Daily Variations in the Number of Prawns in Small Prawn Pots*1

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The number of creatures remaining in a pot may be closely related to the pot construction and the degree of interaction between the captured individuals in the pot, influenced by its passive catching function. We examined aspects of escape and capture of Macrobrachium nipponense in small prawn pots under actual fishing conditions. The number of individuals in a pot changed in an oscillatory pattern. The entry and escape of small prawns was an important factor in daily variations in the number remaining in a pot. There was no difference in the mean values of animals remaining obtained under different conditions. There was a similarity between the period for a peak catch in the experimental results and findings from actual operations.

Generally, pots are made so that it is possible for the creatures to go in and out freely. However, this function complicates the catching mechanism. Many factors affect the escape and entry of creatures. In considering the passive catching function of a pot, the interaction between the individuals in the pot may be one important factor. A number of workers have obtained basic information on escape and entry from field observations1,2 using actual traps and from model experiments3,4 in a tank. The catching mechanism of a pot is very complex, and even after these investigations, there are a number of unclarified points about the catching mechanism.

In this paper, attention is focused on the daily variations in number of oriental river prawns, Macrobrachium nipponense, captured in a pot for the purpose of investigation of the catching mechanism of pots. The objectives of this study were to investigate the relationship between the length of days of stay and body length, and to evaluate the mean number of individuals remaining in a pot.

Methods

The experiments were performed in the south-basin fishing ground of Lake Biwa, Japan (Fig. 1). Cylindrical pots 16 cm high and 20 cm in diameter, with a 2.4-cm neck diameter and one opening on the top, were used (Fig. 2). Five pots without bait were set on the bottom of the lake about 6 m apart at the depth of about 1.5–2.5 m. Each pot was hauled up at about 10 a.m. every day for a week. The number of prawns, M. nipponense, in each was counted. Each individual was marked on its carapace with enamel paint to identify the

Fig. 1. Experimental area.

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*1 Model Experiments on the Catching Mechanism of a Small Shrimp Pot-IV (えびかごの漁獲機構に関する実験的研究-IV).
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date of entry and escape. The prawns were returned to the pots, which were replaced at the same site. The week-long experiment was performed four times in 1988 (on July 1–7, August 1–7, September 1–7, and November 4–10). The water temperature was between 23.2°C and 14.6°C during the experimental period.

Results

We examined the problem of escape and capture, considering the variations in environmental conditions in a pot. The spatial behavior of prawns may be controlled by environmental conditions such as pot construction and the number of creatures in the pot. In the passive catching function of a pot, the construction of the pot is an important factor. Field measurements made at an actual
Fig. 4. Relationship between the length of stay (days) and body length. A, data gathered in July, August, and September, with those for oviferous individuals excluded. B, data for oviferous individuals only. C, data obtained in November. □ S □ M □ L.
fishing ground were analyzed to identify some fundamental data on how the numbers of entering and escaping individuals affected the amount of catch, considering the length of days of stay of the prawns in the pot.

The experimental values for the number of individuals remaining in a pot are shown in Fig. 3. The number of prawns in a pot tended to change in an oscillatory pattern, with the exception of the results obtained in September. The calculated mean of the curve of oscillation is also shown for each case (upper right). Figure 3 shows that the peak of the curve appeared three days after the number of prawns in the pot reached a minimum. In July and August, the daily variations were larger than for the other months. Perhaps the difference arose from the activity of the individuals, which might be strongly affected by small seasonal differences in temperature. There was no difference in the mean catch of each test (statistically insignificant, \( X^2 = 3.93 \times 10^{-2} < X^2(2, 0.05) = 5.99 \)).

The length of an individual’s stay may be closely related to the conditions in the interior of the port. We were interested in the size distribution of prawns captured in the pot (Fig. 4). To consider the relationship between the length of their stay and body length, we classified body length into three categories because of the scantiness of the data. Small, S, was below 30 mm; medium, M, was 30-40 mm; and large, L, was over 40 mm. These data included ovigerous individuals, except for in November. So, we studied the data divided into three subcategories: 1) July, August, and September data, with those for ovigerous individuals excluded; 2) ovigerous individuals only; 3) data for November. In Fig. 4, the oblique lines are for small prawns, the blank areas are for medium-sized prawns, and the vertical lines are for large prawns. The length of stay in the pot was relatively short for all sizes. The small prawns made up a large portion of the prawns remaining for a short time (Fig. 4A). In the cases of ovigerous individuals (B) and the November data (C), there was no relationship between the length of days of stay and body length. At any rate, the entry and escape of small prawns was an important factor in the entry and escape of small prawns was an important factor in the daily oscillations in the number of remaining in a port.

When considering the catching mechanism of a pot, it also becomes necessary to evaluate the entry and escape behavior of the target species. The

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A, total number of entries for each test. B, total number of escapes for each test.

The results indicated that both the total numbers of entries and escapes decreased with decreases in the temperature. On the other hand, the apparent discrepancy in the four values of A-B was not statistically significant (\( X^2 = 0.96 < X^2(2, 0.05) = 5.99 \)). It seems that the pot used here had a characteristic effect on the entry and escape behavior of the prawns.

Discussion

The purpose of this paper was primarily to examine the relationships of entry, escape and the amount of catch. From a practical point of view, the two main questions are how to identify the relationship between the degree of interaction and the number of escapes, and how to identify the cause of the oscillation in the numbers remaining in relation to pot construction, so that the mean value around which there is oscillation might be raised. From the results (Fig. 3), there seems to be interaction among the prawns captured in a pot. These results support the assumption mentioned before for population pressure.

The mean value calculated for each test was about the same. Data here were few, but it is probable that the mean values would be closely related to the pot construction. There was no difference in the mean values, although each test was performed under different field conditions. This suggested that the pot used here had a characteristic effect on the entry and escape behavior of the prawns.

When considering the interaction between individuals in a pot, it is important to compare the results obtained from different experimental conditions such as in an actual operation carried out by fisherman in the same area. We will discuss the relationship between the length of set days and catch per unit effort (C.P.U.E.; catch/day) based on the data obtained for 23 July-23 November 1988. The catch data were from 26 trials with
200 baited pots. The same type of cylindrical pot was used here, with an opening with a diameter of about 3.5 cm. The pot was hauled up after three to nine days, at the fisherman's convenience. The results of actual operations indicated that the catch decreased with an increase in the length of set days (Fig. 5). When the length of set days was relatively long, the amount of catch rapidly reduced. It is not certain because of the insufficient data, but it seemed that there was similarity between the period for a peak catch in the experimental results and findings from actual operations. This suggested that the effect of interactions between individuals in a pot is clearly reflected in the experimental results. We can conclude from above results that the interaction of *M. nipponense* is large. With small pots such as those used here, it is likely that the peak in the amount of catch would appear relatively soon after the pots were set.

There are many unsolved problems remaining. However, the results obtained here are one step in the investigation of the catching mechanism of small prawn pots.

### Summary

1. The pot used here had a characteristic effect on the number of individuals remaining in it during a certain period.
2. Daily variations in the numbers remaining were closely related to the interactions between individuals in the pot.
3. The cause of daily variations arose from the entry and escape of small prawns.

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### References