A PRELIMINARY NOTE ON THE MOVEMENT OF THE SEA URCHIN PARACENTROTUS LIVIDUS

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Résumé : Les déplacements de *Paracentrotus* (Lamarck) ont été suivis pendant deux périodes de 24 heures à Port-Cros (Méditerranée, France). Dans une station peu profonde, les mouvements des individus sont coordonnés (avec des pics d'activité vers le coucher et avant le lever du soleil), alors qu'ils sont non coordonnés et irréguliers dans une station voisine un peu plus profonde. La distance minimale parcourue par un individu en 24 heures est en moyenne de 98 cm ; il n'y a pas de comportement territorial.

Summary : The movement of the grazing sea urchin *Paracentrotus lividus* (Lamarck) was studied over two days at Pointe du Moulin at Port-Cros I. in the NW Mediterranean Sea. At a shallow water station *P. lividus* shows a marked co-ordinated nocturnal movement behaviour with peaks of activity occurring around sunset and before sunrise, but a contrasting unco-ordinated movement behaviour at a neighbouring deeper station. Individuals moved a mean minimum distance of 98 cm in 24 hours, demonstrating an absence of territorial behaviour.

The sea urchin *Paracentrotus lividus* (Lamarck) is often a dominant species of the shallow sublittoral in the Mediterranean, where it grazes on macro-algal populations. An assessment of the ecological effects of grazing by this sea urchin requires an inderstanding of its feeding behaviour, and in particular its diurnal movement for the purpose of feeding. Two sites were selected for the study of the movement and feeding of *P. lividus* at Pointe du Moulin at the northern end of the Bay of Port-Cros.

Station 1 was at 0.5 m depth on rocky substrate and Station 2 at 1.5 m depth some 5 metres away, where the substrate in the decaying fibrous remnants of a former bed of *Posidonia oceanica* (Linnaeus) Delile (the « matte morte »). At the former site there is a sparse cover of a low algal turf 1 (—2) cm in height, apparently subject to heavy grazing by *P. lividus*, with an average density of about 10 m^{-2}, and by *Patella spp.* with densities of 20-50 m^{-2} ; the black sea urchin *Arbacia lixula* (Linné) is also present but not abundant. At the latter site there

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is a more or less uniform low algal turf attached to *Posidonia* rhizomes, with densities of *P. lividus* averaging about 5 m^{-2}. The co-ordinates of each individual were measured with a metre rule at each inspection by reference to fixed X and Y axes. Animals were individually marked by clipping several adjacent vertical rows of spines in accordance with a predetermined code, a method successfully used by Sinclair (1959). At Station 2 the movement of an additional unmarked individual (No. 2-5) was followed, to ascertain whether the method of marking modified its movement behaviour, compared with others at the same station. Observations commenced at 1835 hours on 6.5.1979 and inspections were made at intervals of 1 1/2 — 2 hours during the night, and at less frequent intervals during the following day. The position of individuals was also measured 48 hours after commencement of the study.

In this preliminary report we present for each site (1) the minimal distances moved by individuals over 24 hours (i. e. for each individual the total length of the line joining each position sequentially occupied by it), and (2) the net 24 hour movement by individuals (i.e. the shortest distance between the first and last position of each individual during 24 hours).

Table 1. — Movement of individual *P. lividus* at Pointe du Moulin on 6-7 May 1979.

STATION 1.

Urchin No.	Minimal distance (cm)	Net 24 hr movement (cm) day1	day 2
1-1	477	126	20
1-2	268	142	lost
1-3	121	42	244
			57
1-6	—	—	111
Mean value	260.5	97.5	108

STATION 2.

2-1	54	38	65
2-2	91	47	95
2-3	230	174	173
2-4	174	63	116
			lost
2-6	—	—	115
Mean value	142.6	76.4	112.8

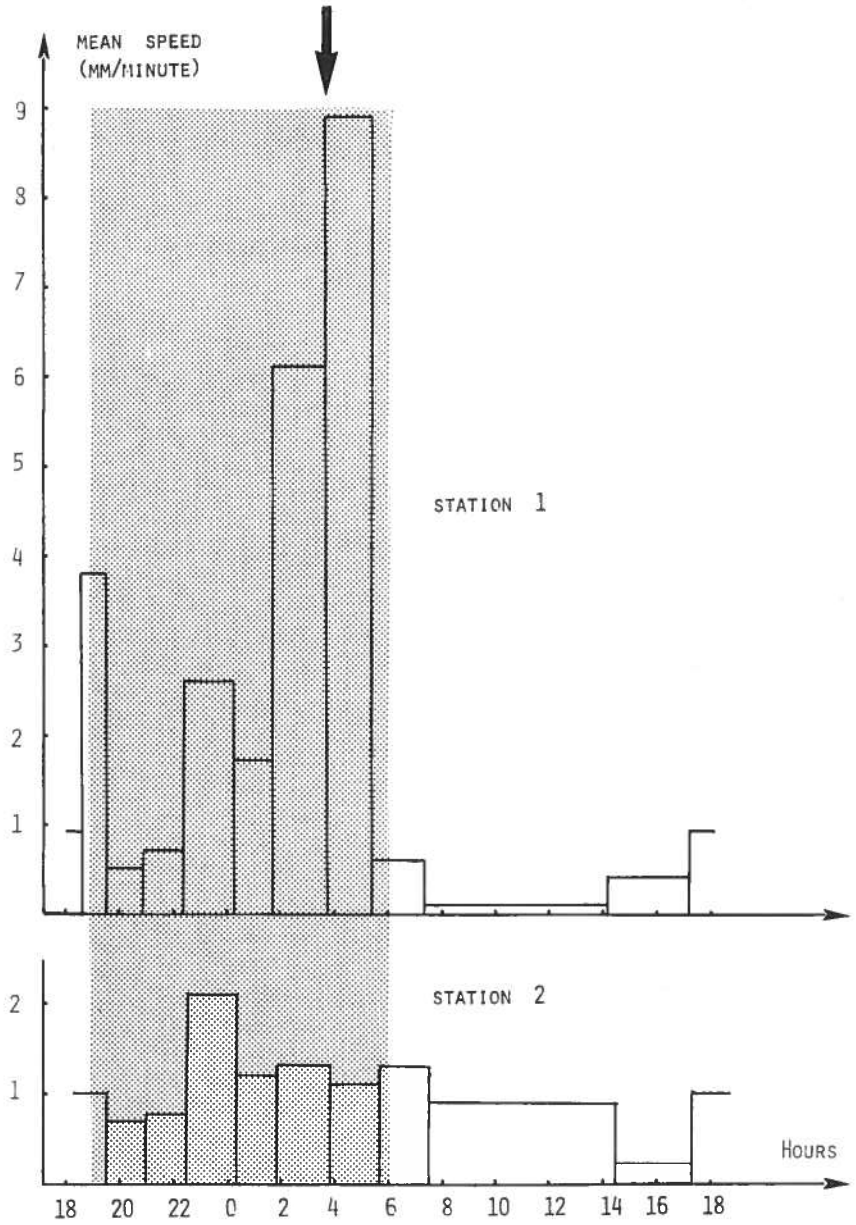

Fig. 1. — The mean speed (mm per minute) of *P. lividus* at Stations 1 and 2 from 1835 hrs on 6 May 1979 until 1800 hrs on 7 May 1979. The time scale is Grennwich Mean Time adjusted for daylight saving in France. The vertical lines indicate the time of each inspection and the shaded area the time from sunset to sunrise. The time of moonset is indicated by an arrow.

The results are given in Table 1. In addition we show in Fig. 1 the mean minimal distance moved by individuals at each site for each time interval during the 24 hour period. While neither the minimal distances nor the net movement of *P. lividus* over 24 hours differ significantly between the two stations (tested by Mann and Witney's non-parametric U test), it is clear from Fig. 1 that there are distinct differences in the periodicity of movement between sites. At Station 1 there are two peaks of maximal movement, the first around sunset, and the second late in the night between moonset and sunrise. At Station 2 slight and somewhat irregular movement occurs throughout the night (with a low peak around midnight) and continues during the day, declining to a minimum level at 1600 hours.

Using Kendall's non-parametric concordance test (Siegel, 1956) we tested the null hypothesis that the minimal distances moved by individuals at each time interval at each site was not correlated. The hypothesis was rejected with confidence for Station 1 ($X^2 = 23.98$; $P < 0.01$) but accepted for Station 2 ($X^2 = 11.79$; $0.2 < P < 0.3$).

While full evaluation of the results must await the conclusion of current studies on feeding and the feeding preferences of *P. lividus*, it is evident that this species of sea urchin shows no territoriality in behaviour, since none of the marked individuals returned to the same site. Secondly there seems to be no obvious relationship between the extent of movement and food availability as suggested by Dix (1970). An intriguing question posed by the study, for which as yet we have no answer is why there is co-ordinated nocturnal movement by the species at one site and a quite different movement behaviour at an adjacent site.

REFERENCES

DIX T.-G., 1970. — Biology of *Evechinus chloroticus* (Echinoidea : echinometridae) from different localities 2. Movement. *New Zeal. J. mar. Freshwat Res.*, 4 (3) : 267-277.

SIEGEL S., 1956. — Nonparametric statistics for the behavioral sciences McGraw-Hill Book Co., New-York : i-xvii + 1-312.

SINCLAIR A.-N., 1959. — Observations on the behaviour of sea urchins. *Austral Mus. Mag.*, 13 : 3-8.