

## INFRALITTORAL BRYOZOA ASSOCIATED TO MACROALGAE FROM THE FIRST ITALIAN ANTARCTIC OCEANOGRAPHIC EXPEDITION (TERRA NOVA BAY, ROSS SEA)

Briozos infralitorales asociados a macroalgas provenientes de la Primera  
Expedición Oceanográfica Antártica Italiana (Bahía de Terranova, Mar de  
Ross)

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### ABSTRACT

Samples for the study of phytobenthos collected by skin-divers in Terra Nova Bay (Ross Sea) during the First Italian Oceanographic Antarctic Expedition, have shown an abundant bryozoan fauna.

Nearly all the analysed colonies live on the macrophytae. A total of 19 species have been determined with a sharp dominancy of Cheilostomida and a ratio Cheilostomida/Cyclostomida of 2,8.

Among the six zoarial forms which have been found, the membraniporiform is the dominant one.

Specific diversity, calculated by means of the Shannon-Wiener Index, fluctuate between 0,69 and 2,28.

Finally some informations about the growth stages of the observed species and their settlement and colonization strategies, are given.

KEYWORDS: Bryozoa, Antarctica. Benthic ecology.

### RESUMEN

Las muestras para el estudio del fitobentos recolectadas por buceo en la Bahía Terranova del Mar de Ross durante la primera Expedición Oceanográfica Italiana Antártica, poseen una abundante fauna briozoológica.

Casi todas las colonias analizadas vivían sobre macrofitas. Se determinó un total de 19 especies con gran predominio de los queilostomados, con una razón Cheilostomida/Cyclostomida de 2,8.

Entre las seis formas zoariales encontradas domina la membraniporiforme. La diversidad específica, calculada mediante el índice de Shannon-Wiener, fluctuó entre 0,69 y 2,28.

Finalmente se entregan algunas informaciones sobre las etapas de crecimiento, fijación y estrategias de colonización de las especies observadas.

### RIASSUNTO

Campioni per lo studio del Phytobenthos, prelevati in immersione nella baia di Terra Nova (Mare di Ross) durante la I Campagna Oceanografica Italiana in Antartide hanno mostrato un'abbondante fauna a Briozoi.

Le colonie esaminate sono quasi tutte epifite sulle macroalghe.

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Dal punto di vista tassonomico sono state individuate complessivamente 19 specie con una netta prevalenza dei Cheilostomida sui Cyclostomida ed un rapporto fra i due gruppi di 2,8.

Per quanto concerne le forme zoariali sono stati riscontrati 6 differenti habitus con predominanza del tipo membraniporiforme.

La diversità specifica, calcolata mediante l'indice di Shannon-Wiener, ha valori compresi fra 0,69 e 2,28.

Infine, vengono date informazioni sugli stadi di sviluppo delle diverse specie e sulle strategie da loro adottate per la colonizzazione.

## INTRODUCTION

Most of the present knowledge of the Ross Sea Bryozoans deals with systematic and zoogeographic topics. Often, papers concern the description of the whole Bryozoan fauna collected during great Antarctic Oceanographic Expeditions (KIRKPATRICK, 1902; THORNELY, 1924; LIVINGSTONE, 1928 and, successively HASTINGS, 1943; BORG, 1944, ROGICK, 1965). Recently, though, HAYWARD and THORPE, during their revision of the Bryozoans stored in the British Museum, have introduced some genera and species which are new to this sea (HAYWARD & THORPE, 1988a; 1988b; 1988c; 1988d; 1989a; 1989b). - Finally, during the eighties some papers (WINSTON, 1983; HAYWARD & TAYLOR, 1984; MOYANO, 1984; ROSSO, 1990) exclusively dealing with the Ross Sea Bryozoans communities, were published.

The present paper represents a contribution to the knowledge of the Bryozoans living on the Infralittoral rocky bottoms of the Terra Nova Bay together with the algal communities characterized by the lack of the large algae such as *Phyllogigas grandifolius* and *Desmarestia menziesi* (DI GERONIMO & ROSSO, 1990; CORMACI *et al.*, 1990) which are common in the neighbouring northern localities like the Adelie Land (ARNAUD, 1974).

## MATERIALS

The samples studied were collected during the First Italian Oceanographic Expedition carried out in the 1987-88 austral summer, in the frame of the Benthic Program directed by Prof. S. Di Geronimo.

Nearly all the samples were collected by a skin-diver (Prof. Scammacca) using the method of the standard surface scraping all vegetal and animal organisms living on a surface of 400 cm<sup>2</sup>; only one sample, consisting of material thrown up from the bottom, was hand-collected on the shore (DI GERONIMO & ROSSO 1990; CORMACI *et al.*, 1990).

The samples pertain to the littoral zone, from the Supralittoral Zone to a depth of 35

metres along lines orthogonal to the shoreline, located between the Terra Nova Italian Base, to the North, and Cape Russell, to the South.

The material was preserved in 4% seawater formaldehyde and destined essentially to floristic and vegetational studies as well as faunistic analysis. The samples were mainly sorted at the Istituto e Orto Botanico and partially at the Istituto Policattedra di Oceanologia e Paleoecologia of Catania University.

The samples consist essentially of Algae, some encrusted with Bryzoan and Hydrozoan colonies, Sponges and several Forams.

Among the organisms living within the algal communities *Laevitorina antarctica* (Mollusca, Gastropoda) is particularly abundant. The asteroid *Odontaster validus* and the echinid *Sterechinus neumayeri* whose aculei are sometimes colonized by bryozoans are present with several specimens. Moreover, diatoms are the best represented and most abundant organism in all the samples and cover, as a nearly continuous felt, both the rocky bottom and all other organisms.

Only one sample comprises part of the rocky substratum which is colonized by bryozoans, hydrozoans and algae.

Nineteen of these samples hold bryozoan faunas (Table 1). They are essentially the deepest ones, collected in the lower part of the Upper Infralittoral and in the Lower Infralittoral. On the contrary, samples taken at depths shallower than 4 metres do not contain bryozoans (nor the macroalgae that they more frequently colonize) but exclusively diatoms or very small algae such as *Ulotrix flacca*, *Prasiola crispa*, *Erythrotrichia cornea*, *Ballia callitrichia*, etc..(CORMACI *et al.*, 1990).

Bryozoan communities are sometimes particularly abundant and, where present, colonize specimens of *Iridea cordata*, *Plocamium cartilagineum*, and, especially, *Phyllophora antarctica* which are the only represented macroalgae. The latter species is the most frequently and densely colonized. *Iridea cordata*, on the contrary, preset bryozoan colonies only on the oldest parts of its *thalli*, near the base, whereas *Plocamium cartilagineum* is colonized

only on the strongest branches, usually cylindrical and filiform which allow the epibionts to grow in all directions forming globular colonies (cf. HARMELIN, 1976). Besides the algae, bryozoans sometimes colonize the aculei of *Sterechinus neumayeri* and hydrozoans too.

## RESULTS

A total number of 19 bryozoan taxa were found (Table 2): 14 of them were determined at a specific level and 5 only at a generic level because they were represented exclusively by very small fragments or by very young colonies whose determination is very difficult, especially for Cyclostomes.

The Cheilostomida is the most important group with 14 species, equally distributed between Anascina and Ascophorina (36.84% each), while Cyclostomida, represented by 5 species, show a dominance of 26.32%, with a ratio Cheilostomida/Cyclostomida of 2.8.

*Celleporella antarctica* and *Harpecia spinosissima* are the most frequent species and, together with *Beania livingstonei* are the dominant ones too; *Ellisina antarctica*, *Lichenopora tubicen* and *Tubulipora* sp. follow, while all the other species are present in a few number of samples showing few or rare specimens, or even a single fragment (for instance, *Notoplites* sp.).

Six zoarial forms have been found. The most frequent type is the membraniporiform shown by 12 species (63.16%) followed by the cellariform one (with 3 species and a dominance of 15.79%); all the other zoarial growth forms (viz vinculariform, reteporiform, buguliform and celleporiform), represented by a single species achieve a dominance of 5.26%. The prevalence of membraniporiforms become still more evident at specimen level. Nearly all other zoarial forms, in fact, are represented by a single specimen.

Most of the species found have already been quoted for the Ross Sea, with the exception of the Cyclostomida *Lichenopora tubicen*, the Cheilostomida Anascina *Harpecia spinosissima* and the Cheilostomida Ascophorina *Fenestrulina proxima*.

## DISCUSSION

The number of species found (19) in the studied samples is low in comparison to the hundred or so listed for the same area in front of the Terra Nova Bay (ROSSO, in progress) and the 150 or so known for the Ross Sea as a whole.

This number is low even in comparison with the communities living in the area and at similar depths (10-40 metres): MOYANO (1984), in fact, has found 46 species living on panels submerged for a period of 10 years near Cape Armitage (McMurdo Sound, Ross Sea).

As regards the ratios between the different taxonomic groups, it can be pointed out that the dominance of the Cyclostomida (26.32%) is very close to that (28.26) calculated by MOYANO (1984). Such dominances, as already pointed out by MOYANO (1984), however, are much higher than the 11.23% calculated considering exclusively the endemic Bryozoan fauna quoted by ROGICK (1965). The observed difference becomes extreme taking into account only the Ross Sea for which ROGICK (1965) quotes 80 Cheilostomida endemic species and only one species pertaining to the Cyclostomida (0.01%).

The dominance of Cheilostomida found might be explained by the lower endemicity generally shown by Antarctic Cyclostomida as well as to the scarcity of data concerning this group which is probably present in the Antarctic waters with a number of species higher than that which is at present known. In a single sample, collected at a depth of 220 metres, near Cape Washington (Ross Sea), in fact, Cyclostomida reach 6% (ROSSO, 1990) and their dominance seems to be higher in the Terra Nova Bay (ROSSO, in progress). Moreover, it is noteworthy to point out that the lower values of the ratio Cheilostomida/Cyclostomida have been calculated for Bryozoan communities living in shallow waters and colonizing artificial substrata submerged for a relatively short time or natural substrata such as the algal thalli which, very probably, have a seasonal growth (SCAMMACCA, pers. com.), above all at shallower depths. Both are, therefore, recently settled communities which have not yet reached a mature and well structures stage, predominantly made up by opportunistic and widely-spread species largely

represented (MOYANO, 1984) by Cyclostomes and some Cheilostomes such as *Celleporella antarctica*.

As regards the biogeographic affinity, 9 of the 13 taxa determined at the specific level are endemic (69.23% and only 4 (30.77%) are common to the Arctic and Subantarctic areas (*Tubulipora tubigera*, *Ellisina antarctica*, *Micropora brevissima* and *Fenestulina proxima*). These data substantially agree with the known literature and are very close to that of the 7% quoted for McMurdo Sound Bryozoan fauna by MOYANO (1984).

A sharp compositional homogeneity of the Bryozoan fauna is shown by the analysis and the comparison of the species list of the studied samples from which it is possible to make the following observations:

1) First of all, two groups of species are distinguishable:

— The first is made up by *Celleporella antarctica*, *Harpecia spinosissima*, *Ellisina antarctica*, *Tubulipora* sp., *Beania livingstonei* and *Lichenopora tubicen*; these species show a high frequency and have been found respectively 18, 18, 14, 13, 11 and 9 times.

— The second group, on the contrary, comprises taxa which have been rarely found; most of them are only present in one sample.

Moreover, it is interesting to point out that some of the species, which are among the most frequent in the studied samples, are also very frequent on the panels analysed by MOYANO (1984). These are *Celleporella antarctica* and *Beania livingstonei*. *Harpecia spinosissima*, on the contrary, not quoted by MOYANO (1984) is present in all the Terra Nova Bay samples.

2) Nearly all the species found show very small colonies with the exception of some specimens of *Harpecia spinosissima* and of *Celleporella antarctica*. Also *Ellisina antarctica* and *Micropora brevissima* living on the rocky substrata collected in the 880535 station reach large sizes, probably in relationship with the persistence of their substratum in all the

seasons. Moreover, several regenerated zooids have been observed in such colonies. The two most frequent species (*Harpecia spinosissima* and *Celleporella antarctica*) also show a very great number of ancestrulae which tend to settle on the younger portions of the macrophytae or, sometimes, lie near the larger and older fertile colonies which have probably already yielded their larvae. These two species, in fact, reach their maturity very early in astogeny and, often, even very small colonies show ovicells and embryos. MOYANO and GORDON (1980) have found ovicells from the fourth or fifth zooid of young *Celleporella antarctica* colonies that would show that this species is an r strategist (MOYANO, 1984). The observed patterns of reproduction allow us to infer that *Harpecia spinosissima* also adopt such a strategy, probably amplified by the larval settlement all around parent colonies. This latter event, together with the early maturity of colonies, could permit a further shortening of the time necessary for sexual reproduction and a quick colonization of the new environment.

Fertile colonies are shown not only by some of the most frequent species such as *Ellisina antarctica* and *Lichenopora tubicen* but also by some rare taxa such as *Micropora brevissima* and *Idmidronea* sp.

*Osthimosia milleporoides*, *Sertella* sp. and, in particular, Cyclostomida species, on the contrary, show only very young colonies or exclusively ancestrulae, as in the case of *Crisia* sp. and *Tubulipora* sp.

3) It has been possible to note a certain selection relative to the substratum. Nearly all the species found, in fact, settle on *Phyllophora antarctica*, that is the most colonized alga; *Iridaea cordata*, on the contrary, is exclusively colonized by *Celleporella antarctica* and *Harpecia spinosissima*. Moreover, these latter species reach their largest sizes on this alga and acquire a very regular round shape owing both to the morphology of *Iridaea cordata* with very large, foliaceous thalli and to the apparent lack, in the studied communities, of a strong spatial competition. Finally *Plocamium cartilagineum*, is nearly

TABLE 1. List of the studied samples with the geographic co-ordinates of the starting points of the lines along which they were collected. For each sample, the collected and colonized macrofite have been quoted: \* = *Phyllophora antarctica*; § = *Plocamium cartilagineum*; § = *Iridaea Cordata*.

LINE NUMBER	LATITUDE ( S )	LONGITUDE ( E )	LOCALITY	SAMPLES	DEPTH (m)	OBSERVED MACROPHYTAE	COLONIZED MACROPHYTAE
0	74° 45,10'	164° 07, 04'		880012	12	*	*
				880022	22	*	*
1	74° 44, 80'	164° 04, 40'		880122	22	*	*
				880133	33	* §	*
2	74° 46,70'	163° 58, 40'	Penguin Bay	8802sp.		* § §	* § §
3	74° 45,70'	164 ° 03, 60'		880312	12	* § §	* §
				880322	22	*	*
4	74° 50, 80'	164° 00, 05'		880412	12	§	§
5	74° 41, 70'	164° 07, 05'	Base Camp	880535	35	*	*
6	74° 30, 90'	165° 30, 00'	C. Washington	880606	6	* §	* §
				880612	12	* §	*
7	74° 54, 00'	163° 54, 70'	C. Russell	880715	15	* § §	*
8	74° 54, 50'	163° 42, 00'	Inexpressible	880804	4	* § §	* § §
				880810	10	§ §	§ §
10	74° 40, 15'	163° 42, 00'	Gerlache Inlet	881006	6	* § §	* § §
				881015	15	* §	* §
				881025	25	*	*
				12-2-05	5	* §	* §
				12-2-10	10	*	*



exclusively colonized by *Celleporella antarctica* which forms very small colonies growing in a pseudovinculariform habitus well adapted to the filiform shape of this alga.

- 4) The bryozoan fauna which settle directly on the rocky substratum of the 880535 station and that observed on the Algae are substantially the same. A single species, *Microporella stenoporta*, has been found exclusively in this sample.
- 5) The values of the specific diversity, calculated for each sample by means for the Shannon-Wiener index, fluctuate between 0.69 and 2.28 although most is comprised between 1.38 and 1.79. It is interesting to point out that specific diversity generally increases with depth. Finally, the group of samples which show the lowest values of specific diversity is essentially characterized by the exclusive presence of the most frequent species which are, probably, the first pioneer species whose

settlement is successively followed by the others.

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