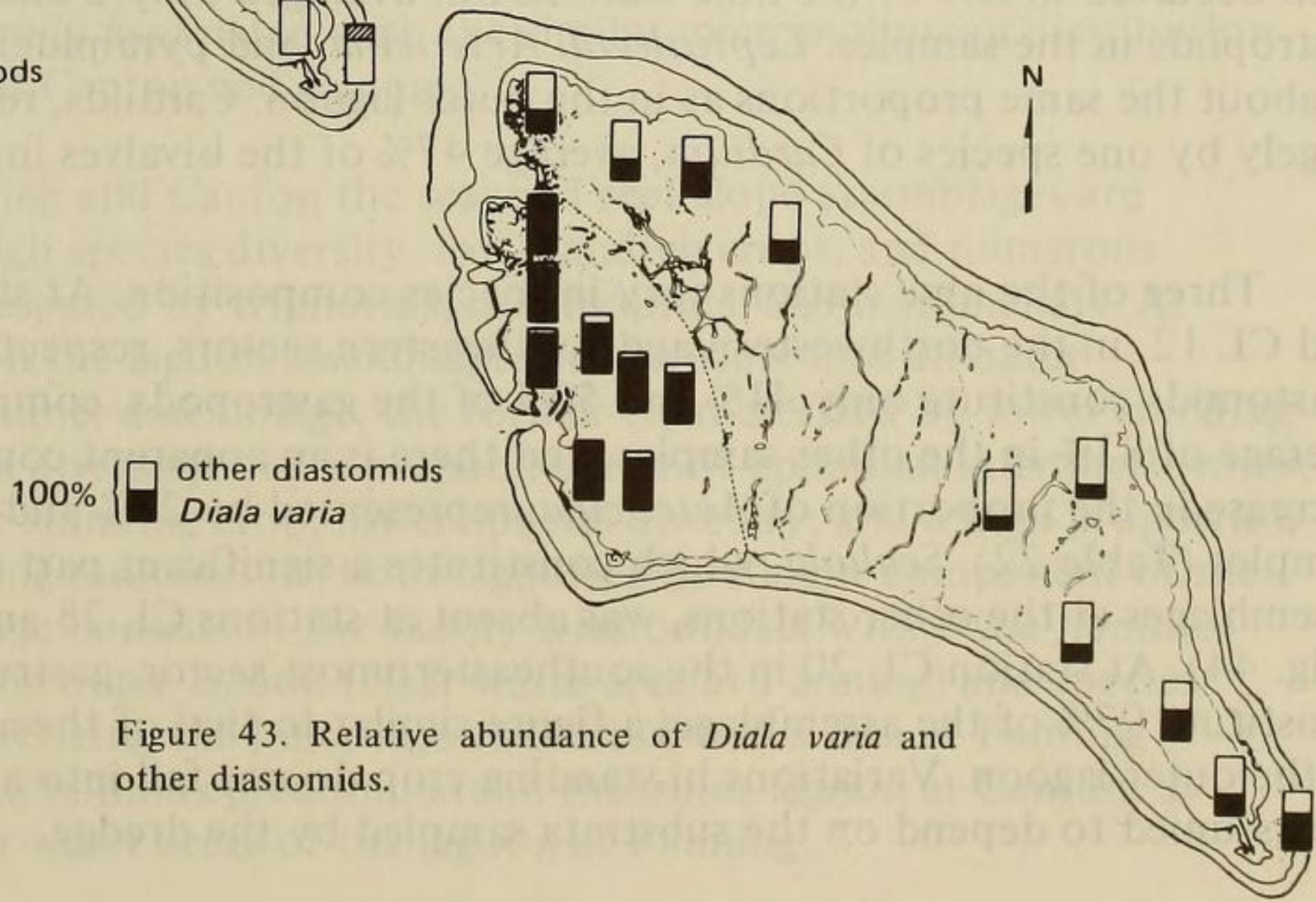


Figure 43. Relative abundance of *Divala varia* and other diastomids.

pupoides, *O. sulcifera*, and *Obtortio* sp. are less abundant and less frequent, each constituting 2 to 3% of the gastropods in the assemblages. Other prominently represented gastropods are rissoids, represented largely by two species, *Parashiela beetsi* and *Parashiela* sp., and the cerithid *Bittium* cf. *glareosum*. Turbinids of the genus *Leptothyra*, the opisthobranch *Acteocina sandwicensis*, and pyramidellids each constitute about 6% of the gastropod species. *Cerithiopsis* spp. and marginellids (Fig. 44) and triphorids are frequent, occurring in five to seven of the samples; but they are not abundant. The bivalves are represented by cardiids and tellinids, with one species of *Cardium* representing 40% of the bivalves and tellinids 42% of the bivalves.

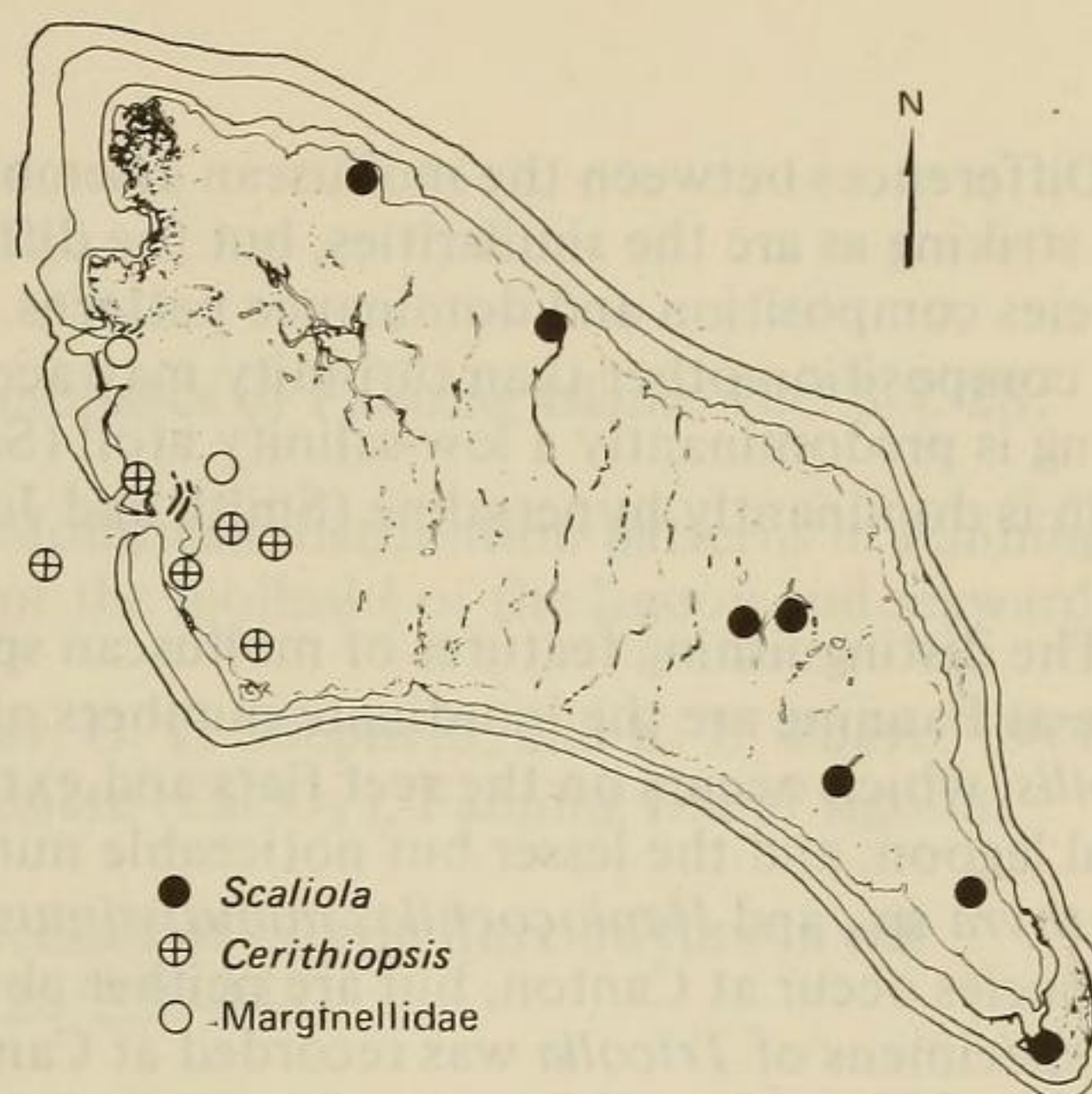
Two stations are somewhat anomalous: at station M18 near the pass and station M1 on a patch reef, diastomids form a conspicuously lesser proportion of the assemblages than they do elsewhere in the outer lagoon, and *Bittium* a higher proportion. Station M1 also lacked cardiids.

In the inner lagoon, 43 species of mollusks were recorded, of which 26 were also found in the outer lagoon, and 17 were restricted to the area. Standing crop averages 15.2 shells per cm³, and the species diversity index ranges from 1.4 to 3.0. Trophic structure shows a strong tendency toward suspension feeding (Table 23), although microherbivores are still dominant. The relative abundance of gastropods and bivalves is shown in Table 22, and the distribution of relative abundance of bivalves and diastomids is shown in Fig. 42 and 43.

Gastropods average 63% of the assemblages and bivalves average 37%. Five species of diastomid are present, with *Diala flammea*, *Obtortio sulcifera*, and *Scaliola* spp. represented by almost equal proportions. Rissoids and cerithids each occurred in five of the nine stations but averaged only 2 and 4% of the gastropods in the samples. *Leptothyra*, *Acteocina*, and pyramidellids are found in about the same proportions as in the outer lagoon. Cardiids, represented largely by one species of *Cardium*, average 47% of the bivalves in the samples.

Three of the nine stations vary in species composition. At stations CL 28 and CL 12, in the northwestern and southeastern sectors, respectively, the diastomids constitute only 41% and 50% of the gastropods, compared with an average of 81% in the other samples, and there is an apparent concomitant increase in the proportion of *Acteocina*, represented by 27% and 17% of the samples (Table 22). *Scaliola*, which constitutes a significant part of the assemblages at the other stations, was absent at stations CL 28 and CL 29 (Fig. 44). At station CL 20 in the southeasternmost sector, gastropods constitute 97% of the assemblage, a figure similar to that of the assemblages in the outer lagoon. Variations in standing crop do not fall into a pattern and are assumed to depend on the substrata sampled by the dredge.

Figure 44. Distribution of *Scaliola*, *Cerithiopsis*, and marginellids.



DISCUSSION

The occurrence of three distinctive assemblages of mollusks at Canton Atoll parallels that reported for Fanning Atoll (Kay and Switzer, 1974). Canton and Fanning Atolls lie in the same biogeographical region in the Central Pacific and have a rather similar physiography (Henderson *et al.*, this volume). Canton, like Fanning, is a roughly oval atoll with a single deep pass and, like Fanning, the lagoon is subdivided into two sectors by line and patch reefs. At Fanning the equivalent of the outer lagoon of Canton is an area of clear water adjacent to the pass through which currents of more than 5 knots have been recorded. The equivalent of the inner lagoon at Fanning is an area of turbid water (Smith *et al.*, 1971). Much of the inner lagoon at Canton is also turbid (Smith and Jokiel, this report), and this turbidity may be the water quality parameter most closely associated with the similar micromolluscan distribution patterns recorded at Canton and Fanning.

At both Fanning and Canton the seaward reef slope assemblages are characterized by high species diversity, low standing crops, and numerous faunal grazers represented by triphorids, cerithiopsids, and marginellids. At Fanning and Canton the lagoon assemblages are divisible into an outer assemblage and an inner assemblage, the former characterized by lower standing crop, higher species diversity, and a preponderance of epifaunal microherbivores, the latter by higher standing crop, lower species diversity, and a high proportion of suspension-feeding mollusks. In both lagoons a dominant component of the gastropod assemblage consists of the family Diastomidae, with *Diala flammea* predominating in the outer lagoon (clear-water area at Fanning) and species of *Obtortio* characterizing the inner lagoon (turbid-water area at Fanning). Among the bivalves, tellinids predominate in the outer lagoon at Canton, as they do in the clear-water areas of the lagoon at Fanning.

Differences between the molluscan assemblages of Canton and Fanning are as striking as are the similarities, but the differences appear to be primarily in species composition and dominance patterns. It is tempting to suggest that water composition other than turbidity may account for the differences: Fanning is predominantly a low-salinity atoll (Smith and Pesret, 1974), while Canton is dominantly hypersaline (Smith and Jokiel, this report).

The distinguishing features of molluscan species composition in the lagoon at Fanning are the inordinate numbers of the phasianellid *Tricolia variabilis*, which occurs on the reef flats and extends onto the patch reefs of the central lagoon, and the lesser but noticeable numbers of *Merelina* sp. A., *Leptothyra* sp., and *Haplocochlias minutissimus* (Kay and Switzer, 1974). All four species occur at Canton, but are neither abundant nor frequent: a total of 37 specimens of *Tricolia* was recorded at Canton, compared with several thousand at Fanning. All four species are presumably microherbivores, and at Fanning are conspicuously absent or few in numbers on the lagoon floor.

Five species distinguish the species composition at Canton: *Bittium* cf. *glareosum*, *Scaliola* spp., *Parashiela beetsi*, *Parashiela* sp., and a cardiid. *Bittium glareosum*, *Scaliola*, and *Parashiela* sp. were not recorded at Fanning; *Cardium* sp. and *Parashiela beetsi* were present, but not in the numbers recorded at Canton. At Canton, *Bittium* and *Parashiela* sp. are almost entirely restricted to the outer lagoon; *Cardium* sp. occurs in both the inner and outer lagoon, but is relatively more abundant in the inner lagoon; and *Scaliola* was found only in the inner lagoon. Of the five species, the habits of only the cardiid are sufficiently known to suggest a reason for its predominance: cardiids are infaunal suspension feeders, and their occurrence may be associated with peculiarities of the substrata at Canton.

Within the lagoon at Canton anomalies in distribution patterns occur most noticeably in the inner lagoon, where *Scaliola* is conspicuously absent from two stations (CL 28 and CL 29), and where there is a lower proportion of bivalves relative to gastropods at a third station (CL 20). Explanations for the anomalies are not readily apparent. The two stations where *Scaliola* is absent are in a disturbed sector of the lagoon near an old pass. Their presence at stations CL 12 and CL 20, which are also in the regions of old passes, would preclude the explanation for their nonoccurrence at stations CL 28 and CL 29 as being due to oceanic water or outer lagoon conditions. The high proportions of gastropods relative to bivalves at station CL 29 does suggest, however, that oceanic or outer lagoon conditions characterize this area.

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