AN ECOLOGICAL STUDY ON SOME MARINE BIVALVE BEDS OF KOREAN TIDELANDS

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ABSTRACT

Marine bivalve beds of 4 species were selected at sandy beaches of intertidal zones in Korea. The soil texture and chemical properties of soil samples collected from various depths of beds were determined and compared with each other. It seems that the soil texture and soil organic matter content may be important factors affecting the distribution of bivalve species.

INTRODUCTION

"The Present Status of Korean Fisheries" (1966) states that in the investigation of a 4.6% sample (193 km^2) of the 3,905 km^2 Korean tidelands, 3.3% (6.4 km^2) of this sample area is cultivated as culture beds and 18.3% (35.3 km^2) is available for additional bivalve culture. It was reported that 52,450 tons of bivalves were produced in the 6.4 km^2 area in 1964 and 289,294 tons of bivalves could be produced in the available tidelands (35.3 km^2) if these areas were improved and cultivated. Based on these facts, if all the available tidal flats for additional bivalve culture were improved, the total quantity of bivalves could be increased as much as twenty-fold.

On the basis of these data it is apparent that the improvement of marine bivalve beds is important and urgently needed for the development of marine bivalve culture in Korea.

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However, although a number of investigators studied the effect of some environmental factors on bivalves, there are not many papers on the physical and chemical properties of tidal flats for bivalve culture. Kurashige (1941) studied the soil composition of short-necked clam beds. Ikematsu (1953), Ikematsu and Wakita (1955, 1957) investigated on the effect of scattering sand on muddy beds for short-necked clam.

In order to improve tidelands for marine bivalve culture, the present study is scheduled to investigate the current status of soil texture, water holding capacity, pH, exchangeable calcium, and organic matter content of different bivalve beds where each one of 4 species of bivalves is densely populated.

MATERIALS AND METHODS

Four sample plots were selected from the intertidal zones of sandy beaches of Kyunggi Bay in Korea, where there were dense populations of *Dosinia japonica*, *Mactra veneriformis*, *Cyclina sinensis* and *Tapes philippinarum*.

The soil samples were collected from depths of 0-5 cm, 5-15 cm and 15-20 cm below the soil surface of bed of each plot.

All of determinations were carried out as follows:

Soil texture was analyzed by Kuhn's method and expressed as percentage of clay, silt, fine sand and coarse sand.

In the determination of water holding capacity, dried soil was placed in 7 cm cylinder and enough water added to moisten the soil nearly but not quite to the bottom of the cylinder. The water content of the upper few centimeters of the column was then determined. Water holding capacity was defined as the percentage of moisture held in the soil.

The pH of soil suspensions (ratio of soil : water was 1:2.5) was determined by the Beckman pH meter.

Exchangeable calcium was precipitated by oxalate and titrated against standard ceric nitrate.

Organic soil matter was determined by the loss on ignition. A sieved soil sample was dried in an oven at 100°C for 2 hours, and ignition was accomplished in an electric muffle furnace at 450°C for 12 hours.

RESULTS AND DISCUSSION

The soil texture of various depths of different beds is illustrated in Figure 1. The soil texture of the various beds differed. Excepting 1 (0-5 cm) and 2 (5-10 cm) of the *D. japonica* bed, the soil textures of four different depths ranging 0 to 20 cm below soil surface of beds showed quite similar characters. These results agree with the report of Ikematsu (1953) who stated that there was no big difference in the soil texture at depths of 0-2 cm, 2-5 cm, and 5-10 cm below the soil surface.

Data on soil texture were treated by statistical analysis in order to know the significance of the results illustrated in Figure 1 (Table I).

Table I

Soil Texture at Different Bivalve Beds

Soil texture / Plot	Clay	Silt	Fine sand	Coarse sand
D. japonica bed	13.37±1.34^{XX}	6.96±1.55^{X}	63.90±3.71^{X}	16.77±4.37^{X}
M. veneriformis bed	4.40±0.92	1.80±0.82	90.85±10.24^{X}	2.95±1.32
C. sinensis	17.20±2.10^{XX}	4.70±0.25	77.55±3.98^{X}	0.55±0.21
T. philippinarum bed	6.89±1.04	3 49±0.19	42.82±2.42^{X}	46.77±1.40^{XX}
L. S. D.	3.71	3.49	13.22	13.91

^{X}significant at the 5% level.

^{XX}significant at the 1% level.

Clay percentages were 13.37% and 17.20% at *D. japonica* and *C. sinensis* beds respectively. The differences are highly significant. Clay percentages at *M. veneriformis* and *T. philippinarum* beds were 4.40% and 6.89%, with no significant difference. There was no significant difference in the silt content between the *M. veneriformis*, *C. sinensis* and *T. philippinarum* beds, excepting the *D. japonica* bed. It was significant that there were difference in the percentages of fine sand among all of four species beds. The coarse sand content showed no difference between *M. veneriformis* and

and *C. sinensis* beds. But it was highly significant that there were differences in the coarse sand content between the beds of *D. japonica*, *T. philippinarum* and *M. veneriformis-C. sinensis*.

Inspecting Table I it is noticed that there were differences in soil texture between beds of each species. It seems that the distribution of each species within a certain restricted area may depend partly on the soil texture of the tidelands. The conclusion agrees with Kurashige's opinion that soil texture is one of most important limiting factors to short-necked clams. On the other hand, Ikematsu and Wakita (1955,1957) reported that when sand was scattered on muddy areas, the density of living, young, short-necked clam seeds in the sanded areas was raised to 2 to 4 times in comparison with non-sanded areas.

Most species of bivalves can survive in a wide range of soil texture but the optimal range of soil texture for bivalve life is not so wide. It is considered that the culture of bivalves may be increased at culture beds by scattering sand and other materials in a percentage adequate for each species.

Figure 2 shows the values for water holding capacity, pH, exchangeable calcium, and organic matter at different depths in the soil strata of the beds of the four species. There were no great variations in water holding capacity, pH, and organic matter content at different depths in the soil strata. It was also demonstrated that there was no statistical difference in exchangeable calcium content at different depths of the four species beds, nor were there significant statistical differences in water holding capacity, pH, exchangeable calcium content among the beds of the four bivalve. Water holding capacity of the *M. veneriformis* and *C. sinensis* beds, was higher than that of the *T. philippinarum* and *D. japonica* beds. No significant statistical difference in water holding capacity was recognized between the groups of *M. veneriformis* and *C. sinensis* lines, nor those of *T. philippinarum* and *D. japonica* lines, though the lines of water holding capacity divided into two groups (Figure 2). The differences in soil organic matter content between *D. japonica* and *M. veneriformis* beds, *T. philippinarum* and *C. sinensis* beds were significant at the 5% level. The differences between *D. japonica* and *T. philippinarum; M.veneriformis* and *C. sinensis; M. veneriformis* and *T. philippinarum* beds were significant at the 1% level, i.e. the differences in soil organic matter content between the various beds, except between *D. japonica* and *C. sinensis* beds were highly significant. Based on these data it can be seen that the organic matter content is one of the important factors for bivalve life in the culture beds of the tidelands.

Ikematsu (1953) suggested that the water holding capacity may depend on the organic matter content in soil. But there was no such evidence from this experiment. The water holding capacity of fine sand beds was higher than that of coarse sand beds. This is partly in agreement with Ikematsu's notes (1953) that the water holding capacity runs parallel with the increasing proportion of soil particles below 0.2 mm, and varies inversely with the proportion of soil particles above 0.2 mm.

From the results of this investigation it is considered that the soil texture and the soil organic matter content may be the most important factors for bivalve life and tend to restrict the distribution of each species of bivalves to different plots, and offers an explanation as to why each bed was densely populated by one species at least within the limited area of tidelands studied.

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SUMMARY

1. Basic investigations on the soil texture, water holding capacity, pH, exchangeable calcium, and organic matter content of beds of *Dosinia japonica*, *Mactra veneriformis*, *Cyclina sinensis* and *Tapes philippinarum* were conducted.

2. It was statistically significant that there were differences in the soil texture between the beds of each species.

3. There was no significant difference in water holding capacity, pH, and exchangeable calcium content between the different bivalve beds.

4. There were significant differences in soil organic matter content between the various beds except between *D. japonica* and *C. sinensis* beds.

5. It is considered that the soil texture and soil organic matter content may be the most important factors restricting the distribution of each species of bivalves within a certain limited area of tidelands.

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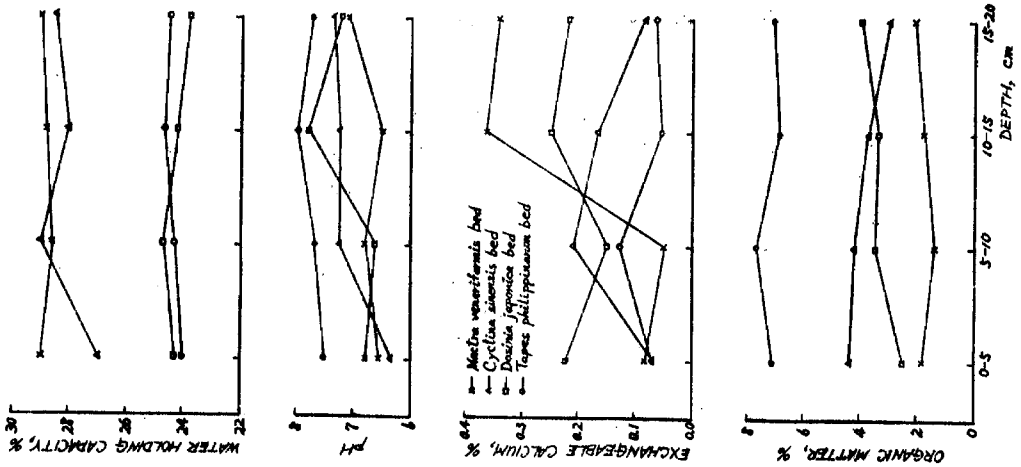

Fig. 2. Chemical properties and different depth of bivalve beds.

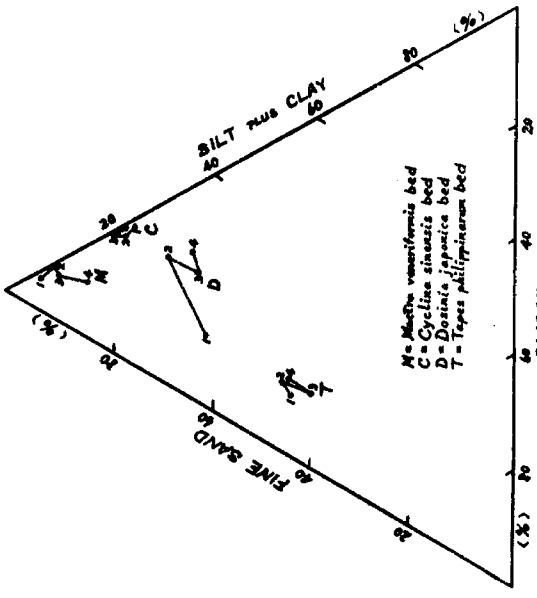

Fig. 1. Soil texture and depth of 4 bivalve beds.
Depth of soil Strata:
1= 0.5 cm; 2= 5-10 cm; 3= 10-15 cm; 4= 15-20 cm.