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THE DECLINE OF A POPULATION OF THE SEA URCHIN PARACENTROTUS LIVIDUS IN THE BAY OF PORT-CROS (VAR, FRANCE)

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Abstract : Censuses of the *Paracentrotus* population, using the same procedure, took place in May 1979 and March-May 1980, before and after a disease, along a permanent transect.

Résumé : Le recensement des populations de *Paracentrotus* a été effectué le long d'un transect permanent, avant et après une maladie, en mai 1979 et en mars-mai 1980.

MATERIAL AND METHODS

In May 1979 a permanent transect was established in the Bay of Port-Cros (BOUDOURESQUE *et al.*, in press) to monitor changes in seagrass communities and some sedentary organisms in them. The transect crossed an inner lagoon colonized by *Cymodocea nodosa* (Ucria) Ascherson, a barrier-reef of *Posidonia oceanica* (Linnaeus) Delile, an « outer reef area » occupied almost entirely by a dead matte (3) of *Posidonia* rhizomes, and terminated in a relatively deep *Posidonia* meadow at about 2.5 m depth (Fig. 3 upper). The transect was permanently marked by steel spikes driven deep into the substrate at 30-50 m intervals throughout its length. The spikes marking the transect were easily relocated and a line, marked at metre intervals, was streched along the transect for the purposes of the study.

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(3) Matte : thick layers of *Posidonia* rhizomes embedded in more or less sandy sediment.

In March 1979 an initial census of the *Paracentrotus lividus* (Lamarck) population was made along the transect. A one metre square divided into a grid of 25 squares, each 20 cm × 20 cm, was placed end to end sequentially on the transect line (SHEPHERD and BOUDOURESQUE, in press) and all individuals, other than juveniles (1), counted in the metre square on each placement. In addition, at several points on the transect, size frequencies of the population were obtained, using a vernier gauge to measure the horizontal test diameter (h.d.) of all individuals within a few metre squares.

Subsequently, the *Paracentrotus* population became infected by a disease, and in March 1980 many fresh empty *Paracentrotus* tests were observed throughout the Bay of Port-Cros, especially toward the lower limit of the *Posidonia* meadow at 7-10 m depth (Figs. 1, 2). Thus the initial census acquired special ecologic significance.

At the time of writing (May 1980) there is no evidence of disease urchins in the Bay.

A second census of the *Paracentrotus lividus* population was made along the permanent transect between March and May 1980, using the same procedure as the earlier one.

RESULTS

The results of the two censuses (Fig. 3 middle and lower) show some noteworthy features :

(1) The *Paracentrotus lividus* population greatly declined between the censuses ; nevertheless, the population is still very high in comparaison with urchin populations on the Corsican coast.

(2) The relative distribution of abundance of urchins along the permanent transect is rather similar on both censuses. Population peaks occur, in both censuses, on the outer slope of the barrier reef, in the region of degradation of the *Posidonia* meadow and of sediment « wash out » (where the matte is deprived of its sedimentary substrate), sites co-incident with the occurence of urchin « nurseries » (SHEPHERD and BOUDOURESQUE, in press). Urchins no longer are to be found on the barrier reef or in the dead matte.

(3) Nevertheless, the decline ratio of *Paracentrotus lividus* is not uniform along the transect (Table I) : it lies between 10 % (in the healthy deep *Posidonia* meadow) and 75 % (barrier reef, outer slope of the barrier reef and dead matte).

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(1) Juveniles : individual sea urchins measuring less than 20 mm horizontal diameter ; the horizontal diameter is the diameter of the test without spines. Numerous individuals, especially young individuals, were collected and transported to the Laboratory for examination, so as to check that there were no examples of the species *Psammechinus microtuberculatus* (Blainville) which closely resembles the investigated *Paracentrotus lividus*.

Fig. 1 and Fig. 2 : Dead *Paracentrotus lividus*, at the lower limit of the *Posidonia oceanica* meadow, at 8 m depth, Port-Cros Bay.

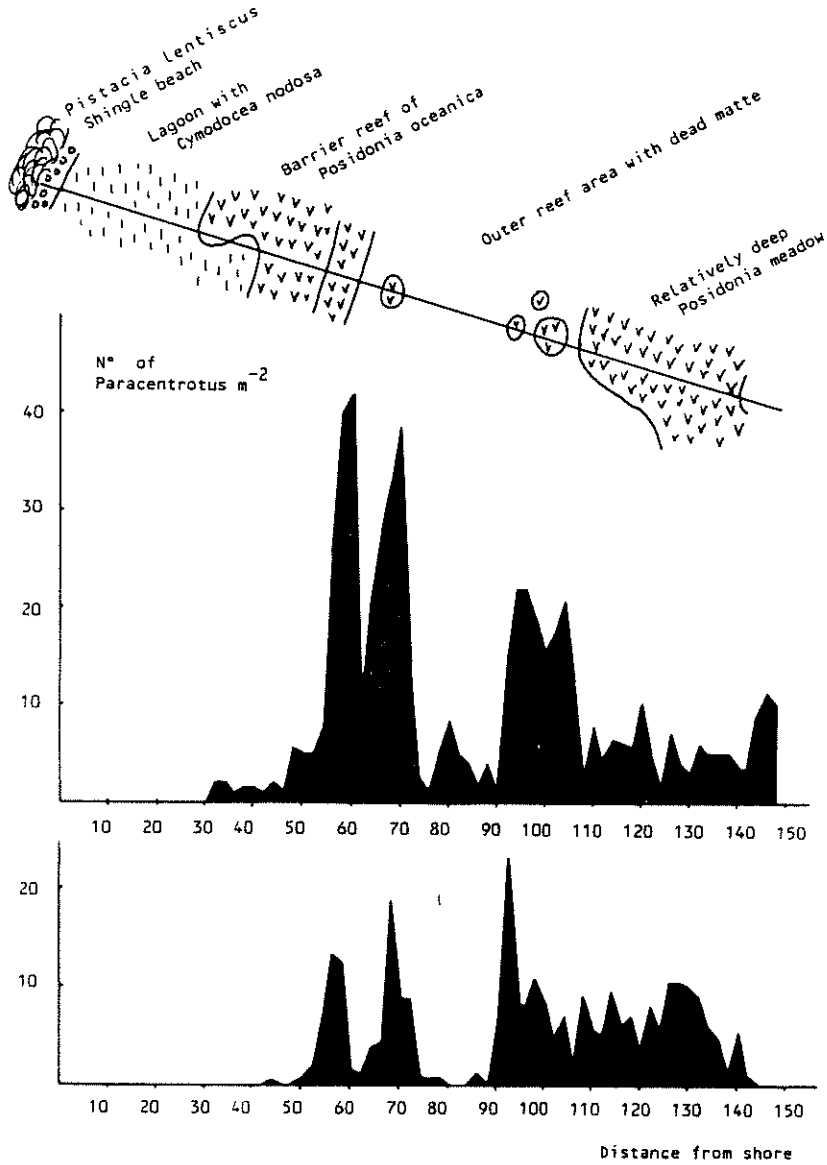

Fig. 3 : Diagrammatic view of the permanent transect (upper), *Paracentrotus lividus* densities in May 1979 (middle) and in March-May 1980 (lower). In order to smooth the curves, each plotted value is a mean of two consecutive values.

Benthic community	Distance from shore (m)	N° of Paracentrotus		Decline of Paracentrotus (per cent)
		1979 census	1980 census	
Inner lagoon with *Cymodocea nodosa*	0-30	0	0	unchanged
Barrier-reef of *Posidonia oceanica*	31-54	70	18	— 74 %
Outer slope of the barrier-reef (healthy *Posidonia* or dead matte with patches of live *Posidonia)*	55-72	510	142	— 72 %
Dead matte	73-90	65	17	— 74 %
Degraded deep *Posidonia* meadow	91-108	292	163	— 44 %
Healthy deep *Posidonia* meadow	109-148	239	216	— 10 %

TABLE I : Decline-ratio of *Paracentrotus lividus* along the permanent transect.

At two points along the transect (at 52 m and 60 m respectively from shore datum) size frequency distributions in May 1979 and March 1980 are compared (Fig. 4). At the 60 m site in the degraded meadow, juveniles (defined as those with test diameter < 20 mm) which were abundant in 1979, have all but disappeared in 1980, leaving only individuals in the 20-45 mm size range. This marked shift to the right of the size-frequency distribution suggests that some migration of *Paracentrotus lividus* may have occured into this region. Conversely, at the 52 m site on the outer edge of the barrier reef, juveniles were absent in 1979 and the size-frequency distribution in unchanged, suggesting some stability in the population here.

Finally, the reliability of our censuses over a two months period, then between night and daytime countings, was investigated along a part of the permanent transect (Fig. 5) : the three histograms are rather similar.

CONCLUSIONS

We presume that the epidemic only acquired its spectacular character because of the high population density of urchins in the Bay of Port-Cros. In Corsica, on the seaward side of the Regional Natural Park, where *Paracentrotus lividus* occurs in low densities and in a « natural equilibrium », the disease passed almost unnoticed.

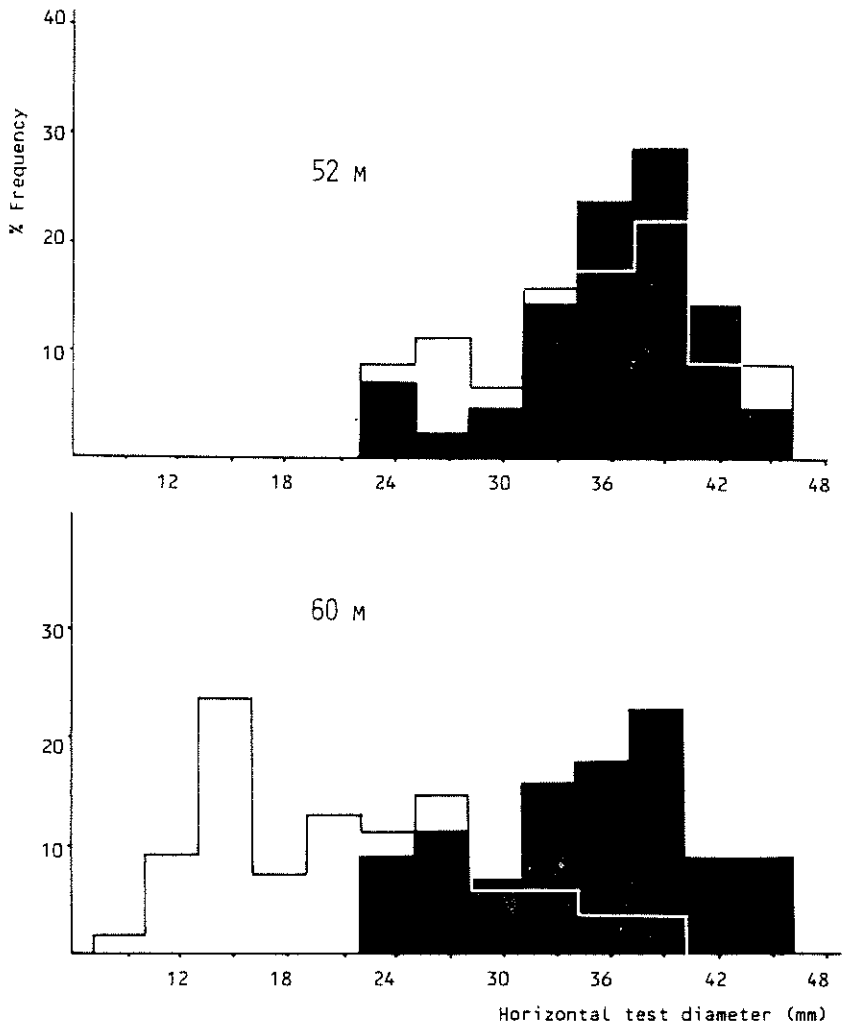

Fig. 4 : Size frequency histograms of *Paracentrotus lividus* at 52 m and 60 m from shore, in May 1979 (open histograms) and March 1980 (solid histograms).

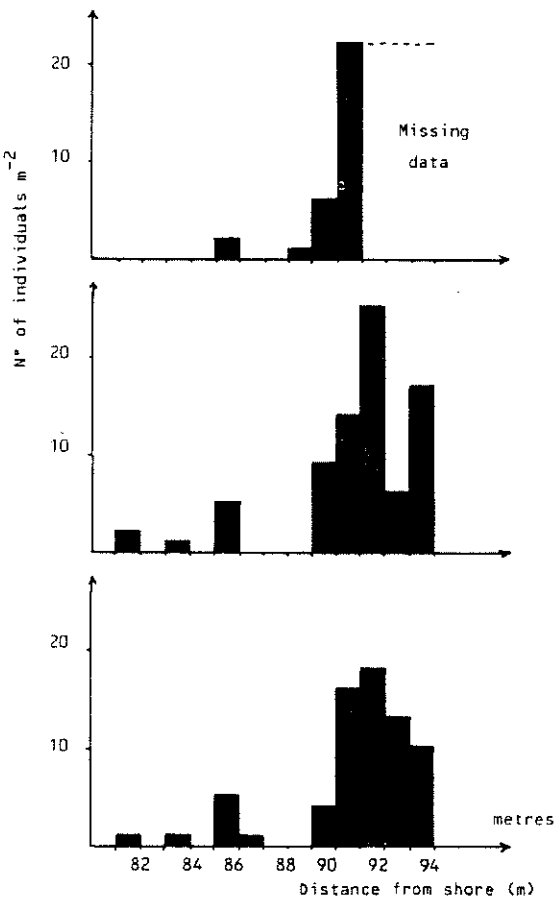

Fig. 5 : Censuses of the *Paracentrotus lividus* population along the same part of the permanent transect : day-census in March 1980 (upper), day-census in May 1980 (middle) and night-census in May 1980 (lower). Juveniles between 10 to 20 mm horizontal diameter, together woth individual adults, were taken into account.

Fig. 6 : The decline of *Paracentotus* has promoted an explosive growth of epiphytes on *Posidonia oceanica* leaves.

Fig. 7 : The explosive growth of epiphytes on *Posidonia oceanica* leaves and on the dead matte. The metal ribbon line stretched along the transect can be seen. Although some parts of the image appear to be blurred, this is not the cases as it is due to the luxuriant growth of algae *(Dictyota, Dilophus, Ectocarpaceae,* etc).

It is also of interest that the decline of urchins has promoted an explosive growth of epiphytes on *Posidonia* leaves (Figs. 6 and 7), especially on the inner edge of the barrier reef, despite the occurence of a few grazing gastropods. Studies, currently in progress, will lead to the understanding of these secundary effects of the disease.

Such mass mortality by disease of populations of sea urchins has been already observed in other areas ; for example, JOHNSON (1971), PEARSE *et al.* (1977) and PEARSE and HINES (1979) relate that in California dense populations of the « red sea urchin » *Strongylocentrotus franciscanus* (Stimpson 1857) were decimated by disease and describe the following expansion of seaweeds.

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