Draft Report, 1996

Marine invertebrate communities of Baie Ternay National Marine Park and Baie Beau Vallon, Mahe, Seychelles

Simon J. Pittman
Seychelles Marine Conservation Expedition
Oct - Nov, 1995

INTRODUCTION

Typically, coral reefs are dominated by sedentary colonial organisms. Species compositions are temporally and spatially dynamic and populations may be seen to interact through similar mechanisms as those observed in terrestrial plant communities. In these areas, intense competition for limited niche space, selects for varied defensive and offensive strategies and reproductive life history traits.

Distributions of colonial invertebrate communities are influenced largely by abiotic environmental parameters such as water movement, light availability and substrate type and biotic interactions such as competition and predation. In addition, phase shifts in species dominance can be influenced by anthropogenic interactions on the coastal zone and sedentary species are typically exposed to any disturbance for longer periods than mobile species. These factors, together with their identifiable sensitivities make them useful indicators of human interference and key species in environmental monitoring of even low level impacts.

Environmental surveillance and monitoring of invertebrate communities is an invaluable skill for any coastal management team.

This section of the report focuses on the non-scleractinian invertebrates of Baie Ternay and Baie Beau Vallon with particular emphasis on the distributions of dominant colonial organisms and the possible effects of human impacts on species compositions.

In many reef environments throughout the tropics, changes in community structure have been observed (Sebens, 1994; Richmond, 1993 and others) and negative impacts are usually expressed as events leading to decreased diversity in an area and an often associated increase in the frequency of single species dominance. Overall faunistic diversity (fish and invertebrates) of a reef is often greatly reduced in areas where changes in the environment lead to keystone species proliferations and large monospecific areas.

Historically, comparatively few studies have focused on the marine invertebrate fauna of the Seychelles, with most research and taxonomic collecting carried out by early expeditions and largely unpublished. More recently, work has provided information on habitat types and associated invertebrate communities for most common or conspicuous groups and recent taxonomic collecting and subsequent identification has further increased the knowledge of species diversity and distributions for many important groups.

Many species, common to the Seychelles, are widespread throughout the tropical Indo-West Pacific and to date, relatively few endemics have been identified. However, this may reflect the current paucity of research on many groups of animals in this region.

As with fish assemblages, invertebrate assemblages in the Seychelles show closest zoogeographic affinities to those found in the Mascarene region south to Madagascar and west to East Africa. Clark (1984) suggests that the diversity of western Indian Ocean echinoderms is relatively limited in comparison to assemblages in Malaysia and Indonesia, having few characteristic species and only a small proportion of the widespread ones. This is likely to be the case for reef associates in general, including fish communities since areas in the eastern Indian Ocean are *hot spots* and evolutionary sources for high diversity.

A review of relevant literature is provided below.

References found with specific mention of key species, distribution and ecology of non-scleractinian invertebrates of the granitic Seychelles

General
Lewis & Taylor, 1966
Taylor, 1968, 1971
Taylor & Lewis, 1970
Vine, 1972 (Nature Booklet)
Selin *et al*., 1992
University of Galway Expedition to Baie Ternay, 1972
International Indian Ocean Expedition, UNESCO, 1965

Soft Corals
Verseveldt, 1976
Sorokin, 1991
Malyutin, 1992
van Ofwegen & Slierings, 1994 (*RV TYRO*)

Anemones
den Hartog, 1994 (*RV TYRO*)

Sponges
Thomas, 1973, 1981
van Soest, 1994 (*RV TYRO*)

Echinoderms
Clark & Rowe, 1971
Clark, 1980, 1984

Crustacea (non-commercials)
Bruce, 1973, 1976a, 1984
Fransen, 1994 (*RV TYRO*)

Polychaetes
Hartman, 1974
ten Hove, 1994 (*RV TYRO*)

Molluscs of Baie Ternay
Shah, unpublished

METHODOLOGY

Many invertebrates are notoriously difficult to identify to species level and many species remain unidentified. This is often due to limited taxonomic expertise and the requirement for some taxonomy to involve intensive collection and morphological examination. A policy of non-collection was decided for this expedition due to its conservational basis and therefore the taxonomic list is inherently limited. Only individuals or colonies larger than $5cm^2$ were recorded, with an emphasis on key species. The taxonomic list only includes obvious species and families and other observations, although included in the taxonomic list, were omitted from the main analysis. Time constraints and difficulty in identification and adequate assessment of distribution meant that the significant colonial Porifera were excluded from this report, along with many observations of epizoids, Annelida, Mollusca, Bryozoa, Echinodermata and Ascidiacea. In addition, undersurface assemblages were largely neglected and nocturnal species were omitted since surveying was confined to daylight hours.

A great variety of invertebrate species, including several identified as keystone groups, are nocturnally active and by day were often seen to be well hidden amongst the reef substratum.

Invertebrate surveys took place along the same transect lines as described in Section 1 for fish but a smaller survey width was used (2m). This technique was found to be necessary to ensure that a large sample could be observed in a relatively short time period and not just a small niche observed intensively. The large survey area was also thought to best incorporate the communities, which would enable later analysis to investigate any potential impacts and trends in community structure across the whole survey area.

Communities were quantified by head counts within a 2m wide band along a 250m transect. Colony size for encrusting species was estimated visually as area (m^2). Large colonies (0.5-1.0 m^2) and small colonies (<0.5m^2) were counted separately in an attempt to examine the extent of single species dominance at each site. In many areas animals were seen to aggregate or were living in clusters. In these instances an overall count was estimated, to reflect area cover for these patches. Total area cover was then calculated for each site (deep and shallow).

Echinoderms and Molluscan species were more easily identified and included many keystone and aesthetic reef-associates and commercial animals. These were recorded as numbers of individuals per transect (500 m^2). Data for BT1 is incomplete and is omitted from the final analysis. However, personal observations suggest that this site is most similar to BT2.

The analysis of the data sets provide a biological signature for the current 'state' of the reef communties in Baie Ternay Marine National Park and the nearby Baie Beau Vallon area. Taxonomic lists will add to the existing knowledge on invertebrate diversity in the area and may act as a 'platform' for further detailed investigations.

RESULTS
(refer to tables and histograms)

Baie Ternay

Significant differences between shallow and deep transects are shown at Baie Ternay. *Sarcophyton* spp. are most abundant in shallow, well developed reef slope sites at BT1 (pers.obs.) and BT2. *Sinularia* show higher abundance at BT3 particularly in shallow areas, although larger colonies are found at deep sites. The granitic shallow reef at BT4 has a high abundance of *Sinularia* spp. with large areas of *Sarcophytons* on the slightly deeper coralline shallow slopes.

Large anemones are a dominant feature of deep transects at BT1 and particularly BT2 with some areas where large anemones aggregate. This site is a popular dive site and is known to local dive centres as the *anemone gardens*. BT3 deep transects encompass a more well developed reef than shallow transects and large anemones are also relatively well represented. Anemones are not a significant feature at BT4.

The Corallimorpharia show greatest abundance at shallow sites at BT2 and deeper sites of BT3. Blue / green forms are more frequently found at shallow sites, in contrast to red / brown forms found rarely and only in deeper transects at BT2 and BT3. Extensive aggregations of blue / green *Actinodiscus* spp. were recorded at shallow sites at BT2.

Encrusting Zoanthiniaria favoured the shallowest regions of the granitic transect at BT4. At all shallow transects at Baie Ternay, Zoanthiniaria were more abundant than on deep transects.

Encrusting sponges were evident across the whole survey area in large numbers and diversity but were not quantified in this survey. Boulder forms were less numerous, and more easily identified. White and green/brown types were most abundant at BT1 and BT2 with similar numbers recorded for BT2 shallow and deep transects, these were mostly the green/brown types observed living mainly in sandy areas. Relatively large numbers of the white form were recorded at BT4 often attached to the granitic substratum.

Other important invertebrates observed in the area and included in the survey, were the holothurians (sea cucumbers); echinoids (sea urchins); asteroids (starfish); nudibranchs (sea slugs) and some large bivalve molluscs.

Highest diversity and abundance of holothurians was recorded along the deep transect at BT2 although habitat preference was distinctive and not all species were seen over coral rich substratum. The shallow transect at BT3 also yielded high diversity and abundance due to its more varied substrate types and extensive sandy areas. Coral rich sites along the shallow transect at BT2 yielded fewer species.

Echinoids were recorded in large numbers at most sites. *Diadema savignyi* and *D. setosum* were most common on the reef slope and the granite areas at BT4, with more cryptic and reef boring forms of the Echinometrids appearing to be more abundant in back reef areas. Shallow sites at BT1, BT2 and BT4 yielded greatest abundance, whilst BT3 yielded greatest abundance on the deep.

Starfish were not well represented across the survey area, although only large or non-cryptic, unconcealed individuals were represented. Greatest abundance and diversity was recorded at BT4 and generally more were observed at shallow sites across Baie Ternay. *Acanthaster planci* (crown of thorns starfish) is present only in low numbers in Baie Ternay.

Of the bivalve molluscs, *Tridacna* sp. (clams) and *Lopha* sp. (zig-zag oyster) were most conspicous in their abundance. Both genera were more numerous in shallow coral rich substrates at BT1 and BT2 and *Lopha* sp. were frequently found attached to granite boulders in large numbers at BT4. Few were recorded at BT3.

Baie Beau Vallon

Overall species abundance and diversity at the more exposed sites at Baie Beau Vallon was lower than at transects in the sheltered Baie Ternay sites. Invertebrate distributions at Beau Vallon are characterized by larger mono-specific areas. This is particularly noticeable for the soft corals and the Corallimorpharians.

Head and colony counts for the Alcyoniidae (soft 'leather' corals) reveal a significantly high total area cover for both genera, with small colonies of *Sarcophyton* spp. dominating the substratum in many segments of the transect. *Sinularia* spp. are well represented at Auberge and Fisherman's Cove but are comparitively recessive at Corsair.

Large anemones (*H. magnifica*) are well represented at each site although individuals are generally smaller than those at Baie Ternay.

The most visually striking feature of invertebrate assemblages at Baie Beau Vallon are the large areas of reef substratum overgrown by extensive aggregations of disk anemones. This is also seen in some areas at Baie Ternay, albeit, to a lesser degree. An estimated 15-20% of reef substratum at Auberge, Corsair and Fisherman's Cove is encrusted by Corallimorpharians. In contrast, the colonial Zoanthinarians are not well represented in these areas.

Boulder sponges are more abundant at all Baie Beau Vallon sites.

Non-colonial invertebrates such as molluscs and echinoderms are also less diverse at Beau Vallon sites with lowest diversity recorded at Fisherman's Cove where holothurians were absent along the transect. At Auberge and Corsair, typical benthic holothurians were less abundant than at Baie Ternay.

Echinoids were found in large numbers, particularly at Fisherman's Cove and observation outside the transect area in shallower water revealed greater abundance.

Asteroids were not well represented, however, 11 *Acanthaster planci* individuals were recorded at Fisherman's Cove, the largest density of this species at any site across the survey area.

Nudibranchia were absent at Fisherman's Cove but several nice specimens of *Phyllidia* sp. were seen at Auberge and Corsair reefs.

Bivalve molluscs were less abundant than in Baie Ternay and individuals encountered were generally smaller.

Alcyonacea (soft corals) : Alcyoniidae (soft leather corals)

Soft corals are a significant characteristic of the reef invertebrate communities of Baie Ternay and Baie Beau Vallon. The prevalence of this animal group has previously been noted for Baie Ternay (Salm, 1977) and the wider Seychelles (van Ofwegen and Slierings, 1994; Verseveldt, 1976; Malyutin, 1992).

Soft coral species in this study are identified principally as *Sinularia spp*. and *Sarcophyton spp*., since *in situ* field identification to species level is impossible. To date, 110 *Sinularia* and 36 *Sarcophyton* (alcyoniidae) species have been described form the Indo - Pacific and many remain undescribed (Verseveldt, 1982). For the Seychelles, some 29 species of *Sinularia* are known with several more currently undergoing classification (van Ofwegen and Slierings, 1994).

Sinularia colonies, typically form mats several centimetres thick with protruding lobes or ridges. Large sclerites are densely packed in the colony and contrast with *Sarcophytons* since they possess only 1 polyp type.

Sarcophyton colonies are distinctly mushroom shaped with a thick fleshy stem elevating the polyp bearing, marginally folded colony disks (capitulum) off the substratum. The colonies are dimorphic with 2 polyp types: the autozooids or feeding polyps, and embedded between them the tentacle-free and sterile siphonozooids. (Fabricius, 1995). *Sarcophytons* are highly efficient predators (Sorokin, 1991) and are thought to be nutritionally one of the most flexible soft corals (Fabricius and Klumpp, 1995).

Both taxa are light dependent due to possession of symbiotic zooxanthellae but also gain significant energy from heterotrophic feeding (Fabricius and Klumpp, 1995).

The range of habitats of the alcyoniidae is wider than that of other soft coral families due to great morphological plasticity. Generally, they also show broader physiological tolerence than most shallow water Scleractinians. In addition, competitive interactions are enhanced with the use of a range of toxic compounds (Coll *et al*., 1982b) which may be released into the surrounding sea water (Sammarco *et al*., 1983) or contained within tissues making them unpalatable to many potential predators (Wylie and Paul, 1989). *Sarcophytons* are known for their very high concentrations of toxic compounds although toxin concentrations vary between species and within tissues (Coll *et al*., 1982b).

Across the survey area, a wide range of habitats have been successfully colonized by alcyoniidae including shallow reef flats, deeper carbonate reef slopes and granitic blocks in high wave energy environments. Success in shallow water environments is related to morphology and taxonomy has shown shallow water species tend to contain less spicules and are consequently less rigid than deeper-water forms, which are not subjected to high wave action (George and George, 1978). *Sinularia spp*. are least subject to drag forces and therefore most resistant to wave stress. Adaptive morphology accounts for the predominance of encrusting *Sinularia* in shallow waters across the survey area particularly at BT4 , Auberge and Fisherman's Cove

At Baie Ternay and Beau Vallon alcyoniidae were found to form aggregations on the reefs in direct competition with Scleractinians. Some regions outside the survey area, particularly in deep (10m-12m) water on the gently sloping bay sides at BT4, were completely dominated by soft corals (mostly *Sarcophyton*) to form a soft coral lawn. Fish diversity in this deeper area was also reduced as a result of a profusion of largely unpalatable food (pers. obs.)

In the past, this area may have been denuded of live coral cover by anchor and line damage (an indirect effect of fishing), with subsequent recolonization dominated by soft corals. Most soft coral population turnover and growth rate is quite slow (average radial growth 0.5 cm yr^{-1}), and comparable with hard coral (Fabricius, 1995). However, studies show slightly faster growth, recruitment and mortality processes in *Sarcophytons* and this may account for their seemingly enhanced ability to colonize denuded substrate in the survey area.

Reefs close to the coast which experience considerable variability in salinity, nutrients, phytoplankton concentrations and sediments are commonly characterised by alcyoniidae, (Dinesen, 1983; Alino *et al*,1992; Riegl, 1995; Fabricius and Klumpp, 1995) and may even be promoted by nutrient enhancement. These conditions may increase the competitive ability of soft corals at the expense of other less adapted organisms resulting in community shifts. This community shift in favour of Corallimorpharians and faster growing soft corals, may be occuring at impacted Beau Vallon sites. At certain sites in the Great Barrier Reef, soft corals are overgrowing live Scleractinian corals to the point of near monopolization (Alino *et al*., 1992) and Scleractinian skeletons now serve mostly as a substratum for soft coral growth.

The occurrence of monospecific communities has been related to disturbance in terrestrial plant communities and more recently to coral reef systems. Sebens, (1994) and Connell, (1978), note that often in areas with too much disturbance, most species cannot recruit and grow fast enough to persist. As a result, the community is dominated by a few 'weedy' or opportunistic species with high rates of reproduction and recruitment. Hughes *et a*l , (1987) notes that competition for space can be strong enough to cause total local exclusion of a species and this would have far reaching effects throughout the community, generally resulting in a reduction of overall ecosystem diversity.

Competition for space is particularly noticeable at survey sites especially between hard and soft corals and both with Corallimorpharians.

At survey sites, *Sinularia* spp. were often seen overgrowing and killing neighbouring hard corals. This is often achieved directly by smothering or by release of toxic compounds into the water (allelopathic mechanisms) (Coll *et al*, 1987). However, in some instances, soft corals were avoiding contact with hard corals and large anemones.

Examinations of the undersides of *Sarcophytons* especially at Corsair, commonly revealed micro-communities of disk anemones, ascidians, sponges and bryozoans which were able to colonize the basal region of *Sarcophyton* stalks where toxin concentration is lower. The basal attachment zone of some *Sarcophytons* has been shown to contain less than 10% of the terpene concentration of the polypary (cap) (Coll *et al,* 1987).

Several studies have examined trends in soft coral proliferations around the world. Sammarco and Crenshaw (1984) postulate that increased competitive advantage of soft corals at sites on the Great

Barrier Reef may be due to nutrient enrichment derived from terrigenous sources such as runoff from nearby rivers. In the same area, Wolanski and Jones (1981) and Riddle (1988) found evidence of increased nutrient concentrations and productivity in inshore waters, where previously, competition between Scleractinian and soft corals had been relatively equal, human disturbance may have shifted the outcome of interspecific competitive interactions.

Sorokin (1991) notes the replacement of stony corals by soft corals after catastrophic events such as *Acanthaster* plagues, hurricanes, low tides and pollution. Nishihira and Yamozato (1974) (Nishihira, 1987) noted that around Okinawa, damage by *Acanthaster* and human interference including dredging, reclamation, construction, coastal development, erosion, release of red clay and chemical pollution, resulted in some areas where alcyonarians dominated the reefs.

In light of increased land based impacts to the reefs of Baie Ternay and more specifically Beau Vallon, these areas may be undergoing similar shifts in community structure as has been observed in other parts of the world.

At the time of survey, Corsair Reef at Beau Vallon was obviously affected by sedimentation. Soft coral colonies parrticularly *Sarcophyton* were frequently seen with polyps retracted and congealed webs of mucus and sediment hanging from colonies. In some cases, the capitulum, in a bowl-like deflated position contained sediment. Some colonies also appeared bleached.

Few studies have investigated the tolerence of soft corals to sedimentation. One recent study by Riegl (1995) showed controlled application of sand of various grain sizes caused partial necrosis and bleaching in most soft corals after 2 weeks. In *Sinularia* and *Sarcophyton*, periodic hydrostatic inflation and deflation of the colony enhanced runoff and all species increased mucus production. Laboratory studies were found to parallel field observations and local community structure. However, it was found that most species could cope with short term episodic sand application.

In *Sarcophytons*, sphericity of colonies proved crucial for the early phases of sand shedding and determined the ability of a colony to clear sand quickly. In *Sinularia*, finger like projections (lobes) meant that a large proportion of the corals surface remained sand free.

Sedimentation generally impairs the ability to function because the greatest proportion of zooxanthellae are located in the polyps of many alcyoniid, thus contraction or retraction of the polyps removes the zooxanthellae from the surface, with the result that higher irradiance is required to reach the algae (Fabricius and Klumpp, 1995).

It was also noted that some colonies of *Sarcopyhton* and *Sinularia* at Beau Vallon reefs were overgrown with an algae fuzz. However, this is thought to occur periodically due to settlement on mucus sheets and most algae are removed when the mucus sheet is sloughed off (Coll *et al* , 1987). Frequency of this type of colonization may be used to monitor the effects of coastal nutrification.

The possible phase shift towards dominance of soft coral communities at Baie Ternay and Beau Vallon may be monitored and the impacts of sedimentation and nutrient enrichment investigated more thoroughly with a view to limiting disturbance in these areas.

Actinaria (sea anemones)

This study includes only three common species of the true anemones, including the most common, *Heteractis magnifica,* and also *H. aurora* and *Stichodactylis mertensii*. All species are known throughout their range to harbour clownfish and have a wide distributional range in the Indo-West Pacific. To date, some 34 species have been identified from the Seychelles by a recent Netherlands expedition (RV TYRO) (den Hartog, 1994).

Considerably higher densities of these large anemones were found in the sheltered Baie Ternay where most reef dwelling Actinarians were seen to thrive. The requirement for shelter is a necessity for these soft bodied animals and distributions reflect this since larger individuals at higher densities were recorded at deep transects. *H. magnifica* generally favours prominant positions on the reef slope with good water circulation but low wave energy.

Shallower, more exposed sites at Beau Vallon showed lower densities of these species, although a high density of smaller individuals were recorded at the more topographically complex reef site at Auberge.

Compared with results from other areas of the Seychelles (RV TYRO expedition), the survey area at Baie Ternay and to a lesser extent, Beau Vallon, have unusually high densities of Actinaria.

Corallimorpharia (disc anemones)

The order of Corallimorpharia includes solitary or colonial forms with polyps resembling those of the true corals, but having no hard external skeleton. This group of animals is very well represented across the survey area. The smaller, aggregatory, encrusting forms were found in a number of areas, with extensive distribution on shallow transects, forming carpets and often overgrowing and killing hard corals. In Corsair Reef, even soft corals were killed in this way. Larger, more foliose *Discosoma sp*. were also prolific. Very little research has focused on these reef - associates in their marine habitat and most accounts are from personal observations or aquarium based research.

Generally, most species are known to reef aquarists as unusually hardy and tenacious animals. They are able to tolerate other anemone toxins and use toxins themselves in defensive and aggressive situations.

Their distributions at survey sites correlate with shelter in the form of reduced current and light. Corallimorpharians harbour photosynthetic zooanthellae but are sensitive to strong light and can be dislodged by strong currents.

Observations from Indo-West Pacific reef sites by Wilkens (1992) suggest that distributions of this group may provide a previously undocumented indicator of environmental stress. Animals are typically tolerant of relatively high nitrate levels up to 10ppm in aquaria and in the marine environment have been observed in abundance on reefs in moderate to strongly nutrient enriched areas. In East Africa, Corallimorpharians occur increasingly as secondary colonists of dead coral and commonly occur in reefs damaged by hotel sewage (Wilkens, 1992). In areas of South-East Asia, reefs are reported as having changed from mostly hermatypic corals to areas with a proliferation of disc anemones as secondary settlers.

Zoanthiniaria (encrusting anemones)

Like the disc anemones, the encrusting colonial Zoanthids are successful reef secondary colonisers. Zoanthids often build large colonies that usually reproduce by budding. They have no internal skeleton and achieve rigidity from a tough outer skin. These symbiotic animals characteristically thrive in shallower, higher energy locations and are not confined to carbonate substrates.

Zoanthids are not as prolific as disc anemones in the survey area except at BT4, where large colonial cushions were observed over granite boulders in often shallow water. Worldwide, Zoanthiniarians have been found thriving in sewage impacted areas such as Kaneohe Bay, Hawaii (Wilkens, 1992) and are known to tolerate relatively high nutrient build up in marine aquaria. However, it is not known if these organisms can be used as effective indicators of organic enrichment. In addition to the encrusting *Zoanthiid sp*. and *Palyzoa sp*., several species of *Parozoanthus* were typically seen as epizoa on sedentary reef animals such as the bivalves *Lophia sp*. and some *Tridacna sp.*

Holothuroidea (sea cucumbers)

10 species of sea cucumbers were identified across the survey area from 3 families. Highest abundance was recorded for species from the genus *Holothuria*. This genus was associated with soft bottom environments and may account for a high percentage of total biomass. 114 species of Holothuria have been identified from the Indo-Pacific (Conand, 1981, 1990) and it is likely that more species are present in the region of the Seychelles than those accounted for in the taxonomic list (Clark, 1984).

Tropical holothuroids are primarily epibenthic sediment feeders and are associated with physiographic zones where sediments are selected with a high organic content (Kerr, Stoffel and Yoon, 1993). Largest individuals were seen along sandy bottoms at the base of the steep, coral rich reef slopes of BT1 and BT2. In these areas organic rich detritus falls down from the rich reef above to provide a continual food supply. These large animals were mainly *Stichopus variegatus* and were not seen more than 5-10m from the reef base.

Holothuria sp. were most abundant at Baie Ternay in areas of discontinuous reef and expanses of sand and coral rubble, such as the shallow transects at BT3 and BT4. Large numbers of *H. atra* were also observed in shallow back reef zones and sandy areas with sea grass at Baie Ternay. Fewer animals were recorded at Beau Vallon sites although habitat types were well represented. This is probably due to a preference for low water turbulence. Generally, species diversity was higher in calmer water areas.

Thelonota ananas and *Bohadschia graeffei* were the single most abundant species at Baie Ternay, Auberge and Corsair with highest abundance in coral rich areas. These species have numerous tube feet and were frequently seen climbing and feeding over hard coral. *T. ananas* is widely distributed in the tropical Indo-West Pacific region and was once prized as a high quality food, known commercially as the prickly redfish (Conand, 1990) and used to make beche-de-mer. Interestingly, *S. Chloronotus* were only found (in moderate numbers) at one relatively small area on the shallow BT3 transect and this distribution may be related to patchy food resources or competitive avoidance.

Echinoidea (sea urchins)

Sea urchins were identified in Section 1 of this expedition report as existing in great abundance throughout the survey area. Head counts reveal highest density on shallow coral rich areas but reconnaisance outside the survey area revealed even greater densities in back reef zones where large mixed species aggregations were seen. Large numbers of *D. savignyi* were also noted on the seaward sand bottom of Baie Ternay at 25-30m depth.

D. savignyi is the commonest species in the western Indian Ocean (Clark, 1984), although distributions may not always be accurate due to the difficulties with species differentation and hybridisation. Generally, *D. savignyi* has a blue ring around the apical system and blue irridescent lines along the interambulacrals with white spots absent or inconspicuous. *D. setosum* typically has an orange anal ring and conspicuous whitedots on the interambulacrals. *E. mathaei* is also prone to taxonomic confusion, where both test and spine colour may vary, ranging from black to grey, purple, brown or green (Drummond, 1994, 1995).

The main species occuring on reefal substratum were *D. savignyi, D. setosum* and the smaller *E. mathaei*. *Echinothrix calamaris* favoured back reef and sea grass beds at Baie Ternay.

The implications to reef integrity of a release of urchin populations has been investigated on reefs around the world. Echinoids can erode hard substratum indirectly through weakening reef structural environment, and directly through feeding behaviour (Bak, 1994). In balanced numbers, sea urchins can increase surface area in some reef blocks, control algal populations and generally increase the complexity of reef carbonate pavement by burrowing and spine abrasion. All of these species found at survey sites are known as important grazers, abraders and borers.

Notes on observations of *Diadema* size classes suggest a preponderence of large individuals, particularly evident at Baie Ternay, which are more effective as bioeroders than small individuals, although rates of erosion vary between species and sizes (Bak, 1990; McClanahan and Muthiga, 1988).

Density is also an important factor and the aggregatory behaviour of these species further increases the degredation in a particular area. Densities vary with depth and this pattern can be seen from the data sets collected at survey sites.

In Jamaica, optimal conditions for coral survival and competitive success with algae were found with intermediate to low urchin densities due to a balance between competition for space and biological disturbance (Sammarco, 1980). High *Diadema* densities ($>16/m^2$) depressed successive coral and resulted in changes in competitive species with lower diversity and a reduction of most benthic fauna. Exposure to $64/m^2$ resulted in the complete destruction of the reef structure.

Calculations of urchin density at Baie Ternay and Beau Vallon survey sites is recommended with a view to long term monitoring of population dynamics. It is also significant to note that counts for urchins were performed during daylight hours when many sea urchins are least active. A more accurate assessment of urchin populations would probably be acquired by undertaking nightime surveys.

The interplay between urchin populations, bioerosion and reef structure, is important and may determine the fate of reef development at Baie Ternay and Beau Vallon sites.

REFERENCES

Alino, P.M., Sammarco, P.W., and Coll, J.C. (1992). Competitive strategies in soft corals (Coelenterata, Octocorallia). IV. Environmentally induced reversals in competitive superiority. *Mar. Ecol. Prog. Ser.*, **81**, 129-145.

Bak, R.P.M. (1990). Patterns of echinoid bioerosion in two Pacific coral reef lagoons. *Mar. Ecol. Prog. Ser.*, **66**, 267-272.

Bak, R.P.M. (1994). Sea urchin bioerosion on coral reefs: place in the carbonate budget and relevant variables. *Coral Reefs*, **13**, 99-103.

Baumeister, W. (1993). Farbtlas Meerresfauna : Rotes Meer, Indischer Ozean (Maldediven). Eugen Ulmer GmbH & Co., Stuttgart.

Bruce, A.J. (1973). The pontoniinid shrimps collected by the Yale-Seychelles expedition, 1957-58 (Decapoda, Palaemonidae). *Crustaceana*, **24**(1), 132-142.

Bruce, A.J. (1976a). A report on some pontoniinid shrimps collected from Seychelles Islands by r/v Manihine. 1972. With a review of the Seychelles pontoniinid shrimp fauna. *Zool. Journ. Linn. Soc.,* **59**, 89-153.

Bruce. A.J. (1984). Marine caridean shrimps of the Seychelles. *In*, Biogeography and Ecology of the Seychelles Islands. Stoddart, D.R. (ed). Dr W. Junk Publishers, The Hague. pp 141-169.

Clark, A.M. (1980). Some ophiuroidea from the Seychelles Islands and Inhaca, Mozambique. *Rev.*

Zool. Afr., **94**, (3), 533-558.

Clark, A.M. (1984). Echinodermata of the Seychelles. *In*, Biogeography and Ecology of the Seychelles. Stoddart, D.R. (ed.). Dr W. Junk Publishers, The Hague. pp. 83-102.

Clark, A.M. and Rowe, F.W.E. (1971). Monograph of shallow-water Indo-West Pacific Echinoderms. No. 690. British Museum. pp. 238.

Coll, J.C., Price, I.R., Konig, G.M. and Bowden, B.F. (1987). Algal overgrowth of alcyonacean soft corals. *Mar. Biol*., **96**, 129-135.

Coll, J.C., La Barre, S., Sammarco, P.W., Williams, W.T. and Bakus, G.J. (1982b). Chemical defences in soft corals (Coelenterata : Octocorallia): a totally submersible sampling apparatus. *J. Exp. Mar. Biol. Ecol*., **60,** 293-299.
Conand, C. (1981). Sexual cycle of three commercially important Holothurian species (Echinodermata) from the lagoon of New Caledonia. *Bulletin of Marine Science*, **31**(3), 523-543.

Conand, C. (1990). The fishery resources of Pacific island countries. Part 2. Holothurians. *FAO Fish. Tech. Pap*, **272.2**, pp. 143.

Connell, J. (1978). Diversity in tropical rainforests and coral reefs. *Science*, **199**, 1302-1310.

den Hartog, J.C. (1994). Sea Anemones of the Seychelles. *In*, J. van der Land (ed*.), Results of the 'Oceanic Reefs' Expedition to the Seychelles (1992-1993)*, volume 2. Zool. Verh. Leiden, **297**, 75-79.

Dinesen, Z.D. (1983). Patterns in the distribution of Soft Corals Across the Central Great Barrier Reef. *Coral Reefs*, **1**, 229-236.

Drummond, A. E. (1994). Aspects of the life history biology of three species of sea urchin on the South African east coast. *In*, 'Echinoderms through Time (Echinoderms Dijon)'. B. David, A. Guille, J.P. Feral and M. Roux (eds.). Balkema, Rotterdam. pp. 637-641.

Drummond, A.E. (1995). Reproduction of the Sea Urchins *Echinometra mathaei* and *Diadema savignyi* on the South African Eastern Coast. *Mar. Freshwater Res*., **46**, 751-755.

Fabricius, K.E. (1995). Slow population turnover in the soft coral genera *Sinularia* and *Sarcophyton* on mid- and outer-shelf reefs of the Great Barrier Reef. *Mar. Ecol. Prog. Ser*., **126**, 145-152.

Fabricius, K.E. and Klumpp, D.W. (1995). Widespread mixotrophy in reef-inhibating soft corals: the influence of depth, and colony expansion and contraction on photosynthesis. *Mar. Ecol. Prog. Ser*., **125**, 195-204.

Fransen, C.H.J.M. (1994). *In*, J. van der Land (ed*.), Results of the 'Oceanic Reefs' Expedition to the Seychelles (1992-1993)*, volume 2. Zool. Verh. Leiden **297**, 117-119.

George, D. and George, J. (1978). Marine Life: An Illustrated Encyclopedia of Invertebrates in the Sea. Harrap, London.

Hartman, O. (1974). Polychaetous annelids of the Indian Ocean including an account of species collected by members of the International Indian Ocean expeditions, 1963-64 and a catalogue and bibliography of the species from India. *J. Mar. Biol. Ass. India.,* **16**, 191-252.

Hughes, T.P., Reed, D.C. and Boyle, M. (1987). Herbivory on coral reefs : community structure following mass mortalities of sea urchins. *J. Exp. Mar. Biol. Ecol.*, **113,** 39-59.

Kerr, A.M., Stoffel, E.M. and Yoon, R.L. (1993). Abundance distribution of Holothuroids (Echinodermata : Holothuroidea) on a windward and leeward fringing coral reef, Guam, Mariana Islands. *Bulletin of Marine Science*, **52** (2), 780-791.

Lewis, M.S. and Taylor, J.D. (1966). Marine sediments and bottom communities of the Seychelles. *Phil. Trans. R. Soc. Lond. A*, **259**, 279-290.

McClanahan, T.R. and Muthiga, N. A. (1988). Changes in Kenyan coral reef structure and function due to exploitation. *Hydrobiologia*, **166**, 269-276.

Malyutin, A.N. (1992). Octocorallia from the Seychelles islands with some ecological observations. *Atoll. Res. Bull.*, **367** (3), 1-4.

Nishihira, M. (1987). Natural and human interference with the coral reef and coastal environments on Okinawa. *Galaxea*, **6**, 311-321.

Nishihira, M. and Yamazato, K. (1974). Human interference with the coral community and Acanthaster infestation of Okinawa. *In*, Cameron, A.M. *et a.*(eds.) Proceedings of the second international symposium on coral reefs. Great Barrier Reef Committee, Brisbane, **1**, 577-590.

Richmond, R.H. (1993). Coral Reefs : Present Problems and Future Concerns Resulting from Anthropogenic Disturbance. *Amer. Zool.,* **33**, 524-536.

Riddle, M.J. (1988). Patterns in the distribution of macro-faunal communities of coral reef sediments on the central Great Barrier Reef. *Mar. Ecol. Prog. Ser.*, **47**, 281-292.

Riegl, B. (1995). Effects of sand deposition on scleractinian and alcoyonacean corals. *Mar. Biol.*, **121**, 517-526.

Salm, R. V. (1977). A Guide to snorkelling and Diving in the Seychelles. Octavian Books, London. pp.60.

Sammarco, P.W. (1980). Diadema and its relationship to coral spat mortality: Grazing, competition, and biological disturbance. *J. Exp. Mar. Biol. Ecol.*, **45**, 245-272.

Sammarco, P.W., Coll, J.C., La Barre, S. and Willis, B. (1983). Competitive Strategies of Soft Corals (Coelenterata : Octocorallia) : Allelopathic Effects on Selected Scleractinian Corals. *Coral Reefs*, **1**, 173-178.

Sammarco, P.W. and Crenshaw, H. (1984). Plankton community dynamics of the central Great Barrier Reef Lagoon: analysis of data from Ikeda *et al*. *Mar. Biol*., **82**, 167-180.

Sebens, K.P. (1994). Biodiversity of Coral Reefs : What are We Losing and Why?. *Amer. Zool*., **34**, 115-133.

Selin, N.I., Latypov, Y.Y., Malyutin, A.N. and Bolshakova, L.N. (1992). Species composition and abundance of corals and other invertebrates on the reefs of the Seychelles islands. *Atoll. Res. Bull.*, **348** (4), 1-5.

Sorokin, Y.I. (1991). Biomass, Metabolic Rates and Feeding of some Common Reef Zoantharians and Octocorals. *Aust. J. Mar. Freshwater Res*., **42**, 729-741.

Taylor, J.D. (1968). Coral reef and associated invertebrate communities (mainly molluscan) around Mahe, Seychelles. *Phil. Trans. R. Soc. Lond. B*, **254** (795), 129-206.

Taylor, J.D. (1971). Intertidal zonation at Aldabra atoll. *Phil. Trans. R. Soc. Lond.*, B, **260**, 173-213.

Taylor, J.D. and Lewis, M. D. (1970). The flora, fauna and sediments of the marine grass beds of Mahe, Seychelles. *J. Nat. Hist*., **4**, 199-220.

ten Hove, H.A. (1994). Serpulidae (Annelida : Polychaeta) from the Seychelles and Amirante Islands. *In*, J. van der Land (ed*.), Results of the 'Oceanic Reefs' Expedition to the Seychelles (1992-1993)*, volume 2. Zool. Verh. Leiden **297**, 107-116.

Thomas, P.A. (1973). Marine Desmospongiae of Mahe Island in the Seychelles Bank, Indian Ocean. Tervuren, Musee royal de L'Afrique centrale. *Anneles. Serie*., **80**, (203). pp. 96.

Thomas, P.A. (1981). A second collection of marine demospongiae from Mahe island in the Seychelles bank (Indian Ocean). Tevuren,Belguim Koninklijk Museum voor Midden- Africa. pp. 54.

UNESCO. (1965). International Indian Ocean expedition collected reprints. UNESCO, Paris.

van Ofwegen, L.P. and Slierings, M. (1994). Octocorallia. *In*, J. van der Land (ed*.), Results of the 'Oceanic Reefs' Expedition to the Seychelles (1992-1993)*, volume 2. Zool. Verh. Leiden **297**, 93-100.

van Soest, R.W.M. (1994). Sponges of the Seychelles. *In*, J. van der Land (ed*.), Results of the 'Oceanic Reefs' Expedition to the Seychelles (1992-1993)*, volume 2. Zool. Verh. Leiden **297**, 65-77.

Verseveldt. J. (1976). Alconacea from the Seychelles (coelenterara : octocorallia). *Rev. Zool. Afr.*, **90** (3), 497-513.

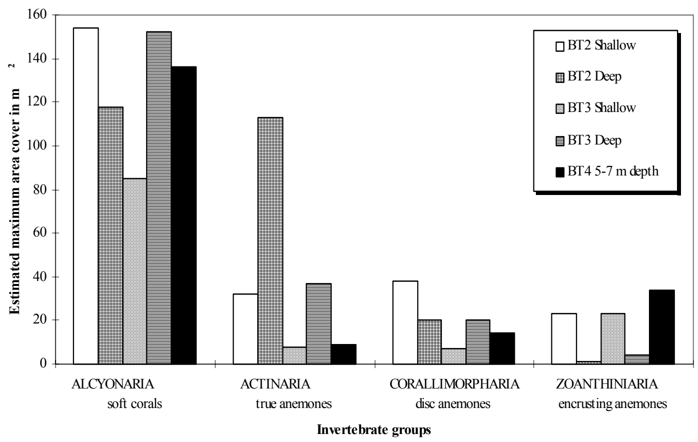
Verseveldt. J. (1982). A revision of the genus *Sarcophyton* Lesson (Octocorallia, Alcyonacea). Zool. Verh., Leiden 192.
Vine, P. (1972). Life on coral reefs in the Seychelles. *Seychelles Nature Booklet*, **3,** pp. 56. G. T. Phillips.

Wilkens, P. (1992). Marine Invertebrates : Stony Corals, Mushroom and Colonial Anemones. Dahne Verlag GmbH, Ettlingen.

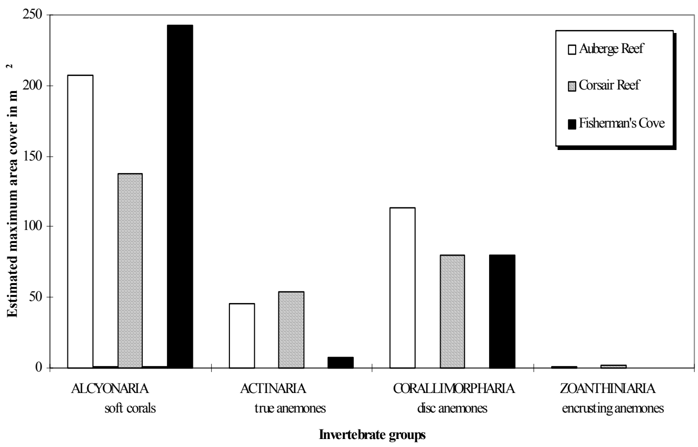
Wolanski, E. and Jones, M. (1981). Physical properties of Great Barrier Reef lagoon waters near Townsville. I. Effects of Burdekin River Floods. *Aust. J. Freshwat. mar. Res.*, **32**, 305-319.

Wylie, C. R. and Paul, V.J. (1989). Chemical defenses in three species of *Sinularia* (Coelenterata, Alcyonacea) : effects against generalist predators and the butterflyfish
Chaetodon unimaculatus Bloch. *J.Exp. Mar. Biol. Ecol.*, **129**, 141-160.

Distribution of dominant colonial and aggregating invertebrate communities at Baie Ternay.



Distribution of dominant colonial and aggregating invertebrate communities at Baie Beau Vallon.



ANIMAL TYPE	BT2					BT3					BT4	
Site / Depth	Shallow		Deep		Total max. m^2	Shallow		Deep		Total max. m^2	5-7m depth	
Size group	< $0.5m^2$	0.5-$1.0m^2$	< $0.5m^2$	0.5-$1.0m^2$		< $0.5m^2$	0.5-$1.0m^2$	< $0.5m^2$	0.5-$1.0m^2$		< $0.5m^2$	0.5-$1.0m^2$
ALCYONARIA (soft corals)												
Soft coral-encrusting (mainly *Sinularia* sp.)	50	26	14	36	94	45	44	24	54	142.5	87	34
Soft coral-mushroom shaped (mainly *Sarcophyton* sp.)	61	73	48	51	178.5	32	3	89	32	95.5	70	24
ACTINARIA (true anemones)												
Heteractis magnifica	33	14	22	102	143.5	16	0	51	10	43.5	16	0
Heteractis aurora	1	0	1	0	1	0	0	2	0	1	3	0
Stichodactylis mertensii	2	0	0	0	1	0	0	2	0	1	0	0
CORALLIMORPHARIA (disk anemones) (mainly *Actinodiscus* sp.)												
Red / Brown types	0	0	0	1	1	0	0	0	1	1	0	0
Blue / Green types	23	27	3	18	58	14	0	27	6	26.5	15	7
ZOANTHINIARIA (encrusting anemones) (mainly *Palythoa* sp. and *Zoanthus* sp.)	7	20	3	0	25	30	8	8	0	27	26	21
PORIFERA (sponges-boulder forms only) various colours mostly white and mustard /green	23	2	6	19	40.5	5	0	25	0	15	35	0

NB: where individual colonies cluster, area cover is estimated, for example, where a large group of anemones congregate total area may be several m^2. This is particularly significant for *H.magnifica*, *Sarcophytons*, boulder sponges and all Corallimorpharians.

TABLE. 1 Dominant colonial non-scleractinian invertebrate distributions at Baie Ternay.

Data is represented as number of colonies for both deep and shallow and as total estimated area cover per site (500 m^2).

ANIMAL TYPE Site Size group	AUBERGE			CORSAIR			FISHERMAN`S COVE		
	< 0.5 m²	**0.5-1.0 m²**	**Total max. m²**	**<0.5 m²**	**0.5-1.0 m²**	**Total max. m²**	**<0.5 m²**	**0.5-1.0 m²**	**Total max. m²**
ALCYONARIA (soft corals) Soft coral-encrusting (mainly *Sinularia* sp.)	119	18	77.5	16	2	10	94	8	55
Soft coral-mushroom shaped (mainly *Sarcophyton* sp.)	252	4	132	248	4	128	377	0	188.5
ACTINARIA (true anemones) *Heteractis magnifica*	68	11	45	43	32	53.5	12	0	6
Heteractis aurora	1	0	0.5	1	0	0.5	1	0	0.5
Stichodactylis mertensii	1	0	0.5	1	0	0.5	2	0	1
CORALLIMORPHARIA (disk anemones) (mainly *Actinodiscus* sp.) Red / Brown types	0	0	0	0	0	0	3	0	1.5
Blue / Green types	92	67	113	56	52	80	126	16	79
ZOANTHINIARIA (encrusting anemones) (mainly *Palythoa* sp. and *Zoanthus* sp.)	2	0	1	4	0	2	0	0	0
PORIFERA (sponges-boulder forms only) various colours mostly white and mustard /green	49	0	24.5	32	0	16	68	0	34

NB: where individual colonies cluster, area cover is estimated, for example, where a large group of anemones congregate total area may be several m². This is particularly significant for *H.magnifica*, *Sarcophytons*, boulder sponges and all Corallimorpharians.

TABLE. 2 Dominant colonial non-scleractinian invertebrate distributions at Beau Vallon.

Data is represented as number of colonies for both deep and shallow and as total estimated area cover per site (500 m²).

TABLE 3. Distributions of Echinoderm and Molluscan species at Baie Ternay.

Some of these are identified as *keystone* species and others are known largely for their aesthetic value. Counts are recorded as individuals per 500 m^2.

SPECIES/GROUP **Site** / **Transect**	**BT1**		**BT2**		**BT3**		**BT4**
	Shallow	Deep	Shallow	Deep	Shallow	Deep	5 -7 m depth
HOLOTHUROIDEA (sea cucumbers)							
Thelonota ananas	10	3	0	6	3	1	3
Bohadschia graeffei	2	2	2	11	3	4	1
Holothuria sp.	8	9	5	8	15	7	11
Stichopus sp.	0	2	0	2	7	0	0
Synapta maculata	0	1	0	1	0	0	0
ECHINOIDEA (sea urchins)							
Diadematidae/Echinometridae	80	11	54	27	9	17	37
ASTEROIDEA (starfish)							
Ophidiasteridae (*Fromia* sp. *Linkia* sp. and *Ophidiaster* sp.)	3	1	2	5	6	1	12
Acanthaster planci (crown of thorns)	2	3	0	1	2	0	0
NUDIBRANCHIA (sea slugs)							
Phyllidia sp.	3	2	1	2	2	0	several egg ribbons
BIVALVIA							
Tridacna sp.	common	common	common	less than BT1	0	few	few
Hyotissa hyotis sp. *Lopha* sp.?	common	common	common	more on deep	few	few	large numbers on granite rock

TABLE 4. Distributions of Echinoderm and Molluscan species at Baie Beau Vallon.

Some of these are identified as *keystone* species and others are known largely for their aesthetic value.

Counts are recorded as individuals per 500 m^2.

SPECIES/GROUP **Site**	**Auberge Reef**	**Corsair Reef**	**Fisherman's Cove**
HOLOTHUROIDEA (sea cucumbers)			
Thelonota ananas	4	2	0
Bohadschia graeffei	5	6	0
Holothuria sp.	3	0	0
Stichopus sp.	0	0	0
Synapta maculata	0	0	0
ECHINOIDEA (sea urchins)			
Diadematidae/Echinometridae	36	30	53
ASTEROIDEA (starfish)			
Ophidiasteridae (*Fromia* sp. *Linkia* sp. and *Ophidiaster* sp.)	1	1	0
Acanthaster planci (crown of thorns)	1	1	11
NUDIBRANCHIA (sea slugs)			
Phyllidia sp.	5	3	0
BIVALVIA			
Tridacna sp.	uncommon	5	1
Hyotissa hyotis sp.	uncommon	5	6

Invertebrate species list for Baie Ternay and Baie Beau Vallon.

This taxonomic list was compiled using a variety of sources including, principally, George and George (1977); Vine (1986) and Baumeister (1993). Classifications may have changed since

Phylum: Annelida

Class : Polychaeta
Order : Sabellida

Hydroides sp.

Family : Sabellidae

Sabellastarte sanctijosephi
Sabellastarte sp.
Sabella sp.

Family : Serpulidae

Serpula sp.
Spirobranchus sp.

Phylum: Arthropoda

Class: Crustacea
Order : Decapoda
Family: Alpheidae

Alpheus rapax
Alpheus sp.

Family: Hippolytidae

Thor amboinensis

Family: Ocypodidae

Ocypode ceratopthalma
O. cordimana
Uca sp.

Family: Palaemonidae

Periclimenes sp.
Stegopontonia commensalis

Family: Palinuridae

Panulirus versicolor

Family: Stenopodidae

Stenopus hispidus

Order : Stomatopoda

Lysiosquilla maculata

Family : Callianassidae

Callianassa sp.

Phylum: Bryozoa

Class : Gymnolaemata
Order : Cheilostomata
Suborder : Ascophora
Family : Sertellidae

Sertella sp.

Phylum: Coelenterata

Class : Anthozoa
Order : Actiniaria (sea anemones)
Family : Stichodactylidae

Heteractis aurora
H. crispa
H. magnifica
Stichodactyla mertensii

Order : Ceriantharia
Family : Cerianthidae

Pachycerianthus mana

Class: Alcyonaria
Order: Alcyonacea (soft corals)

Sarcophyton glaucum
Sarcophyton trocheliophorum
Sarcophyton sp.
Sinularia sp.
Xenia sp.

Order: Corallimorpharia

Family : Discosomatidae

Discosoma nummiforme
D. rhodostoma
Discosoma. sp / Rhodactis sp.

Family: Actinodiscidae

Actinodiscus sp.

Family : Ricordeidae

Ricordea yuma

Order: Gorgonacea (horny corals)

Acaberia splendens
Acaberia sp.(yellow, white, orange and red specimens)
Cirrhipathes sp. (sea whip)

Order: Stolonifera

Tubipora sp.

Order: Zoanthiniaria
Family: Zoanthidae

Palythoa tuberculosa
Palythoa sp.
Zoanthus sp.

Class: Hydrozoa
Family: Aglaopheniidae

Lytocarpus sp.

Phylum: Echinodermata

Order: Aspidochirotida
Class: Holothuroidea (sea cucumbers)
Family: Holothuriidae

Actinopyga sp.
B. graeffei
H. atra
H. edulis
H. nobilis

Family: Stichopodidae

Stichopus chloronotus
S. variegatus
Stichopus sp.
Thelenota ananas

Order: Apodida
Family: Synaptidae

Synapta maculata

Class: Echinoidea
Order: Cidaroida
Family: Cidaridae

Eucidaris metularia
Phyllacanthus imperialis
P. parvispinus

Superorder: Diadematacea

Asthenosoma varium
Astropyga radiata
Diadema savignyi
D. setosum
Echinothrix calamaris
E. diadema

Superorder: Echinacea
Family: Echinometridae

Echinometra mathaei
Heterocentrotus mammillatus

Family: Toxopneustidae

Toxopneustes pileolus
Tripneustes gratilla

Order: Comatulida (Feather stars)
Family: Himeromentridae

Himerometra sp.

Subphylum: Asterozoa
Class: Stelleroidea (starfishes, brittle-stars and basket-stars)
Subclass: Asteroidea

Order: Valvatida
Family: Oreasteridae

Culcita schmideliana
Culcita sp.

Family: Ophidiasteridae

Fromia elegans
Fromia sp.
Linkia laevigata
Linkia multifora
Linkia sp.
Ophidiaster sp

Order: Spinulosida
Family: Acanthasteridae

Acanthaster planci

Family: Mithrodiidae

Mithrodia clavigera

Phylum: Mollusca

Class: Bivalvia
Subclass: Pteriomorphia
Order: Mytiloida
Family: Pinnidae

Pinna muricata
Atrina vexillum

Family : Mytilidae

Lithophaga sp.

Subclass: Heterodonta
Order: Veneroida
Family: Tridacnidae

Tridacna maxima
T. squamosa
Tridacna sp.

Subclass: Pteriomorphia
Order: Pterioidea
Family: Pteriidae

Pteria sp.
Pinctada sp.

Family: Ostreidae

Hyotissa hyotis
Lopha cristagalli / folium

Family: Pectinidae

Pedum spondylium

Class: Cephalopoda

Order: Teuthoidea
Suborder: Myopsida
Family: Loliginidae

Loligo vulgaris

Order: Octopoda
Family: Octopodidae

Octopus cyaneus

Order: Sepioidea
Family: Sepiidae

Sepia sp.

Class: Gastropoda
Subclass: Prosobranchia

Order: Archaeogastropoda
Family: Trochidae

Trochus maculatus

Order: Mesogastropoda
Family: Strombidae

Strombus gibberulus
S. mutabilis
Lambis lambis
L. crocata
Lambis sp.

Family: Cypraeidae

Cypraea annulus
C. moneta
C. tigris
Cypraea sp.

Family: Vermetidae

Vermetus sp.

Order: Neogastropoda
Suborder: Toxoglossa
Family: Conidae

Conus litteratus
C. leopardus
C. textile
Conus sp.

Subclass: Opisthobranchia
Order: Nudibranchia
Suborder: Doridacea
Family: Phyllidiidae

Phyllidia bourguini
P. ocellata
P. varicosa
P. zeylanica

Order: Aplysiomorpha
Family: Aplysiidae

Dolabella auricularia

Phylum: Platyhelminthes

Order: Polycladida
Family: Pseudocerotidae

Pseudoceras sp.
Callioplana sp.