Echinoderms from the North-East Coast of Madagascar

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Chapter 3

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INTRODUCTION

This study was realized under the Rapid Assessment Program (Marine RAP) of marine biodiversity by Conservation International Madagascar. In total, 26 sites were surveyed over 20 days, on the northeast coast of Madagascar from Ambodivahibe Bay to Vohemar. There are few publications or inventories of Echinoderms in Madagascar notably Cherbonnier (1988), Cherbonnier & Guille (1978), Marshall & Rowe (1981). Only holothurians, which are extensively exploited for the preparation of trepang, have been studied in detail.

The main objectives of the study were to:

- inventory the echinoderms of northeast Madagascar;
- test hypotheses about the ecological roles of echinoderms related coastal ecosystems and in particular the coral reef ecosystem;
- determine the existence or degree of overexploitation of sea cucumbers as one of the main fisheries in Madagascar.

METHODS

In this survey, only the four most common classes namely echinoids, asteroids, holothuroids and ophiuroids were studied, and some crinoids were also observed. Twenty six sites were surveyed in a total of 30 hours of observation, by walking on the reef flat, snorkeling in shallow depths and by SCUBA diving (up to 25 meters) on outer reef slopes.

Species identification was primarily made from in-situ observation based on personal experience and guides on echinoderms (Guille et al. 1986). Many species are easily identified by eye, however many aspects of external appearance are variable, and therefore unreliable for identification for some species. Additionally, there is often very similar appearance of two different species. Underwater photography was used to document and check on identifications, and to avoid collecting many specimens, particularly for rare or over-utilized species such as holothurians. One night dive was undertaken to check on diversity patterns at night, in Loky Bay. Specimens that were collected were preserved in 70° ethanol, renewed after several days as the colour from the animals is leached into the alcohol. Initial preservation in dilute (buffered) formalin (10% in seawater) for several days helps to preserve colour.

RESULTS

Echinoderms were found across a range of habitats, from reef flats and seagrass beds to deep water on outer slopes. Most ophiuroids live either in the branches of live corals like *Acropora* or *Porites*, or under coral debris or blocks of dead coral. Many juvenile sea cucumbers are also under coral debris and dead blocks sometimes covered with algae. Many echinoderms are

active only at night, in particular sea cucumbers, crinoids and gorgonocephalids.

In total, 68 species belonging to the five classes were recorded. These are 3 species of crinoid, 18 holothurians, 27 ophiuroids, 10 echinoids and 10 asteroids. Two other species were not found during this survey, but were found by the author in Ambodivahibe in 2007. This brings the total number of inventoried Echinoderms in the area to 70 species.

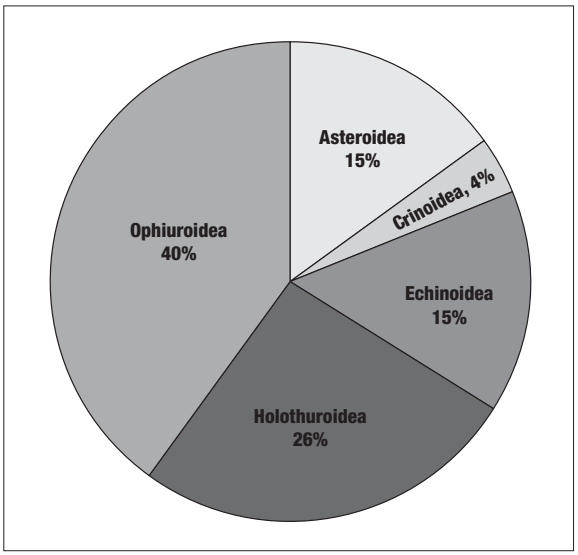

Figure 3.1. Distribution of echinderms by class, northeast Madagascar.

The most diverse sites were site 10 in Loky Bay, site 14 in Vohemar Bay and site 2 in Ambodivahibe Bay. It should be noted that the large number of echinoderm species recorded in Vohemar Bay is mainly due to the abundance of opportunistic species that benefit from the input of organic matter in the vicinity of the town. Among these species are the echinidea *Tripneutes gratilla*, *Diadema setosum, Toxopneutes pileolus*; the ophiuroids *Macrophiotrix* cf. *rugosa, Ophioplocus imbricatus, Ophiocoma erinaceus, O. scolopendrina* and holothurians *Synapta maculata and Euapta godeffroyi*.

Acanthaster planci, a seastar predator of hard corals, was not encountered. The scarcity of commercial holothurians such as *Holothuria scabra*, *Thelenota ananas, Microthele fuscogilva and Microthele nobilis* was observed, and *Microthele fuscopunctata* was encoutered only once in the Loky Bay. A single specimen of *Holothuria scabra versicolor* was encoutered once in the Andravina Bay on muddy bottom at 12 meters in depth. Only holothurian species of inferior quality, or unexploited species, were encountered. Among these are *Holothuria atra, Holothuria verrucosa, H. leucospilota, Synapta maculata*, *Euapta godeffroyi* etc.

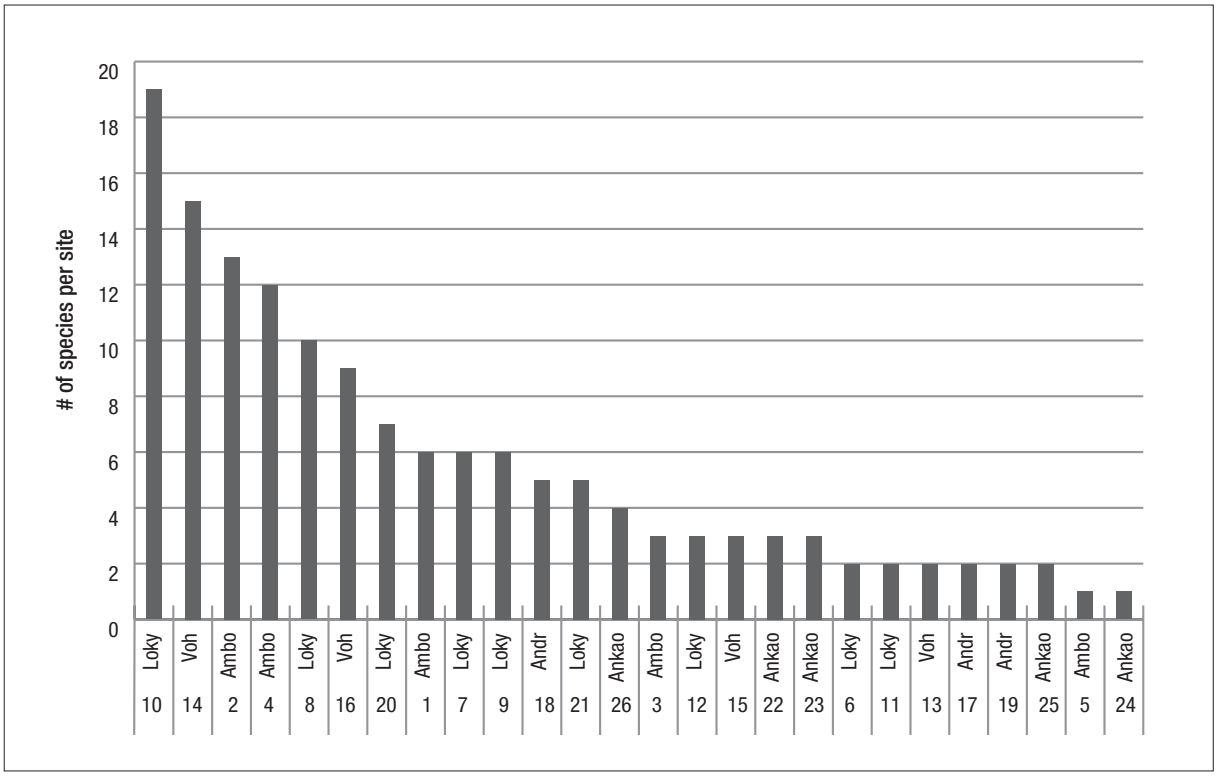

Figure 3.2. Number of species of echinoderms by site, with the location of the site also indicated.

DISCUSSION

Echinoderm diversity

Seventy species of echinoderms are reported here from northeast Madagascar, a low number compared to the few echinoderm inventories from other parts of Madagascar, and compared to other parts of the world. This number compares with 125 species (Maharavo 1990, unpublished) from Tulear in southwest Madagascar where coral reefs are much more developed geomorphologically, 90 species in Rodrigues lagoon (Mauritius) and 240 species in New Caledonia (Guille et al. 1986).

Several factors may cause this low number of species in the northeast, such as the low diversity of reef habitats in the region, low reef area and ecological conditions. Habitats occupied by the echinoderms included reef flats (seagrass beds, detritus reef flats, basin reef, and compact reef flat) and outer slopes. But the narrow coastline prevents the development of large lagoonal and island systems with complex reef topography, thus limiting diversification of habitats that might favour a higher diversity of echinoderms. The amount of reef habitat in the area is limited by the narrow and steep continental coast, restricting reefs to a narrow fringe along the coastline. The physico-ecological condition of the reefs was relatively severe – with high wave energy and exposure affecting all outer reefs, and high turbidity and sedimentation from runoff affecting all reefs and especially those in the larger bay systems. Finally, though many echinoderms are noctural, a night dive did not encounter a large number of new species other than a basket star (*Euryale aspera*).

In quantitative terms, the 26 sites surveyed appears sufficient to represent the entire survey area, shown by the plateau in species number against number of sampling sites (fig. 3.3). In fact, no more new species were discovered after site 21. We therefore believe that the sampling was sufficient to get a representative sample of echinoderms in the area, and the diversity of echinoderms here is low.

Echinoderms as environmental indicators

The distribution of species in the different classes of echinoderms reflects environmental conditions, summarized below for ophiuroids, echinoids and holothurians.

Some Ophiurids (brittle stars) live in degraded areas under rocks, or in crevices in the compact reef flats. They extend their arms out at high tide to trap suspended solids on which they feed. Among these species associated with degraded areas, we found *Ophiocoma scolopendrina, Ophiocoma erinaceus, Ophioplocus imbricatus* and *Ophiarthrum elegans*. *Macrophiothrix* cf.*rugosa* hides beneath dead blocks which must be reversed to discover it. Other ophuiroids live in association with over living organisms such as branching corals, antipatharians or sponges, and feed by grazing settled particulate matter on the surface of these organisms. These species are often associated with outer slopes, and we found *Ophiothela tigris* and *Ophiomastix caryophillata* belong to this group. *Ophionereis porecta* seems to prefer high sandy areas subject to strong tidal currents. Finally, ubiquitous species were found which occupy different types of environment at the reef flat and deeper sediment slopes or live beneath blocks of dead coral.

Five families of echinoids were represented: Cidaridae (*Eucidaris metularia*), Toxopneustidae (*Tripneustes gratilla* and *Toxopneustes pileolus*), Diadematidae (*Diadema setosum*, *Echinothrix diadema, Echinothrix calamaris, Diadema savignyi and Astropyga radiata*), Stomopneustidae (*Stomopneustes variolaris*) and Echinometridae (*Echinometra mathaei*). *Echinostrephus molaris* lives in holes in coral rock and was the most widely distributed sea urchin, encountered on 12 sites during this expedition, and is typical of healthy reef environments. Most other species were nearly or totally absent from undisturbed sites such as Loky Bay, Ambodivahibe Bay and Andravina Bay.

Vohemar, by contrast, supported a large and diverse echinoid community. *Diadema setosum* is a suspension feeder, using its spines to trap suspended material such as algal

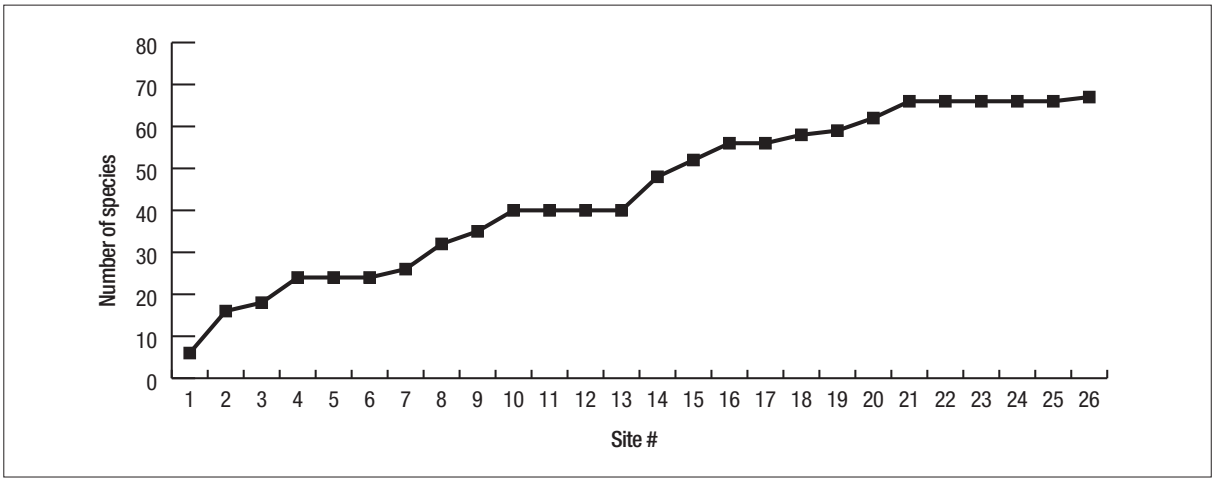

Figure 3.3. Accumulation of species with subsequent samples, northeast Madagascar.

fronds to ingest (Régis and Thomassin, 1982). Consequently, it can often be an indicator species of degradation. It was only encountered at the reef flat at Vohemar. *Echinometra mathaei* was found in crevices in the compact reef flat in Vohemar, thus contributing to bioerosion of the reef, and is also indicative of reef alteration by overfishing (McClanahan and Muthiga, 1989). *Toxopneustes pileolus* and *Tripneustes gratilla* were found on seagrass beds and areas of debris in Vohemar. *Tripneustes gratilla* is an herbivore as well as feeding on organic waste. *Toxopneustes pileolus* is similar, but is a more cryptic species that covers itself with debris (Maharavo, 1993). It is normal to encounter these two species on reef debris and seagrass beds near towns where the input of organic matter is high. This echinoid population at Vohemar is an indicator of environment degradation. By contrast, the near-absence of these species from the other locations (Loky Bay, Ambodivahibe Bay and Andravina Bay), testifies to their ecological health.

Many echinoids common to other parts of Madagsacar, particularly the west coast, were absent here. This includes the great Cidaridae (*Prionocidaris* and *Phylacanthus*), Oreasteridae (*Protoresater*, *Pentaceraster* and *Choriaster*), the Luididae and Astropectenidae. *Colobocentrotus atratus*, an urchin typically found in very high energy conditions was also not found. These species are also not commercially exploited, and the reefs otherwise appear to be in an undisturbed condition. It is not clear why they are not present on the northeast coast.

Various species of exploited and non exploited holothurians were recorded. The most common was *Holothuria atra*, at five sites. This species is very common in the western Indian Ocean, occuring between the surface and 30m depth, and seems to prefer substrates of coral sand with or without seagrass. Its body is always covered with thin layer of sand, but once this layer is rubbed with fingers, it gives off a reddish color. The most distinctive finding of this inventory was the extreme scarcity of holothurians, especially the target species of exploitation: *Holothuria scabra, Microthele nobilis, Microthele fuscogilva,* and *Thelenota ananas*. In most cases, only one specimen of these exploited species was seen.

This scarcity is probably the result of overexploitation of sea cucumbers, as in other regions of Madagascar, for the preparation of trepang (bêche-de-mer) for export, mainly to Asia. During the survey, enquiries in the villages and discussions with fishermen confirmed the intensive exploitation of holothurians. For twenty years now, sea cucumbers have been extensively exploited along every coast of Madagascar resulting in the quasi-absence of target species in the depth range from 0 to 20 meters.

CONCLUSION

This survey identified 70 species of echinoderms from the north-east coast of Madagascar, finding lower levels of species diversity than the west coast. Unusually for Madagascar, there were no large species of seastars (asteroids) from the Oreasteridae family, such as *Protoreaster* or *Pentaceraster*, nor urchins (echinoids) from the family Cidaridae, such as *Prionocidaris*, *Phylacanthus, Heterocentrotus* etc. The absence of the coral predator starfish, *Acanthaster planci*, was also noted.

In general, there was a scarcity of echinoids and asteroids, a scarcity that seems abnormal given that the reefs are fairly well developed. It would be interesting to study the relationship between the distribution of larvae and the currents of the northeast coast in order to explain this situation. Overfishing of holothurians, already observed in other parts of Madagascar, was confirmed during this expedition. Indeed, there is an extreme scarcity of target species. This result emphasizes the need for fisheries management and the need for regeneration of holothurian stocks.

Echinoderm species are also indicators of environmental condition. Indicator species of degradation included *Diadema setosum, Tripneustes gratilla* and *Echinometra mathaei*, which were only encountered in the immediate vicinity of the town and port of Vohemar. This is indicative of the significant reef pollution from port activities and organic pollution related to the proximity of the town.

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