

NOTES

Aggregating in the Echinoid *Evechinus chloroticus*

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Evechinus chloroticus, a large regular urchin endemic to New Zealand, shows marked clumping within populations, observable throughout the year in the field (Fig. 1) and also demonstrated by quadrat sampling (variance ratio test for 60, m² samples along a transect gave $P < 0.005$).

In his review, "The Complex Behaviour of Echinoderms," Reese (1966, p. 180) suggests that it is a "moot question" as to whether such clumping results from interaction between individuals or whether clumps are simply a result of individual reaction to the physical environment. The occurrence of *Evechinus* clumps on some rocks but not on similar neighbouring rocks suggested that aggregations of this species might result from individual interactions. To ascertain whether individuals of *Evechinus* might be chemically attracted, a series of Y-maze experiments was performed. A stationary animal was placed behind a partition in one arm of a maze through which water flowed continuously at a slow rate. A second, mobile individual was placed in the tail of the Y; responses were recorded as positive if the mobile individual moved up to the partition containing the stationary animal, negative if to the other. After about every three responses the stationary animal was moved to the opposite arm of the maze to remove possible bias, and after the end of each experiment the animals were sexed. Results of these experiments using 44 *Evechinus* over a period of six months (Table 1) indicate that the ratios of total negative to total positive responses show a highly significant departure from 1:1 ($\chi^2 = 26.51$, $P < 0.001$), suggesting that chemical attraction may play a significant part in the aggregating behaviour of *Evechinus*.

It appears that no significant difference exists between homosexual and heterosexual response ratios ($\chi^2 = 1.19$, $P = 0.3$) suggesting that attraction between individuals is independent of sex. This suggestion is strengthened by field observations. Relative positions of 161 individuals (72 females and 89 males) from five different aggregations were recorded in the field; for each individual its sex and that of its nearest neighbour were noted. The numbers of pairs of females nearest females, males nearest males, and females nearest males thus observed were tested against expected numbers under the hypothesis that "there is no preferred association between two individuals in terms of sex" or that "the sexes are randomly distributed with respect to each other." Under this hypothesis, if p is the proportion of females in a sample and q the proportion of males, then the proportion of female nearest female pairs = p^2 , male nearest male pairs = q^2 , and female nearest male pairs = $2pq$. Results show that there is no cause to reject the hypothesis in any of the five samples (Table 2). Thus aggregations appear to consist of individuals which are chemically attracted to each other independently of sex, a 1:1 sex ratio and chance ensuring that enough males and females are present in each



FIG. 1. Typical subtidal clump of *Evechinus chloroticus* at Kaikoura, New Zealand.

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TABLE 1
Y-MAZE RESPONSES OF *Evechinus chloroticus*

PAIRING	POSITIVE	NEGATIVE
Heterosexual	97	50
Homosexual	40	14
Total	137	64

clump to ensure reproductive success. If mass spawning occurs in nature, it is unlikely that

the reproductive success of closely packed aggregations showing random distribution of sexes would be any less than that of aggregations showing heterosexual pairing.

LITERATURE CITED

REESE, E. S. 1966. In: R. A. Boolootian, ed., *Physiology of Echinodermata*. New York, John Wiley & Sons. 822 pp.

TABLE 2
PAIRING OF INDIVIDUALS IN *Evechinus chloroticus*

SAMPLE	♀ ♀	♂ ♂	NEAREST NEIGHBOUR PAIRS			χ^2	P
			♀-♀	♀-♂	♂-♂		
A	15	10	6	16	3	1.50	0.4
B	13	14	8	14	5	1.12	0.5
C	13	19	5	14	13	0.54	0.7
D	14	23	5	20	12	0.73	0.6
E	17	23	9	18	13	0.58	0.7