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SPATIAL DISTRIBUTION IN THE NATURAL POPULATION OF A CLAM, *TAPES JAPONICA**

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(With one figure)

Several observations have been reported on the spatial distribution in natural populations of bivalve molluscs inhabiting sandy intertidal zones (Holme, 1950; Furukawa and Suzuki, 1953; Ikematsu, 1957). Nevertheless, our knowledge on this problem is still quite insufficient. In this study an attempt was made to examine the mode of micro-distribution of individual clams in the natural population of *Tapes japonica*.

In summer, *Tapes japonica* population at the Mukasa-shoal in the Bisan Seto Channel of the Inland Sea was mainly composed of young clams (5–15 mm in shell length) derived from autumnal spawning in the previous year. Besides them, however, some older clams (15–30 mm in length) and other molluscan species, such as *Brachidontes senhausia*, were also found. The latter may sometimes occur in a large number (Ohba, 1959).

Field works were performed in August of 1955 and in the same season of 1957. In all, ten samples were taken from different parts distributed irregularly in a definite region of the shoal of about 20 × 10 m in area. The size of each sample was definitely 100 and it covered the area of 0.1 m² in all, as shown in Fig. 1. On each unit area of 0.001 m², the kinds of molluscs and number of each species were recorded. In some cases, the total weight of them were also measured. The young (0-year old) and adult (1- or 2-year old) *Tapes japonica* were separately enumerated.

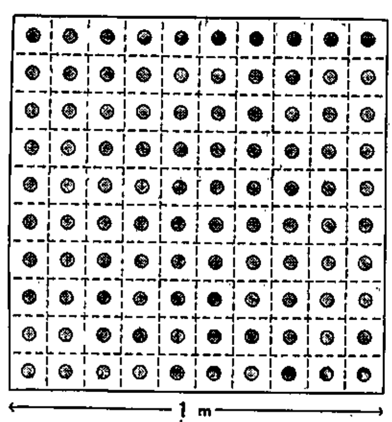

Fig. 1. Arrangement of unit divisions in each sample. Sand of ● parts (10 cm² in area, 10 cm in depth) was taken for examination.

* Contributions from the Tamano Marine Laboratory, No. 53.

The total population densities of each species in each sample are shown in Table 1.

Table 1

Total number of molluscs obtained from a 100 unit divisions
Total area examined is 0.1 m² (0.001 m² × 100) in each sample. Sample I–III were collected in August of 1955 and IV–X in August of 1957.

Sample	Number of individuals per 0.1 m²						
	Tapes japonica		*Brachidontes senhausia*	*Nassarius spp.**	*Batillaria cummingii*	Other molluscs**	Total
	Adult	Young					
I	36	82	17	2	4	0	141
II	1	10	26	2	1	0	40
III	34	105	806	2	1	0	948
IV	42	2400	45	9	2	1	2499
V	40	1318	45	4	9	5	1421
VI	30	1260	458	10	4	1	1763
VII	31	777	608	13	10	11	1450
VIII	11	291	37	5	5	0	349
IX	36	18	644	29	8	3	738
X	24	391	1	5	3	2	326

* *Nassarius festivus* and *Nassarius hiradoensis.*
** *Siphonalia fucoides, Umbonium moniliferum, Lunella coronata coreensis, Pyrene varians,* etc.

Statistical analyses of the mode of distribution in three main groups (young *Tapes*, adult *Tapes* and *Brachidontes*) were attempted on the data of a 100 unit records. First, interferences in the distribution of these three groups were examined. The density of the adult *Tapes* is relatively low, 300–400/m² in usual cases. In comparing the unit records which contains adults with-those without adults, we can never find significanct differences either in mean density or in frequency distribution of young *Tapes* per unit area. Similar relations were also found between the adult *Tapes* and *Brachidontes*. This means that the existence of the adult *Tapes* has no influence on spatial distribution of young *Tapes* or *Brachidontes* which set on the same habitat more than a year later.*

The densities of young *Tapes* and *Brachidontes* fluctuate widely from sample to sample, as seen in Table 1. But no definite relationship in densities can be detected among these two groups. In most cases in which one of the two groups is of low density, the frequency distribution in the other group is not influenced by the coexistence of the former in the same unit area. In samples VI and VII where both groups show relatively high densities, the correlation coefficient between them is –0.408 and –0.132. The latter can not be accepted as to be significantly different from 0 with the significance level of 0.01. That is, the distribution of young *Tapes* and *Brachidontes* may be also independent of each other, except for a case of sample VI in which negative correlation in a slight degree is probable.

* It is evident that all individuals of *Brachidontes* are of 0-year old.

From these results it can be concluded that, as regards the distribution of individuals, the above three groups are respectively independent in general, although they exhibit overlapping distributions in the same habitat.

Distributions of individual clams were analysed as to the type of distribution function and of distribution structure in space. For these purposes, two kinds of coefficient, "divergence coefficient ($V/\bar{x}$*)" (="coefficient of dispersion", Holme, 1950) and "sample structural correlation coefficient (γ)", were calculated according to the methods reported by Torii (1952). Considering these two coefficients together, exact knowledge of the mode of distribution in natural populations may be obtained (Torii, 1952).

The outlines of the results are briefly summarized in Table 2. In the adult *Tapes* the mode of individual distribution is always of the same type; i.e., random distribution or slight patch-type distribution in which distribution function is of the Poisson type. On the other hand, some different modes of distribution are seen in young groups of the species. In two cases of high densities (samples VI and VII) strong patch-type distribution of concentrating non-Poisson type is observed, while in samples of low densities ($\bar{x}<3$) random distribution of Poisson type is usually seen. Furthermore, strong gradient distribution (sample V) and clear uniform distribution (=self-spacing arrangement; sample X) are also found. In *Brachidontes* strong patch-type distribution is common and random distribution is rather rare, without regard to the population density of the samples.

Table 2

Results of mathematical analyses of the type of distribution function and of the type of distribution structure in space

Values of coefficient		Distribution function	Distribution structure in space	Number of samples		
				Tapes japonica		*Brachidontes senhausia*
$V/\bar{x}$	γ			Adult	Young	
=1	=0	Poisson type	Random or slight patch-type distribution	10	6	3
>1	=0	non-Poisson type (negative binomial)	Strong patch-type distribution	0	2	7
>1	>0	〃	Strong gradient distribution	0	1	0
<1	=0	non-Poisson type (positive binomial)	Uniform distribution	0	1	0

=: differences are in significant with the level of significance of 0.01
> and <: differences are significant with the level of significance of 0.01

It may be naturally considered that setting of planktonic *Tapes* larvae on sandy habitats occurs at random, at least in a small area. Ikematsu (1957) reported on the random distributions of Poisson type in a dense population of spats

* V: unbiased estimate of variance, $\bar{x}$: sample mean density

of the species just after setting. After three months this type of distribution was maintained in spite of a considerable decrease in the population density. The results of the present study indicate that the Poisson distribution is a usual case in both young and adult *Tapes* when the population density is relatively low. On the other hand, concentrating non-Poisson distribution is observed in cases of high densities in young *Tapes*. But detailed developmental mechanisms of this type of distribution remain uncertain. Uniform distribution which was found for once in young *Tapes* may be a special case. Although Holme (1950) reported clear uniform distribution in a *Tellina tenuis* population, similar mechanisms can not be considered in *Tapes japonica*. In the present case, that special types of distribution re rarely observed (uniform distribution and gradient distribution) may be a result of micro-environmental differences in habitats.

Strong concentrating non-Poisson distributions are generally seen in *Brachidontes senhausia*. This is probably due to the mode of sessile life of this species. As it has well-developed byssus, sand granules come to be connected in masses and, as a result of development of the process, several individuals are often found together in a mass.

The weight of young *Tapes* per unit area shows typical normal distributions in samples, IV, V and X. It is impossible, however, to make clear the relationships between frequency distribution in number and that of weight in *Tapes japonica* populations, because the data of weight are scanty.

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