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 469 dredgings, it was possible to define three main benthic communities. Echinodermata were found in 37.8% of the dredges; 22 species of Echinoidae, 30 Asteroidea species and 26 species of Holothuroidea. Correlations exist between the presence of principal species, the mud content of the sediments and the bathymetry. Distribution maps are given for the following species: Lagonus depressum, Karetia planulata, Gymnachinus epistichus, Prissopoeis luzonica, Astrotectum polycanthus, Pinctaster australis, Echinarachnius and Tassia fusca. Some species have very particular ecological requirements, such as Prissopoeis luzonica which is a mud-dwelling; Gymnachinus epistichus and Karetia planulata live in sand but dislike mud. Other species such as Lagonus depressum and Astrotectum polycanthus, are very ubiquitous and their distribution seems to be unaffected by sediments or depth.

INTRODUCTION

Since 1984, ORSTOM 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 (figures 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; Thomasin, 1981; Intès 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 programme (1976 to 1981).
have been carried out (Intes and Menou, 1979; Con- nand, 1979, 1981; Conand and Chardy, 1985).

![Figure 3. Preliminary mapping of sea beds established by dredging.](image)

**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).

![Figure 4. Distribution of the *Laganum depressum* species in the S.W. lagoon.](image)

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

<table>
<thead>
<tr>
<th>Species</th>
<th>Occurrence</th>
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<tbody>
<tr>
<td><em>Echinoluidae</em></td>
<td></td>
</tr>
<tr>
<td><em>Echinus depressus</em> L. Ammior, 1881</td>
<td>26.02</td>
</tr>
<tr>
<td><em>Echinus planulatus</em> L. Ammior, 1881</td>
<td>10.99</td>
</tr>
<tr>
<td><em>Dendraster excentricus</em> H. &amp; W. 1814</td>
<td>57.78</td>
</tr>
<tr>
<td><em>Dendraster isenbecki</em> (Gray, 1849)</td>
<td>9.50</td>
</tr>
<tr>
<td><em>Dendraster elongatus</em> Müller &amp; Troschel, 1847</td>
<td>6.61</td>
</tr>
<tr>
<td><em>Dendraster alatus</em> Müller &amp; Troschel, 1847</td>
<td>21.49</td>
</tr>
<tr>
<td><em>Dendraster ovalis</em> Müller &amp; Troschel, 1847</td>
<td>1.43</td>
</tr>
<tr>
<td><em>Echinus planulatus</em> (Gray, 1849)</td>
<td>10.40</td>
</tr>
<tr>
<td><em>Echinus planulatus</em> adult Lagoon, 1930</td>
<td>4.10</td>
</tr>
<tr>
<td><em>Echinus planulatus</em> young Lagoon, 1930</td>
<td>1.49</td>
</tr>
<tr>
<td><em>Echinus planulatus</em> specimens from the Lagoon, 1930</td>
<td>2.07</td>
</tr>
</tbody>
</table>

![Figure 5. Distribution of some species of sea urchins gathered by dredging.](image)

Of the four Echinoid species, only *Synonym crassus 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.

*Echinus planulatus* 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.

*Brisopsis 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).
Regarding the Asteroids, 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).

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).

*Laganus depressus* 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 60 m, (figure 7 B).

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

*Gymnaster pseudotrunculus* 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 Asteroids (figure 8 A and 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 lizonicus*, however, has never been observed at more than 30 m.

The correspondence analysis and what can be learned from it

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

![Figure 6. Distribution of asteroids collected by dredges.](image)

![Figure 7. % of occurrence of the main echinoid species in relation to silt sediment and the bathymetry in the S.W. lagoon.](image)

![Figure 8. % of occurrence of the main asteroid species in relation to silt sediment and the bathymetry in the S.W. lagoon.](image)
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 26.33 %, 15.13 % and 14.93 %, respectively of the variance (figure 9 A, 9 B, 9 C).

A general analysis covering all the 489 stations and the 54 more frequent species of echinoderms (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*, *Gymnchinus epistichus* and *Aretia planulata* between the two extremes.

If our results are compared with those of Thomassin (1978) working on the *A. 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 bottoms, 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 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
specialised species such as Brissomia fusca. 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.

REFERENCES


2. SSIQ : Natural Subsidies of Marine Fishes.