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Mass mortality of *Paramuricea clavata* (Anthozoa, Cnidaria) on Portofino Promontory cliffs, Ligurian Sea, Mediterranean Sea

Mortalité massive de Paramuricea clavata *(Anthozoa, Cnidaria) sur la falaise du promontoire de Portofino, mer Ligurienne, mer Méditerranée*

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Key-words : *gorgonians,* Paramuricea clavata, *mass mortality, marine zoobenthos, Mediterranean Sea.*

ABSTRACT

Bavestrello G., S. Bertone, R. Cattaneo-Vietti, C. Cerrano, E. Gaino, D. Zanzi, 1994 - Mass mortality of Paramuricea clavata *(Anthozoa, Cnidaria) on Portofino promontory cliffs, Ligurian Sea, Mediterranean Sea.* Mar. Life, **4** (1) : 15 - 19.

An extreme case of mass mortality of the sea fan Paramuricea clavata *on the Portofino Promontory is reported. During October 1993 about 10,000 sea fans, living in the 20 to 35 m depth range, underwent a degenerative process, which caused the progressive detachment of the coenenchyma from the gorgonians' branches. About 80 % of the affected colonies were reduced to a bare. It may be assumed that an increase in this mortality may be related to a violent storm that caused a drop in salinity and suspended sediment locally. Specific analysis has provided no evidence of bacterial involvement.*

RÉSUMÉ

Bavestrello G., S. Bertone, R. Cattaneo-Vietti, C. Cerrano, E. Gaino, D. Zanzi, 1994 - [Mortalité massive de Paramuricea clavata *(Anthozoa, Cnidaria) sur la falaise du promontoire de Portofino, mer Ligurienne, mer Méditerranée].* Mar. Life, **4** (1) : 15 - 19.

On a établi une mortalité tout à fait exceptionnelle de la gorgone Paramuricea clavata *le long de la côte du promontoire de Portofino. Pendant le mois d'octobre 1993, à peu près 10 000 gorgones, vivant entre 20 et 35 mètres de profondeur, ont subi un processus dégénératif, qui a provoqué le détachement progressif du coenenchyme des branches des gorgones. Près de 80 % des colonies endommagées était réduit au squelette nu. On peut supposer la relation de cette mortalité avec une violente tempête qui a fait augmenter localement le sédiment en suspension et diminuer la salinité. Des analyses spécifiques au niveau du coenenchyme n'ont pas mis en évidence de bactéries responsables de ces processus dégénératifs.*

INTRODUCTION

Anthozoans are an important component of the coralligenous biocoenosis on Mediterranean submarine cliffs, reaching 95 % of the total biomass in some areas (Gili, Ros, 1985). Among the gorgonians, which are the main representatives of this biocoenosis (Pérès, Picard, 1964), *Eunicella singularis* (Esper) is commonly found on horizontal or sub-horizontal bottoms whereas *E. cavolinii* (Koch) occurs on the vertical cliffs at intermediate depth. At greater depths this species is replaced by *Paramuricea clavata* (Risso), the biggest Mediterranean sea fan (Weinberg, 1991), whose population is very stable, and which has a very slow growth rate, ranging from 12.5 to 60 mm/year (Peirano, Tunesi, 1989; Weinberg, 1991; Mistri *et al.*, 1992).

The present note reports a dramatic case of mass mortality involving a population of *Paramuricea clavata* living on the vertical cliffs at Portofino Faro along the Portofino Promontory (Ligurian Sea).

RESULTS AND DISCUSSION

The occurrence of a widespread population of *P. clavata* along the Portofino cliffs was previously mentioned by Tortonese (1958, 1961), and Morri *et al.*, 1986. According to Rossi (1965) the bathymetric distribution and density of this population vary in proportion to the level of solar radiation. These data are substantiated by other observations on several octocorallian communities (Rossi, 1965; Weinberg, 1978).

Scuba diving surveys along the northeastern and southern sides of Portofino Faro (Portofino Promontory) have made it possible for the distribution of *P. clavata* to be mapped and data to be gathered for a better characterization of both its structure and biology. In this area, *P. clavata* lives from 20 m to 50 m depth. Along the northeastern side at a depth of 20 m, the population density is around 7 colonies/m^2 and their maximum height is 20 cm. The most extensive development is found at 30 m with 16 colonies/m^2 and a maximum height of 40 cm. This

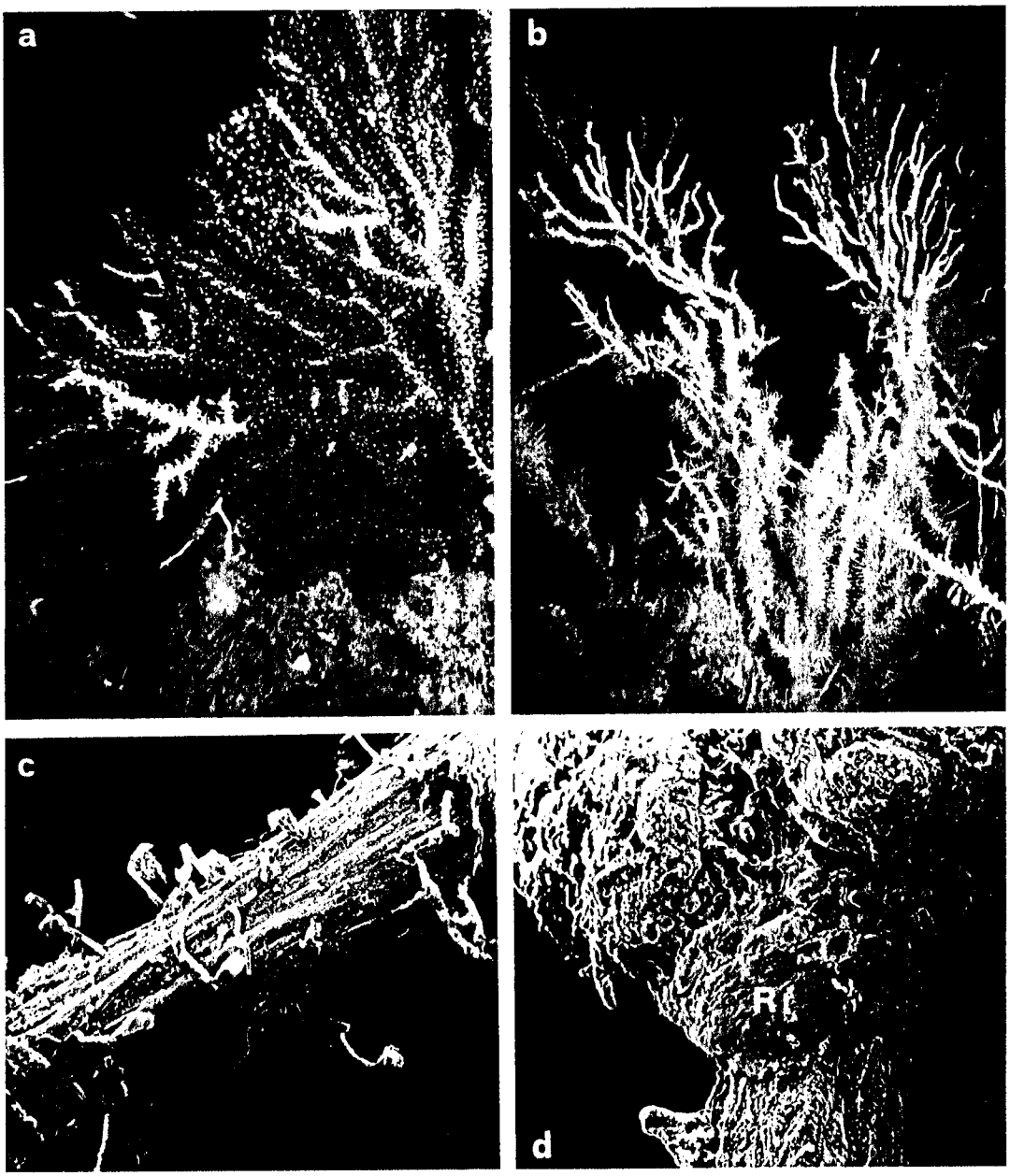

Figure 1 - Morphological aspects of the large-scale mortality affecting *Paramuricea clavata*. a - spoiled areas (arrows) are scattered among the unaffected ones ; b - branches showing widespread degeneration of the coenenchyma ; c - SEM micrograph evidencing a sector of the completely bare skeleton with just settled epibiontic hydroids ; d - SEM micrographs showing out the regenerative rim (Rr) spreading over the eroded skeleton./ *Aspects morphologiques de la mortalité massive de* Paramuricea clavata. *a - les zones dénudées sont dispersées sur la surface de la gorgone ; b - rameaux montrant des dégénérescences étendues du coenenchyme ; c - photographie au microscope à balayage montrant une zone du squelette nu qui a été colonisée par des hydraires ; d - photographie au microscope à balayage montrant le tissu régénératif en train de recouvrir le squelette mort.*

population ends at 50 m on a detritic bottom. On the southern side, *P. clavata* is present from 28 m and reaches maximum density at 38 m depth with about 12 colonies/m².

In mid-September 1993 no obvious signs of damage to the colonies were observed. But during a survey on 20th October extensive mortality was detected, affecting the colonies living from 20 to 38 m depth. The area affected covered was about 800 m² with an average population density of 12 colonies/m². In particular, from 20 to 25 m, 100 % of the colonies were involved. Among these, about 20 % showed clear signs of necrosis (Figure 1a) with progressive detachment of the living tissue (Figure 1b), whereas in about 80 %, only the bare skeleton was exposed. The exposed skeletons were abundantly covered by epibiontic hydroids *(Obelia, Campanularia* and *Clytia).* From 25 m, the percentage of affected colonies decreased gradually and below 38 m no damage was detected.

Overall, about 10,000 specimens were involved in this mass mortality. The phenomenon was limited to the Portofino Faro area ; in several other investigated sites no degenerative signs were observed. Scanning electron micrographs confirmed that several sectors of the colony's branches were completely spoiled (Figure 1c), whereas others were involved in a proliferative activity of the coenenchyma revealed by the spreading of living tissue over the bare skeleton (Figure 1d).

Mass mortality events are well documented for madreporian corals and reported as "bleaching" phenomena (e.g. von Prahl, 1986 ; Pecheux, 1993). By contrast, few data are available for sea fan populations, apart from those coming from the Southern Caribbean, where two species of *Gorgonia* were sporadically involved in heavy mortality phenomena. In this area *Gorgonia ventalina* represents the most abundant species. Mortality was first observed in November 1981 along the north coast of Trinidad (Laydoo, 1983). The following year other species were affected, such as *Gorgonia flabellum,* which underwent rapid degeneration along the Costa Rican coast (Guzman, Cortés, 1984). The most recent reports concern the Santa Marta area, where a population of *G. ventalina* was similarly devastated from 1988 to 1990 (Garzon-Ferreira, Zëa, 1992). In all cases a specific sensitivity to the environmental conditions was evident. Likewise, on Portofino Promontory mortality was confined only to *P. clavata,* since the two species of *Eunicella* did not show any damage.

In the Mediterranean Sea, similar events have been seen off the coast of Provence, where extensive mortality of gorgonians and red coral was documented (Rivoire, 1991). In Paraggi Bay (Portofino Promontory, Ligurian sea), a small population of *E. cavolinii* was reported to have undergone partial degeneration (Bavestrello, Boero, 1986). Mass mortality of *Paramuricea clavata* was also reported along the cliffs of Montecristo Islands (Guldenschuh, pers. comm.).

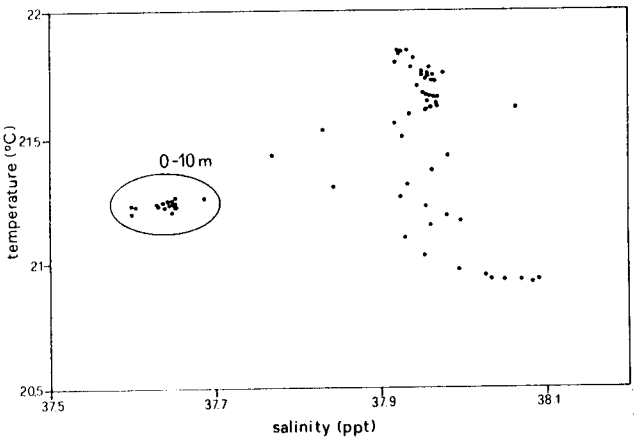

Figure 2 - Hydrographic conditions (temperature *versus* salinity) of the surface water column (0-35 m depth) of a site (St. A) (9° 14' E, 44° 18' N), inside the Marconi Gulf 2.7 km from the Portofino Faro. The data, collected on 30th September 1993 after heavy rainfall, demonstrate the presence of an upper layer (0-10 m) characterized by low salinity and temperature./ *Conditions hydrographiques (température et salinité) à la station A, située dans le golfe Marconi à 2,7 km du phare de Portofino. Les données recueillies le 30 septembre 1993, après une période d'orages, montrent la présence d'une couche superficielle caractérisée par des valeurs basses de salinité et de température (by courtesy of ISAM, University of Genova).*

Other marine organisms have been involved in large-scale mortality in both Caribbean and Mediterranean areas. Commercial sponge beds were depleted in 1938-1939 by a disease that rapidly spread outwards causing severe reduction in the sponge populations (Galtsoff, 1942). In the Mediterranean basin a more recent epidemic caused heavy losses in sponge biomass (Gaino, Pronzato, 1992); the sponge body was reduced to a network of brittle fibres contaminated by bacteria (Gaino, Pronzato, 1989).

As far as the gorgonians are concerned, many physical and biological causes have been cited to explain these mortalities (Guzman, Cortès, 1984), even though it is very difficult to attribute their mortality to any specific agent. One hypothetical cause of these events could be related to heavy rainfall which occurred from the second half of September to the end of October 1993. This rainfall slightly modified the salinity and temperature in the first layer of the in-shore water column (Figure 2) and caused an increase in turbidity. Secchi disk measures indicated an average value of 8.7 and 9.2 in September and October respectively as against 23.5 m in August. Nevertheless, these changes do not seem to be radical enough to cause damage to the benthic communities, and are consistent with the normal seasonal trend of the physical conditions of the considered area (Della Croce *et al.,* 1994).

The possible involvement of bacteria in the phenomenon has been tested by specific analysis carried out on healthy and damaged colonies together with the surrounding sea water.

In order to isolate the bacterial strains, inoculation on the culture medium was carried out in the laboratory immediately after the sampling of the gorgo-

nians. Two samples of both the healthy and the damaged gorgonians were shaken with small sterile glass balls (diameter 2 mm) in 10 ml of sterile sea water for 10 minutes : the bacterial suspension after dilution was spread on marine agar plates (2216 Difco) and incubated at room temperature (23-25°C). Five days later, bacterial colonies with different morphology were selected as different strains and isolated on marine agar : a total of 10 and 9 bacterial strains were recovered from the damaged and healthy colonies respectively, and 14 from sea water. The bacterial strains, all Gram-negative rods, were identified by analysis of their gas chromatographic fatty acid composition : the fatty acid profile of an unknown strain is compared to a data base of standard profiles (Bertone *et al.*, 1993). No predominant strains were detected among those coming from the damaged colonies. In a general sense the microflora composition of the healthy and damaged gorgonians appeared to be rather similar, reflecting the species present in the surrounding water (Table I). In addition, the values of 6×10^4 and 3×10^4 bacteria/cm^2 found on the surface of diseased and healthy colonies respectively, do not show significant differences with regard to the bacterial charge (Austin, 1988).

Even considering the predatory activity of Gastropoda and Polychaeta, it is well known that colonies are not completely destroyed by these predators (Guzman, Cortés, 1984; Theodor, 1967). Finally, the presence of the alga *Dictyota dichotoma* on *P. clavata* was recorded during the summer, especially on colonies living below a depth of 35 m, but very few colonies there were affected by the mortality.

Table I - Identified bacterial strains from *Paramuricea clavata* and surrounding sea water./ *Souches bactériennes isolées de* Paramuricea clavata *et de l'eau de mer environnante.*

Source	Species	N° of bacterial strains
Damaged sea fans	*Alteromonas* sp.	3
	A. espejiana	1
	A. haloplanktiis	2
	Cytophaga sp.	1
	Deleya marina	1
	Oceanospirillum minutulum	1
Healthy sea fans	*Deleya* sp.	2
	D. aquamarina	1
	O. minutulum	2
	O. pelagicum	1
	Vibrio sp.	1
Sea water	*Alteromonas* sp.	1
	A. haloplanktis	1
	C. litica	1
	D. aquamarina	4
	Pseudomonas sp.	1
	Vibrio sp.	1
	V. damsela	1
	V. nereis	1

As reported for sponges (Gaino, Pronzato, 1989), *P. clavata* also showed, in some cases, reparative mechanisms allowing partially damaged specimens to recover by regenerative processes. This feature represents a successful strategy to face mass mortality and to survive.

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