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A COMPARATIVE SURVEY OF REEF-ASSOCIATED GASTROPODS AT MAZIWI ISLAND, TANZANIA

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INTRODUCTION

The status of Western Indo-Pacific marine communities has become of increasing interest over the past two decades. Numerous studies of the marine invertebrate fauna have provided records and ecological data necessary to evaluate the existing coastal environments. These initial studies provide a basic knowledge of marine community dynamics, essential in promoting conservation.

In the past 20 years, a number of descriptive papers on the Indo-Pacific gastropod fauna has been published, including Desmond (1957, Micronesia), Macnae (1958, Mozambique), Spry (1961, Tanzania), Cernohorsky (1964a, 1964b, 1967 and 1969, Fiji), Maes (1967, Cocos-Keeling Island), Taylor (1968, Seychelles) and Yaninek (1976, Kenya). Taylor (1968) states that most of the work done has been of an inventory nature and that a large gap in the knowledge of the Indo-Pacific fauna lies in East Africa.

Historically, the few assessments of marine communities in East Africa have dealt with botany and coastal geology. Some of the first accounts of local reefs were those of Crossland (1902 and 1903) in Zanzibar. A lapse of nearly 50 years followed before studies by Abbott (1951, parts of East Africa), Bailey (1953, Kenya) and Verdcourt (1954, 1959 and 1960, East Africa) appeared. Recently, much more work has been done, including Spry (1961, Tanzania), Talbot (1965, Tanzania), Jones (1969, Kenya), Lawson (1969, Kenya and Tanzania), Ray (1969, Kenya), Knowles (1970, Kenya), Brander *et al.* (1971, Kenya and Aldabra) and Yaninek (1976, Kenya). Other relevant studies done in the vicinity of eastern Africa include Crossland (1907, Sudanese Red Sea), Macnae and Kalk (1958, Mozambique), Abbott (1959, 1960 and 1961, Indo-Pacific region) and Taylor (1968, Seychelles; 1971 and 1976, Aldabra).

In this study, epifaunal gastropods from the offshore reef of Maziwi Island, Tanzania, were surveyed. Records and ecological data are compared with previous studies of the Indo-Pacific area.

Description of Study Area: Maziwi Island

The study area is a platform reef which is identified by Maziwi Island, a sand cay located on the northwestern edge of the reef. This reef, situated in the western Indo-Pacific, lies approximately seven miles off the Tanzania coast at E 39°4′ and S 5°30′ (Fig. 1). It is ovoid in shape with an inner lagoon found half way between the island and the outer edge of the reef. The outer edges of the platform drop sharply into the surrounding water of approximately 15 fathoms. At MLWS (Mean Low Water Spring) three-quarters of the outer edge of the reef is exposed forming a barrier to the inner submerged areas. At ELWS (Extreme Low Water Spring) the inner area is covered by 0.5 m of water except for a few scattered patches of exposed reef platform and the lagoon, which is roughly 10 m deep.

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Sandy beaches surrounding the island had grown larger on the southeastern and southwestern faces due to the Southeastern Monsoon, present at the time of the study. This habitat compares with the Type I habitat of Kohn (1967).

The inner reef shallows were a mixture of sand, coral rubble and sandstone surfaces. Near the lagoon the reef substrate dropped 1–2 m before rising into a built-up platform surrounding the lagoon. This platform was composed of living coral interwoven with patches of sand, limestone and dead coral substrates. The dominant corals, *Acropora* and *Pocillopora*, were interspersed

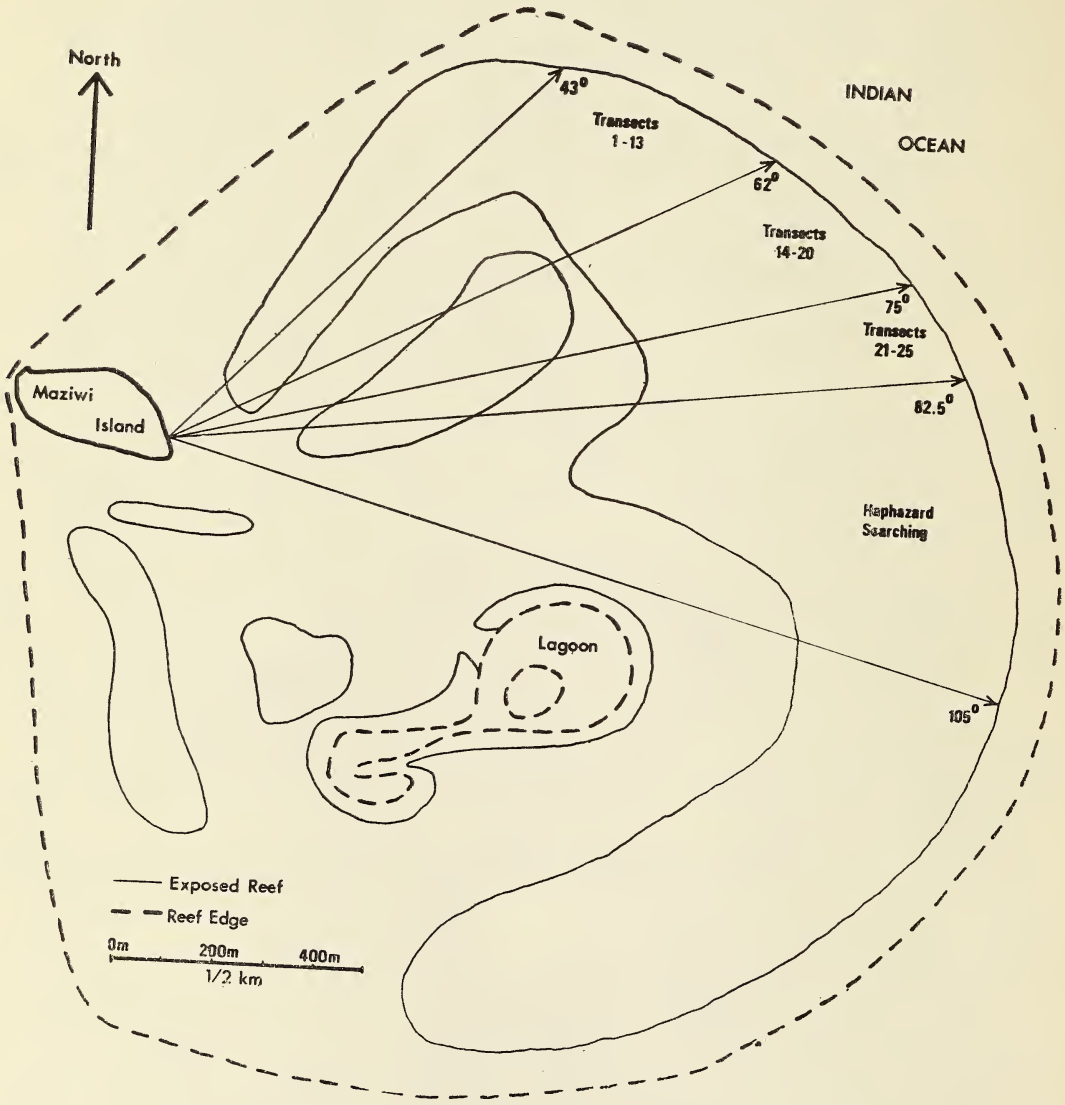

Figure 1

Diagramatic sketch of Maziwi Island and associated reef. The heavy dashed line indicates the boundaries of the reef edge while the fine lines delineate the exposed portions of the reef at low tide. The positioning of transects of the daytime survey area in degrees from north are shown in the arrow tipped lines. The daytime haphazard survey area is indicated.

with *Fungia*. The edge of the lagoon dropped off sharply as a near-vertical cliff. This area of the reef platform corresponds to the Type II habitat of Kohn (1967). The outer edge of the platform was composed of intertidal benches, exposed only at ELWS, also corresponding with the Type II habitat. An apex formed in the middle of the bench sloped progressively into richer biotic habitats near the water's edge. The seaward side was the most diverse. This outer bench was composed of a smooth limestone substrate, covered with dense algae, numerous crevices and large pieces of detached coral heads that had been broken off and tossed up on the bench from the outer submerged edge of the reef.

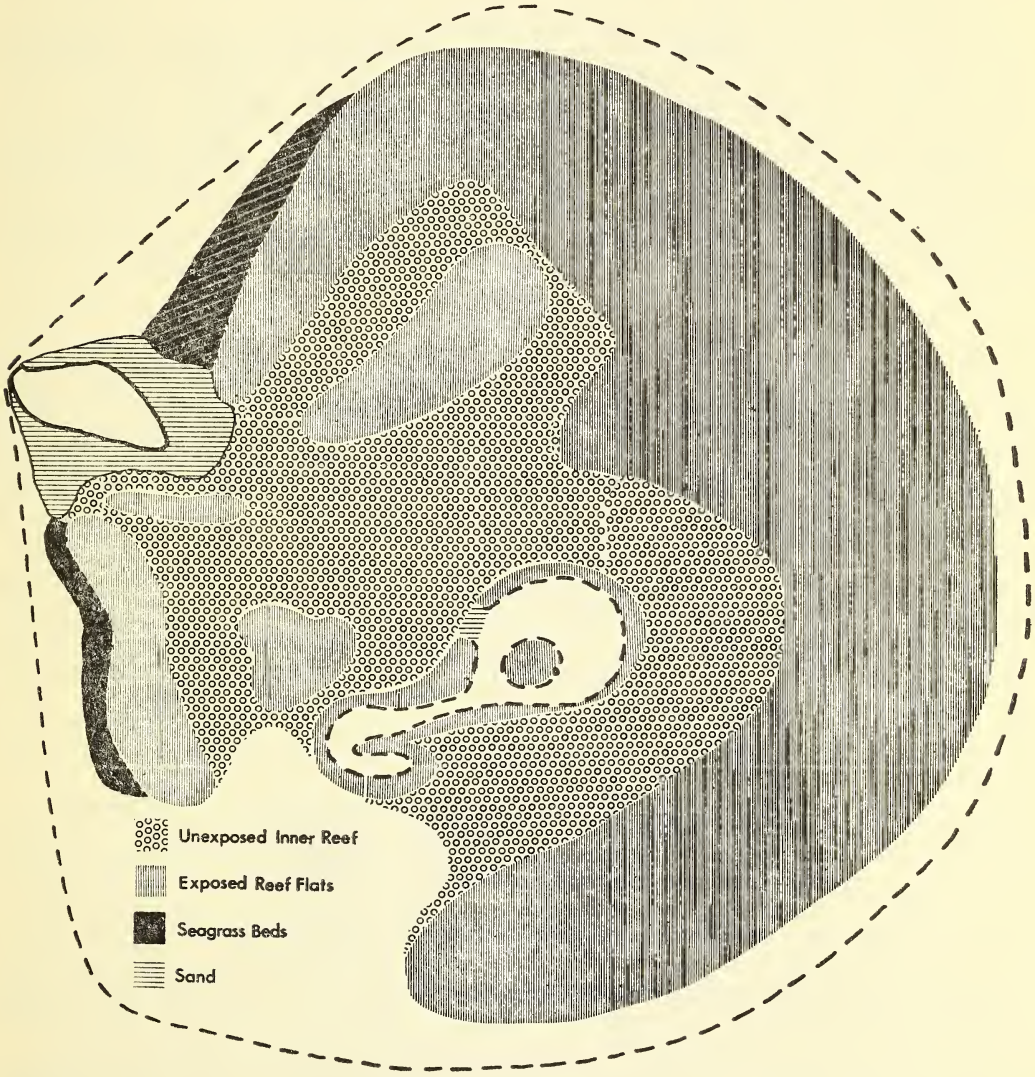

Figure 2

The major geographical features of the reef.

METHODS

Several methods were used to collect data. During four consecutive days, the outer north-eastern edge of the reef was surveyed both day and night (Fig. 1). Census data were obtained from local fishermen searching in the inner reef shallows at night for the gastropod *Cypraecassis rufa*.

For the first three daytime surveys, consecutive transects running perpendicular to the seaward reef edge were covered by foot every 30 m. Transects 1–13 were covered the first day; transects 14–20 were covered the day after and transects 21–25 were covered the third day. Each transect covered 2 m in width and extended approximately 40 m from the water's edge toward the centre of the reef platform. Each group of transects was oriented in degrees to a marker on the sland for daily relocation.

On the fourth day a haphazard search was conducted between 83° to 105° as measured from a reference point on the island (Fig. 1). Most specimens counted were observed in, around and under boulders. Those animals occurring between boulders were also counted.

The night surveys were conducted each evening during low tide following the daytime transect survey. The search method used emphasized boulder associated fauna.

Data on *Cypraecassis rufa* were obtained from fishermen on three consecutive spring low tide intervals during April–June 1975. The specimens were counted each night as they were collected. Specimens collected were removed from the surveyed area.

Gastropods included in this study follow the criteria of Yaninek (1976) with the additional proviso that living gastropods with shell length longer than 1.5 cm were counted.

RESULTS

The daytime survey of the reef revealed 38 species totalling 240 individuals (Table 1). The ten most abundant species accounted for 76% of the total observations. Moreover, only three species *Thais tuberosa*, *Cypraea annulus* and *Paralagena smaragdula*, represented nearly 40% of the total. Twenty species were observed fewer than three times each. Figure 3 shows the distribution of the total numbers of species and individuals recorded over the three surveyed zones.

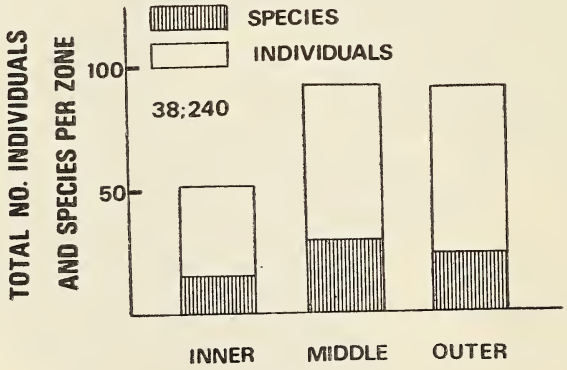

Figure 3
Total numbers of individuals (clear area) and species (hatched area) observed per surveyed zone. The numbers 38; 240 refer to overall totals of species and individuals, respectively.

Three families, each represented by a single genus, accounted for 2/3 of all observations; these included *Conus* spp., 32%; *Cypraea* spp., 23% and *Vasum* spp., 11% (Fig. 4).

Ten species of the genus *Conus* were observed 76 times (Table 2). Four species, numbering nine individuals or more represented 79% of all *Conus* spp. including *C. ebraeus*, 29%; *C. rattus*, 25%; *C. fulgetrum*, 13% and *C. lividus*, 12%. The number of observations were greater in the middle and outer zones as expressed by totals of 20, 28 and 28 individuals, respectively (Fig. 4).

TABLE 1
Numbers observed (n), *frequencies* (f) *and densities of species recorded during the daytime survey*

Species	n	f	Density per 100 m²
Thais tuberosa	34	.142	1.70
Cypraea annulus	30	.125	1.50
Paralagena smaragdula	29	.121	1.45
Conus ebraeus	22	.092	1.10
C. rattus	19	.079	0.95
C. fulgetrum	10	.042	0.50
Vasum turbinellus	10	.042	0.50
Conus lividus	9	.038	0.45
Cypraea lynx	9	.038	0.45
Vasum rhinoceros	9	.038	0.45
Vasum ceramicum	8	.033	0.40
Conus chaldeus	5	.021	0.25
Cypraea isabella	5	.021	0.25
Conus coronatus	4	.017	0.20
Cypraea caputserpentis	4	.017	0.20
Conus miles	3	.013	0.15
Mitra stictica	3	.013	0.15
Strombus mauritianus	3	.013	0.15
Conus varius	2	.008	0.10
Cypraea carneola	2	.008	0.10
C. helvola	2	.008	0.10
Harpa major	2	.008	0.10
Bursa rosa	1	.004	0.05
Conus marmoreus	1	.004	0.05
C. sp.	1	.004	0.05
Cypraea felina	1	.004	0.05
C. fimbriata	1	.004	0.05
C. histrio	1	.004	0.05
C. moneta	1	.004	0.05
C. staphylaea	1	.004	0.05
Drupa ricina	1	.004	0.05
Fucinus colus	1	.004	0.05
Lampusia aquatilis	1	.004	0.05
Latirus polygonus	1	.004	0.05
Ranularia gallinago	1	.004	0.05
Thais gemmulata	1	.004	0.05
Trochus maculatus	1	.004	0.05
T. sp.	1	.004	0.05
TOTAL	240	1.000	

Ten species of the genus *Cypraea* were represented by 57 individuals (Table 2). *Cypraea annulus* alone accounted for 53% of all *Cypraea* spp. and 13% of all observations, second only to the 14% of *Thais tuberosa*. Seven species were infrequently observed. Figure 4 shows the species distribution and the total number of individuals observed per surveyed zone.

Several of the *Cypraea* spp. appeared to brood egg masses. *Cypraea tigris* was found brooding egg masses in crevices on the surface of the reef flat. The egg capsules were purple-red in color and shaped like grains of white rice (5 mm in length). Each capsule was laid adjacent to the previous one, resulting in a symmetrical spiral of capsules layered in vertical stalks. One particular mass had over 300 capsules.

Cypraea lynx was observed brooding egg masses during the night. These capsules (2 mm in length) were ivory in color and stalked in the same manner as the egg masses of *C. tigris*. The capsules of *C. lynx* were similar in shape to those of *C. tigris*. *C. isabella* was not seen brooding egg masses, but it was observed laying yellow capsules the same size as those of *C. lynx*. The symmetry of the *C. isabella* egg capsules corresponded to those of *C. tigris* and *C. lynx*.

For three species of the genus *Vasum*, 27 records were obtained (Table 2). This genus was the least frequent of the three prominent genera discussed here. The numbers of individuals

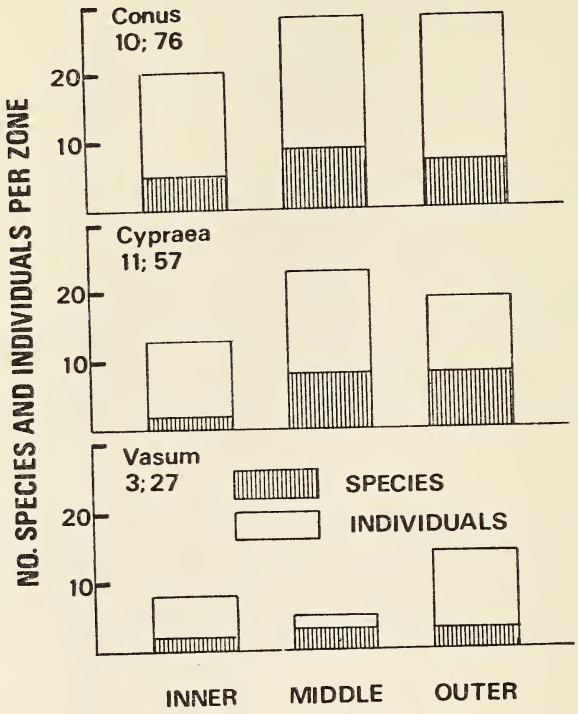

Figure 4
Distributions of the combined congeneric species of *Conus*, *Cypraea* and *Vasum* over the three surveyed zones. The number of observed individuals for each genus is indicated by the clear blocks while the number of species is shown by the hatched blocks. Total numbers of observed species and individuals over the three zones given are below the generic name.

observed per species were similar: *V. turbinellus*, 37%; *V. rhinoceros*, 33%; and *V. ceramicum*, 30%.

Results of the daytime haphazard survey are tabulated in Table 3. Included in this survey was *Clanculus puniceus*, a ubiquitous trochid not counted in the transect survey. This survey focused on the large boulders tossed on the reef platform. As a result, half the *Cypraea* spp. observed were more than or equal to the number observed in the transect survey. On the other hand, a single *C. annulus* was observed compared to 30 observations for the transect survey. Since *C. annulus* is usually found on top of the reef flat, partially or completely exposed, this infrequency near coral rubble was expected. Because of a similar distribution, *C. fulgetrum* and *C. lividus* were observed only once.

Searching during the night at spring low tide revealed 42 species from more than 137 individuals (Table 4). Many of the species found during the daytime were also found at night. Differences observed among the three night surveys are recorded in Table 5.

A survey of the night population revealed eight species representing 64% of the total observations. Seven of these species were cypraeids, *Trochus tentorium* being the exception. The remaining 34 species were infrequently observed, twenty-two species only once.

TABLE 2
Numbers observed per surveyed zone and densities of congeneric members of Conidae, Cypraeidae and Vasidae from the transect survey

	ZONES				
Conus:	Inner	Middle	Outer	Total	Density per 100 m²
C. ebraeus	12	7	3	22	1.10
C. rattus	1	8	10	19	0.95
C. fulgetrum	2	5	3	10	0.50
C. lividus	1	3	5	9	0.45
C. chaldeus	—	1	4	5	0.25
C. coronatus	4	—	—	4	0.20
C. miles	—	1	2	3	0.15
C. varius	—	1	1	2	0.10
C. marmoreus	—	1	—	1	0.05
C. sp.	—	1	—	1	0.05
TOTAL	20	28	28	76	

	ZONES				
Cypraea:	Inner	Middle	Outer	Total	Density per 100 m²
C. annulus	12	14	4	30	1.50
C. lynx	1	3	5	9	0.45
C. isabella	—	3	2	5	0.25
C. caputserpentis	—	1	3	4	0.20
C. carneola	—	1	1	2	0.10
C. helvola	—	—	2	2	0.10
C. felina	—	1	—	1	0.05
C. histrio	—	1	—	1	0.05
C. moneta	—	1	—	1	0.05
C. fimbriata	—	—	1	1	0.05
C. staphylaea	—	—	1	1	0.05
TOTAL	13	25	19	57	

	ZONES				
Vasum:	Inner	Middle	Outer	Total	Density per 100 m²
V. turbinellus	—	2	8	10	0.50
V. rhinoceros	5	1	3	9	0.45
V. ceramicum	3	2	3	8	0.40
TOTAL	8	5	14	27	

TABLE 3
Species and number of each (n) *recorded during daytime haphazard surveying*

Species	n
Clanculus puniceus	8
Cypraea caputserpentis	3
C. carneola	2
C. histrio	2
C. isabella	2
Lampusia aquatilis	2
Conus fulgetrum	1
C. lividus	1
C. sp.	1

Species	n
Cypraea annulus	1
C. felina	1
C. helvola	1
C. kieneri	1
Cypraecassis rufa	1
Ranularia retusa	1
TOTAL	28

Species found only at night included *Cypraea teres*, *C. felina* and *C. erosa* plus *Conus geographus*, *C. textile*, *Cypraecassis rufa* and *Trochus tentorium*, each encountered at least twice in three nights. These seven species comprised 72% of more than 36 individuals observed. It should be noted that the species most conspicuous during the night include the *Cypraea* spp., usually hidden under rocks and up in crevices during the day; *Conus* spp., which except for *C. geographus* and *C. textile* were rather scarce compared to the daytime survey; and *Trochus tentorium*, found only on the underside surface of boulders. All three specimens of *C. geographus* were found underneath boulders associated with pockets of sand and scattered algal and seagrass cover. They moved actively until removed from the habitat which prompted withdrawal into their thin shells. *Cypraecassis rufa*, another ubiquitous reef species, was noticeably absent from the exposed reef flat. This absence is expected because this species buries itself during the day in patches of sand, covered by at least half a meter of water at low tide.

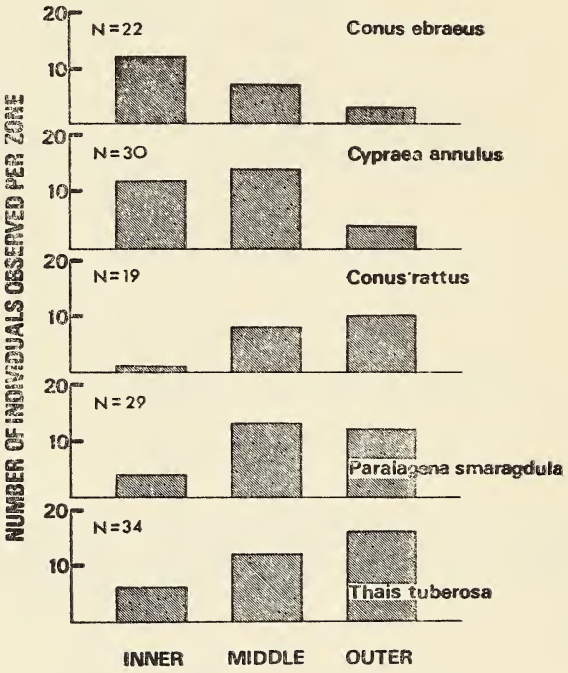

Figure 5
Observed distributions of the five most abundant species in the surveyed zones.

Census data collected on *Cypraecassis rufa* are tabulated in Table 6. The first week of collecting yielded more than 300 individuals based on estimates provided by local fishermen. For the subsequent two periods of low tide, individuals were counted daily, yielding totals of 388 and 182, respectively. These specimens were taken from approximately 1/3 of the total reef surface, an area dominated by coral rubble and patches of the seagrass *Thalassodendron*. The patches of *Thalassodendron* were eaten by the sea urchin *Tripneustes*, the basic food of *C. rufa*. This section of the reef is never exposed, even at extreme low tide.

A list of all molluscan species identified for the Maziwi Island Reef is provided in an Appendix.

TABLE 4
Species and number of each (n) *observed during the night surveys*

Species	n	Species	n
Cypraea lynx	41	*C. gubernator*	1
C. caputserpentis	10	*C. litoglyphus*	1
C. helvola	9	*C.* sp.	1
C. carneola	7	*Cymatium pyrum*	1
Trochus tentorium	6	*Cypraea fimbriata*	1
Cypraea erosa	5	*C. kieneri*	1
C. felina	5	*C. limacina*	1
C. isabella	5	*C. staphylaea*	1
Conus geographus	3	*Drupa ricina*	1
C. rattus	3	*Harpa major*	1
Cypraea teres	3	*Latirus polygonus*	1
Conus chaldeus	2	*Mitra stictica*	1
C. coronatus	2	*Paralagena smaragdula*	1
C. fulgetrum	2	*Pleuroploca filamentosa*	1
C. miles	2	*Ranularia gallinago*	1
C. textile	2	*R. retusa*	1
Cypraea annulus	2	*Strombus floridus*	1
C. histrio	2	*S. mauritianus*	1
Cypraecassis rufa	2	*Trochus maculatus*	1
Lampusia aquatilis	2	*Turbo* sp.	1
Bulla ampulla	1		
Conus ebraeus	1	TOTAL	137

TABLE 5
Species and numbers of each, observed only *during the night survey. X's shown for the first night indicate at least two occurrences for that species (full counts began the second night)*

	NIGHTS			
Species	1	2	3	Total
Trochus tentorium	x	5	—	7
*Cypraea felina**	—	2	3	5
C. erosa	—	2	3	5
C. teres	x	1	1	4
Conus geographus	—	2	1	3
C. textile	—	2	—	2
Cypraecassis rufa	—	2	—	2
Strombus floridus	x	—	—	2
Conus gubernator	1	—	—	1
Cymatium pyrum	1	—	—	1
Conus litoglyphus	—	1	—	1
Nassarius margaritifera	—	1	—	1
Pleuroploca filamentosa	—	1	—	1
Ranularia gallinago	—	1	—	1
R. retusa	—	1	—	1
Cypraea kieneri	—	—	1	1
C. limacina	—	—	1	1
TOTAL	8	21	10	39

*Observed once during the daytime survey (see Table 3).

TABLE 6

Census data on Cypraecassis rufa *over three consecutive intervals of spring low tides in April–June, 1975*

	Day—1	2	3	4	5	6	7	Total
Period I:			Not Recorded Daily					300
Period II:	19	41	40	101	102	69	16	388
Period III:	64	11	30	40	23	14	—	182
								870

DISCUSSION

The distribution of the surveyed species did not reveal distinct ecological regions corresponding with the three surveyed zones. Statistically ($X^2=5.59$, d.f.$=4$, $p<.10$), the three most abundant genera (*Conus*, *Cypraea* and *Vasum*) showed no significant preference among the surveyed zones (Fig. 4). The total number of species and individuals observed in the middle and outer zones was very similar for both *Cypraea* and *Conus* spp. *Vasum* spp. were too rare to warrant any conclusions.

Individual distributions of the more abundant species did not always reflect the cumulative distribution of the congeners (Fig. 5). The low densities precluded statistical analysis, but inspection of individual species distribution patterns show preferences toward either the inner or outer zone.

Conus ebraeus and *Cypraea annulus* were least abundant in the outer zone (Fig. 5). Because these two species occur higher intertidally, they undergo prolonged exposure in a habitat which was less heterogeneous and thus less diverse. Kohn (1959 and 1968) reports the same intertidal preference for *C. ebraeus* and states that it represents the dominant component of the *Conus* constituency in that habitat. *Cypraea annulus* also represents the dominant *Cypraea* spp. for this habitat.

Conus rattus, *Paralagena smaragdula* and *Thais tuberosa* each were more abundant in the middle and outer zones (Fig. 5). These species are less tolerant of prolonged exposure and thus were found low in the intertidal exposure gradient. Desmond (1957) observed that *C. rattus* was generally found under rocks near the low water mark while Maes (1967) noted that *C. rattus* was common on more sheltered parts of the reef. The latter contrasts with observations made at Maziwi, which found *C. rattus* on the most seaward edge of the reef.

The distribution patterns of individual species of *Conus* over the three zones were not always consistent with the overall distribution for that family (compare Figures 4 and 5). In Figure 5, *Conus ebraeus* and *C. rattus* show preferences toward opposite ends of the surveyed zones.

The family Cypraeidae showed an overall increase in abundance and species diversity toward the outer reef edge, while the single most abundant species *C. annulus* preferred the inner edge (Fig. 4).

It is generally agreed that species diversity increases while relative density decreases as one moves toward the outer edge of a tropical reef (Kohn, 1959, 1967, 1968, 1971 and 1975; Taylor, 1968 and 1971). Taylor (1971) states that species diversity increases "as a complex interaction of many factors including varying predation intensity, increased habitat diversity, less emersion, and the gradient from a physically controlled to a biologically regulated one." Kohn (1971 and 1975) contends that increased species diversity is a result of habitat heterogeneity and ecological specialization.

The species diversity index was calculated for each surveyed zone. This index increases with the number of species; thus, using $H'' = -\sum \frac{Ni}{N} \ln \frac{Ni}{N}$ (Kohn, 1975), where Ni=number of

individuals of the ith species, and N=total number of individuals. Values of 2.25, 2.68 and 2.64 were computed for the inner, middle and outer zones respectively. Kohn (1975) found that the number of species averaged 15 and the species diversity averaged 2.3 for the most heterogeneous habitat type on the fringing reefs of Thailand and Indonesia. Brander *et al.* (1971) questioned the usefulness of comparing reefs by calculating densities and diversities of small invertebrates for large scale habitats. Dickman (1968) maintained that comparison of relative productivity is more useful in areas where significant variations exist between species composition. He states that the relative productivity reflects changes in the relative abundance of all trophic levels.

The section of the reef surveyed was ecologically very diverse, supporting a large number of species and individuals. The overall diversity was nearly equal in the middle and outer zones. The middle zone probably supported a high diversity of individuals because of an increase in the surface area as a result of coral boulders washed up from the reef edge. Large concentrations of Cypraeidae, some Conidae and numerous other organisms take refuge in and around this coral debris, increasing the habitat diversity.

Most *Conus* spp. showed a general preference for the exposed reef flat substrate rather than the coral boulders. This diversity increased toward the outer edge of the reef. The small difference between the abundance and diversity of species of the middle and outer zones reflects the homogeneity between zones.

The overall number of species encountered during the night survey was 42 compared to 38 for the daytime survey. Comparing the number of individuals between day and night is biased by the sampling effort favouring the daytime survey. This bias entailed spending more searching time per day, surveying more days and covering a wider variety of the reef habitat. That more species were found at night probably reflects the fact that ecologically complex habitats of coral boulders support a greater variety of species not obvious during the day. This is surely the case for members of the family Cypraeidae which seek refuge from insolation during the day and emerge at night to graze (Cernohorsky, 1964a and Spry, 1961). Several of the *Conus* spp. such as *C. geographus* and *C. textile* were conspicuous only at night around boulder habitats.

Census data for *Cypraecassis rufa* indicate a relatively high density of individuals existing on the unexposed reef flat (Fig. 2). The first two periods of collecting yielded over 300 and 384 individuals, respectively. The yield for the third period, 182, was down 50% from the second period. Given that the searching intensity was the same each time, it appears that the resident population was significantly altered. The adult population may remain reduced for several years until the juveniles mature. Significant recruitment of adults by immigration probably can not occur because the most suitable habitat was the one carefully scoured during the collection period.

SUMMARY

The overall abundance and species diversity of gastropods at Maziwi Island was greater than that of any of the sites surveyed by the author at Diani Beach or Malindi Marine National Park in Kenya (Yaninek, 1976). The remote location of the reef is probably the single most important factor contributing to its relatively protected state. Even though most species of the family Conidae were not included in the previous survey, the species distributions and habitat preferences were similar to those observed at Maziwi Island. The species distributions observed at Malindi and Maziwi were similar, except for the occurrence of *Pleuroploca trapezium* at the former site, where it was dominant on *Thalassodendron* benches.

Commercial collecting or "predation" on gastropods hits the rare species of a reef community, but in a naturally regulated community it is usually the most abundant species which receive the heaviest predation. Limiting human exploitation of the reef's resources would help restore stability to the community.

Further quantitative studies along the East African coast are needed to provide a basic understanding of the existing reef communities. These studies can result in the improvement of conservation measures since sound management policies can lead to a sustained yield of this natural resource.

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APPENDIX

This appendix lists all Molluscan species identified from the Maziwi Island Reef. The specimens were recorded in the months of May and July, 1975. The common names used below follow Abbott (1962).

Phylum: MOLLUSCA
Class: GASTROPODA

Haliotidae—VENUS EAR SHELLS
Haliotis pustulatus (Reeve)

Fissurellidae—KEYHOLE LIMPETS
Diodora rupelli (Sowerby)

Patellidae—LIMPETS
Cellana eucosmia (Pilsbry)

Trochidae—TOP SHELLS
Clanculus puniceus (Philippi)
Pyramidae nodulifera (Chemnitz)
Trochus maculatus (Linne) Maculated Top
Trochus tentorium (Gmelin)

Stomatiidae
Gena planulata (Lamarck)
Stomatella orbiculata (A. and H. Ad.)

Phasianellidae—PHEASANT SHELLS
Phasianella jaspidea (Reeve)

Neritidae
Nerita albicilla (Linne)

Littorinidae—PERIWINKLES
Littorina obesa (Sowerby)

Cerithiidae
Cerithium nodulosum (Bruguiere) Giant Knobbed Cerith
Cerithium sinensis (Gmelin)

Epitoniidae—WENTLETRAPS
Epitonium coronatum (Lamarck)

Janthinidae—VIOLET SHELLS
Janthina globosa (Swainson)
Janthina janthina (Linne)

Strombidae—CONCH AND SCORPION SHELLS
Lambis chiragra (Röding) Chiragra Spider Conch
Lambis lambis (Linne) Common Spider Conch
L. truncata (Humphrey) Giant Spider Conch
Strombus auris-dianae (Linne) Diana Conch
Strombus dentatus (Linne)
S. floridus (Lamarck)
S. lentiginosus (Linne) Silver Conch
S. mauritianus (Lamarck)

Eratoidae
Trivia oryza (Lamarck)

Cypraeidae—COWRIES

Cypraea annulus (Linne) Gold-ringer
Cypraea caputserpentis (Linne) Snake-head Cowrie
C. carneola (Linne) Carnelian Cowrie
C. caurica (Linne) Caurica Cowrie
C. chinensis (Gmelin) Chinese Cowrie
C. erosa (Linne) Eroded Cowrie
C. felina (Gmelin) Kitten Cowrie
C. fimbriata (Gmelin) Small-toothed Cowrie
C. helvola (Linne) Honey Cowrie
C. histrio (Gmelin) Histrio Cowrie
C. isabella (Linne) Isabelle Cowrie
C. kieneri (Hidalgo) False Swallow Cowrie

C. limacina (Lamarck) False Grooved Cowrie
C. lynx (Linne) Lynx Cowrie
C. mappa (Linne) Map Cowrie
C. moneta (Linne) Money Cowrie
C. staphylaea (Linne) Grooved Cowrie
C. talpa (Linne) Mole Cowrie
C. teres (Gmelin) Tapering Cowrie
C. testudinaria (Linne) Tortoise Cowrie
C. tigris (Linne) Tiger Cowrie
C. vitellus (Linne) Pacific Deer Cowrie

Ovulidae
Calpurnus verrucosus (Linne)
Ovula ovum (Linne)

Naticidae—MOON SHELLS
Natica chinensis (Lamarck)
Polinices mammilla (Linne)
Polinices melanostoma (Gmelin)
P. zanzibarica (Recluz)

Cassididae—HELMUT SHELLS
Cypraecassis rufa (Linne) Bull Mouth Helmut
Phalium erinaceus (Linne)
Phalium vibex (Reeve) Bonnet Shell

Cymatiidae—TRITON SHELLS
Charonia tritonis (Linne) Pacific Triton
Cymatium pyrum (Linne)
Lampusia aquatilis (Reeve)
Ranularia gallinago (Reeve)
Ranularia retusa (Lamarck)

Bursidae—FROG SHELLS
Bursa lampas (Linne)
Bursa rugosa

Tonnidae—TUN SHELLS
Tonna caniculata (Linne)
Tonna galea (Linne) Giant Tun

Muricidae—ROCK SHELLS
Chicoreus ramosus (Linne) Ramose Murex
Murex haustellum (Linne) Snipe's Bill

Thaisidae
Drupa ricina (Linne) Prickly Drupe
Drupa rubusidaeus (Röding)
Morula granulata (Duclos)
Thais gemmulata
Thais tuberosa (Röding)

Buccinidae—WHELKS
Engina mendicaria (Linne)

Nassaridae—DOG WHELKS
Nassarius albescens (Dunker)
Nassarius callospira (A. Adams)
N. crematus (Hinds)
N. crenulatus
N. margaritifer (Dunker)

Fasciolariidae—TULIP SHELLS
Cantharus fumosus (Dillwyn)
Cantharus undosus (Linne)
Fusinus colus (Linne) Distaff Spindle
Latirus nassatula (Lamarck)
Latirus polygonus (Gmelin)
Paralagena smaragdula (Linne)
Pleuroploca filamentosa (Röding)
Pleuroploca trapezium (Linne)

Olividae—Olive shells
Ancilla (?)
Oliva episcopalis (Lamarck) Purple-mouthed Olive

Mitridae—Mitre shells
Mitra arenosa (Lamarck)
Mitra digitalis (Dillwyn)
M. mitra (Linne) Episcopal Miter
M. stictica (Link) Pontifical Miter
Pterygia conus (Gmelin) Cone Miter
Pterygia crenulata (Gmelin)
P. nucea (Meuschen) Nucea Miter
Strigatella litterata (Lamarck)

Vasidae—Vase shells
Vasum ceramicum (Linne) Ceram Vase
Vasum rhinoceros (Gmelin)
V. turbinellus (Linne) Pacific Top Vase

Harpidae—Harp shells
Harpa major (Röding)

Turridae—Tower shells
Xenuroturris cingulifera (Lamarck)

Conidae—Cone shells
Conus arenatus (Hwass)
Conus chaldeus (Röding)
C. coronatus (Gmelin)
C. ebraeus (Linne) Hebrew Cone
C. ermineus (Born)
C. flavidus (Lamarck)
C. fulgetrum (Sowerby)
C. geographus (Linne) Geography Cone
C. gubernator (Hwass)
C. litoglyphus (Hwass) Lithograph Cone
C. litteratus (Linne) Pacific Lettered Cone
C. lividus (Hwass)
C. marmoreus bandanus (Lamarck) Marble Cone
C. miles (Linne) Soldier Cone
C. rattus (Hwass)
C. striatellus (Link)
C. tesselatus (Born) Tessellate Cone
C. textile (Linne) Textile Cone
C. vexillum (Gmelin)

Terebridae—Auger shells
Terebra crenulata (Lamarck) Crenulata Auger
Terebra dimidiata (Linne) Dimidiate Auger
T. maculata (Linne) Marlinspike
T. nebulosa (Sowerby) Nebulose Auger

Hydatinidae
Hydatina physis (Linne) Paper Bubble

Bullidae
Bulla ampulla (Linne) Pacific Bubble

Akeridae
Akera soluta (Chemnitz)

Aplysiidae—Sea hares
Dolabella scapula (Martyn)

Class BIVALVIA

Atrina vexillum (Born)
Codakia interrupta (Lamarck)
Donax faba (Gmelin)
Donax incarnatus (Gmelin)
Naranio lapicida (Chemnitz)
Pinna muricata (Linne)
Pinctada margaritifera (Linne) Black-lipped Pearl Oyster
Pinctada sp.
Tellina pharaonis (Hanley)
Tridacna elongata (Lamarck)

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