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THE ECHINODERMS OF THE SOFT BOTTOMS OF THE SOUTH-WESTERN LAGOON OF NEW CALEDONIA.

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ABSTRACT

A bionomic mapping survey of the soft bottoms of the south-western lagoon of New Caledonia was carried out by dredging. From analysis of the sediments and the fauna and flora found in 489 dredgings, it was possible to define three main benthic communities. Echinodermata were found in 37.8 % of the dredges : 22 species of Echinoidea, 30 Asteroidea species and 26 species of Holothuroidea. Correlations existed between the presence of principal species, the mud content of the sediments and the bathymetry. Distribution maps are given for the following species. *Laganum depressum*, *Maretia planulata*, *Gymnechinus epistichus*, *Brissopsis luzonica*, *Astropecten polyacanthus*, *Pentaceraster alveolatus*, *Echinaster luzonicus* and *Tamaria fusca*. Some species have very particular ecological requirements, such as *Brissopsis luzonica* which is a mud-dwelling; *Gymnechinus epistichus* and *Maretia planulata* live in sand but dislike mud. Other species such as *Laganum depressum* and *Astropecten polyacanthus*. are very ubiquitous and their distribution seems to be unaffected by sediments or depth.

INTRODUCTION

Since 1984, ORSTOM[1] has been carrying out a programme of studies on the benthic communities of the lagoons of New Caledonia. Special attention has been paid to the soft bottoms of the south-west (figure 1 and 2), where qualitative sampling has been done with the Charcot dredge (Richer de Forges *et al.* 1987) and quantitative sampling with the Smith-McIntyre grab (Chardy *et al.*, in press). Combining these two types of approach, it has been possible to define three principal communities in the south-western lagoon based on the floral and faunal groups and on the sediments (figure 3) :

- a community living on sediments which typically have a high content of lutites ; this kind of community is found all along the coast and in the submarine valleys;
- a grey sand community that occupies the median zone of the lagoon, where there are *Caulerpa* beds;
- a coral sand or white sand community situated along the barrier reef.

Several authors who have worked in this area have already referred to these three types of bottom indicating zonation from the coast towards the reef (Salvat, 1964; Thomassin, 1981; Intes and Menou, 1979).

Furthermore, an inventory of the principal species of echinoderms has been drawn up (Laurent, 1987) on the basis of the specimens gathered in the course of dives made during the SNOM[2] programme (1976 to 1981).

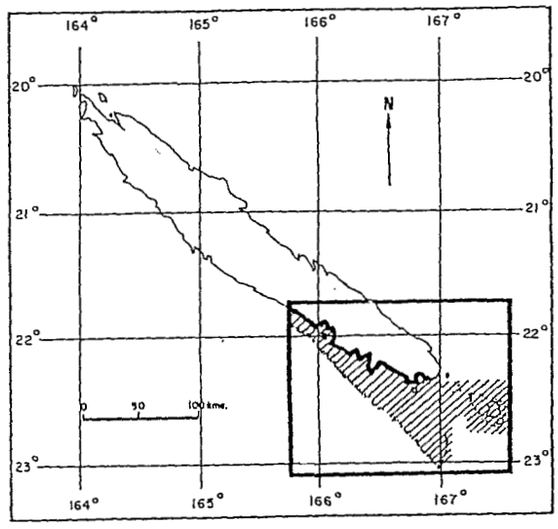

Figure 1. Location map.

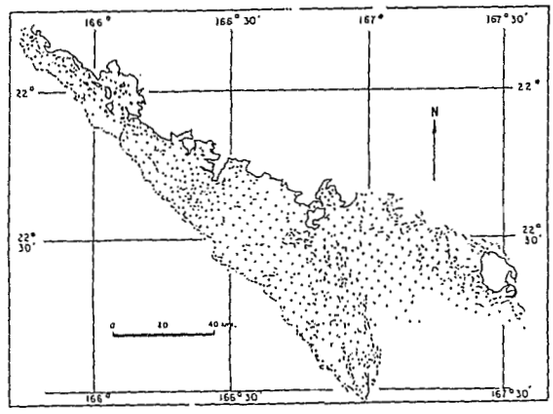

Figure 2. Location of dredge hauls.

These collections were given to the French Natural History Museum, Paris, and the Holothuroidea were studied by Cherbonnier and Feral (1984) the Asteroidea by Jangoux, (1984), and the Echinoidea by De Ridder, (1985). The main taxonomic problems having thus been solved, a guide for the use of ecologists was published (Guille *et al.* (1985). With the aid of this fundamental work, it was possible to identify precisely the samples taken in 489 dredging of the south-western lagoon (figure 2). Studies of the biology of certain species of Holothuroidea that are of commercial value

have been carried out (Intes and Menou, 1979; Conand, 1979, 1981; Conand and Chardy, 1985).

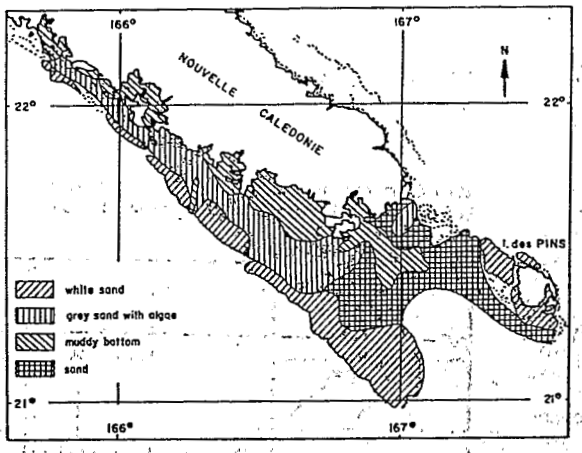

Figure 3. Preliminary mapping of sea beds established by dredging.

RESULTS

78 species of echinoderms were found in the dredgings, including 22 species of echinoids, 30 species of asteroids and 26 species of holothurians. Only the most frequently found species in each group were selected with a view to studying their ecological significance (table 1).

Table 1. Echinoderm species frequency dredged in the S.W. lagoon of New Caledonia.

SPECIES	occurrence	%
Echinoidea :		38.22
Laganum depressum L. Agassiz 1841	90	18.59
Maretia planulata (Lamarck, 1816)	52	10.74
Gymnechinus epistichus H.L. Clark, 1912	46	9.50
Brissopsis luzonica (Gray, 1851)	32	6.61
Asteroidea :		27.89
Astropecten polyacanthus Müller et Troschel, 1842	41	8.47
Pentaceraster alveolatus (Perrier, 1875)	20	4.13
Echinaster luzonicus (Sladen, 1882)	20	4.13
Tamaria fusca (Gray, 1840)	15	3.10
Holothuroidea :		20.66
Holothuria (Halodeima) edulis Lesson, 1830	22	4.54
Thelenota ananas (Jaeger, 1833)	14	2.89
Stichopus chloronotus Brandt, 1835	13	2.68
Holothuria (Thymiosycia) hilla Lesson, 1830	10	2.07

Of the four Echinidae species, only *Gymnechinus epistichus* is not a burrower. It lives clinging to shell debris in areas of strong currents.

It will be noted that there are not many holothurians in our dredgings for this method undersamples organisms that are large in size and very scattered. Conand and Chardy (1985) in diving counts on 100 m² observed much higher densities of holothurians (as many as 8 individuals/100 m² in the inner lagoon).

Geographical distribution of the species

The presence of each species in the dredgings was mapped in order to give an idea of its spatial distribution.

Laganum depressum is found throughout the south-western lagoon regardless of the depth and of the type of bottom (figure 4). It is however more abundant on the inner reef white sand bottoms (Salvat, 1964); Chardy *et al.* (1987) gathered about 1 individual/m² with the grab.

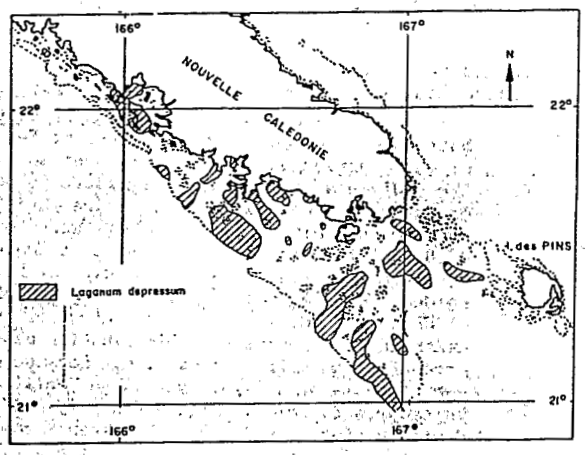

Figure 4. Distribution of the *Laganum depressum* species in the S.W. lagoon.

Gymnechinus epistichus is found in the middle of the lagoon on the 'grey bottoms' with green algae, and especially in the maerl zones that are typical of high degree of hydrodynamic effect (figure 5).

Maretia planulata is a burrowing species that is found in the muddy coastal zone and on the 'grey bottoms' (figure 5). In diving counts, Chardy *et al.* (1987) observed as many as 7 individuals/m².

Brissopsis luzonica, a species with a fragile test, lives in the very muddy bottoms of the bays and burrows deeply; it is never found anywhere other than on the coastal fringe (figure 5).

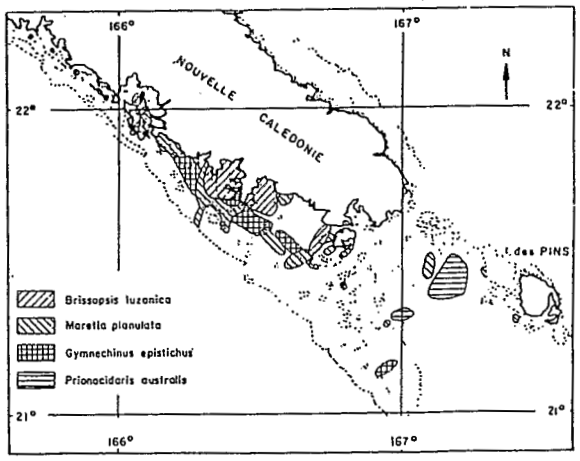

Figure 5. Distribution of some species of sea urchins gathered by dredging.

Regarding the Asteroidea, simply mapping the distribution of the four species most commonly found does not provide enough information to allow general considerations about their preferences to be deduced (figure 6).

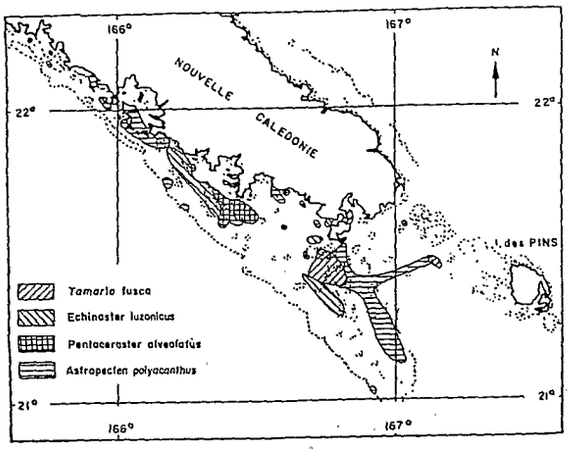

Figure 6. Distribution of asteroids collected by dredgings.

Factors explaining the species distribution

Work on sedimentology that was being conducted simultaneously with that on benthic ecology led to grain-size maps being drawn up (Chevillon, 1985). Correlations have been made, using the map showing siltation, defined by the percentage of mud (particles < 0.063 mm) and the bathymetry (figure 7 and 8).

Laganum depressum is affected by the content of mud (figure 7 A) and although this species is more frequently found in depths of 15 to 30 m, it can be found on bottoms as deep as 80 m, (figure 7 B).

Maretia planulata is found on all types of bottom containing up to 75 % mud, its optimum depth being between 10 and 30 m.

Gymnechinus epistichus is restricted to bottoms less than 40 m deep and prefers sediments with little mud, < 25 % .

Brissopsis luzonica has very marked preferences regarding the depth (10 to 30 m,) and the content of mud, which is always more than 40 % (figures 7 A and 7 B).

In the Asteroidea (figure 8 A and 8 B), it will be seen that the four most common species are found on bottoms having less than 50 % mud. As regards depth, *Tamaria fusca* is the most tolerant, being often found even at 50 to 80 m depth. *Echinaster luzonicus*, however, has never been observed at more than 30 m.

The correspondance analysis and what can be learned from it

Two series of correspondance analyses were carried out on all the data about the echinoderms of the south-western lagoon, in order to

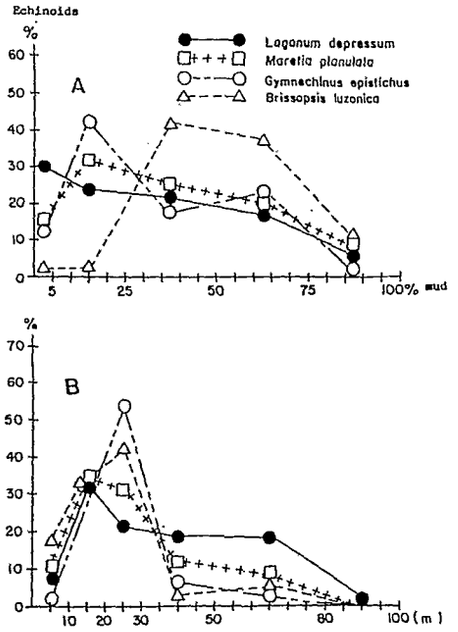

Figure 7. % of occurence of the main echinoids species in relation to silt sediment and the bathymetry in the S.W. lagoon.

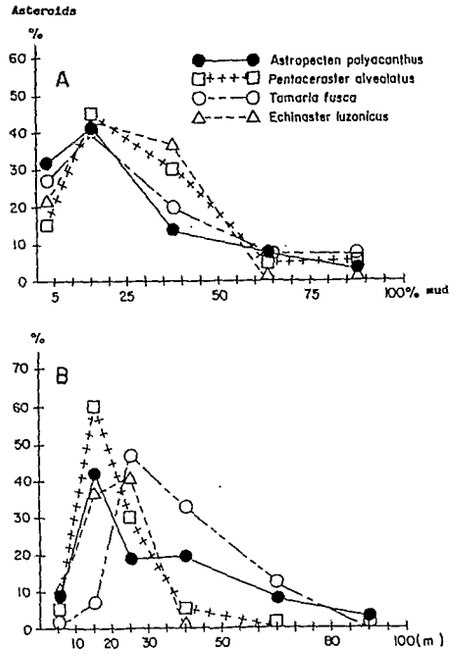

Figure 8. % of occurence of the main asteroid species in relation to silt sediment and the bathymetry in the S.W. lagoon.

group the stations according to their faunal composition. Analyses by group (figures 9 A, 9 B, 9 C) were carried out on echinoid, asteroid and holothurian but the frequency of species belonging to the latter two groups being insufficient, this technique is not reliable.

Regarding echinoid, the analysis projects station-points and species points on the planes defined by axes 1, 2 and 3 explaining 28.53 %, 15.13 % and 14.93 % respectively of the variance (figure 9 A, 9 B, 9 C).

Axis 1 separates *Laganum depressum* from the three other species; axis 2 classes the species in terms of their affinity for mud, *Brissopsis luzonica* being found in the muddiest stations and *Gymnechinus epistichus* in the least muddy, with *Maretia planulata* between the two extremes.

A general analysis covering all the 489 stations and the 54 more frequent species of echinoderm (figures 9 D, 9 E, 9 F), has made it possible to isolate the two ubiquitous species *Laganum depressum* and *Astropecten polyacanthus*. These diagrams also show the echinoids species that have fairly clear preferences : *Brissopsis luzonica*, *Gymnechinus epistichus* and *Maretia planulata*. The other species are all mingled together at the origin of the axes and the only ones that can be distinguished are *Halodeima edulis* and *Tamaria fusca*. Arnold and Birtles (1985) state that the latter species is found in patches in the Great Barrier Reef lagoon.

DISCUSSION

If our results are compared with those of Thomassin (1978) working on the *M. planulata* in Tulear is described as sand-dwelling and disliking mud whereas its distribution is far from being so clearly demarcated at *Noumea*, where it is sometimes found on bottoms with more than 75 % mud. *Brissopsis luzonica* is sand-dwelling and mud-dwelling both at Tulear and at Noumea, where it does not occur on bottoms having less than 40 % mud. *A. polyacanthus* and *L. depressum* which are very common in New Caledonia on all types of bottom, are described at Tulear as being strictly sand-dwelling.

It would appear therefore that the 'ecological significance' of the echinoderms reported by Thomassin (1978) should be modified. It should be noted too that the scale of observation is very different in the two places, the south-western lagoon of New Caledonia being more than 20 times greater in area than the Tulear lagoon. Moreover, the sub-species of certain species such as *Astropecten polyacanthus* and *Laganum depressum* are different, depending on whether they live in the Indian ocean or in the Pacific Ocean.

CONCLUSIONS

Judging by the results of sampling obtained by dredging, echinoderms are not good biological indicators, save in the case of a few very

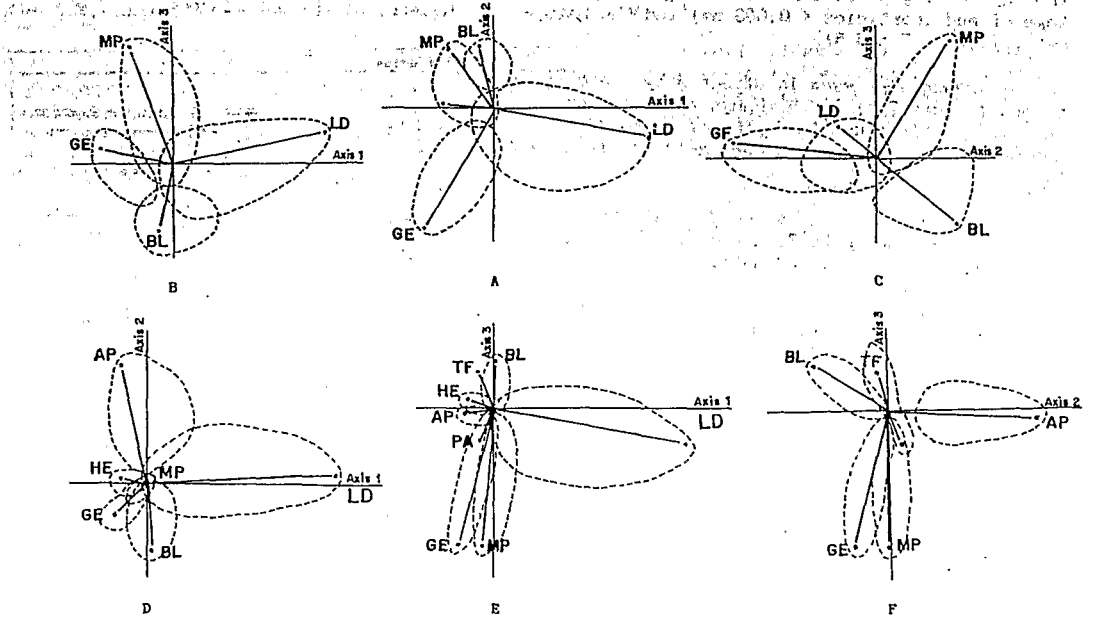

Figure 9. - A, B, C : Correspondance analyses on Echinoidea ; Ld *Laganum de pressum*, MP : *Maretia planulata*, GE : *Gymnechinus epistichs*, BL : *Brissopisis luzonica*.
- D, E, F : correspondance analysis for all echinoderms; HE *Halodeima edulis*; AP : *Astropecten polyacanthus*; TF *tamaria fusca*; PA : *Pentaceraster alveolatus*.

specialised species such as *Brissopsis luzonica*. The larger asteroid and holothurian species, which are fairly widely scattered, are not properly represented in samples taken by dredging. The 'ecological significance' of a species is governed by the sampling scale used, which very much limits the possibilities of making valid generalisation.

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1. ORSTOM : Institute for Scientific Research of Development in Cooperation.

2. SNOM : Natural Substances of Marine Origin.